VOL. 86 JANUARY AND FEBRUARY 1975 NOS. 1 & 2

ENTOMOLOGICAL NEWS

Publication date: 9–30 , 1975

THE AMERICAN ENTOMOLOGICAL SOCIETY

ENTOMOLOGICAL NEWS is published bi-monthly except July and August by The American Entomological Society at the Academy of Natural Sciences, 1900 Race St., Philadelphia, Pa., 19103, U.S.A.

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A KEY TO THE NEW WORLD GENERA OF THE BEETLE FAMILY LIMNICHIDAE[1]

David P. Wooldridge[2]

ABSTRACT: Fifteen genera of Limnichidae are known from the new world. All recent keys to the North American representatives of the family omit many valid genera, and no key has previously been presented which will separate those genera that are restricted to Central and South America. The key presented here will separate all new world genera known to date.

DESCRIPTORS: Coleoptera, Limnichidae, genera of Limnichidae, Key, New world.

Three subfamilies and fifteen genera of Limnichidae have been described from the Western Hemisphere, including two subfamilies and seven genera which occur in the United States. To my knowledge, however, there is no key suitable for separating these genera. The small size (0.5 - 4.5 mm) and relative scarcity of most species has tended to cause them to be neglected.

The U.S. genera and species, with the exception of *Lutrochus* and *Throscinus* which were at that time placed in other families, were treated by Casey (1912). Casey established five new genera which more recent keys [eg. Arnett, (1963), Leech and Chandler, (1963), and Hatch (1965)] have largely ignored. This situation is entirely unsatisfactory in that many diverse groups are included under the name *Limnichus*, a primarily old world genus. In any case, the value of all these keys is limited if the specimen under study is from outside the region covered in the particular work. Generic placement of a specimen from any point south of the U.S. has required considerable study for anyone not familiar with the family. The following key has been designed with the hope that generic identifications will be made somewhat easier.

Of the 15 genera included in the key, I have seen specimens of all but *Phalacrichus* and *Cephalobyrrinus*. In the key the characters used to separate these two genera are based on the original descriptions. *Lutrochus* and *Ersachus*, often placed respectively

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[1] Accepted for publication: June 12, 1974

[2] Department of Biology, The Pennsylvania State University, Ogontz Campus, Abington, Pennsylvania 19001.

with the Dryopidae and Elmidae were included with the Limnichidae by Hinton (1939). The genus *Cyphonichus* Sharp (1902) has been reduced to a synonym of *Byrrhinus* (cf. Arrow, 1909) and I have not attempted to resurrect it. Those species described as *Cyphonichus* that I have seen certainly belong in *Byrrhinus*, but I have not yet seen all of Sharp's species, and the original description of the genus was somewhat vague.

An indication as to approximate numbers of species and the distribution of each genus is included in the key. Where no distributions are mentioned, the genus is found throughout all or most of North and South America.

Key to the Genera of New World Limnichidae

1. Eyes separated on vertex by less than diameter of one eye, often nearly contiguous; tarsal formula 4-5-5. Subfamily Thaumastodinae (1 sp., Panama; 1 sp. Cuba) . . . . *Martinius* Spilman 1959

Eyes separated on vertex by more than diameter of eye; tarsal formula 5-5-5 2

2(1). Body elongate; eyes large and dorsally prominent, venter not grooved for reception of legs. Subfamily Cephalobyrrhinae .3

Body oval; eyes usually small and not prominent; venter grooved for reception of legs. Subfamily Limnichinae 4

3(2). Elytra with a sutural stria and several short basal striae. (1 sp., Costa Rica) . . . . *Cephalobyrrhinus* Pic 1923

Elytra without a trace of striae (3 spp. U.S.; 1 sp., Haiti) . . . . *Throscinus* LeConte 1874

4(2). Pronotum with a deep excavation on each side of the head to receive antennae. Size about 0.8-1.1 mm (1 sp., U.S.) . . . . . *Physemus* LeConte 1854

Pronotum not excavated. Size variable, but usually larger 5

5(4). Elytral hairs of two types: dense, short recumbent hairs, and scattered, long, upright hairs 6

Elytral hairs all alike, either short and recumbent or long and upright 7

6(5). Prosternal process with a median longitudinal sulcus (ca. 20 spp.) . . . . *Limnichoderus* Casey 1889

Prosternal process without a median longitudinal sulcus (1 sp., Guadeloupe) . . . . *Limnichus Latreille 1829*

7(5). Elytral hairs short and recumbent, somewhat scale-like 8

Elytral hairs scattered, long, erect, not scale-like 12

8(7). Eyes prominent, visible from above 9

Eyes vertical, flattened, not visible from above 11

9(8). Head, including antennae, capable of being completely retracted into thorax (ca. 12 spp., Canada to Central America . . . . *Limnichites* Casey 1889

Head not capable of being retracted into thorax 10

10(9). Posterior angles of pronotum extended into acute, elongate projections (4 spp. Central America and Colombia) . . . . *Ersachus* Erichson 1847

Posterior angles of pronotum normal (ca. 12 spp.) . *Lutrochus* Erichson 1847

11(8). Prosternal process with a median longitudinal sulcus (ca. 20 spp.) . . . . *Eulimnichus* Casey 1889

Prosternal process without a median longitudinal sulcus (1 sp., Pacific States of U.S.) . . . . *Lichminus* Casey 1889

12(7). Pronotum with a distinct semicircular series of punctures extending laterally from each side of midpoint, curving toward base 13

Pronotum plain or at most with an indistinct series of punctures 14

13(12). Antennal club 5-segmented (3 spp., Central America) . . . . *Limnichalia* Casey 1912

Antennal club 3-segmented, terminal segments slender (1 sp., Mexico) . . . . *Phalacrichus* Sharp 1902

14(12). Second antennal segment short, not much longer than third segment, although much thicker (ca. 11 spp. Central and South America)
. . . . *Byrrhinus* Motschulsky 1858

Second antennal segment elongate, several times longer than third segment, and curved to fit around eye (2 spp., Guatemala)
. . . . *Euthryptus* Sharp 1902

Little is known about the habitats and life histories of many of these genera, since many have been collected primarily in light traps. It is hoped that anyone with such information will make it available. In addition, I would welcome the opportunity to examine any specimens anyone might wish to loan.

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A REVIEW OF THE NEARCTIC GENERA OF OLIGOTROPHIDI WITH PIERCING OVIPOSITORS (DIPTERA: CECIDOMYIIDAE)[1]

Raymond J. Gagne[2]

ABSTRACT: Descriptions of *Cystiphora, Procystiphora, Sackenomyia,* and *Lygocecis,* new genus, show that ovipositors modified for piercing plants have evolved independently at least 6 times within the supertribe Oligotrophidi. *Laubertia* is synonymized under *Cystiphora* and *Phlyctidobia* under *Sackenomyia. Sackenomyia viburnifolia* (Felt) is renamed and several new combinations are proposed.

DESCRIPTORS: Cecidomyiidae; Cystiphora, Procystiphora, Sackenomyia and Lygocecis n.g.; North America

At least four groups of species of Nearctic Oligotrophidi have ovipositors modified for piercing plant tissue. While preparing a key to the genera of Cecidomyiidae, I found that the generic placement of most of those species was haphazard. It showed little regard for the various adaptations of the female abdomens, but was based instead on what now appear to be superficial characters, such as the number of palpal segments and whether the tarsal claws are toothed or simple. *Cystiphora* and *Sackenomyia* each contained two unrelated species groups; one of them common to both genera. On the other hand, *Procystiphora,* based on Nearctic species, had been misinterpreted and contained 2 additional, separate groups of exotic species.

In this paper I am redescribing the several genera involved and describing a new genus for the practical purpose of properly placing the Nearctic species. I am also interested in determining generic affinities and the relationships of the Nearctic species to their exotic congeners to provide a foundation for future studies. The genera treated here are: *Procystiphora,* reared from *Juncus* and possibly *Carex; Sackenomyia,* leaf gallmakers on *Viburnum; Cystiphora,* leaf gallmakers on the composite tribe Cichoreae; and *Lygocecis,* new genus, stem gallmakers on *Salix.*

The various modifications of the female postabdomen in these genera and in the 2 exotic species groups formerly placed in *Procystiphora* show that a piercing ovipositor evolved at least 6 times within the Oligotrophidi. Three genera, *Sackenomyia, Procystiphora,* and *Lygocecis,* new genus, are so

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[1] Accepted for publication: August 26, 1974

[2] Systematic Entomology Laboratory, Agricultural Research Service, USDA Mail Address: c/o U.S. National Museum, Washington, D.C. 20560.

specialized that their separate affinities are not apparent. *Cystiphora* and the 2 exotic species groups, here transferred to *Dasineura* (see discussion under *Procystiphora* for details), are, however, clearly derived from *Dasineura* in the broad sense. The males of all 3 groups fit easily into a general concept of *Dasineura*, a cosmopolitan, very large, and diverse genus, with almost 100 described species in the Nearctic Region alone.

The "Felt Collection" noted below is on a long-term loan to the Systematic Entomology Laboratory, USDA, from the New York State Museum in Albany.

Cystiphora Kieffer

Cystiphora Kieffer 1892: 212. Type-species, *Cecidomyia hieracii* Löw (Rübsaamen 1910: 337).

Laubertia Rübsaamen 1914: 94. Type-species, *schmidti* Rübsaamen (monotypic). *New synonym.*

Adult. Antenna with 11-12 flagellomeres. Palpus 2 to 4-segmented (3-segmented in Nearctic species). Wing vein R_5 joining C anteriad of wing apex. Tarsal claws each with strong tooth. Empodia as long as claws. Male abdomen: terga I-VI with complete row of caudal setae, without lateral setae, and with occasional scales; tergum VII as for VI but caudal setal row interrupted mesally; tergum VIII sclerotized only basally, naked except for basal pair of trichoid sensilla; sterna II-VII quadrate, weakly sclerotized and naked between caudal and middle setal rows; claspettes elongate, setulose, tapered to pointed apex; telomere widest near base, tapered to apical tooth; cerci large, ovoid; sternum X deeply bilobed. Female abdomen: anterior segments as in male; tergum VII quadrate except for lateral indentations, caudal setal row complete, naked cephalad except for trichoid sensilla; tergum VII sclerotized, shaped as in fig. 1, with caudal setae and basal pair of trichoid sensilla; sternum VII quadrate, with caudal and mesal rows of setae; segment VIII subspherical, surrounded basally by sclerotized band; ovipositor cylindrical, tapering evenly to pointed, weakly sclerotized cercus.

Pupa. Not seen.

Larva. Spatula clove shaped. Abdominal segments each with 4 dorsal papillae. Hind ventral papillae haired. Terminal segment with 4 setose papillae of uniform length.

Cystiphora contains 1 Nearctic and 7 Palearctic species, all reared from blister galls on leaves of Compositae of the tribe Cichoreae. The Nearctic species was reared from *Prenanthes.*

Laubertia, synonymized here, was erected for a species with the same kind of ovipositor (Rübsaamen 1914) and same general biology as *Cystiphora,* but with a 2-segmented palpus instead of the typical 4. The Nearctic species with its 3-segmented palpus fills the gap between *Cystiphora* and *Laubertia.* Also, Möhn (1955) shows the larvae of both genera to be very similar.

Cystiphora is distinctive only for the modifications of the female postabdomen, which are the sclerotized ring around segment VIII and the pointed ovipositor. The close resemblance of the males of *Cystiphora* and *Dasineura,* however, indicates a close relationship.

The larvae of *Cystiphora* have a reduced number of papillae, but, interestingly, there are the same reductions, i.e. loss of some dorsal and terminal papillae, in other widely separated gall midge genera found in leaf galls, viz. *Asteromyia* (Lasiopteridi) and *Caryomyia* (Cecidomyiidi).

Cystiphora canadensis Felt

Cystiphora canadensis Felt 1913b: 417.

Wing length: ♀, 1.2 mm. Female postabdomen as in fig. 1.

Syntypes: 3 ♀♀, reared VII-10-1913 ex blister leaf galls on *Prenanthes alba* L. or *P. altissima* L., Toronto, Canada, A. Cosens, a2441, in Felt Collection.

Lygocecis Gagné, new genus

Type-species, *Sackenomyia packardi* Felt.

Derivation of name: lygo = willow, cecis = gall; feminine gender.

Adult. Antenna with 18-20 short-necked flagellomeres. Palpus 2-3 segmented. Wing vein R_5 joining C at wing apex. Tarsal claws simple. Empodia as long as claws. Male abdomen: terga I-VII each with 2-3 caudal rows of short setae, no lateral setae, and covered with scales; sterna II-VII quadrate, entire, with several caudal rows of setae continuous with lateral setae; mesal area sparsely setose to naked; basimere elongate, densely setose; claspette glabrous, thin, elongate; telomere short, stout, with wide tooth; cerci large, barely separated mesally; sternum X long, narrow, deeply bilobed. Female abdomen: as in male except for postabdomen; segment VII membranous, tergum and sternum VII weakly defined; segment VIII subspherical, membranous, naked but for basal trichoid sensilla of tergum VIII, with a ventrobasal apodeme extending within segment VII; ovipositor elongate, basal half cylindrical, short-setose, distal half bilaterally flattened, strongly sclerotized basally, laterally in 2 long strips, and apically; cercus pointed, with scattered setae.

Pupa. Antennal horns very strongly developed. Prothoracic setae elongate. Face naked. Abdominal spicules of uniform size throughout.

Larva. Spatula strongly developed, apical collar very wide, multidentate. Abdominal segments with 4 tiny, dorsal papillae. Hind ventral papillae haired. Terminal segment with probably only 4 tiny papillae.

Lygocecis contains 2 described and at least 2 undescribed Nearctic species, all stem gallformers on willow. It shows certain superficial resemblances to *Rhabdophaga,* a large genus containing most willow gallmakers. Both genera have robust, very setose adults, a long R_5 wing vein, and many short-necked antennal flagellomeres, but those are not characters on which affinity can be based. *Lygocecis* has very distinct male genitalia, particularly the long, glabrous claspettes and stout telomeres. It differs from *Rhabdophaga* also in the distinct ovipositor, simple tarsal claws, and reduced larval papillae.

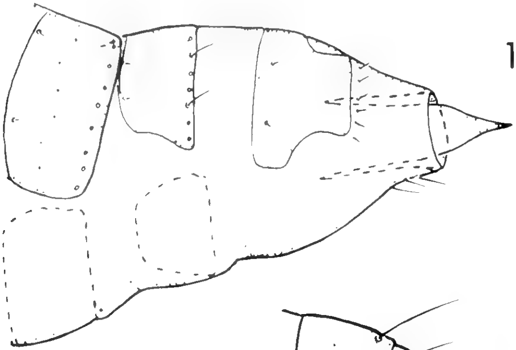
Lygocecis packardi (Felt), new comb.

Sackenomyia packardi Felt 1909: 290.

Wing length: ♂, 2.2-2.6 mm.; ♀, 2.0-2.8 mm. Palpus 2-segmented. Male genitalia as in fig. 8. Female postabdomen as in fig. 3. Pupal antennal horns bifid.

Syntypes: 2♂♂, 2♀♀, 3 pupal exuviae, and 2 larvae, from irregular twig swellings of *"Salix longifolia"* (=*S. interior* Rowles), adults emerged IV-15 to 16-1909, Canton, Mass., W. Packard, a1934, USNM Type No. 29338.

This species is known from Massachusetts, Virginia, Illinois, and Texas. It differs from *porterae* in the 2-segmented palpus, the absence of spinose setulae on the distal half of the ovipositor, and the bifid pupal antennal horns.



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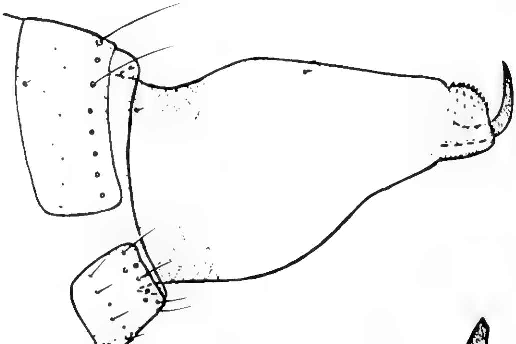

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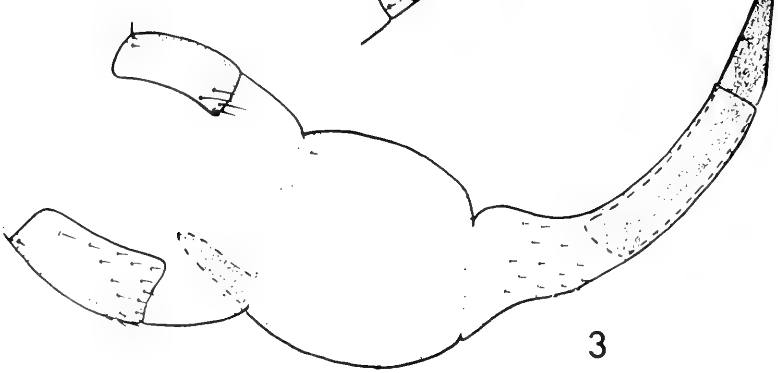

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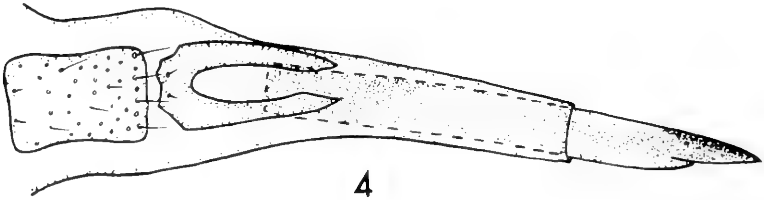

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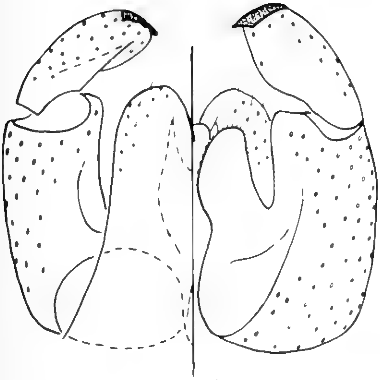

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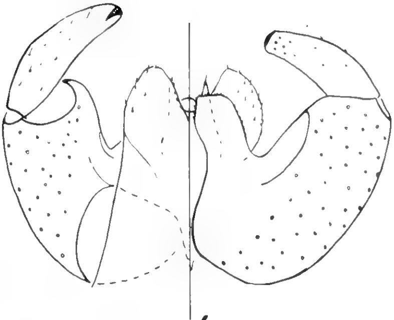

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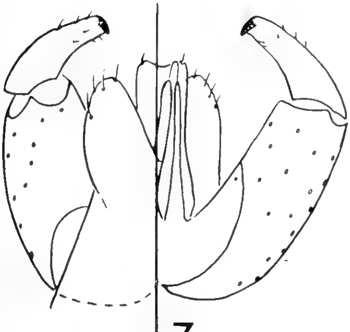

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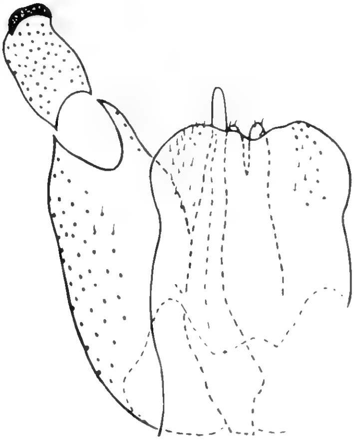

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Figs. 1-4, female postabdomens: 1, *Cystiphora canadensis,* segments VI to end, incl. (dorsolateral view); 2, *Sackenomyia acerifolia,* VI to end, incl. (lat.); 3, *Lygocecis packardi,* VII to end, incl. (lat.); 4, *Procystiphora coloradensis,* VII to end, incl. (dorsal, but distal half or ovipositor lateral).

Figs. 5-8, male genitalia (left half, dorsal view; right half, ventral): 5, *Procystiphora colorandensis;* 6, *P. junci;* 7, *Sackenomyia viburnifolia;* 8, *Lygocecis packardi.*

Lygocecis porterae (Cockerell), new comb.

Rhabdophaga porterae Cockerell 1904: 155.

Wing length: ♀, ca. 2.0 mm. Palpus 3-segmented. Female with recurved spinose setulae on basal half of ovipositor. Pupa with long, undivided antennal horns.

Syntypes: 3♀♀, pupal exuvium, from twig gall on willow, I-31-1904, near Las Vegas, New Mexico, W. Porter & M. Cooper, in USNM.

Procystiphora Felt

Procystiphora Felt 1915: 212. Type-species, *coloradensis* Felt (orig. des.).

Adult. Antenna with 15 flagellomeres. Palpus elongate, 4-segmented. Wing vein R_5 joining C slightly anteriad of wing apex. Tarsal claws each with small basal tooth. Empodia longer than claws. Male abdomen: terga I-VI with only caudolateral setae and covered with scales; tergum VII as for VI but with several lateral setae; tergum VIII sclerotized only basally, naked but for basal pair of trichoid sensilla; sterna II-VIII quadrate, entire, each with complete caudal row or rows of setae, several scattered lateral and central setae, and uniformly covered with scales; claspettes wide, blunt-tipped; telomere somewhat flattened, the apical tooth wide; cerci large, rounded; sternum X deeply incurved, the lobes pointed. Female abdomen: as in ♂ except for postabdomen; tergum and sternum VII as long as preceding sclerites but narrower, more strongly sclerotized, and with complete rows of caudal setae; tergum VIII bifid beyond base, longer than tergum VII, and strongly sclerotized; ovipositor very long, the distal half sclerotized, bilaterally compressed the pointed cercus covered with tiny setae.

Immature stages unknown.

This genus differs from the other genera considered here by the shape of the ♂ claspettes and sternum X, the small-toothed claws and long empodia, and the shape of the female abdominal sclerites; but possibly even more important than those characters is that the abdominal sterna lack a middle row of setae and are covered with scales even immediately cephalad of the caudal setae, an area that is naked in most other Oligotrophidi.

Procystiphora contains 2 Nearctic species reared from *Juncus* and possibly *Carex*. *Sterrhaulus corneolus* (Rübsaamen) reared from *Carex* in Germany has a piercing ovipositor and may belong here, but I have not seen specimens.

Three extra-Nearctic species have been placed in *Procystiphora* but are here transferred to *Dasineura*. These are *Dasineura autumnalis* (Mamaev), new combination, *D. mangiferae* Felt, restored combination, and *D. indica* (Grover and Prasad), new combination. The first species has been reared from elm in Europe, the 2 last from mango in India. *D. autumnalis* is probably more closely related to typical *Dasineura* than to the 2 mango midges. Except for the piercing ovipositor, the 3 species fit well in *Dasineura* for the following reasons: the tarsal claws have large teeth, the empodia are as long as the claws; the abdominal terga II-VI have lateral setae and the caudal setal rows, both of which are complete; and the male claspettes are attenuate and setulose.

Procystiphora coloradensis Felt

Procystiphora coloradensis Felt 1915: 212.

Wing length: ♂, 2.6 mm.; ♀, ?. Male genitalia as in fig. 5. Female postabdomen as in fig. 4.

Syntypes: 2♂♂, ♀, "possibly from *Carex*," VII-21-1914, Long's Peak Inn, Long's Peak, Colorado, a2573, in Felt Collection.

Procystiphora junci Felt

Procystiphora junci Felt 1922: 166.

Wing length: ♂, 2.0 mm.; ♀, 1.8 mm. Male genitalia as in fig. 6.
Syntypes: 2♂♂, 8♀♀, reared from *Juncus dudleyi* Wieg., X-6-1921, Centralia, Ill., W.B. Cartwright, A3209, in Felt Collection.

Sackenomyia Felt

Sackenomyia Felt 1908: 361. Type-species, *Rhopalomyia acerifolia* Felt (orig. des.).
Phlyctidobia Kieffer 1912: 200. Type-species, *Oligotrophus solmsi* Kieffer (orig. des.). *New synonym.*

Adult. Antenna with 10-12 flagellomeres. Palpus 3-segmented. Wing vein R_5 joining C. anteriad of wing apex. Tarsal claws simple (in type-species) or toothed. Empodia as long as claws. Male abdomen: terga I-VI with complete, sparse caudal row of setae, occasional lateral setae, and several scales; tergum VII sclerotized only basally, only caudolateral setae present; tergum VIII sclerotized only basally, naked except for basal pair of trichoid sensilla; sterna II-VIII quadrate, naked between caudal and middle setal rows; claspettes elongate, narrow parallel-sided, glabrous; telomere short, widest near base, tapering gradually to apical tooth; cerci large, ovoid; sternum X weakly concave apically. Female abdomen: anterior segments as in male; segments VII-VIII tubular, slightly sclerotized; terga VII-VIII not differentiated from surrounding area, both naked, identifiable only by basal pair of trichoid sensilla; sternum VII either apparent only by basal pair of trichoid sensilla (as in type-species) or quadrate with caudal row and other scattered setae; ovipositor short, cultrate, tapering abruptly beyond segment VIII to the strongly sclerotized, minutely setose cercus.

Pupa. Antennal horns with acute, pigmented apices. Prothoracic setae elongate. Metathoracic spiracles elongate, sclerotized. Face naked. Abdominal spicules of uniform size.

Larva. Spatula clove-shaped. Abdominal segments each with 4 dorsal papillae. Hind ventral papillae haired. Terminal segment with 4 setose papillae of uniform length.

Sackenomyia contains 4 species: 3 Nearctic, listed below, and the Palearctic species, *S. solmsi* (Kieffer) (n. comb.), of which I have seen a male and a female from the Barnes Collection. All form blister leaf galls on *Viburnum* spp.

Unlike the other genera treated here, the female abdominal terga VII and VIII have almost lost their identity. The cultriform cercus is also unique. The male genitalia differ from those of *Cystiphora* (and hence *Dasineura)* by the elongate, thin, glabrous claspettes. The larvae of *Sackenomyia* and *Cystiphora* resemble one another in the loss of a pair of papillae on each of the abdominal segments and of 2 pairs of terminal papillae. Inasmuch as the same reduction has occurred also in such widely separated genera as *Asteromyia* in the Lasiopteridi and *Caryomyia* in the Cecidomyiidi, I am inclined to consider the similarities between larvae of *Sackenomyia* and *Cystiphora* as separately derived.

Within *Sackenomyia, S. commota* has the more primitive characters with its toothed claws and well-developed female abdominal sternum VII, whereas the other 3 species have simple claws and a much reduced sternum VII.

Sackenomyia acerifolia Felt

Rhopalomyia acerifolia Felt 1907: 25 (as *acerifoliae)*

Wing length: ♀, 1.2 mm. Female postabdomen as in fig. 2.

Holotype, ♀, swept V-1-1906, Albany, N.Y., C38, in Felt Collection.

This species is very likely synonymous with *viburnifolia*. Its name is due to the fact that it was swept from maple leaves.

Sackenomyia viburnifolia Felt

Sackenomyia viburnifolia Felt 1909: 290.

Wing length: ♂, 1.0 mm.; ♀, 1.2-1.3 mm. Male genitalia as in fig. 7. Female postabdomen as in fig. 2.

Syntypes, 2 ♂♂, 3 ♀♀, 3 larvae, adults reared V-1909 ex purplish, fusiform, vein swellings on *Viburnum dentatum* L., Magnolia, Mass., C.H. Clark, a1896, in Felt Collection.

Sackenomyia commota Gagne, new name

Cystiphora viburnifolia Felt 1911: 480. Secondary junior homonym of *viburnifolia* Felt 1909.

Wing length: ♀, ca. 1.2 mm.

Holotype, ♀, reared V-5-1909, ex blister leaf gall on *Viburnum ? lentago* L., Magnolia, Mass., C.H. Clarke, a1897, in Felt Collection.

This species is renamed *commota* for the excited manner in which the mature larvae of *Sackenomyia* spp. move about when disturbed.

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NOTES ON TYPES OF *TOXOMERUS* (DIPTERA: SYRPHIDAE)[1]

Charles Gerdes[2]

ABSTRACT: Types of the genus *Toxomerus* (Diptera:Syrphidae) from the American Museum of Natural History were examined. The genitalia of some of these types were removed and similarities not previously known were revealed. Comparisons were made with Ecuadorean specimens in the Western Illinois University collection. These types and Ecuadorean specimens were studied in a general taxonomic survey (Gerdes, 1974). Abdominal patterns and genitalia not previously figured in the literature were drawn.

DESCRIPTORS: Diptera, Syrphidae, *Toxomerus pichinchae* n. sp., from Pichincha, Ecuador.

1. Holotypes of *Toxomerus idalius* (Hull) and *Toxomerus eurydice* (Hull)

The genitalia of these holotypes appeared identical and these types may represent one species. Both species were first described by Hull (1951), with the description of *T. idalius* occurring first.

Genitalia of *Toxomerus idalius* holotype (Figure 1).--In side view superior lobe with dorso-basal extension, forked distad; short baso-lateral protuberance; bristles along distal margin and shorter bristles along ventral margin. In dorsal view each stylus with convex lateral and medial margins, which form a distal blunt tip. Triangular process two-thirds length of styli when measured from a line connecting the bases of the styli; in side view there appears below the stylus a medial, triangular, blunt projection ventrad. In dorsal view epandrium fairly rectangular and three-fourths length of styli. In dorsal view ejaculatory hood with distal tip narrowed, then laterally flared into a rounded end with a small distomedial depression; in side view distal end similarly narrowed, then expanded into a bulbous end.

Abdominal pattern of *Toxomerus idalius* holotype (Figure 2).---Posterior part of first segment and base of second segment black; posterior part of second segment shining black; third and fourth segments each with reddish brown posterior fascia and dark brown medial spots; fifth segment with oval black spot.

2. Holotype of *Toxomerus antiopae* (Hull)

This species was first described by Hull (1951).

Genitalia of *Toxomerus antiopae* holotype (Figure 3).--In dorsal view each superior lobe with long baso-lateral protuberance reaching almost to lateral margin of stylus. In side view styli closely pressed down on superior lobes and ejaculatory hood, making a clear side view impossible. In side view distal and ventral margins of superior lobe

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[1] Accepted for publication: September 4, 1974

[2] Department of Entomology, University of Illinois, Urbana, Illinois 61801.

covered with bristles. In dorsal view each stylus with convex lateral margin; fairly straight disto-medial margin; scattered hairs over dorsal surface; a few bristles on disto-ventral surface. In dorsal view epandrium almost same length as styli. Triangular process one-third length of styli. In dorsal view ejaculatory hood slightly concave on distal margin; in side view rounded disto-dorsal tip leading into a small lateral flap ventrad on each side; larger ventral flap on each side.

Abdominal pattern of *Toxomerus antiopae* holotype (Figure 4).—First segment almost completely shining black. Second segment black basad and mediad except for narrow yellow medial fascia; shining black on posterior one-third of segment. Third and fourth segments each with basal dull black fascia, medially incised; posterior fasciae of same segments dull black on anterior part and medially incised, but shining black near posterior margin. Fifth segment with large oval black spot mediad and black subbasal areas; posterior black fascia mainly shining black but narrowly separated from surrounding margin of segment.

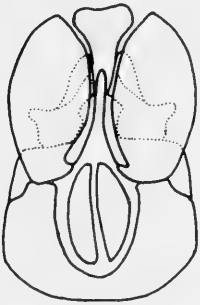
3. Holotype and allotype of *Toxomerus sylphus* (Hull) and holotype of *Toxomerus ultimus* (Hull)

The allotype of *T. sylphus* and the holotype of *T. ultimus*, both females, appeared to have identical genitalia and may represent the same species. *Toxomerus sylphus* was first described by Hull (1943b) and *T. ultimus* by Hull (1951). *Toxomerus nasutus* Sack was first described by Sack (1941) and may also belong to the same species, although the types were not available. The *T. sylphus* abdominal pattern was drawn by Hull (1943a). The *T. sylphus* holotype abdomen has the lateral margins curled ventrad and highly distorted fourth and fifth segments. The allotype of *T. sylphus* appears to be covered with a white fungal growth, making comparison difficult. However, the genitalia of the *T. sylphus* allotype and the female specimens from Ecuador referred to the species *T. nasutus* appeared identical; the abdominal patterns were similar.

Female genitalia of *Toxomerus nasutus* (Figures 8-10).—In ventral view hypogynium widest mediad; slightly flared on basal tips; very small medial depression on distal margin. In side view dorsal valve half length of ventral valve, which is straight on dorsal margin and convex on ventral margin. In ventral view genital plate with medial depression on basal margin; disto-lateral margins concave. In dorsal view epigynium with rounded lateral and distal margins, the latter very slightly produced into a distomedial projection; transverse sclerotized spot on distal half of dorsal surface; basal margin straight except at tips; in side view dorsal margin straight except for small hump over sclerotized spot.

Female specimens from Ecuador examined.—All were collected by E. Velastiqui, a professional collector; identified by the author; and stored in the Western Illinois University collection. Banos, 47, 23-VII-1963 to 15-V-1965; Chaupi, 1, 2-VIII-1963; Conquista, 1, 19-V-1967; Naguazo, 1, 27-VIII-1963; Napo Oriente, 1, 9-V-1967; Obitagua, 1, 8-III-1965; Obitahua, 5, 11-III-1965 to 30-III-1965; Rio Blanco, 2, 1 on 20-VII-1963, 1 on 21-V-1965; Rio Negro, 5, 14-III-1965 to 20-VI-1965; Runtun, 15, 15-VII-1963 to 7-V-1965; Salado, 2, 1 on 3-VIII-1963, 1 on 4-VIII-1963; Sanqay, 2, 10-III-1966; Santana, 8, 1 on 22-V-1965, 7 on 2-V-1966; Sarayaco, 1, 13-II-1965; Sasayaso Oriente, 5, 4 on 18-I-1965, 1 on 28-II-1965; Yunguilla, 1, 4-V-1966.

Fig. 1. Genitalia of *Toxomerus idalius* (Hall) holotype, dorsal view. Fig. 2. Abdomen of *Toxomerus idalius* (Hull) holotype, dorsal view. Fig. 3. Genitalia of *Toxomerus antiopae* (Hull) holotype, dorsal view. Fig. 4. Abdomen of *Toxomerus antiopae* (Hull) holotype, dorsal view.



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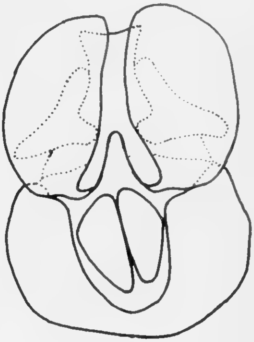

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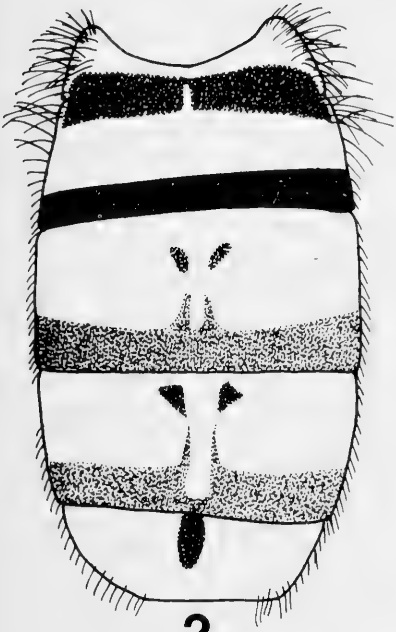

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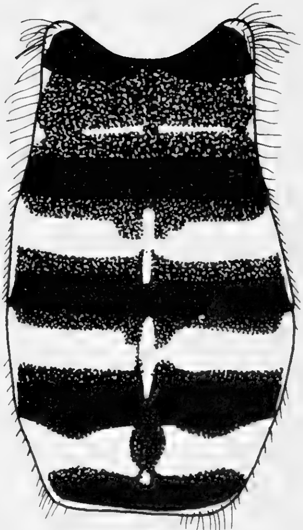

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4. Holotypes of *Toxomerus productus* (Curran) and *Toxomerus cyrillus* (Hull) and allotype of *Toxomerus cyrillus* (Hull)

The genitalia of the holotypes, both males, appeared identical and may represent the same species. *Toxomerus productus* was first described by Curran (1930) and *T. cyrillus* by Hull (1951). The *T. productus* abdominal pattern was drawn by Hull (1943a).

These three types are alike in having the humeri, margins of the scutum, propleural spots, dorsal sternopleural spots, and posterior mesopleural spots, all yellow. The face is slightly shorter than the antennae. Both males have a dark brown subapical band on the posterior femur and a medial band on the posterior tibia. The female has a light brown subapical band on the posterior femur and a subbasal band on the posterior tibia. The color pattern of the *T. cyrillus* holotype is very obscure and cannot be easily compared to the *T. cryillus* allotype, which is well-marked. Four males and eleven females from Ecuador, referred to the species *T. productus* in the following description, were found to have the same genitalia as the types of *T. cyrillus* but showed considerable diversity of the abdominal patterns.

Male genitalia of *Toxomerus productus* (Figures 5-7).—In side view superior lobe with short dorsal extension, forked distad; disto-ventral margin convex and bordered by bristles; a few very long bristles on baso-ventral curved margin. In dorsal view each stylus gradually wider distad; each with blunt distal triangular tip; scattered short hairs on dorsal surface; more close-spaced short hairs on disto-ventral surface. Triangular process three-fourths length of styli. In side view ejaculatory hood with evenly concave dorsal margin; narrowed neck on dorso-distal extension, which enlarges and becomes bulbous at distal end; on each side very slightly developed lateral flaps below bulbous end; larger ventro-basal flaps. Dorsal and ventral keels on sustentacular apodeme. In side view ejaculatory sac and ejaculatory apodeme narrow. Chitinous box with distal hooked extension inside ejaculatory hood.

Female genitalia of *Toxomerus productus* (Figures 11-13).—In ventral view hypogynium slightly constricted basad and gradually constricted past middle toward distal margin, where each side forms a triangular blunt projection with a medial depression between these two projections. In side view dorsal valve half length of ventral valve, which is fairly straight on dorsal margin and more convex on ventral margin. In ventral view genital plate with acute basomedial indentation; straight disto-lateral margins meeting in a blunt tip. In dorsal view epigynium with continuously rounded lateral and distal margins; baso-medial transverse sclerotized spot; in side view dorsal margin slightly convex.

Specimens from Ecuador examined.—All were collected by E. Velastiqui; identified by the author; and stored in the Western Illinois University collection. Males: Napo Oriente, 1, 1-V-1964; Obitahua, 3, 18-III-1965; Sanqay, 1, 10-III-1966; Sarayaco, 1, 1-III-1965; Sasayaso, 1, 28-II-1965. Females: Banos, 2, 1 on 3-III-1965, 1 on 16-III-1965; Obitagua, 1, 8-III-1965; Obitahua, 3, 18-III-1965; Rio Negro, 2, 27-III-1965; Runtun, 2, 3-V-1965; Sasayaso Oriente, 2, 28-II-1965.

5. Holotype of *Toxomerus brevifacies* (Hull) and allotype of *Toxomerus productus* (Curran)

These two types may represent the same species. *Toxomerus brevifacies* was first described by Hull (1943a). Both types have a face as long as the antennae; dark brown, white pilose, third antennal segments; yellow humeri, scutellar margins, dorsal sternopleural spots, and posterior mesopleural spots; yellow, slightly infuscated scutella with long black hair; and posterior yellow femora and tibiae with black hair. The thorax

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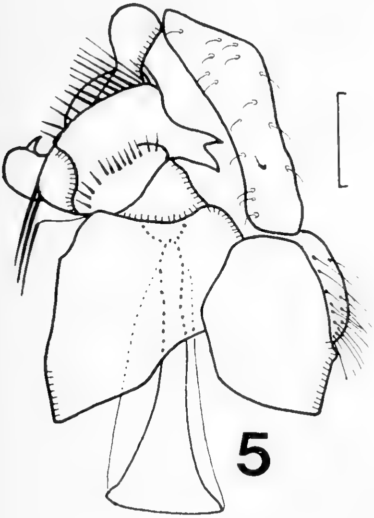
Fig. 5. Male genitalia of *Toxomerus productus* (curran), right side, scale line = 0.17 mm. Fig. 6. Male genitalia of *Toxomerus productus* (Curran), dorsal view, scale line = 0.17 mm. Fig. 7. Male genitalia of *Toxomerus productus* (Curran), axial system, scale line = 0.12 mm. Fig. 8. Female genitalia of *Toxomerus nasutus* Sack, right side, scale line = 0.17 mm. Fig. 9. Female genitalia of *Toxomerus nasutus* Sack, ventral view, scale line = 0.17 mm. Fig. 10. Female genitalia of *Toxomerus nasutus* Sack, dorsal view, scale line = 0.17 mm.



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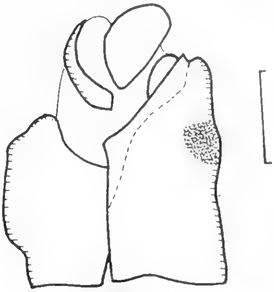

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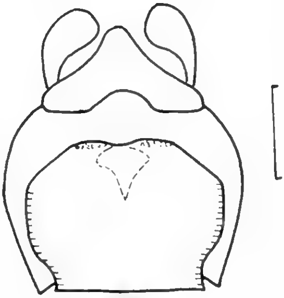

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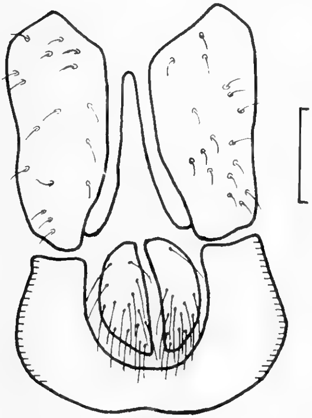

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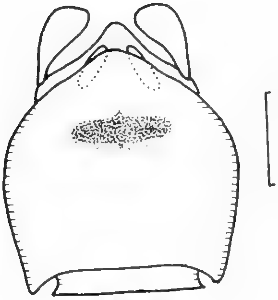

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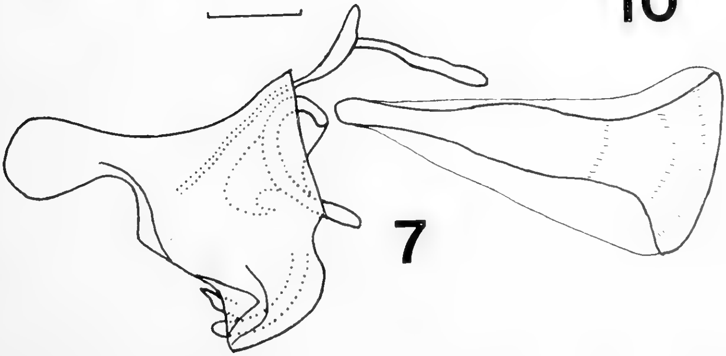

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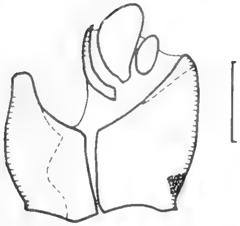

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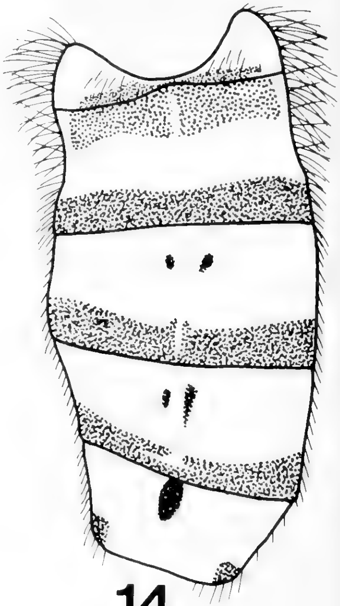

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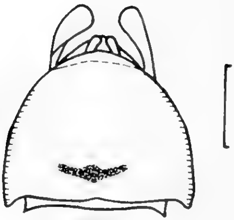

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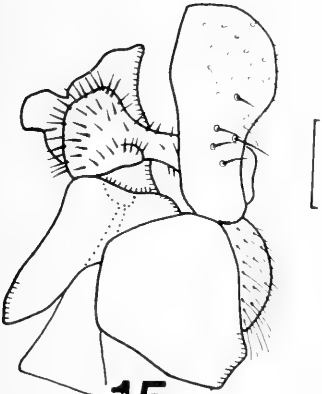
Fig. 11. Female genitalia of *Toxomerus productus* (Curran), right side, scale line = 0.17 mm. Fig. 12. Female genitalia of *Toxomerus productus* (Curran), ventral view, scale line = 0.17 mm. Fig. 13. Female genitalia of *Toxomerus productus* (Curran), dorsal view, scale line = 0.17 mm. Fig. 14. Abdomen of *Toxomerus brevifacies* (Hull) holotype, dorsal view.

Fig. 15. Male genitalia of *Toxomerus brevifacies* (Hull), right side, scale line = 0.17 mm. Fig. 16. Male genitalia of *Toxomerus brevifacies* (Hull) dorsal view, scale line = 0.17 mm. Fig. 17. Male genitalia of *Toxomerus brevifacies* (Hull), axial system, scale line = 0.12 mm. Fig. 18. Female genitalia of *Toxomerus brevifacies* (Hull), right side, scale line = 0.17 mm. Fig. 19. Female genitalia of *Toxomerus brevifacies* (Hull), ventral view, scale line = 0.17 mm. Fig. 20. Female genitalia of *Toxomerus brevifacies* (Hull), dorsal view, scale line = 0.17 mm.



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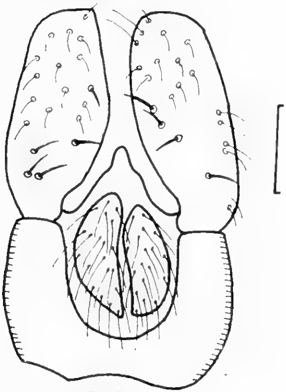

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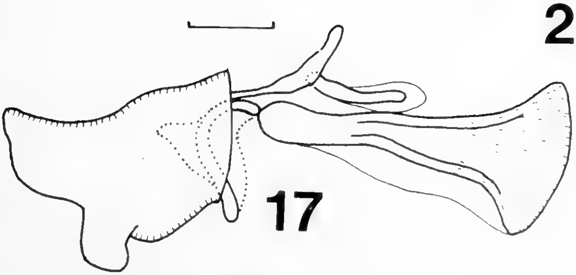

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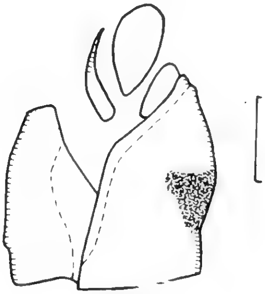

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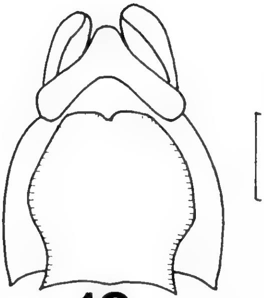

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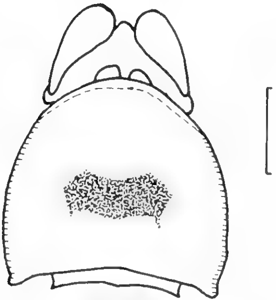

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of the holotype is faded and appears to have a yellow propleural spot; the allotype has no such spot. However, of the twenty-five males from Ecuador whose genitalia agreed with the holotype, a spot was present on three. Sixteen females from Ecuador were found whose genitalia agreed with the allotype; these are referred to the species *T. brevifacies* in the following description. The abdominal patterns of the two types were similar but showed some variation. The abdominal drawing of the *T. brevifacies* holotype (Figure 14) is slightly asymmetric since the abdomen is twisted on the left posterior side.

Abdominal pattern of *Toxomerus brevifacies* holotype (Figure 14).—Posterior margin of first segment light brown but not reaching lateral edges. Second segment with wide, basal, light brown fascia, medially incised and not reaching lateral edges; complete posterior brown fascia. Third and fourth segments each with brown posterior fascia and darker medial spots, which are unconnected to the posterior fascia. Fifth segment with basal black spot and brown posterior corner spots.

Male genitalia of *Toxomerus brevifacies* (Figures 15-17).—In side view superior lobe with long dorsal extension, forked distad; rounded ventro-distal and ventral margins; baso-medial lateral protuberance; short bristles on ventro-distal and ventral margins; smaller bristles and hairs continuing up distal margin; scattered hairs on lateral surface; a few hairs on dorsal extension and lateral protuberance. In side view stylus wide; in dorsal view truncate distad; sparse scattered hairs dorsad; short scattered hairs on disto-ventral surface. Triangular process one-third length of styli. Epandrium three-fourths length of styli. In dorsal view ejaculatory hood with small medial projection on distal margin, which flares slightly on each side as a lateral lobe; in side view ventro-medial lobes and rounded ventro-basal keel. Sustentacular apodeme with no dorsal keel and small ventral keel. In side view ejaculatory apodeme narrow but slightly wider distad, with peripheral area unsclerotized distad. In side view ejaculatory sac narrow. Chitinous box with distal extension inside ejaculatory hood.

Female genitalia of *Toxomerus brevifacies* (Figures 18-20).—In ventral view hypogynium constricted basad; flared slightly at basal tips; with small disto-medial notch. In side view dorsal valve half length of ventral valve, which is slightly convex on dorsal margin and more convex on ventral margin. In ventral view genital plate concave basad; with slightly concave disto-lateral sides; with rounded distal end. In dorsal view epigynium concave on basal margin with continuously rounded lateral and distal margins; large oval to rectangular spot mediad, which is slightly concave on distal edge; in side view slight hump extending from basal end of spot to near distal margin.

Specimens from Ecuador examined.—All were collected by E. Velastiqui; identified by the author; and stored in the Western Illinois University collection. Males: Banos, 17, 24-VII-1963 to 3-VII-1965; Chaupi, 1, 25-VIII-1963; Conquista, 3, 19-V-1967; Obitagua, 3, 2 on 8-III-1965, 1 on 18-III-1965; Rio Blanco, 2, 1 on 21-VII-1963, 1 on 10-IV-1965; Rio Negro, 5, 27-III-1965 to 10-VI-1965; Runtun, 2, 18-VIII-1963; Sanqay Oriente, 1, 10-III-1966; Sarayaco, 1, 17-III-1965; Sasayaso Oriente, 2, 28-II-1965; Topo, 1, 5-V-1965; Ulvilla, 4, 15-V-1965. Females: Abitagua Oriente, 1, 23-VI-1967; Banos, 5, 27-VII-1963 to 15-V-1965; Chaupi, 1, 25-VIII-1963; Conquista, 2, 19-V-1967; Naguazo, 2, 26-VIII-1964; Rio Negro, 4, 1 on 27-III-1965, 3 on 6-IV-1965; Runtun, 1, 5-III-1965; Santana, 1, 22-V-1965; Sasayaso, 2, 18-II-1965; Ulvilla, 4, 15-V-1965.

6. Holotype of *Toxomerus ecuadoreus* (Hull)

Twelve specimens from Ecuador were found with genitalia identical to the holotype, a male. This species was first described by Hull (1943a).

Abdominal pattern of *Toxomerus ecuadoreus* holotype (Figure 21).—First segment mainly charcoal colored except narrowly on lateral edges. Second segment with wide

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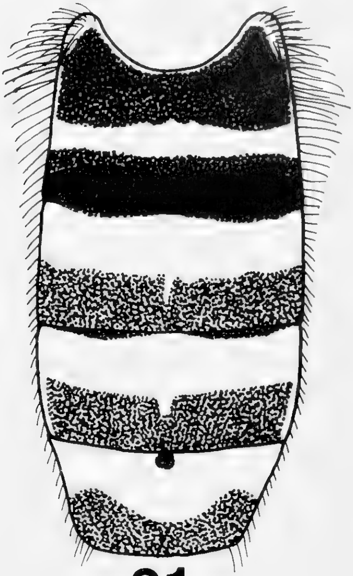
Fig. 21. Abdomen of *Toxomerus ecuadoreus* (Hull) holotype, dorsal view. Fig. 22. Male genitalia of *Toxomerus ecuadoreus* (Hull), right side, scale line = 0.17 mm. Fig. 23. Male genitalia of *Toxomerus ecuadoreus* (Hull), dorsal view, scale line = 0.17 mm. Fig. 24. Male genitalia of *Toxomerus ecuadoreus* (Hull), axial system, scale line = 0.12 mm.



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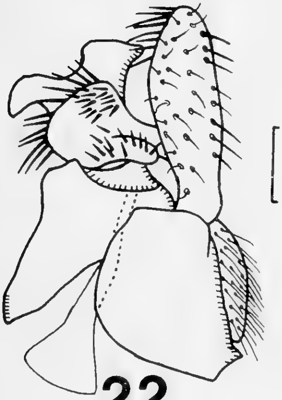

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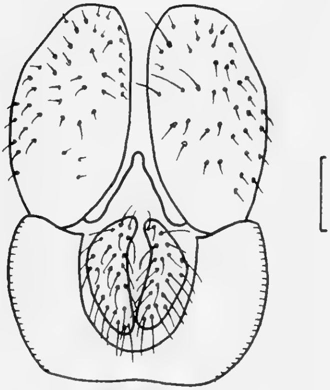

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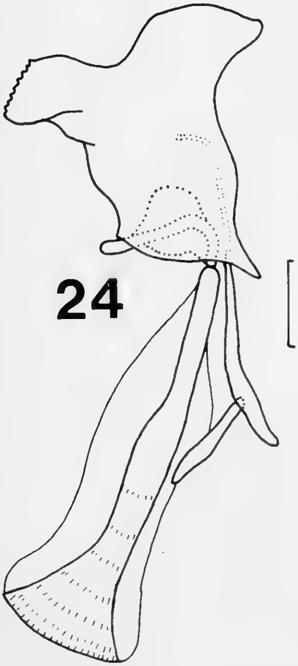

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basal fascia of same color except narrowly on lateral edges; posterior fascia same color anteriorly but shining black posteriorly. Third segment with two thin basal strips and wide posterior fascia, both black; small medial incision in posterior fascia. Fourth segment similar except posterior fascia does not reach lateral edges. Fifth segment with tiny baso-medial spot and large posterior fascia, both reddish black. The holotype possessed no spots on the third and fourth segments, but several specimens with identical genitalia showed varying degrees of development of spots.

Male genitalia of *Toxomerus ecuadoreus* (Figures 22-24).--In side view superior lobe with dorsal projection, forked distad; baso-medial lateral protuberance; ventral margin covered with bristles; scattered hairs on lateral surface and baso-medial lateral protuberance. In dorsal view styli set close together; each with scattered hairs on dorsal surface and longer hairs on distal one-third of ventral surface. Triangular process one-third length of styli. Epandrium three-fourths length of styli. In dorsal view ejaculatory hood concave on distal margin; in side view concave on dorsal margin, which is produced into a rounded disto-dorsal end, which is flared moderately on each side into a lateral flap; with larger ventral flaps that have pitted lateral surfaces and serrate ventral margins. In side view sustentacular apodeme with ventral keel larger than dorsal keel. In side view ejaculatory sac narrow. In side view chitinous box with rounded medial extension inside ejaculatory hood.

Male specimens from Ecuador examined.--All were collected by E. Velastiqui; identified by the author; and stored in the Western Illinois University collection. Aloag, 7, 23-VI-1967 to 27-VI-1967; Banos, 1, 19-VIII-1963; Obitagua, 1, 8-III-1965; Rio Blanco, 1, 20-VII-1963; Rio Negro, 4, 1 on 27-III-1965, 3 on 6-IV-1965; Runtun, 5, 15-VIII-1963 to 7-V-1965.

Conclusion.---It is hoped that this paper will encourage further and more comprehensive comparisons of the genitalia of *Toxomerus.* Little work has been reported on the genitalia of this genus for which over 100 species have been reported in the literature. Doubtless several species have been incorrectly designated but more work is needed to reach reliable conclusions.

ACKNOWLEDGEMENTS

The author would like to thank the American Museum of Natural History for its generous loan of types and Dr. Yale Sedman of Western Illinois University for his loan of Ecuadorean specimens.

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SEVEN FAMILIES OF AQUATIC AND SEMIAQUATIC HEMIPTERA IN LOUISIANA[1]

Part V. Family Nepidae Latreille, 1802. "Water Scorpions".

Gene J. Gonsoulin[2]

ABSTRACT: This paper contains data on the collection, taxonomy, distribution, and synonymy of two genera and seven species of the family Nepidae in Louisiana. Included are keys to the genera and species along with detailed locality data for each species. A review of the literature is presented with the family discussion. Ecological information is given with each species. Collections for this study were made on a year around basis.

DESCRIPTORS: Nepidae, collection, taxonomy, distribution, synonymy, two genera, seven species, Nepidae, Louisiana, keys, locality data, literature, ecological, information.

Although of very diverse form, members of this family are at once distinguished from other aquatic insects by their long, slender respiratory filaments. They possess three pairs of disc-like "static sense organs" on the sides of the second, third, and fourth ventral segment. The body may be elongate, oval, or linear and is often exceeded in length by the respiratory filaments. The three-segmented antennae are located beneath the protruding eyes. The beak is three-segmented, short, and stout. Being adapted for climbing among aquatic vegetation, the middle and hind pair of legs are long and slender. The front legs are raptorial, inserted very near the margin of the prosternum. The front femora are toothed for holding prey and grooved to receive the tibia and the tarsi.

Only three genera of water scorpions are known from North America. Two of these, *Curicta* and *Ranatra*, with a total of five species, are recorded for Louisiana. *Ranatra* is the dominant genus in the United States, *Curicta* being a Neotropical genus with only two species extending into the southern United States. A third genus, *Nepa*, may eventually be found in Louisiana as it has

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[1] Accepted for publication: October 2, 1974.

[2] Director of Herbarium, Dept. of Biology, East Tennessee State Univ., Johnson City, TN 37601.

been reported from Georgia by Van Duzee (1917) and Blatchley (1926). For this reason it is included in the generic key. In addition, two species of *Ranatra (R. kirkaldyi* and *R. drakei)* that have not been thus far recorded for Louisiana are included in the species key since they have been recorded for Mississippi by Wilson (1958).

Nepids are not considered free swimmers. They are more often found clinging to various types of aquatic vegetation, replenishing their air supply with respiratory filaments protruding just above the surface. Nevertheless, they occassionally can be seen in open water, swimming in a most ungainly fashion. They are voracious feeders, attacking any organism of suitable size. As slow swimmers they do not pursue their prey but rather lie in wait, concealed by vegetation.

Water scorpions can produce a rasping noise or stridulation when disturbed or at rest. The sound is produced by a "tonal apparatus" located in the coxal cavaties of the first pair of legs.

Nepids overwinter as adults. Egg-laying takes place during the spring and early summer months. The eggs are oval to oval-elongate and have two to seven slender filaments. The eggs are completely inserted into aquatic plant tissue or mud with the slender filaments protruding. According to Torre-Bueno (1906), who studied the life history of *Ranatra* in the eastern United States, the incubation period varies from two weeks to a month. The five nymphal instars each require a week or more.

Review of the Literature. Holmes (1904, 1906, 1907, 1912) published a number of interesting papers on the physiology of various species of *Ranatra.* Bueno (1905a, 1905b, 1906) published taxonomic notes of three species of *Ranatra,* discussion of tonal apparatus, and a life history study. The major work of the family is a monograph of the *Nepidae* of America north of Mexico by Hungerford (1922) which contains keys to genera and species, descriptions, synonymy and locality data. Several new species of *Nepidae* from the Americas were described by Kuitert (1948, 1949).

Key to the Louisiana Genera of *Nepidae* Latreille

1. Body broadly oval and flat, more than 1/3 as wide as long . . . . *Nepa* Linn.

   Body elongate-oval to linear, less than 1/4 as wide as long 2

2. Prothorax a little broader than the head; body elongate-oval . . . . *Curicta* Stal.

   Prothorax narrower than head; body elongate-linear (Fig. 2a) . . . .*Ranatra* Fabricius

1. *Curicta drakei* Hungerford, 1922; Univ. Kans. Sci. Bull., 14:432

Description. Body elongate-oval; eyes small, globular; tylus larger than jugae; penultimate segment of antenna with a long slender prolongation; pronotum a little broader than the head; membrane of wing well developed and as long as the elytral suture; fore coxa and femur stout, the coxa one-half the length of the femur which bears a well-developed tooth nearer the base than the apex; metathorxic femur and tibia of equal length; length ranges from 16-22 mm. exclusive of the respiratory filaments, themselves being 7-8 mm. long.

Curicta may be readily distinguished from *Ranatra* by its broader more oval-shaped body. It seems to be rather infrequent in Louisiana and is not reported from adjoining states other than Texas. Wiley (1922, 1924) studied the biology of *C. drakei* in Texas. She reports that the female lays five to ten eggs in a group, preferably in soft mud. The incubation period varies from 12 to 13 days. Five nymphal instars were reported with the following durations: 14, 22½, 23½, 23½, and 46 days.

This insect was not collected in Louisiana during the course of this study. However, it has been recorded previously in the state by Ellis (1952). Four specimens are in the collection at Tulane University. Three were taken in fresh-water marshes from one to four feet deep, and the fourth from a fresh-water lagoon. In both these locations there was abundant submerged, floating and emergent vegetation. In addition, it was reported to occur in southeastern Louisiana by Hungerford (1922).

Distribution by Parish (Fig. 2c). No specimens were collected during the course of this study.

Previous Parish Records: Jefferson, Lafourche, Orleans (Ellis, 1952)

Key to the Louisiana Species of *Ranatra* Fabricius (From Wilson, 1958)

1. Antennae simple beneath the eyes (Fig. 1d); distal end of next to last segment without lateral prolongation (Fig. 1a); front femora broad and stout and not narrowed near middle (Fig. 13) . . . . *R. Kirkaldyi* Bueno

   Antennae with distal end of next to last segment with a lateral prolongation (Figs. 1b & 1c); front femora somewhat narrowed near middle (Figs. 1f & 1i) 2

2. Lateral prolongation of next to last segment of antennae not greater than one-half the length of the ultimate segment (Fig. 1b) 3

   Lateral prolongation of next to last segment of antennae greater than one half the length of the ultimate segment (Fig. 1c) 4

3. Prosternum with a single wide, deep longitudinal groove (Fig. 2b); eyes very prominent . . . . *R. bueno* Hungerford

   Prosternum without the deep trough, but possessing two longitudinal depressed lines characteristic of most species of *Ranatra* . . . . *R. nigra* Herrich-Schaffer

4. Front femur broad and without apical tooth (Fig. 1g) . . . . . *R. australis* Hungerford

   Front femur with apical tooth (Fig. 1h & 1i) 5

5. Anterior portion of pronotum fully twice as long as thickened posterior portion; eyes large, plainly greater than interocular space; jugae of head prominent; front femur long and slender (Fig. 1h); hind femur surpassing middle of next to last abdominal segment, caudal filaments as long as body . . . . . . *R. drakei* Hungerford

   Anterior portion of pronotum shorter than above; eyes not much, if any, greater than interocular space; jugae not prominent; front femur fairly stout (Fig. 1i); middle and hind femora short, not reaching middle of next to last abdominal segment; caudal filaments shorter than body . . . . *R. fusca* Palisot de Beauvois

1. *Ranatra buenoi* Hungerford, 1922. Univ. of Kans. Sci. Bull. 14:442
***Ranatra fusca* Torre-Bueno, 1905. Can. Ent. 37:183.**

Description. Body elongate-subcylindrical; eyes very prominent, their diameter greater than the width of interocular area; lateral prolongation of next to last segment of antenna not greater than one-half the length of the ultimate segment (Fig. 1b); front portion of pronotum only slightly wider at apex than at middle, about twice as long as the smaller posterior portion; prosternum with a single wide, deep longitudinal groove (Fig. 2b); front femora long and slender, more than one half longer than the coxae, distinctly narrowed in front of rather large submedian tooth (Fig. 1f); hind femora scarcely reaching end of abdomen; length ranges from 32-38 mm. respiratory filaments 22-27 mm.

Although *R. nigra* is often confused with this species, *R. buenoi* can be readily recognized by the distinctive longitudinal groove in the prosternum. It has been previously recorded for Louisiana by Blatchley (1926), Penn (1951), and by Ellis (1952). Although it has been recorded in a variety of habitats it seems to occur more frequently in low lying areas (as observed by Ellis, 1952) whose waters are quite turbid and contain abundant aquatic vegetation.

Distribution by Parish (Fig. 3a). **Allen** – W. of Reese, 7-17-67 (GJG 90). **Bienville,** N. of Ringgold, 6-8-67 (GJG 51). **Bossier,** S. of Fillmore, 6-8-67 (GJG 49). **Caddo-** E. of Hosston, 6-7-67 (FJF 43). **Claiborne** – S.E. of Summerfield, 6-7-67 (GJG 45). **Jefferson Davis** – W. of Jennings, 7-17-67 (GJG 97). **Lafayette** – W. of Lafayette, 10-26-66 (GJG 6); Lafayette, 1-16-67 (GJG 14); Lafayette, 10-26-66 (GJG 3); N. of Scott, 11-1-66 (GJG 8); Beaver Park (Laf.), 10-29-66 (GJG 10); S. of Lafayette, 1-31-66 (GJG 19). **Sabine** – E. of Converse, 8-14-67 (GJG 110). **St. Landry** S. of Opelouses, 6-14-67 (GJG 56).

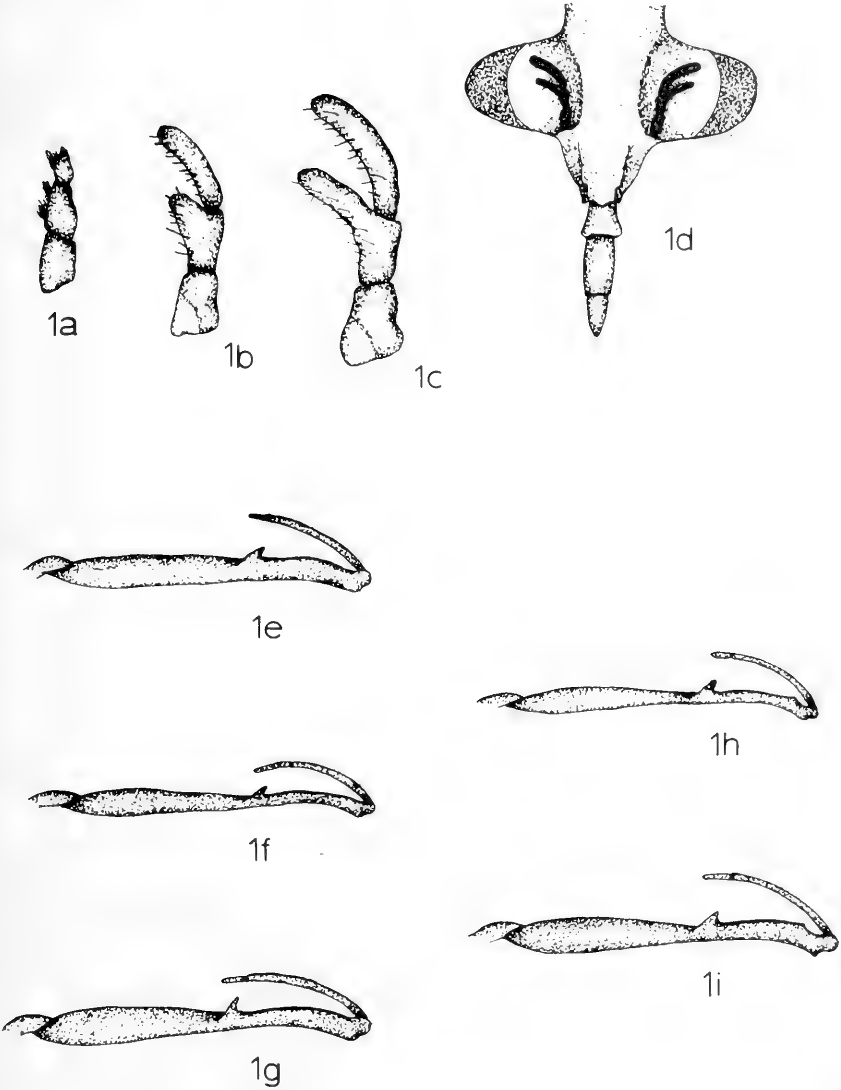

Figure 1. a) antenna of *R. kirkaldyi;* b) antennae of *R. buenoi* and *R. nigra*; c) antennae of *R. australis* and *R. fusca;* d) ventral view of head showing antennae position; e) fore femur of *R. kirkaldki;* f) fore femur of *R. buenoi* and *R. nigra;* g) fore femur of *R. australis;* h) fore femur of *R. drakei;* i) fore femur of *R. fusca.*

Previous Parish Periods. Madison (Hungerford, 1922). Franklin, Grant (Penn, 1951). Iberville, Orleans, Pointe Coupee, St. Charles, St. Martin, St. Mary, St. Tammany, Washington (Ellis, 1952).

2. *Ranatra Nigra* Herrick-Shaffer, 1853. G.A.W. Wanzenartiger insectung 9:32.
Ranatra protensa Montandon, 1910. Bull. Soc. Sci. Bucarest 18:185

Description. Body elongate-subcylindrical; eyes prominent, but less so than in *buenoi;* lateral prolongation on next to last segment of the antennae not greater than one half the length of the ultimate segment (Fig. 1b); pronotum relatively short, the front lobe about two and one fourth times the length of the hind one; prosternum having two longitudinal depressed lines but no deep groove; front femora long and slender, more than one-half longer than the coxae, distinctly narrowed in front of the submedian tooth (Fig. 1f); hind femora reaching tip of elytra; length 30-32 mm., respiratory filaments 18-21 mm.

Ranatra nigra has a fairly wide distribution in Louisiana. It was previously recorded for Louisiana by Penn (1951) and by Ellis (1952), who indicated that they seem to occur entirely in permanent bodies of water. However, during this study, this species was collected in a wide variety of habitats, some of which were indeed temporary. It is occasionally mistaken for *R. buenoi* from which it can be readily identified by the lack of a deep groove on the prosternum.

Distribution by Parish (Fig. 36). **Desoto** – W.S.W. of Mansfield, 6-7-67 (GJG 40). **East Baton Rouge** – S.E. of Fred, 7-10-67 (GJG 80). **East Feliciana** – W. of Amite, 7-10-67 (GJG 82). **Grant** – S. of Colfax, 8-16-67 (GJG 116). **Iberville** – W. of Plaquemine, 6-14-67 (GJG 61). **Lafayette** – W. of Lafayette, 10-26-66 (GJG 130). **St. Mary** – S.W. of Centerville, 4-27-67 (GJG 35). S. of Louisia, 3-16-67 (GJG 21). **Terreborne** – S. of Chauvin, 8-23-67 (GJG 130). **Webster** – W. of Sarepta, 6-7-67 (GJG 44).

Previous Parish Records. Caddo, East Carroll, Franklin, St. Bernard, St. Charles (Penn, 1951). Lafourche, Orleans, Tangipahoa (Ellis, 1952).

3. *Ranatra australis* Hungerford, 1922. Univ. Kans. Sci. Bull. 14:449.

Description. Body elongate-subcylindrical; eyes rather small, their diameter less than the interocular area; jugae very prominent and more elevated than the tylus; lateral prolongation of next to last segment of antennae greater than one-half the length of the ultimate segment (Fig. 1c); front part of pronotum about twice as long as thickened basal portion, the hind margin of latter broadly and shallowly emarginate; prosternum having two longitudinal depressed lines; front femora rather broad and stout, without preapical sinuation (Fig. 1g), more than one-half longer than the coxa; hind femora passing middle of last ventral abdominal segment; length 32-37 mm., respiratory filaments 27-30 mm.

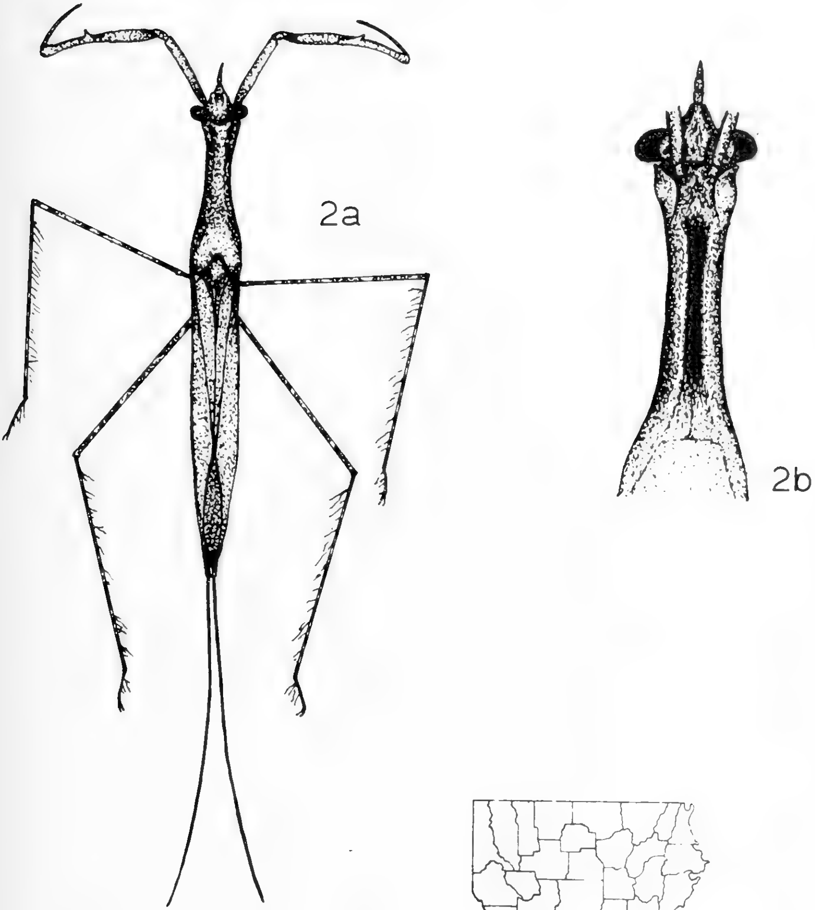

Figure 2. a) habit of *Ranatra;* b) prosternum of *R. buenoi.*

Figure 2c. Distribution of *Curicta drakei* Hungerford.

This seems to be the most common species of *Ranatra* in Louisiana. It was previously recorded for Louisiana by Hungerford (1922) and Blatchley (1926), who mentions that it is also the most common species found in Florida. As seen from the distribution maps, it seems to occur primarily along the deltaic plains and Mississippi alluvial plain. However, several collections were made in the higher mixed woods areas of the state.

R. australis can be readily separated from *R. fusca,* both of which have long lateral prolongation of the next to last antennal segment, by the lack of a preapical tooth on the front femora.

Distribution by Parish (Fig. 3c). **Calcasieu** – S.W. of Vinton, 7-17-67 (GJG 71). **Catahoula** – S. of Peck, 8-17-67 (GJG 125). **Evangeline** – W. of Bayou Chicot, 6-27-67 (GJG 71). **Jefferson Davis** – W. of Jennings, 7-17-67 (GJG 97). **Lafayette** – Lafayette, 1-25-67 (GJG 15); 10-5-66 (GJG 3); 1-16-67 (GJG 14); S. of Lafayette, 1-31-66 (GJG 19); N. of Scott, 11-1-66 (GJG 8). **Plaquamine** – N. of Myrdle Grove, 8-24-67 (GJG 136). **St. Charles** – S.S.W. of Paradis, 6-3-67 (GJG 38). **St. James** – N.E. of Thibadaux, 10-27-67 (GJG 153). **St. Mary** – N.W. of Louisiana, 3-16-67 (GJG 23); S.W. of Centerville, 4-27-67 (GJG 35); **St. Tammany** – C. of Parish line, 7-10-67 (GJG 78); W. of Hickory, 7-11-67 (GJG 86); **Webster** – N.W. of Plaquimine, 6-14-67 (GJG 61).

Previous Parish Record – Livingston, Madison, Orleans (Hungerford, 1922). Bienville, Franklin, Lafayette, Richland, St. Charles (Penn, 1951). Cameron, Iberia, Iberville, Jefferson, Lafouche, Plaquemines, St. Bernard, St. Mary, St. Tammany, West Baton Rouge (Ellis, 1952).

4. *Ranatra fusca* var. *edentula* Montandon, 1910. Bull. Sci. Bucharest 19:65.
R. fusca var. *edentula* Hungerford, 1922. Univ. Kans. Sci. Bull. 14:446.

Description. Body elongate-subcylindrical; eyes prominent, as wide as interocular area; lateral prolongation of next to the last segment of antennae greater than one-half the length of the ultimate segment, (Fig. 1c); front portion of pronotum a little wider at apex than middle, about one-half longer than thicker basal portion; prosternum with a wide, shallow, median groove; front femora relatively stout, one-half longer than the coxa, and with a distinct preapical sinuation (Fig. 1i); hind femora relatively short; hind tibia reaching to apical fourth of respiratory filament; length 35-42 mm., respiratory filaments 21-24 mm.

This species was not collected in Louisiana during the course of this study. It has been previously recorded for Louisiana by Penn (1951) and Ellis (1952). *R. fusca* can be easily distinguished by the preapical sinuation of the front femora. The only species that has a preapical sinuation, *R. drakei,* is yet to be recorded for Louisiana. It has been recorded at Biloxi, Mississippi, by Wilson (1958), and therefore most likely occurs in Louisiana also.

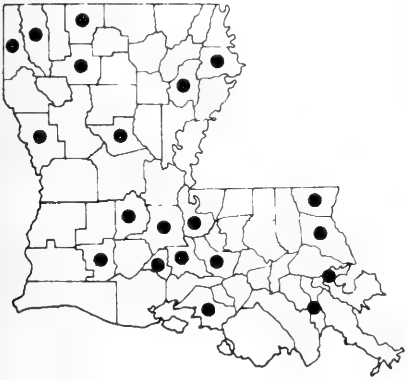

Figure 3a. Distribution of *R. buenoi* Hungerford.

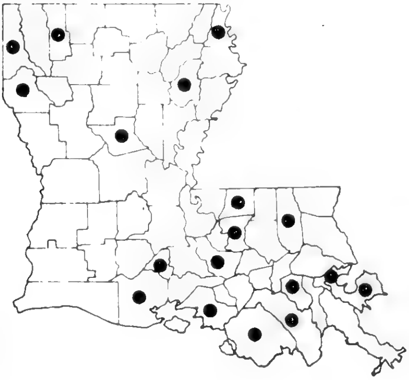

Figure 3b. Distribution of *R. nigra* Herrich-Schaffer.

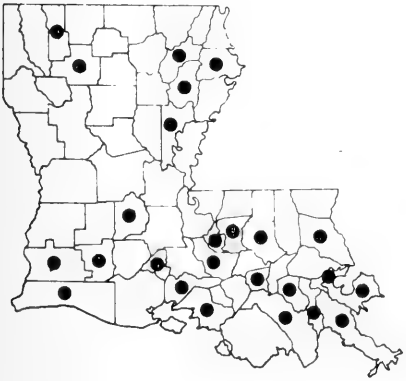

Figure 3c. Distribution of *R. australis* Hungerford.

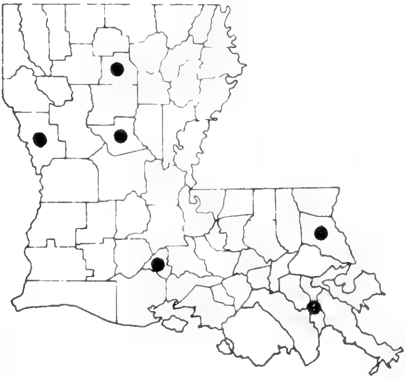

Figure 3d. Distribution of *R. fusca edentula* Montandon.

Distribution by Parish (Fig. 3d). This species was not found in Louisiana during this study.

Previous Parish Records. Grant, Jackson, Lafayette, Sabine, St. Tammany, (Penn, 1951). Jefferson (Ellis, 1952)

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COMPARATIVE EVALUATION OF METHODS FOR SAMPLING OF MITE *TETRANYCHUS CUCURBITAE* RAHMAN AND SAPRA[1]

By

S.K. Gupta,[2] M.S. Dhooria[3] and A.S. Sidhu[4]

ABSTRACT: Five principal methods, *viz.* i) Direct counting, ii) Imprinting, iii) Floatation, iv) Jarring and V) Brushing were compared for their efficiency and precision in determining the population density of *Tetranychus cucurbitae* Rahman and Sapra (Acarina: Tetranychidae), seriously infesting brinjal in Punjab, India. All the methods were equally efficient but significant difference existed in respect of time taken. Brushing method was significantly better than direct counting but not better than jarring and imprinting. Direct counting was as good as imprinting and jarring. Because of convenience and simplicity the imprinting method may be preferred for determining the population density of this mite.

DESCRIPTORS: Evaluation of sampling methods for *T. cucurbitae* (Acarina: Tetranychidae)

Methods of sampling are important in estimating the population density of various organisms. As many as five principal methods, *viz.* i) direct counting, ii) imprinting, iii) floatation, iv) jarring and v) brushing have been devised by different workers from time to time to determine the population of various mite species. But no comparison has been made of the available methods taken together. The object of this paper is to evaluate all these methods and find out a rapid yet accurate procedure for determining the population density of phytophagous mites.

MATERIAL AND METHODS

Five principal methods as stated above were compared for their precision and efficiency. The test mite was *Tetranychus cucurbitae* Rahman and Sapra which heavily infested *Moong* crop (*Phaseolus aureus* Linn.) at the Punjab Agricultural University experimental farm during October, 1971.

Ten plants were selected randomly and one leaf was plucked randomly from each selected plant and as such a total of fifty leaves were plucked per field for five methods. This experiment was repeated in five different fields. As the mite was confined to the lower surface of the leaf, only that surface

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[1] Accepted for publication: October 8, 1974

[2] Assistant Entomologist (Mites), Department of Entomology, Punjab Agricultural University, Ludhiana, *Presently:* – Zoologist, Zoological Survey of India, Calcutta-12, India.

[3] M.S. Dhooria, Research Assistant, P.A.U., Ludhiana.

[4] A.S. Sidhu, Entomologist, P.A.U., Ludhiana.

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was taken into consideration. The descriptions of the individual methods are given below:

i) **Direct counting**: This is the commonest of all the methods used for estimating mite population. The sampled leaf was placed into a Petri-dish containing chloroform soaked cotton to immobilize all the mites. Mites were then counted from individual leaves under stereoscopic binocular microscope. Time spent to count the mites from each leaf was recorded with the help of a stop watch.

ii) **Imprinting method**: Venables and Dennys's (1941) method was adopted with slight modification. In this case Whatman No. 1 filter paper was placed over the undersurface of the sampled leaf and a wooden roller was rolled rapidly from base to apex and back with pressure sufficient enough to crush all the mites. The mites upon being crushed left characteristic stains on the paper which kept permanent record. The stains were deep brownish to reddish in case of active stages and pale coloured in case of eggs. The time spent in crushing and counting of stains was recorded.

iii) **Floatation method**: The conventional floatation methods, as recommended by Jones and Pendargast (1937), Newell (1947) and Lord (1965), were modified to make these more simple in order to meet the present requirements. Individual sampled leaf was put into a specimen jar (capacity: 250 ml) containing 200 ml water and 5 ml of Teepol (a detergent supplied by Union Carbide). Teepol was added to dislodge the mites from the leaves. The jar was then capped tightly and shaken vigorously ten times. The leaf was then removed and the liquid was filtered through filter paper (Whatman No. 1). The residue which contained mobile forms and eggs was dispersed on the paper by adding few drops of water and the counts of active stages of mites were taken under stereoscopic binocular microscope. The time spent in all the three phases, viz. shaking, filtering and counting was recorded.

iv) **Jarring method**: In this case the technique adopted by Powell and Landis (1965) was followed. A piece of cotton filter cloth was put into a Petridish (13 cm dia) and held beneath the leaf. The leaf was struck ten times with the broad end of a pen holder so as to dislodge the mites which fell on the filter cloth. The mites were entangled in cotton fibres and thus could be easily counted.

v) **Brushing method**: Brushing machine devised by Henderson and Mcburnie (1943) was used in this experiment. Leaves were passed through two contrarotating brushes and the mites were swept into a rotating disc coated with a thick film of vaseline which acted as adhesive. Each counting disc was divided into 12 rings and 8 equal

Comparative efficiency and precision of different methods for determining population density of *Tetranychus cucurbitate* Rahman and Sapra on *Moong* (*Phaseolus aureus* Linn.) Plants

Sr. No.	Methods	Average population/leaf basing on 10 leaves					Mean	Average time in seconds					Mean
		Field Nos.						Field Nos.					
		1	2	3	4	5		1	2	3	4	5	
1.	Direct counting	8.65	7.79	12.73	17.11	17.97	12.85	82.00	54.1	105.0	124.2	137.6	100.58
2.	Imprinting	6.76	9.53	10.81	10.98	19.25	11.47	28.9	49.7	54.0	46.6	111.20	58.08
3.	Floatation	10.46	13.39	8.87	12.34	15.39	12.09	596.8	744.4	776.0	700.1	643.7	692.20
4.	Jarring	6.83	8.05	10.16	13.79	19.75	11.52	34.0	42.1	56.3	70.3	144.7	69.48
5.	Brushing	13.80	12.91	11.84	14.28	22.21	15.01	20.3	18.8	18.7	18.6	25.9	20.46
	C.D. (p = 0.01)						N.S.						54.95
	C.D. (p = 0.05)						N.S.						59.30

sectors. Segments in the sectors were alternatively black and white. Counting was done under stereoscopic binocular microscope. As the population was heavy, counting was done from white segments in each of two sectors numbered 1, 6 or 8, 5 or 7, 4 or 2, 5 etc. and that when multiplied by 16 gave the total mite population. This counting method was followed as per the instruction sheet supplied with the machine by M/s Ciba India Limited.

RESULTS AND DISCUSSION

The statistical analysis of the data (Table 1) indicated that all the methods were equally efficient to determine the population of mites. However, there was significant difference in the time taken to operate the methods. Brushing method was superior to direct counting but the latter was as good as imprinting and jarring. Brushing, imprinting and jarring consumed least amount of time (20.46-69.48 secs). Floatation method consumed maximum time (69 2.20 secs) for estimating mite population (Table 1).

So, from the above data any method other than floatation can be adopted for quick and accurate determination of population density of *T. cucurbitae.* Brushing method demands the availability of a machine and counting discs, which may not be readily available to the workers. So, other techniques except floatation method can be followed. Imprinting method has advantage where conditions require quick sampling as under field conditions, this method keeps a permanent record which can be processed later as and when desired.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. O.S. Bindra, Professor and Head, of this Department for providing facilities and encouragements and to M/s CIBA India Limited Bombay, for making the mite brushing machine available for studies. Thanks are also due to Drs. Balraj Singh, Insect Physiologist, and G. S. Sandhu, Entomologist (Maize) for their valuable suggestions during experimentation and improving upon the manuscript. Lastly, the financial help received from I.C.A.R., New Delhi, is also duly acknowledged.

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INSECT ASSOCIATES OF *GINKGO BILOBA*[1]

A.G. Wheeler, Jr.[2]

ABSTRACT: Biological notes are given for the insect species collected on *Ginkgo biloba* trees in nurseries and ornamental plantings in Pennsylvania and the Charlotte, North Carolina area during 1971-72. The few plant-feeding insects found breeding on ginkgo are all known as polyphagous species; the predator fauna was also poorly developed. As an introduced species without any close relatives in North America, it is not surprising that ginkgo has failed to acquire an extensive fauna. However, even in its native habitat of eastern Asia, ginkgo has no known insect specific to it. Apparently no intimate herbivore-host relationship has evolved. This relative immunity to insect injury perhaps has aided the survival of this ancient tree species.

DESCRIPTORS: *Ginkgo biloba,* insect associates, polyphagous species, depauperate fauna, Pennsylvania, North Carolina.

Coadaptation between insects and their plant hosts has resulted in intimate plant-insect relationships and complex interactions (Ehrlich and Raven, 1965; de Wilde and Schoonhoven, 1969; Whittaker and Feeny, 1971; Root, 1973). It is common knowledge that some trees harbor large numbers of insect species, and others comparatively few (Southwood, 1960a); most vascular plants have developed a characteristic fauna and are subject to insect attack. However, *Ginkgo biloba* L., a deciduous gymnospern and sole survivor of the family Ginkgoaceae, has a depauperate fauna and often is cited as being unusually free from insect injury (Herrick, 1935). In the words of Li (1956), ginkgo "defies the scourge of all pests." In Japan its leaves have been used as an insecticide (Franklin, 1959), but Hartzell and Wilcoxon (1941) and Heal et al. (1950) did not find evidence for insecticidal activity. Recently, Major (1967) reported that the production of 2-hexenal by damaged leaves may provide some resistance to insect attack.

Ginkgo in its native habitat of eastern Asia (Franklin, 1959) is fed on by 2 species of scale insects, a tiger moth, a silkworm, and a looper (Hase, 1955). This tree was introduced as an ornamental into the Philadelphia area during the late 18th century (Franklin, 1959), and in North America certain polyphagous insects have become occasional pests: grape mealybug, *Pseudococcus maritimus* (Ehrhorn); peach lecanium, *Lecanium persicae* (F.); white-marked tussock moth, *Hemerocampa leucostigma* (J.E. Smith); omnivorous looper, *Sabulodes caberata* (Guenée); and fruittree leafroller, *Archips argyrospilus* (Walker) (Herrick, 1935; Pirone, 1970). In addition, Dekle

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[1] Accepted for publication: December 3, 1974.

[2] Bureau of Plant Industry, Pennsylvania Department of Agriculture, Harrisburg, PA., 17120

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(1965) listed ginkgo as a host of several scale insects, and recently the zebra caterpillar, *Ceramica picta* (Harris), was reported to defoliate small trees in a nursery (Coop. Econ. Ins. Rept., 1973). Major and Tietz (1962) noted that Japanese beetles, *Popillia japonica* Newman, fed slightly on leaves of ginkgo when trees were in direct sunlight.

This paper summarizes observations of insects associated with *Ginkgo biloba* made while studying species on other ornamentals. Predators collected as adults only and other species thought to be of accidental occurrence have been omitted. Most of the observations were made on trees and seedlings in nurseries and landscape plantings in Pennsylvania during 1971-72. A few records from 1971 in the Charlotte, North Carolina area are included. All localities are in Pennsylvania except those labeled "Charlotte" or "Monroe, N.C."

ORTHOPTERA

Gryllidae

Oecanthus nigricornis Walker – Last-instar nymph 19 Aug., Fairview; last instar 25 Aug., Manchester.

DERMAPTERA

Forficulidae

Forficula auricularia L. – Adult under bark 4 Aug., Harrisburg.

PSOCOPTERA

Caeciliidae

Caecilius sp. – Nymph on dead, fungus-covered leaves 11 Aug., Charlotte, N.C.

Graphopsocus cruciatus (L.) – 1 ♀ taken with above.

Ectopsocidae

Ectopsocus meridionalis Ribaga – 8 ♀♀, 6 nymphs on dead fungus-covered leaves 5 Aug., Manchester; 1♀ 12 Aug., Charlotte, N.C.

Ectopsocopsis cryptomeriae (Enderlein) – 1♀, Manchester and 1♂, Charlotte, N.C., same data as *Ectopsocus meridionalis.*

Psocidae

Blaste sp. prob. *quieta* (Hagen) – 1♂ 5 Aug., Manchester.

Metylophorus novaescotiae (Walker) – 1♀ 11 Aug., Charlotte, N.C.

HEMIPTERA – HETEROPTERA

Pentatomidae

Podisus maculiventris (Say) – Eggs on leaf 22 June, Johnstown; eggs, and adult found feeding on meadow spittlebug, *Phalaenus spumarius* (L.), 5 Aug., Manchester; adult and nymph 18 Aug., Butler.

Miridae

Lygus lineolaris (Palisot de Beauvois) – 2 adults, 2 nymphs on seedlings 8 June, near Indiana; probably accidental on ginkgo.

Anthocoridae

Xylocoris sp. – Fifth-instar nymph under bark 11 Aug., Charlotte, N.C.

HEMIPTERA – HOMOPTERA

Diaspididae

Lepidosaphes ulmi (L.) – Several ♂♂ and ♀♀ 16 June, Harrisburg; eulophid wasp *Aphytis mytilaspidis* (Le Baron) reared from scales collected at same locality on 6 and 16 July. Oystershell scale is known from more than 100 tree species (Baker, 1972), but apparently has not been reported from ginkgo.

Pseudococcidae

Pseudococcus maritimus (Ehrhorn) – Nymphs in leaf axils 16 June, 26 Aug., Harrisburg. Grape mealybug is also known from more than 100 hosts (Neiswander 1949) and has been reported from ginkgo (Herrick, 1935).

Flatidae

Metcalfa pruinosa (Say) – Nymph 15 July, Manchester; adult, several cast nymphal skins 18 Aug., Butler.

Cicadellidae

Graphocephala coccinea (Forster) – 2 adults 17 Aug., Stroudsburg; adult 18 Aug., Butler; adult 20 Aug., Meadville; 7 adults 25 Aug., Manchester.

NEUROPTERA

Chrysopidae

Chrysopa oculata Say – Eggs and adult 5 Aug., Manchester.

COLEOPTERA

Melandryidae

Symphora flavicollis (Haldeman) – pupa in dead twig 13 May, Stroudsburg.

Anthicidae

Anthicus scabriceps LeConte – 2 adults in dead stem 19 Aug., Fairview.

A. virginiae (Casey) – 2 adults in dead stem of seedling 24 Sept., Indiana.

Cryptophagidae

Toramus pulchellus (LeConte) – Adult in dead stem of seedling 24 Sept., Indiana.

Coccinellidae

Coccinella transversoguttata Faldermann – 2 adults on seedlings 8 June, Indiana; pupa 19 Aug., Fairview.

Coleomegilla maculata (De Geer) – same data as *C. transversoguttata.*

Cycloneda munda (Say) – Adult (parasitized by *Perilitus coccinellae*) and pupa 18 Aug., Butler.

Hippodamia convergens Guérin – Adult 5 Aug., Manchester; pupa 19 Aug., Fairview.

Olla abdominalis (Say) – 2 adults, 1 pupa 17 June, Charlotte, N.C.; 2 adults 13 Aug., Monroe, N.C.

Psyllobora vigintimaculata (Say) – Pupa 12 Aug., Charlotte, N.C.

Phalacridae

Acylomus ergoti Casey – Adults on dead, fungus-covered leaves 5 Aug., Manchester.

Orthoperidae

Orthoperus sp. prob. *glaber* (Le Conte) – Adults on dead leaves 5 Aug., Manchester; larvae on dead, fungus-covered leaves 12-13 Aug., Charlotte, N.C.; adult 25 Aug., Manchester.

Lathridiidae

Melanophthalma distinguenda (Comolli) – Adults, larvae on dead, fungus-covered leaves 5 Aug., Manchester; adult 18 Aug., Butler; larvae on fungus-covered leaves 12 Aug., Charlotte, N.C.

M. pumila (Le Conte) – Larvae on fungus-covered leaves 12 Aug., Charlotte, N.C.

Mycetophagidae

Litargus nebulosus Le Conte – Adult in crevice of bark 4 Aug., Harrisburg.

LEPIDOPTERA

Arctiidae

Spilosoma virginica (F.) – Several egg masses, groups of larvae and feeding damage on leaves 19 Aug., Fairview.

Noctuidae

Agrotis ipsilon (Hufnagel) – Egg mass on leaf 28 July, Lancaster Co.; reared to maturity on ginkgo in laboratory, but in nature larvae probably would have dropped to ground to feed.

Ceramica picta (Harris) – Egg mass on seedling 8 June, Indiana; reared to maturity on ginkgo in laboratory; reported from ginkgo (Coop. Econ. Ins. Rept., 1973).

Peridroma saucia (Hübner) – Egg mass 8 July, State College; reared to maturity on ginkgo in laboratory.

Prodenia ornithogalli Guenée – 4 larvae, feeding damage 12-13 Aug., Charlotte, N.C.

Lasiocampidae

Malacosoma americanum (F.) – Larva 27 May, State College; 2 cocoons 8 June, numerous cocoons 23 June, Indiana; 2 egg masses 22 June, Johnstown. Occurrence on ginkgo may be accidental.

Geometridae

Anavitrinella pampinaria (Guenée) – Larva feeding on leaves 13 Aug., Charlotte, N.C.

Biston cognataria (Guenée) – Larva 17 June, Charlotte, N.C.; larva 18 Aug., Butler.

Lymantriidae

Hemerocampa leucostigma (J.E. Smith) – Early-stage larva 22 June, Johnstown; 1 early-and 1 late-stage larva 12-13 Aug., Charlotte, N.C.; several larvae 18 Aug., Butler;

egg masses, several groups of early-stage larvae and feeding damage 19 Aug., Fairview. The whitemarked tussock moth, a general feeder on deciduous and coniferous trees (Baker, 1972), is known to feed on ginkgo (Pirone, 1970).

Psychidae

Thyridopteryx ephemeraeformis (Haworth) – 6 larvae in small bags on undersides of leaves 16-20 June, Harrisburg; 3 larvae, feeding damage 22 June, Johnstown; larva 25 June, nr. Carlisle; larvae common on small trees in nursery 15 July, Manchester; larva 3 Sept., Ephrata; 3 larvae, damage 30 Sept., nr. Carlisle. Although the bagworm is known from a wide range of hosts (Davis, 1964), it apparently has not been reported to feed on ginkgo. Larvae usually fed on the lower surfaces, leaving unsightly blotched areas.

Lyonetiidae

Bucculatrix sp. – Pupae on leaves 17 June, Charlotte, N.C.; pupa 12 Aug., emerged 15 Aug., Monroe, N.C.; ca. 40 pupae 17 Aug., Stroudsburg; pupa 18 Aug., Butler. Cocoons were sometimes abundant, but the relationship to ginkgo was not determined. It is possible that nearby deciduous trees had served as hosts for this *Bucculatrix* and that merely pupation had occurred on ginkgo.

Limacodidae

Sibine stimulea (Clemens) – 4-5 larvae, feeding damage 12-13 Aug., Charlotte, N.C.

Tortricidae

Archips argyrospilus (Walker) – Larvae averaged 2/tree on 16 of 20 trees (8'-10') sampled at random in street planting 27 May, State College; 2 pupae and numerous pupal cases on same trees 8 July; larva rolling leaves of seedlings in nursery 8 June, Indiana. The fruittree leafroller feeds on a wide variety of hosts (Chapman and Lienk, 1971) and has been recorded from ginkgo (Tulecke and Colavito, 1966).

A. griseus (Robinson) - Larva 29 May, State College.

Argyrotaenia velutinana (Walker) – Larva on seedling 8 June, Indiana.

Choristoneura rosaceana (Harris) – Larva on seedling 8 June, Indiana; pupa 14 June, Montoursville; larva 18 Aug., Butler. The obliquebanded leafroller is a general feeder, although the number of its primary hosts may be limited (Chapman and Lienk, 1971).

Platynota flavedana Clemens – Larva on seedling 8 June, Indiana; larva 19 Aug., Fairview.

P. idaeusalis (Walker) – Larva 15 July, Manchester.

Sparganothis sulfureana (Clemens) – Larva 18 Aug., Butler. Howard (1896) reported this species from ginkgo at Washington, D.C.

Tineidae

? Genus poss. *Opogona* sp. – 4 larvae under bark 22 Sept., Fairview.

DIPTERA

Phoridae

Phalacrotophora epeirae (Brues) – Puparia on leaf 5 Aug., Manchester; a parasite of spider eggs (Brues, 1902).

Lonchaeidae

Lonchaea sp. prob. *polita* Say – Teneral adult at base of dead seedling and numerous larvae under bark of dead seedlings 8 June, Indiana.

Chloropidae

? *Oscinella* sp. – 2nd or early 3rd-stage larvae inside dead twigs of living trees 14 April, State College; reared in laboratory with adults emerging during 1st week of May; empty puparia of probably this species in dead twigs 11 May, Stroudsburg and 31 Aug., State College.

Sarcophagidae

Sarcophaga houghi Aldrich – Numerous larvae in old cocoons of *Malacosoma americanum* collected 23 June, Indiana.

HYMENOPTERA

Braconidae

Perilitus coccinellae (Schrank) – Emerged from coccinellid *Cycloneda munda* collected 18 Aug., Butler.

Ichneumonidae

Itoplectis conquisitor (Say) – Emerged from tortricid larva collected 18 Aug., Butler.

Zatypota cingulata Townes – Reared from cocoon collected 12 July, Harrisburg.

Eulophidae

Aphytis mytilaspidis (Le Baron) – Ex. oystershell scale, *L. ulmi,* collected 6 and 16 July, Harrisburg.

Scelionidae

Telenomus sp. – Ex. eggs of lepidopteran collected 18 Aug., Butler.

Torymidae

Monodontomerus minor (Ratzeburg) – Ex. ? bagworm, *T. ephemeraeformis,* collected 18 Aug., Butler. Known as a parasite of bagworm (Burks, 1967).

DISCUSSION

These observations on the insect associates of ginkgo support its placement among tree species most immune to insect attack (Felt, 1905; Herrick, 1935). Ginkgo does appear to be attacked rarely, and then almost exclusively by chewing insects. The only sucking species found breeding on ginkgo were oystershell scale and grape mealybug (the flatid *Metcalfa pruinosa* possibly completes its development on ginkgo). Certainly there are few other vascular plants that do not serve as host for some aphid, leafhopper, or plant bug.

Insects capable of feeding on ginkgo appear also to be generalists having a wide host plant range. Oystershell scale, grape mealybug, whitemarked tussock moth, bagworm, and fruittree leafroller all are polyphagous species.

As might be expected from the absence of a well-developed herbivore fauna, ginkgo harbors few predaceous species. Immature stages of predators were found only rarely. Pupae of 5 coccinellid species were collected, but since larvae were never taken, development may have been completed on some other plant species.

Southwood (1960a) noted that tree species recently introduced into Britain tend to have fewer insect associates than native trees, especially those species that have been abundant throughout recent geological history. Southwood (1960b) further pointed out that introduced species that have no closely related species in the native fauna and that remain relatively rare, may have few, if any, insect associates. Since ginkgo is the sole survivor of the family Ginkgoaceae and order Ginkgoales, it is not surprising that this tree has not acquired an extensive fauna in North America. What is perhaps unusual is that no insect is known to be specific to ginkgo in its native habitat of eastern Asia. According to Hase (1955): "Wir kennen von Ginkgo keine einzige Insektenart, die daran monophag odor oligophag lebt. Auch in der Heimat in Ostasien wird Ginkgo nur von sehr polyphagen Insekten befallen." Thus no intimate herbivore-host relationship has evolved; no characteristic fauna organized around key chemicals, as in members of the Cruciferae, Umbelliferae, Solanaceae (Fraenkel, 1959), has developed.

Reasons for the survival of ginkgo are not clearly understood (Franklin, 1959), but to survive for a hundred million years, ginkgo ". . . must have come from a most tenacious stock . . ." (Li, 1956). Perhaps its relative immunity to insect attack has aided survival. This resistance to insect injury should encourage the further use of ginkgo as an ornamental plant.

ACKNOWLEDGEMENTS

B.D. Burks, R.J. Gagne', J.M. Kingsolver, P.M. Marsh, C.W. Sabrosky, G.C. Steyskal, T.J. Spilman, D.M. Weisman, and W.W. Wirth of the Systematic Entomology Laboratory, USDA, Washington, D.C.; J.G. Franclemont, Cornell University; and E.L. Mockford, Illinois State University, kindly identified specimens. I thank Heinz Wolff, a Pennsylvania Department of Agriculture regional employee, for collecting the tineid larvae. I also appreciate the help of L.L. Pechuman, Cornell University, and my colleague at the Bureau of Plant Industry, T.J. Henry in improving the manuscript.

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VOL. 86 MARCH AND APRIL 1975 NOS. 3 & 4

ENTOMOLOGICAL NEWS

Publication date: Oct. 8, 1975

THE AMERICAN ENTOMOLOGICAL SOCIETY

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GYNANDROMORPHISM IN THE RED IMPORTED FIRE ANT, *SOLENOPSIS INVICTA* BUREN (HYMENOPTERA: FORMICIDAE)[1],[2]

A.C.F. Hung,[3] W.N. Norton,[3] S.B. Vinson[3]

ABSTRACT: Gynandromorphism in the red imported fire ant, *Solenopsis invicta* Buren (Hymenoptera: Formicidae) – a gynandromorphous fire ant was collected from a polygynous colony in Texas. It has a male head and female petioles and gaster, but the alitrunk shows a combination of characteristics of both sexes.

DESCRIPTORS: Gynandromorph; *Solenopsis invicta;* Polygyny.

In ants, as in many other Hymenoptera, all the fertilized eggs become females (both queens and workers) while the unfertilized eggs become males. During certain times of the year both male and female alates are produced in a mature ant colony although the mechanism by which the queen controls the fertilization of her eggs is still unknown.

In April 1974 we collected 128 males (including pupae and alates) of *S. invicta* from one polygynous colony in College Station, Texas. One of these specimens turned out to be a gynandromorph (Fig. 1). The head of this specimen is decisively that of the male (cf. Buren 1972 for morphological characters of both sexes). It is also clear that the petioles and the gaster are all those of the female. However, the alitrunk shows a combination of characteristics of both sexes. Although structurally it is a female alitrunk as shown by the robust legs, the hind wings, and the striation, it has the characteristic concolorous black of the male.

Gynandromorphs have been reported in 22 genera of ants (Buschinger and Stoewesand 1971, Donisthorpe 1929, Wheeler 1931 and 1937). The origin of gynandromorphs has been studied both genetically and cytologically in several groups of insects. In *Drosophila* they result from the loss of the X-chromosomes during early cleavage in the female (Morgan and Bridge 1919). Whiting (1943) shows that in *Habrobracon* they arise from androgenesis. In honeybees, a combination of androgenesis and zygogenesis is the cause of sex mosaicism (Rothenbuhler et al. 1952). Wheeler (1903) suggested several possible causes of gynandromorphism in ants. However, due to the difficulty in gamete manipulation, no genetical or cytological data have yet been secured in ants.

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[1] Accepted for publication: November 11, 1974

[2] Approved as TA-11411 by the Director of the Texas Agricultural Experiment Station. Supported in part by the Texas Department of Agriculture Interagency agreement IAC (74-75)-0448. We thank Jutta Frankie for translating the German literature.

[3] Department of Entomology, Texas A&M University, College Station TX 77843.

ENT. NEWS, 86: 3 & 4: 45 - 46, March & April 1975

Fig. 1. Scanning electron micrograph of a gynandromorphous fire ant.

The pictured specimen has been placed in the insect collection of the Department of Entomology, Texas A&M University.

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LABRAL STRIDULATION IN A KATYDID (A COCONUT-INFESTING "TREEHOPPER") (ORTHOPTERA: TETTIGONIIDAE: MECOPODINAE)[1,2]

James E. Lloyd, Ashley B. Gurney[3]

ABSTRACT: An unusual kind of stridulation by a member of the Orthoptera occurs in a large katydid, *Sexava femorata* C. Willemse, which was observed in New Guinea. A single female was seen to move her labrum vertically back and forth over the mandibles, producing a weak rasping sound, apparently on the downward stroke. Motion pictures and a sound recordings, here produced as audiospectrograms, were made.

DESCRIPTORS: Orthoptera, Stridulation, Tettigoniidae, Mecopodinae, Coconut.

The Orthoptera are well-known for their acoustical versatility, but few use their mouthparts in making sounds. Reported mechanisms include maxillo-mandibular stridulation and mandible snapping, clicking and rasping. Most or all of these sounds are believed to function in sexual communication (Dumortier, 1963). A female of *Sexava femorata* C. Willemse that produced brief, raspy sounds with her mouthparts was found in a forest at Sek Harbor, near Madang on the north coast of New Guinea, during the 1969 Alpha Helix Expedition.[4]

This species is a large katydid or "long-horned grasshopper", called a "coconut treehopper" by entomologists who have reported on the importance of the genus as a pest of coconut trees on New Guinea and nearby islands. The overall length, including folded wings and ovipositor, of the specimen observed is about 100 mm. . Lepesme (1947: 142-146) gave a

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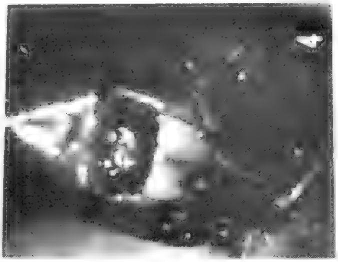
[1] Accepted for publication: October 15, 1974.

[2] Florida Agricultural Experiment Station Journal Series No. 5606.

[3] Department of Entomology, University of Florida, Gainesville, Fl. 32611, and Systematic Entomology Laboratory, Agricultural Research Service, USDA (Mail address: c/o U.S. National Museum, Washington, D.C. 20560).

[4] This expedition was supported by the National Science Foundation under grant number GB8400 to the Scripps Institution of Oceanography for the operation of the Alpha Helix Research Program. The female specimen was deposited in the collection of the U.S.N.M.

ENT. NEWS, 86: 3 & 4: 47 - 50, March & April 1975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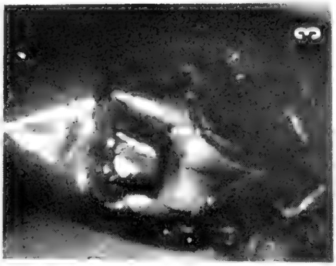
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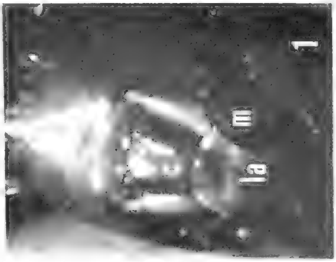
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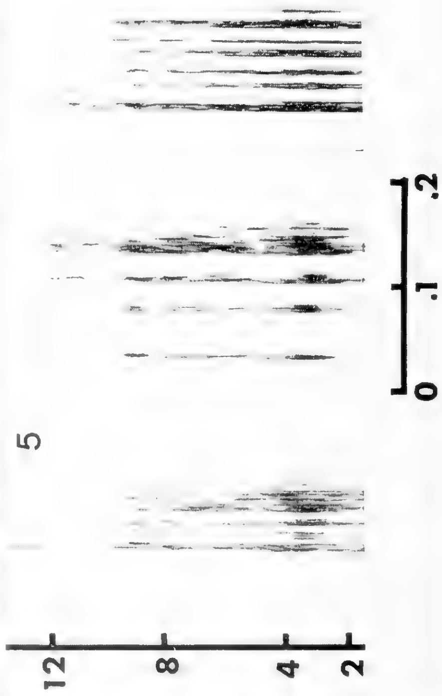
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well-illustrated general account of the genus *Sexava,* and Willemse (1961: fig. 14) published a photograph of *S. femorata.* A more detailed account of the biology of *Sexava* was given by Froggatt and O'Connor (1940: 17-26), but no mention of mandibular stridulation was included.

The observed female produced the sound while being held tightly in the hand, and with each sound moved her labrum vertically over the anterior surface of her mandibles. The labrum is curved in the vertical plane and fits snugly against the curved face of the mandibles. The sound was apparently emitted on the downward stroke, and the upward stroke was probably silent. A cinematic film (super-8) was made of several labral motions[5], and the sound was recorded on electromagnetic tape (not synchronized with the film)[6].

Examination of the film indicates the following: On the upward stroke the labrum slides over the face of the mandibles and its dorsal margin makes an invagination and slides under the clypeus somewhat like the lid on a rolltop desk. The lower portion of the clypeus is flexible, and its lower margin, being attached to the basal (upper) margin of the labrum, rolls under and follows the disappearing margin of the labrum. At the extreme upward position about

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[5] Bauer C 1 camera, at standard speed of 18 frames/sec; Kodachrome II.

[6] Uher 4000 Report L tape recorder, 7.5 ips: frequency response = 40 – 20,000 Hertz (but above 14 kHz sensitivity is much reduced).

Figures 1-4. Single frames of cinematic film showing face of *Sexava* female at various times during upward movement of labrum (m = mandible, c = clypeus, la = labrum). (1) Time 0, resting position (2) Time 0.12 sec, clypeus begins to disappear under its apical end as the labrum moves upward. (3) Time = 0.19 sec. (4) Time = 0.29 sec, labrum is at top of its stroke and the clypeus is maximally rolled under.

Figure 5. Audiospectrograms showing 3 samples of female's sound. Vertical scale indicates frequency in kiloHertz; horizontal scale, time in seconds.

Figure 6. Portion of the labrum (150X) that may be the scraper. The asymmetrical tip and adjacent folds are at the center of the micrograph. At the upper right are setae attached to the outer, apical surface of the labrum. When articulated with the head capsule, as in life, the labrum would be seen in this view when looking into the buccal cavity (with mouth at lower left).

one-third of the labrum's length has passed under the clypeus, and more than one-third of the clypeus has rolled under and out of sight. Figures 1-4 show these movements. The duration of the upward movement averages 0.29 seconds (range = 0.22-0.39 sec, n = 16) and of the downward movement 0.33 seconds (range = 0.22-0.44 sec, n = 16, 29.5°).

The sound was difficult to record: Soon after capture the female would not readily emit it. For recording she was stimulated by repeated tapping and stroking on the face with a pencil. Being of low intensity the sound required that the sensitivity of the recording equipment be turned up, and this caused extraneous sounds, including the pencil taps and strokes, to be amplified. Three presumed rasps are shown in Figure 5. Each is about 100 milliseconds in duration. Carrier frequency range extends from 1 to at least 20 kHz.

The stridulatory apparatus is not obvious. The labrum has a small carina on the right side of its inner surface and a thick asymmetrical tip with 2 thickened ridges adjacent to it (Fig. 6). There are irregular, weak striae on the bevelled cutting surface of the incisor lobe of the mandible such as would be expected by mandibular apposition in biting and shearing. Possibly the tip of the labrum rubs the mandibular striae; there are 2 or 3 longitudinal scratches there. The film reveals no other structure or appendage moving rhythmically with the labrum.

ACKNOWLEDGEMENTS

We thank J.J. Whitesell for technical assistance in sound analysis; A. Owens for technical assistance in the cinematic analysis; T.C. Carlysle for making the scanning electron micrograph. T.J. Walker made helpful comments on the manuscript. J.E.L. thanks members of the Expedition, especially J.B. and E. Buck, and J.F. Case. This research was performed during the tenure of N.S.F. Grant GB 7407.

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STUDIES OF THE BYRON BOG IN SOUTHWESTERN ONTARIO 50. ADDITIONAL OBSERVATIONS ON INSECTS IN THE BOG[1]

W.W. Judd[2]

ABSTRACT: Various insects in Coleoptera, Diptera, Homoptera, Hymenoptera, Lepidoptera and Orthoptera were collected and observed in the Byron Bog since observations were begun there in 1956. Comments on their relationships to features of the bog are included. W.W. Judd, Department of Zoology, University of Western Ontario, London, Ontario, Canada.

DESCRIPTORS: Coleoptera, Diptera, Hymenoptera, Lepidoptera, Orthoptera of Byron Bog.

The Byron Bog at London, Ontario has been described by Judd (1957). There are three zones in it: the outer Zone C consisting of relatively dry, wooded slopes; the middle Zone B, damp or flooded throughout the year and including a heavy growth of trees and shrubs; the inner Zone A, a floating mat of *Sphagnum* moss with a central pond, Redmond's Pond. Since 1956 studies of various aspects of the bog have been carried out, including several on the population of insects in ponds and occurring on plants (Judd, 1958b, 1960, 1961, 1962, 1966a, 1966b, 1969, 1973). During the course of these studies collections of and observations on insects have been made, unrelated to particular projects. The present paper includes an account of these insects.

Most of the insects were identified by members of the Biosystematics Research Institute, Agriculture Canada, Ottawa: J.R. Barron (*Therion* sp.), H.E. Bisdee (*Banchus* sp.), K.B. Bolte (Geometridae), J.M. Campbell (Coleoptera), Bruce Cooper (Bombyliidae, Tabanidae), K.G.A. Hamilton (Homoptera), M. Ivanochko (other Hymenoptera), J.F. McAlpine (Anthomyiidae), A. Sauve *(Vespula)*, J.R. Vockeroth (Syrphidae) and D.M. Wood (Tachinidae). Other insects were identified by the writer. All insects that were collected are deposited in the collection of the Department of Zoology, University of Western Ontario except some noted as "kept" in the National Collection, Ottawa.

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[1] Accepted for publication: November 19, 1974.

[2] Department of Zoology, University of Western Ontario, London, Ontario, Canada.

Insects associated with flowering bog laurel, *Kalmia polifolia* Wang.

The bog laurel, *Kalmia polifolia,* is present on the bog as scattered shrubs growing above the *Sphagnum* mat in Zone A. In 1956 its period of blooming extended from June 1 to June 20 with maximum bloom on June 7 (Judd, 1958a). In 1969 it was determined to study the insects associated with the flowers of this plant. On two days, May 23, 28, when the plants were in full bloom and the temperature between 70° and 85°F. and the sky either clear or with scattered cumulus clouds, insects were collected from the flowers from 1:30 to 3:30 p.m.

Coleoptera: Nitidulidae

Brachypterolus pulicarius (L.) – 1 beetle. Beetles of this genus are often found on flowers in wet areas and marshes (Chagnon and Robert, 1962).

Diptera: Anthomyiidae

Hydrophoria laticornis (Ringdahl) – 1 fly (kept). – This species is widely distributed across northern North America (Stone *et al.,* 1965).

Tachinidae

Siphona intrudens (Curran) – 1 fly. This species has been reported from Ontario (Stone *et al.,* 1965).

Hymenoptera: Formicidae

Dolichoderus taschenbergi (Mayr) – 1 ant (kept). This species has been reported from Ontario (Muesebeck *et al.,* 1951).

Formica fusca L. – 8 ants (2 kept). This species was found on flowers of boneset, *Eupatorium perfoliatum* L., in the bog (Judd, 1969).

Halictidae

Halictus confusus Sm. – 1 bee. This species was found on flowers of boneset in the bog (Judd, 1969).

Dialictus inconspicuus (Sm.) – 1 bee. This species occurs in eastern North America (Muesebeck *et al.,* 1951).

Apidae

Bombus bimaculatus Cress. – 3 bees. This species was found on flowers of leatherleaf and blueberry in the bog (Judd, 1966a, b).

All the insects collected from the bog laurel were dusted with pollen or were moving about in the corollas of the flowers and thus were active or potential pollinators.

Other insects in the bog

Orthoptera: Mantidae

Mantis religiosa L. – One male, green phase, was collected from a shrub of leatherleaf on September 7, 1964. This species was first recorded from London in 1950 (Judd, 1953).

Homoptera: Delphacidae

Macrotomella carinata VanD. – 8 nymphs. These were collected from a swarm of these insects on leaves of water-lily, *Nuphar advena* (Ait.), at the edge of Redmond's Pond on September 29, 1968.

Lepidoptera: Geometridae

Alsophila pometaria Harris – Several Fall Cankerworms were in flight among the trees in Zones B and C on November 8, 1964.

Rheumaptera hastata L. – 1 moth (kept), June 1, 1964. This species, the Spear-mark, is widely distributed through northern North America (Holland, 1916).

Euchoeca albovittata Guen. – 1 moth in flight about low vegetation, August 5, 1969. This species, the White-striped Black, is widely distributed in North America (Holland, 1916).

Phigelia titea Cramer – 1 moth (kept), June 5, 1964. This species occurs in eastern North America (Holland, 1916).

Saturniidae

Callosamia promethea Drury – A cocoon of the Promethea moth was collected from a shrub of Alder-buckthorn, *Rhamnus frangula* L., on February 3, 1962 and yielded a male moth on April 30.

Aegeriidae

Synanthedon acerni Clemens – A male and a female, *in copulo,* were collected on June 6, 1964. A likely host of this moth, the Maple-borer, in the bog is Silver Maple which grows in Zone C (Judd, 1957).

Nymphalidae

Boloria toddi Holland – One butterfly caught in flight over leatherleaf bushes, May 22, 1965.

Nymphalis antiopa L. – Mourning Cloaks hibernate in the bog and regularly appear early in the spring in sunny clearings in Zones B and C: April 7, 1962; April 27, 1963; May 5, 15, 1966; April 2, 5, 1967; March 28, 29, April 17, 1968; April 12, 1969; April 13, 29, 1970; April 19, 1971; April 12, 1972. The butterfly seen on April 13, 1970 was feeding on sap exuding from a cut in the bark of a Silver Maple. Sightings later in the year were made on September 16, 1964 and October 1, 1967.

Nymphalis milberti Latreille – Milbert's Tortoise-shells hibernate in the bog and appear in the spring in sunny clearings: April 2, 1967; April 6, 1974. Some were feeding at flowers on October 1, 1967.

Vanessa atalanta L. – Red Admirals were found in flight on May 10, 1964 and some were feeding at flowers of leatherleaf on April 17, 1968. They were found previously, in May, 1964, feeding at flowers of leatherleaf (Judd, 1966a).

Vanessa virginiensis Drury – American Painted Ladies were seen in flight in Zone A on May 10, 1964 and May 9, 1965.

Polygonia interrogationis Fabr. – Question Marks were feeding at flowers in the outer part of Zone C on October 1, 1967.

Polygonia comma Harris – The Comma hibernates in the bog and appears in spring in sunny clearings in Zones B and C: April 5, 16, 1967; March 29, 1968; April 3, 1970; April 19, 1971; April 12, 1972. They settled among dead leaves beneath the trees and at intervals would fly up in pairs among the branches. When a Mourning Cloak flew across a clearing a Comma would commonly dash at it and whirl about it in rapid flight.

Danaidae

Danaus plexippus L. – One Monarch was settling on leatherleaf bushes in Zone A on October 3, 1974.

Lycaenidae

Lycaenopsis argiolus pseudargiolus B. and L. – Spring Azures were in flight in spring around the bases of larch and black spruce trees and over leatherleaf bushes in Zone A: April 29, 1962; May 5, 1964; May 9, 1965; May 5, 15, 1966; April 17, 1968; April 30, 1974. They were found feeding at flowers of leatherleaf in May, 1964 (Judd, 1966a).

Everes comyntas Godart – One Tailed Blue was caught when in flight on June 1, 1964.

Incisalia augustinus Westwood – Brown Elfins were in flight in spring over leatherleaf bushes in Zone A: April 27, 1963; May 5, 1964; May 9, 1965; May 15, 1966. They were found previously in flight over leatherleaf in May, 1956 (Judd, 1960) and feeding at leatherleaf flowers in May, 1964 (Judd, 1966a).

Lycaena epixanthe michiganensis Raw. – Bog Coppers were in flight over bushes of leatherleaf in summer: July 2, 1962; July 18, 1967; July 6, 1968. They were previously found in July, 1956 over leatherleaf (Judd, 1960).

Pieridae

Pieris rapae L. – Cabbage Whites were in flight in the bog in spring: April 27, 1963; May 9, 1965. They have been found feeding at flowers of leatherleaf (Judd, 1966a) and boneset (Judd, 1969).

Hesperiidae

Thymelicus lineola Ochsenheimer – European Skippers were in flight around the bog on July 9, 1968. This skipper was found for the first time in North America at London in 1910 (Saunders, 1916).

Erynnis lucilius (S. and B.) – One Columbine Dusky Wing was caught when settling on dry earth at the outer edge of Zone C on May 27, 1965.

Diptera: Tabanidae

Atylotus thoracicus (Hine) – One fly was collected on August 13, 1967. This species was trapped previously in August, 1956 in the bog (Judd, 1958b).

Bombyliidae

Villa lateralis (Say) – 4 flies, August 13, 1967. These were found settling on bushes of leatherleaf in Zone A. This species is widely distributed in North America (Stone *et al.*, 1965).

Syrphidae

Metasyrphus americanus (Wied.) – 2 flies, October 31, November 3, 1956.

Eristalis tenax (L.) – 1 fly, October 25, 1956.

These flies were trapped in a baited trap set out on the bog in 1956 (Judd, 1957).

Hymenoptera: Ichneumonidae

Banchus sp. – 4 wasps, May 11, 14, 20, 1964

Therion sp. – 4 wasps, September 9, 1964

These wasps were found flying among branches of leatherleaf. Wasps of these genera are parasites of various caterpillars (Muesebeck *et al.*, 1951).

Vespidae

Dolichovespula maculata (L.) – This wasp was trapped in a baited trap set out on the bog in Zone A in 1956 (Judd, 1962) and occurred from June to October. In later years hibernating females were looked for under shelters in Zone B. Two were found under logs on September 29 and November 3, 1968. One, found on December 3, 1970, had excavated a circular cavity one inch in diameter on the lower surface of a log and was curled up in it. On December 5, 1970 it was decided to find as many as possible hibernating females beneath logs turned over in the full circuit of Zone B and six were found.

Vespula arenaria (Fabr.) – One female was found beneath a log on December 5, 1970. This wasp was previously found in August, 1956 in a baited trap on the bog (Judd, 1962).

Sphecidae

Prionomyx atratus (Lep.) – One female wasp was found on flowers of goldenrod at the outer edge of Zone C on September 17, 1964. This species was found on boneset in 1967 (Judd, 1969).

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NOMENCLATURAL CHANGES IN NORTH AMERICAN *ANTHONOMUS* (COLEOPTERA: CURCULIONIDAE)[1]

Horace R. Burke[2]

ABSTRACT: New synonymy cited in the genus *Anthonomus* of America North of Mexico is as follows: *Sexarthrus* Blatchley (= nominate subgenus of *Anthonomus* Germar); *Anthonomus costulatus* Suffrian (= *Anthonomus elegans* LeConte); *Anthonomus disjunctus* LeConte (= *Anthonomus blatchleyi* Schenkling & Marshall); *Anthonomus signatus* Say (= *Anthonomus scutellatus* Gyllenhal); *Anthonomus stolatus* Fall (= *Anthonomus mimicanus* Fall); *Anthonomus tenuis* Fall (= *Epimechus gracilis* Fall); *Anthonomus suturalis* J.E. LeConte (= *Anthonomus flavicornis* Boheman, *Anthonomus hicoriae* Pierce, *Anthonomus vespertinus* Dietz). Lectotypes are designated for *A. costulatus, A. elegans, A. stolatus* and *A. vespertinus. Anthonomus lecontei* is proposed as a new name for *A. variegatus* LeConte 1876, not Suffrian 1871.

DESCRIPTORS: Coleoptera, Curculionidae, North American, *Anthonomus, Epimechus, Sexarthrus,* synonymy, lectotypes, new name.

The following synonymy in *Anthonomus* Germar is presented at this time so that the proposed changes may be incorporated into the forthcoming Catalog of Coleoptera of America North of Mexico being sponsored jointly by the U.S. Department of Agriculture and the Smithsonian Institution. Lectotypes are also designated where necessary. Types representing the various names involved in the synonymy have been examined; these are deposited in the following collections: Museum of Comparative Zoology (MCZC); Purdue University (PURC); Naturhistoriska Riksmuseet, Stockholm (NRS); U.S. National Museum of Natural History (USNM); Zoologisches Institut, Halle (ZIH).

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[1] Accepted for publication: December 2, 1974

[2] Department of Entomology, Texas A&M University, College Station, Texas 77843. Technical contribution 11476 of the Texas Agricultural Experiment Station.

ENT. NEWS, 86: 3 & 4: 57 - 62, March & April 1975

Anthonomus Germar

Anthonomus Germar 1817:340. Type species: *Curculio pedicularius* L., designated by Dieckmann 1969:689.

Sexarthrus Blatchley, 1916:311 (as subgenus). Type species: *Anthonomus subfasciatus* LeConte, designated by Blatchley 1930:29. NEW SYNONYM of nominate subgenus.

Blatchley (1916) described *Sexarthrus* as a subgenus of *Anthonomus* to contain 10 eastern North American species having the antennal funicle 6 segmented. Most of the species included are not especially closely related and eventually will have to be redistributed among several other taxa of the Anthonomini. A type species was not originally designated for *Sexarthrus* but Blatchley (1930) subsequently designated *Anthonomus subfasciatus* LeConte for this purpose. The latter species should be assigned to the *Anthonomus signatus* Species – Group of the nominate subgenus, consequently, *Sexarthrus* must be considered a synonym of the subgenus *Anthonomus.* The number of funicular segments alone is not a reliable character on which to base subgenera of *Anthonomus.*

Anthonomus costulatus Suffrian

Anthonomus costulatus Suffrian, 1871:137. Lectotype here designated: male; Anth costulatus/Cuba/39254; in ZIH.

Anthonomus elegans LeConte, 1876:202. Lectotype here designated: male, Haulover Fla./March 10/Type 1949/J.L. LeConte coll.; in MCZC. NEW SYNONYMY.

Gates and Burke (1972) discussed the confusion which has existed concerning the application of the names *Anthonomus costulatus* Suffrian and *Anthonomus irroratus* Dietz. Up to time of publication of that paper the latter name had generally been considered as a synonym of *A. costulatus;* however, examination of pertinent type material indicated that both are valid names. It was further revealed during the study of these types that *A. elegans* LeConte is a junior synonym of *A. costulatus.*

Anthonomus disjunctus LeConte

Anthonomus disjunctus LeConte, 1876:204.

Anthonomus blatchleyi Schenkling & Marshall, 1934:40 (=*A. australis* Blatchley 1925:98, not Boisduval 1835:417). NEW SYNONYMY.

Burke (1971) indicated that *A. blatchleyi* was possibly a synonym of *A. disjunctus* but adequate material to make a decision was not available at that time. Additional specimens of significance to the solution of the problem were subsequently provided by D.B. Gates who reared a series assignable to *A. disjunctus* from the same plant species in Harrison Co., Miss. This series shows considerable variability in size (2.0 - 3.5 mm.) and color pattern. Some of the smaller specimens closely resemble the type of *A. blatchleyi* while the larger, more distinctly vittate specimens are similar to the lectotype of *A. disjunctus.* In view of this I consider the type of *A. blatchleyi* to be a depauperate, teneral specimen of *A. disjunctus.*

A second male specimen in the LeConte series of *A. disjunctus* bearing a yellow disc and the labels "Type 2064" and "J.L. LeConte coll." is designated a paralectotype.

Anthonomus lecontei Burke, New Name

Anthonomus scutellatus: LeConte, 1876:198, not Gyllenhal 1836:342.
Anthonomus variegatus LeConte, 1876:199, not Suffrian 1871:139.

LeConte (1876) recognized the possibility that weevils which he considered as *A. scutellatus* might not be conspecific with Gyllenhal's *A. scutellatus* and, consequently, suggested that if the two proved to be distinct the species he treated could be known as *A. variegatus.* Subsequent authors followed LeConte in assignment of this rather common northeastern and northcentral U.S. weevil to *A. scutellatus.* As it turned out upon comparison of the type of *A. scutellatus* Gyllenhal with considerable material of *A. scutellatus* of LeConte and subsequent authors, the two indeed represent different species. *A. variegatus* LeConte is an available name but is preoccupied by *Anthonomus variegatus* Suffrian, therefore, LeConte's species must be renamed. The type series of *A. lecontei* consists of 8 specimens in the LeConte Collection (MCZC) as follows: 2 females and 1 male, each of which bears a yellow disc and, in addition, 1 of the females is also labeled "A. scutellatus Gyll." in LeConte's handwriting; 1 male bearing pink disc; 1 male labeled "Cambr./21.2.74/L."; 1 female bearing orange disc; and 2 males labeled "1458."

LeConte (1876) listed the species from "Massachusetts, Texas, Missouri." The specimen bearing the pink disc, and the one labeled "Cambr[idge]" are probably the Massachusetts specimens listed. Those bearing the yellow discs are probably the Missouri specimens; the female with the handwritten label "A. scutellatus Gyll." is herein selected as lectotype. It is not clear which of these, if any, represent the Texas record. LeConte's orange disc designates the southeastern U.S. and his designation for Texas was a dark blood red disc which is not represented in the series. The origin of the 2 males labeled "1458" is not known.

Anthonomus signatus Say

Anthonomus signatus Say, 1831:25.
Anthonomus scutellatus Gyllenhal, 1836:342. Type: male, Typus/scutellatus Say/ Missuri; in NRS. NEW SYNONYMY.

A. scutellatus Gyllenhal discussed in connection with *A. lecontei* above proves to be a junior synonym of *A. signatus* Say. This synonymy was determined by comparison of the type of *A. scutellatus* with numerous specimens considered to represent Say's species.

Anthonomus stolatus Fall

Anthonomus stolatus Fall, 1901:264. Lectotype here designated: Female; San Diego Co. Cal./Type stolatus/MCZ Type 25176. In H.C. Fall Collection, MCZ.
Anthonomus mimicanus Fall, 1913:54. NEW SYNONYMY.

Four other specimens (2 females, 2 males) of *A. stolatus* in the Fall Collection bearing the same locality data as the lectotype are designated paralectotypes. Examination of type material representing these two names and numerous other specimens from Arizona and California substantiates this synonymy.

Anthonomus tenuis Fall

Anthonomus tenuis Fall, 1913:57.
Epimechus gracilis Fall, 1913:59. NEW SYNONYMY.

Fall (1913) recognized the close similarity of the weevils which he described under these two names, but placed them in separate genera on the basis of what he thought were differences in the tarsal claws; the claws of *E. gracilis* were supposedly simple while those of *A. tenuis* were toothed. Examination of the types of both species indicated that both have toothed claws. The teeth on the claws of the *E. gracilis* type are minute and difficult to see because of the legs being encased in glue, but are visible at high magnification. The teeth can also be seen in other specimens of the type series of *E. gracilis.* There is a slight difference in location of the antennae of the two male types, as noted by Fall, but in a series the position of antennal insertion is found to be variable; therefore, it is not considered as a reliable character for recognition of species in this case.

Anthonomus suturalis J.E. LeConte

Anthonomus suturalis J.E. LeConte, 1824:171.
Anthonomus flavicornis Boheman, 1843:231. NEW SYNONYMY.
Anthonomus vespertinus Dietz, 1891. Lectotype here designated: Jacksonville, Fla. 13.5/Type 2041/W.G. Dietz Coll./; in MCZC. NEW SYNONYMY.
Anthonomus hicoriae Pierce, 1908: 175. NEW SYNONYMY.

Types of all of the species listed above have been examined. A series of *A. suturalis* collected on the leaves of a pecan tree at Gonzales, Texas by C.L. Cole was of special importance in determining this synonymy. Specimens in this series ranged from completely unicolorous individuals to those with a reddish area of varying size on each elytron; the latter color pattern is typical of *A. suturalis.* The types of *A. flavicornis, A. vespertinus* and *A. hicoriae* are unicolorous above as are a large number of the Gonzales specimens of *A. suturalis.* I am unable to find any characters which will consistently separate these from *A. suturalis.*

ACKNOWLEDGEMENTS

My sincere appreciation is expressed to the following persons who loaned type material for study and/or allowed me to examine types under their care: J.C. Hüsing, Zoologisches Institut, Halle; John F. Lawrence, Museum of Comparative Zoology; Tord Nyholm, Naturhistoriska Riksmuseet, Stockholm; and Rose Ella Warner, Systematic Research Laboratory, USDA, U.S. National Museum.

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NOTES ON THE ODONATA OF BLACK HAWK COUNTY, IOWA[1]

Steve Hummel[2], A.C. Haman[2]

ABSTRACT: 51 species of odonates are reported as indigenous to Black Hawk County. Of these, *Lestes congener* Hagen and *Sympetrum costiferum* (Hagen) are new records for the State of Iowa.

During the past two years a survey was conducted of the Odonata in Black Hawk County, updating the only previous study made by Miller (1906), who reported 28 species for the county. Adults were captured and identifications were made using Needham and Westfall (1955) and Walker (1953). Adults were placed in cellophane envelopes and stored in the University of Northern Iowa's insect collection. Determinations of state records were confirmed by M.J. Westfall, Jr. The following is a listing of species collected by the authors, an asterisk indicates species previously reported by Miller.

ANISOPTERA

Gomphidae

1. *Gomphus submedianus* Will. 1914
2. *Gomphus esternus* Hagen 1857
*3. *Gomphus fraternus* (Say) 1839

Aeschnidae

*1. *Anax junius* (Drury) 1770
2. *Aeschna constricta* Say 1839
3. *Aeschna umbrosa* Walk. 1908

Corduliidae

*1. *Epicordulia princeps* (Hagen) 1861
*2. *Tetragoneuria cynosura* (Say) 1839

Libellulidae

1. *Celithemis elisa* (Hagen) 1861
*2. *Erythemis simplicicolis* (Say) 1839
*3. *Holotania luctuosa* (Burm.) 1839
*4. *Leucorrhinia intacta* Hagen 1861
*5. *Neotetrum pulchellum* (Drury) 1770
6. *Pantala flavescens* (Fabr.) 1798
7. *Pantala hymenaea* (Say) 1839
*8. *Plathemis lydia* (Drury) 1770
*9. *Pachydiplax longipennis* (Burm.) 1839
10. *Sympetrum corruptum* (Hagen) 1861
11. *Sympetrum costiferum* (Hagen) 1861 (New record)
12. *Sympetrum internum* Mont. 1943
13. *Sympetrum obtrusum* (Hagen) 1867
14. *Sympetrum rubicundulum* (Say) 1839
15. *Sympetrum vicinum* (Hagen) 1861
16. *Tramea lacerata* Hagen 1861
17. *Tramea onusta* Hagen 1861

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[1] Accepted for publication: February 7, 1975

[2] Department of Biology, University of Northern Iowa, Cedar Falls, Iowa 50613

ENT. NEWS, 86: 3 & 4: 63 & 64, March & April 1975

ZYGOPTERA

Calopterygidae

*1. *Calopteryx aequabilis* Say 1839
*2. *Calopteryx maculata* (Beauv.) 1905
*3. *Hetaerina americana* (Fabr.) 1798
4. *Hetaerina titia* (Drury) 1778

Lestidae

1. *Archilestes grandis* (Rbr.) 1842
2. *Lestes congener* Hagen 1861 (New record)
3. *Lestes eurinus* Say 1839
*4. *Lestes forcipatus* (Rbr.) 1842
*5. *Lestes rectangularis* Say 1839
*6. *Lestes unguiculatus* Hagen 1861

Coenagrionidae

*1. *Amphiagrion* sp.
2. *Argia apicalis* (Say) 1839
3. *Argia moesta* (Hagen) 1861
*4. *Enallagma antennatum* (Say) 1839
5. *Enallagma boreale* Selys 1875
6. *Enallagma civile* (Hagen)
*7. *Enallagma ebrium* (Hagen) 1861
*8. *Enallagma hageni* Walsh 1863
*9. *Ischnura verticalis* (Say) 1839
*10. *Nehalennia irene* (Hagen) 1861

Fifty-one species of odonates currently inhabit Black Hawk County. Of the 28 species previously reported by Miller (1906) only six, *Lestes dryas* Kirby, *Anomalagrion hastatum* (Say), *Gomphus cornutus* Tough, *Gomphus ventricosus* Walsh, *Nasiaeschna pentacantha* (Rbr.) and *Macromia illinoiensis* Walsh, were not collected in this study. Three of the above six species, *G. ventricosus, N. pentacantha* and *M. illinoiensis,* have been recorded in Iowa only by Miller. One of the six species, *L. dryas,* has been captured by the authors in Fayette and Delaware counties and should be found in Black Hawk. Three species, *A. hastatum, G. cornutus* and *G. ventricosus,* were possibly overlooked during the study due to small size and secretive habits, *A. hastatum;* or rarity, *G. cornutus* and *G. ventricosus.* Two species, *N. pentacantha* and *M. illinoiensis,* may be extinct in Black Hawk County due to the present lack of suitable habitat.

Perithemis tenera (Say) although not collected was sighted adding 24 species not previously reported. Of these 24 species, two, *Lestes congener* Hagen and *Sympetrum costiferum* (Hagen) represent new records for the State of Iowa (Montgomery, 1967). Personal collections and literature records (Whedon, 1912) from adjacent counties indicate that the list is still incomplete.

ACKNOWLEDGMENTS

The authors wish to acknowledge the assistance of Dr. George Bick in general advisement and Dr. M.J. Westfall, Jr., in assistance in making determinations.

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THE THIRD EDITION OF THADDEUS WILLIAM HARRIS'S "TREATISE ON SOME OF THE INSECTS INJURIOUS TO VEGETATION.", 1862.[1]

F. Martin Brown[2]

ABSTRACT: No date of publication for the new names in Harris's "Treatise", third edition, 1862, has been acknowledged except the mandatory 31 December 1862 of the Code. It is demonstrated here that the proper date is 31 January 1862. It is also noted that at least six different "Third Edition" were published during 1862 using a variety of publishers and printers.

During the winter of 1973-1974 I was looking into the name *Lycaena americana* Harris, 1862. I soon discovered that the situation was complicated. Harris had died in 1856 and the volume was published posthumously*. [*For those interested, a bibliography of biographies of Harris will be found in Carpenter, 1945, p. 43.] Posthumous publication always brings up the problem of authorship. In this case there is more involved.

The editor's preface to the 1862 edition opens "By a resolve of the Legislature of Massachusetts, 1859, chap. 93, I was directed to issue a new edition of Dr. Harris's admirable Treatise on Insects Injurious to Vegetation, *with suitable additions* and illustrations." (The italics are mine.) This was to be enlarged and updated revision of the 1852 edition. The "I" of the statement of authority was Charles L. Flint, Secretary of the State [Massachusetts] Board of Agriculture. Not only is there a problem of authorship brought on by posthumous publication but also the real problem of what Harris wrote and what Flint added.

The latter problem is resolved further on in the Introduction. There Flint stated "It has been thought best to insert the additions contemplated in the resolve, in the form of footnotes. No alterations have been made in the author's language, and the additional notes are enclosed in brackets to distinguish them from those in the former editions. Large additions to the text, however, have been made from the author's own manuscripts. These will be found exclusively in the chapter upon the butterflies." This explains the wholly different texts of Chapter V when the Second (1852) and Third (1862) editions are compared.

Centering on chapter five and the Editor's Preface, it is evident that Dr. John G. Morris of Baltimore acted as editor for the new work. Just how much of the interweaving of the scant treatment of butterflies in the second edition and Harris's new material is Flint's invention we will never know. That the

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[1] Accepted for publication: December 12, 1974

[2] 6715 South Marksheffel Road, Colorado Springs, Co. 80911

ENT. NEWS, 86: 3 & 4: 65 - 68, March & April 1975

selecting and blending was done by Flint is obvious from Morris's additions. There are 26 bracketed statements as footnotes added by Morris. Read carefully these are strong evidence that Morris did not alter any of the manuscript he received. All that he did was point out places where he thought Harris (or Flint) in error. Thus the authorship problem involves only Harris and Flint.

Here is the problem: In a posthumous work are the new zoological names introduced to be credited to the deceased author or to the gentleman responsible for publishing the names? Numerous articles and recommendations in the International Code of Zoological Nomenclature (1973 edition) refer to publication. None of these mentions posthumous publication. Authorship is covered in Section XI. Although nothing is specifically said about posthumous publication, it clearly is the philosophy of the Code to award authorship where it is due. There are no arbitrary rules. Article 50 reads as follows: "The author (authors) of a scientific name is (are) the person (persons) who first publish(es) it [III] in a way that satisfies the criteria of availability [IV], unless it is clear from the contents of the publication that only one (or some) of the joint authors, or some other person (persons), is alone responsible both for the name and the conditions that make it available."

It is clear from the Editor's Preface that he (the editor) considered the names the creation of Harris and it is implied that the text devoted to new names was written by Harris. Therefore Harris is alone responsible for the names. But, what about the second requirement, availability? This is treated of in Article 11. To become available a name must comply with seven criteria. The names in the Flint edition of Harris comply with all that are applicable to species-group names. There is nothing in this section that states that an author must publish the name, only that the name must have been published. Thus there is nothing in the Code that prevents assignment of the names to Harris, or to Harris in Flint.

There is a third aspect to be considered. In 1862 Morris published descriptions of the butterflies that Harris first named in the Third Edition. These were published by Morris in his "Synopsis". Now the problem is which of the two volumes was published first? Morris's "Synopsis" was published in February, 1862, by the Smithsonian Institution. Internal evidence for the Third Edition is no more than that it was published in 1862. According to the Code, Article 21, (b) (i) the assumed date for the publication of Morris is 28 February 1862; and in Article 21 (b) (ii) for Harris in Flint is 31 December 1862. Thus on the basis of internal evidence it appears that Morris's publication antedates Harris in Flint and the names of the butterflies must be credited to Morris (nominally before 28 February 1862.) If it can be proven that the Third Edition was published before 28 February 1862, then the author is Harris.

I started a search of library accession books to discover when in 1862 copies of the Third Edition of Harris had been received. It was discouraging work. Either there was no way to establish the date of receipt or the volume was a gift long after 1862. An unexpected surprise developed during this work. There are a variety of 1862 editions of the Third Edition. The first inkling of this came to me in a letter from Mr. William Matheson of the Rare Book Division of the Library of Congress. He sent me a photo copy of the frontispiece of their copy of the book with a title page differing in publisher from my copy. To make a long search short, I have found six different 1862 printings of the Third Edition. These I list at the end of this paper. There are others extending into the 1880's.

The first concrete evidence for a date of publication came from Mrs. Hugh M. Hill, Librarian at the Museum of Comparative Zoology at Harvard University. They have four different 1862 editions in that library, the largest number in a single library. The earliest receipt of one of these was between 24 October and 31 December, 1862. Later, at the Academy of Natural Sciences library in Philadelphia I found that their earliest copy was received as a gift from Dr. Samuel Lewis between 10 March and 14 April, 1862. It began to look as though Harris's Third Edition might have appeared in February, 1862, the same month as Morris's "Synopsis".

At this time I wrote to three friends with bibliophilic leanings: Dr. Cyril F. dosPassos, Mr. Norman D. Riley and Mr. Patrick B. McHenry. Dr. dosPassos could not help me with anything but encouragement to keep digging into the problem. Mr. McHenry advised me of a copy that he had purchased some years ago from Eric Lundberg, Ashton, Maryland. This is a presentation copy inscribed "Hon. E.W. Bull, With the Cordial Regards of the Editor, Boston, Jan. 1862." This copy carries an "Editor's Preface" dated "Boston, January, 1862". Thus it appears that the Third edition was published before 31 January, 1862.

Mr. Riley brought to light an even earlier edition! The copy in the British Museum (N.H.) library has the "Editor's Preface" dated "Boston, December, 1861". The publication date for this printing is "1862". Thus it is apparent that the Flint Edition of T.W. Harris's "Treatise" antedated by about a month Morris's "Synopsis" and that names are to be credited to Harris, or Harris in Flint if you wish to be precise.

The Editor's Preface in the earliest volume differs from that in those dated "January 1862." In the preface dated "January 1862" the second paragraph is a new one. It reads: "By resolve of the Legislature of 1861, chap. 80, I was authorized to use the plates prepared for the illustration of the edition for the Commonwealth, in the publication of one or more editions designed for a wider circulation than that for the State could be expected to have." This is the reason for the variety of printings. Over I list the 1862 printings known to me.

A. **State printings:** These have an abbreviated title page when compared with the others. It simply states: "A / Treatise / on some of the / Insects Injurious to Vegetation / by Thaddeus William Harris, M.D. / Third Edition."

   I. Editor's Preface dated December, 1861.
      Publisher: "Boston: / William White, Printer to the State. / 1862."
      Printer: "Cambridge: / Welch, Bigelow, and Company, / Printers to the University."
      Held by British Museum (N.H.)

   II. Editor's Preface dated January, 1862.
      Publisher: the same as for I.
      Printer: the same as for I.
      Held by numerous libraries, institutional and private.

B. **Published under Chapter 80, Legislature of 1861:** The title page is the same as for the State editions with this added in place of "Third Edition": A new Edition / enlarged and improved, with additions from the author's manuscripts / and original notes. / Illustrated by engravings drawn from nature under the supervision of / Professor Agassiz. / Edited by / Charles L. Flint, / secretary of the Massachusetts State Board of / Agriculture." In all of these the Editor's Preface is dated January, 1862.

   III. Publisher: "Boston: / Crosby and Nichols / 117 Washington Street"
      Printer: "Cambridge: Welch, Bigelow and Company, / Printers to the University."
      Held by Carnegie Museum Library.

   IV. Publisher: "Boston: / Crosby and Nichols, / New York: Oliver S. Felt. / 1862."
      Printer: the same as for I, II, III.
      Held by numerous institutional and private libraries.

   V. Publisher: "New York / Orange Judd and Company, / 245 Broadway / 1862."
      Printer: "Cambridge: Printed by H.O. Houghton and Company."
      Held by Museum of Comparative Zoology and Field Museum of Natural History.

   VI. Publisher: "Boston: / Printed for private circulation / 1862."
      Printer: the same as for I, II, III, IV.
      Held by Museum of Comparative Zoology.

I wish here to express my grateful thanks to the many librarians who helped me in this search.

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EMERGENCE, OCCURRENCE, and MATING BEHAVIOR OF *HYDROBAENUS PILIPES* (MALLOCH) (DIPTERA, CHIRONOMIDAE)[1]

John B. Stahl[2]

ABSTRACT: The chironomid, *Hydrobaenus pilipes* (Malloch), emerged in winter from just two of about 40 similar ponds at a southern Illinois fish farm. Emergence from one pond occurred in December in two successive years and from the adjacent pond in February of just one year. The ponds are similar; it is speculated that differences in the time of draining and refilling the ponds might account for the emergence pattern and restricted occurrence of this species. This midge invariably mated on a substratum in the end-to-end position, unlike most species of chironomids. It showed little inclination to fly.

DESCRIPTORS: Diptera; Chironomidae; *Hydrobaenus pilipes;* emergence; mating behavior.

Conspicuous emergences and matings of the orthocladiine chironomid, *Hydrobaenus pilipes* (Malloch), were observed in two fish-rearing ponds at a southern Illinois fish farm. The season of emergences, the occurrence of the species in the ponds of the fish farm, and the mating behavior were rather peculiar. To my knowledge the mating behavior of this species has not been observed before.

The dates and approximate intensity of the emergences are presented in Table 1. In Pond 1 early December was the season of emergence in two successive years, while in Pond 2 the peak of the emergence was in late February. Although adults were fairly abundant in Pond 1 on 25 Feb 69 it seems likely that they had emerged from Pond 2 because pupal exuviae were absent in Pond 1 but abundant in Pond 2. On 5 Jan 69 the ponds were completely covered by ice 9 cm thick.

H. pilipes occurred only in ponds 1 and 2, even though there were about 40 additional ponds at the fish farm. No other species of chironomids emerged in the wintertime. The ponds are small (about 1000 m^2 in area), shallow (1.1 m), and flat-bottomed. They are drained when the fish are harvested and usually left dry until needed again for rearing fish. In the summer of 1969 ponds 1 and 2 were used for intensive fish-culture experiments. These apparently extirpated *H. pilipes* in these two ponds.

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[1] Accepted for publication: February 5, 1975

[2] Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901.

The species is unusual in that copulation invariably occurred on a substratum. A floating dock was a favorite substratum, but mating was also seen on the surface of the water. Mating was also observed on the surface of the water in pans with reared adults. Reiss (1966) lists just six other species of chironomids that are known to copulate on a substratum. These are: *Allochironomus crassiforceps* Kieff., *Camptochironomus tentans* Fabr., *Clunio marinus* Hal., *Corynocera ambigua* Zett., *Propsilocerus danubialis* Botnariuc and Albu (synonym of *Propsilocerus lusatiensis* Barthelmes), and *Tanytarsus sylvaticus* Reiss. Fittkau (1971) adds *Halliella, Tanytarsus miriforceps* Kieff., and *Thienemanniola* to this list.

Mating invariably occurred in the end-to-end position. In this respect *H. pilipes* is like *C. ambigua,* as described by Hirvenoja (1960), but different from *A. crassiforceps,* in which copulation is usually head-to-end (Syrjämäki 1964). A few pairs were seen in which one (presumably the male) vibrated its wings and dragged the female along the surface of the water, in a manner similar to that described for *C. ambigua* by Hirvenoja (1960).

The duration of copulation was not observed, but it must be quite long because I never saw a mating pair separate (unless disturbed). It seems likely that mating lasts considerably longer than the average of 10 minutes described for *C. marinus* by Caspers (1951). The duration of mating has not been described for any of the other species that mate on a substratum, to my knowledge.

Some other characteristics of this chironomid's behavior are noteworthy even though not directly connected with mating. The adults sometimes showed a marked tendency to congregate in compact masses. Thus, in Pond 1 on 17 Dec 67 the adults occurred in clusters of a score or more on the surface of the water and on a floating dock; on 27 Feb 69 in Pond 2 the adults were densely packed on one valve handle of the inlet pipe. This pipe extended about 20 cm above the surface of the water to about one meter from shore. The adults flew only occasionally, and when they did so their flight was invariably just above the surface of the water; swarms of flying adults were never seen. Frequently the adults walked on the floating dock, and sometimes they were seen crawling about on the grass stubble on the banks of the ponds. On 9 Dec 69 the ponds were almost completely covered by ice 1 cm thick, yet a dozen or so adults were seen running, walking or standing on the surface of the ice and on a dock.

Discussion

In the adult and pupal stages *H. pilipes* must be a cold stenotherm. The larval stage probably is eurythermic because the ponds in summer may have a temperature of 30°C. No collections were made in the summer, however, so it is conceivable that only the egg stage is able to tolerate warm temperatures, and that the eggs do not hatch until the water is cool.

Why was the time of emergence different in the two ponds? The ponds are so similar it is difficult to find a reason for the differences in emergence pattern. The ponds are adjacent to each other, and essentially identical in area

Table 1. Emergences of *Hydrobaenus pilipes* from Ponds 1 and 2, Fountain Bluff Fish Farm, Gorham, Illinois

Date	Pond 1	Pond 2
17 Dec 67	Adults abundant, many copulating pairs	None
2 Dec 68	20 or 30 adults, a few copulating pairs	None
4 Dec 68	Some adults, several mating pairs	None
7 Dec 68	Few adults, just two mating pairs	None
9 Dec 68	About a dozen adults, no mating pairs, a number of pupal exuviae	None
5 Jan 69	None	None
25 Feb 69	Adults fairly abundant, some copulating pairs, no pupal exuviae	Hundreds of adults, some copulating pairs, hundreds of pupal exuviae
27 Feb 69	None	Adults abundant, a few copulating pairs
11 Mar 69	None	8-10 adults, no copulating pairs
16 Mar 69	None	Dozens of adults, many pupal exuviae
6 Apr 69	None	None

and depth. Both receive about 100 m^3 of water per week to maintain the water level. With this rapid turnover in water differences in water chemistry would be negligible. In Pond 1 on 2 Dec 68 the pH was 8.4, alkalinity 220 mg/1 $CaCO_3$, conductivity 717 micromhos at 25°C, total iron 0.45 mg/1, and sulfate 16 mg/1. Temperatures were virtually identical in the two ponds during the emergences; they varied from 4.9°C (17 Dec 67) to 7.2°C (25 Feb 69).

The ponds at the fish farm do vary in the season in which they are drained and the length of time they are left dry. These differences might account for the restricted distribution of *H. pilipes* at the farm and the difference in emergence times. This is speculative, however, as no records were kept of the dates of draining and refilling of the ponds, unfortunately. Other differences in the treatment of the ponds include occasional use of herbicides and of chemicals to kill fish parasites, and differences in the kinds and quantities of fish stocked.

The restricted distribution of this midge is strikingly similar to that of *P. danubialis* in some German fish-rearing ponds (Barthelmes 1964). This species is similar to *H. pilipes* in that it also mates on a substratum and flies very little. Barthelmes thought this reluctance to fly partly accounted for the restriction of this species to just three ponds in the fish farm he investigated.

The phylogenetic and ecological significance of the mating of chironomids on a substratum rather than in a swarm of flying adults is discussed by Reiss (1966) and Fittkau (1971).

ACKNOWLEDGEMENTS

I am most grateful to Dr. J.E. Sublette for identifying *Hydrobaenus pilipes.*

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NEW EXOTIC CRANE-FLIES (TIPULIDAE: DIPTERA) PART XXV[1]

Charles P. Alexander[2]

ABSTRACT: Three new species of Oriental Tipulidae are described, these being *Tipula (Pterelachisus) mcdonaldi, of* Taiwan, *Limonia (Dicranomyia) recurvistyla* and *Helius (Helius) arunachalus,* of Arunachal Pradesh (formerly Kameng, Northeast Frontier Agency, Assam), India. In addition figures of venation and the male hypopygium for seven species of the Hexatomine genus *Epiphragma* not previously illustrated are provided.

The preceding part under this title was published in Entomological News, vol. 85: 1-8. The present paper is based almost entirely on the extensive collections of crane-flies made in various parts of India by the veteran collector Dr. Fernand Schmid. One species described as new was taken by John L. McDonald in Taiwan. I express my thanks and appreciation to the collectors of these particularly interesting materials. As has been done in previous parts under this title figures showing the venation and male hypopygium are provided, these concerning species of Oriental *Epiphragma* that have not been illustrated in earlier papers. The types of the new species are preserved in the Alexander Collection.

Tipula (Pterelachisus) mcdonaldi, NEW SPECIES

General coloration of thoracic dorsum brown, pleura and abdomen chiefly yellow; legs with femora brown, outer third yellowed, enclosing a narrow brown subterminal ring; wings weakly infuscated, prearcular field, costal border and stigma darker brown; abdomen yellowed, subterminal segments brown; male hypopygium with posterior border of tergite shallowly emarginate, the blackened border roughened, with a small central point; outer dististyle with beak long, blackened, outer basal region with two small points; basistyle and apex of eighth sternite with brushes of very long yellow setae.

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[1] Accepted for publication: February 10, 1975

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

ENT. NEWS, 86: 3 & 4: 73 - 79, March & April 1975

MALE – Length about 11 - 14 mm.; wing 12 - 16 mm.; antenna about 3.5 - 5 mm.

FEMALE – Length about 15 - 18 mm.; wing 14 - 15 mm.; antenna about 3 mm.

Described from alcoholic specimens. Frontal prolongation of head brown, nasus slender; palpi with three proximal segments dark brown, incisures whitened, terminal segment subequal in length to the combined preceding segments, paler brown to yellowish brown. Antennae with scape and pedicel light yellow, flagellum black; flagellar segments with small basal enlargements, longest verticils subequal or slightly longer than the segment. Vertex apparently gray in fresh specimens, lower parts of head light brown.

Pronotum yellowed. Mesonotum with sides of praescutum light yellow, disk with four grayish brown stripes that are narrowly bordered by darker brown, interspaces with conspicuous darkened setigerous punctures; scutal lobes and central parts of scutellum and postnotum darker brown than the sides. Pleura and pleurotergite yellowed, dorsopleural membrane clearer yellow. Halteres pale, base of knob weakly darkened, apex whitened. Legs with coxae and trochanters yellow; femora basally narrowly yellowed, remainder brown, the extreme tip and a much more extensive subterminal to nearly apical ring yellowed, including approximately one-third the segment, this area usually with a very narrow nearly terminal paler brown ring, about equal in extent to the yellow apex; tibiae brownish yellow, tips blackened; tarsi black; claws of male with a conspicuous spur at near midlength, female with claws very small, simple. Wings weakly infuscated, prearcular field, cells *C* and *Sc*, and the stigma darker brown; veins brown. Venation: Cell *1st* M_2 small; cell M_1 long-petiolate, the petiole about three times *m; m-cu* at fork of M_{3+4}.

Abdomen chiefly yellowed, segment eight and midregions of tergites six and seven brown; hypopygium yellowed. Male hypopygium (Fig. 3) with the tergite, *t,* broad, posterior border very shallowly emarginate, margin very narrowly blackened, with low roughenings including a more evident median point. Basistyle with numerous very long setae. Outer dististyle, *d,* dilated at near midlength, outer half with numerous relatively short setae; inner style with outer beak blackened, elongate and slightly curved, lower beak smaller, appearing as a straight slender black rod; region of outer basal lobe with two points, the more basal slender, curved, apex acutely pointed, outer spur stouter, apex obtuse. Phallosome with aedeagus, *a,* short and stout, blackened; gonapophysis, *g,* appearing as a blackened plate with both ends extended into points, the dorsal one more curved. Eighth sternite, *8s,* broad basally, narrowed outwardly, apex with a brush of long yellow setae, remainder of plate with abundant small setae.

HABITAT – Taiwan. Holotype: ♂, on slide, Chung-Ta Shan, 8,600 feet, August 11, 1971 (John L. McDonald). Allotype: ♀. Paratopotypes, about 40 ♂♀ in alcohol, with the types.

The species is named for Dr. John L. McDonald, University of Arizona, who collected the material, together with several associated Tipulidae. The

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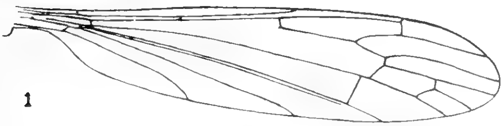
Figures 1 - 8 – Fig. 1, *Limonia (Dicranomyia) recurvistyla,* new species; venation. Fig. 2, *Helius (Helius) arunachalus,* new species; venation. Fig. 3, *Tipula (Pterelachisus) mcdonaldi,* new species; male hypopygium. Fig. 4, *Limonia (Dicranomyia) recurvistyla,* new species; male hypopygium. Fig. 5, *Helius (Helius) arunachalus,* new species; male hypopygium. Fig. 6, *Epiphragma (Epiphragma) commoptera* Alexander; male hypopygium. Fig. 7, *Epiphragma (Epiphragma) dysaithria* Alexander; male hypopygium. Fig. 8, *Epiphragma (Epiphragma) dysommata* Alexander; male hypopygium. (Symbols: *a,* aedeagus; *b,* basistyle; *d,* dististyle; *g,* gonapophysis; *i,* interbase; *p,* phallosome; *s,* 8th sternite; *t,* 9th tergite.)



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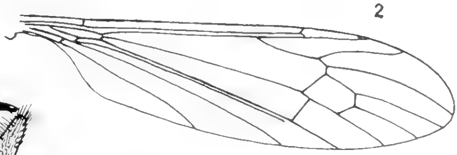

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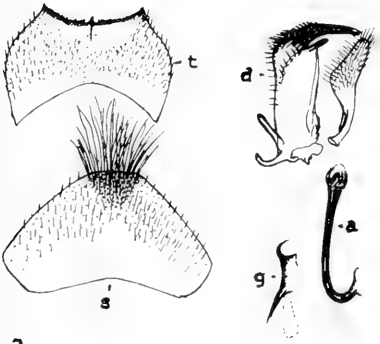

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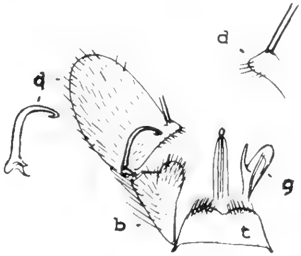

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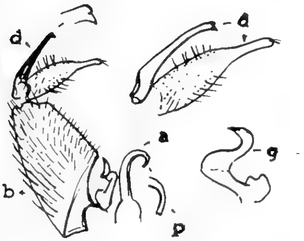

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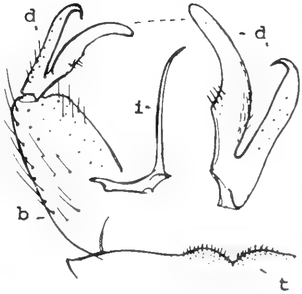

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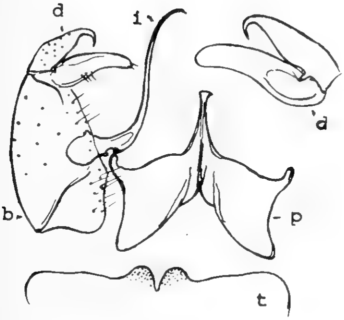

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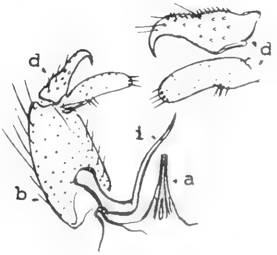

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most similar species is *Tipula (Pterelachisus) taikun* Alexander, 1921, of Japan (Honshu, Hokkaido), which differs most evidently in hypopygial structure, especially the tergite and inner dististyle.

Limonia (Dicranomyia) recurvistyla, NEW SPECIES

Size medium (wing about 7 mm.); general coloration of thorax and abdomen yellow, praescutum with a pale brown central stripe; halteres yellow; legs yellow, femora with a narrow light brown subterminal ring; wings light yellow, restrictedly patterened with brown, Sc_1 ending shortly beyond origin of *Rs*, Sc_2 far retracted, Sc_1 longer than *Rs*, the latter square at origin, *m-cu* before fork of *M;* male hypopygium with apex of dorsal dististyle recurved into a short spine; aedeagus narrow, terminating in a small oval blade.

MALE – Length about 6 - 6.2 mm.; wing 7 - 7.2 mm.; antenna about 1.2 - 1.25 mm.

Rostrum short, light brown; palpi dark brown. Antennae with scape and pedicel light brown, flagellum pale brown; proximal flagellar segments short oval to subglobular, more elongate outwardly. Head brown.

Pronotum brown, cervical sclerites more blackened. Mesonotum yellow, praescutum with a central pale brown stripe, the lateral pair and centers of scutal lobes much paler brown; remainder of thorax yellowed, with strong greenish tints in fresh specimens. Halteres yellow. Legs with coxae and trochanters greenish yellow; femora yellow with a narrow light brown subterminal ring, subequal to the yellow apex; tibiae yellow, tips narrowly light brown; tarsi yellow, outer three segments brownish black; claw with a slender nearly basal spine. Wings (Fig. 1) light yellow with a restricted but conspicuous brown pattern that includes the arculus, Sc_2, origin of *Rs*, stigma, cord and outer end of cell *1st* M_2; distal ends of outer radial cells weakly suffused; longitudinal veins M_3 to *2nd A* with brown seams, largest over the Anal veins; veins yellow in the ground, brown in the patterned areas. Venation: Sc_1 ending shortly beyond origin of *Rs* to about one-fourth the length of this vein, Sc_2 very far retracted, at near midlength of the vein; free tip of Sc_2 short, in virtual transverse alignment with R_2; Rs square at origin, short-spurred, especially in the holotype; cell *1st* M_2 subequal to or slightly shorter than the distal section of M_{1+2}; *m-cu* before fork of *M*, in cases to one-third its length.

Abdomen yellow. Male hypopygium (Fig. 4) with posterior border of tergite, *t*,

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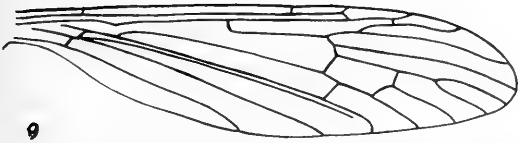
Figures 9 - 17 – Fig. 9, *Epiphragma (Epiphragma) commoptera* Alexander, venation. Fig. 10, *Epiphragma (Epiphragma) dysaithria* Alexander, venation. Fig. 11, *Epiphragma (Epiphragma) dysommata* Alexander, venation. Fig. 12, *Epiphragma (Epiphragma) perocellata* Alexander, venation. Fig. 13, *Epiphragma (Epiphragma) rhododendri* Alexander, venation. Fig. 14, *Epiphragma (Epiphragma) subvicina* Alexander, venation. Fig. 15, *Epiphragma (Epiphragma) rhododendri* Alexander, male hypopygium. Fig. 16, *Epiphragma (Epiphragma) scoptes* Alexander, male hypopygium. Fig. 17, *Epiphragma (Epiphragma) subvicina* Alexander, male hypopygium. (Symbols: *a*, aedeagus; *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *i*, interbase; *p*, phallosome; *t*, 9th tergite.)



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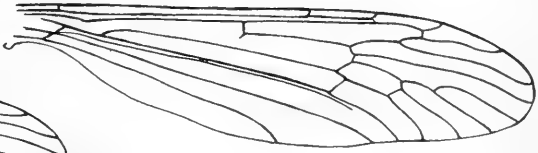

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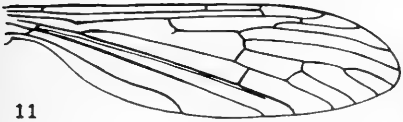

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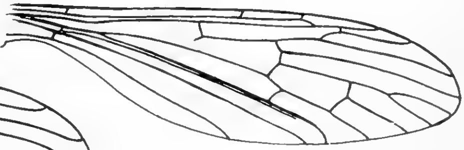

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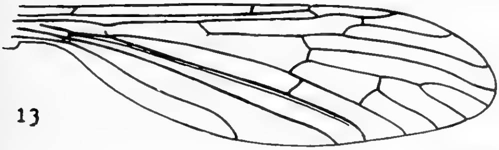

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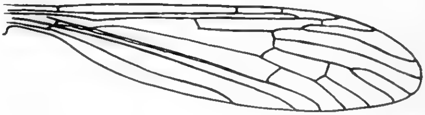

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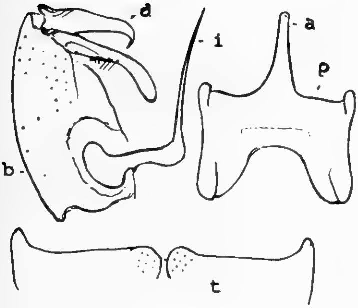

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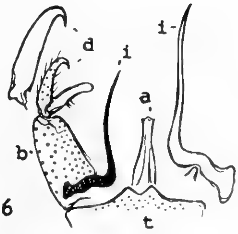

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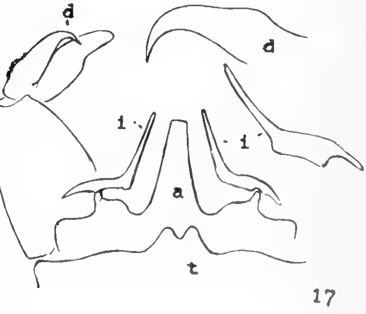

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shallowly emarginate, the lobes with numerous setae. Basistyle, *b*, less than one-third the size of the ventral dististyle, ventromesal lobe oval with numerous moderately long setae. Dorsal dististyle, *d*, strongly bent beyond midlength, the apex recurved into a short spine; ventral style with rostral prolongation very small, apex obtuse; spines two, long and straight, placed close together, about one-half longer than the prolongation. Gonapophysis, *g*, with mesal-apical lobe long and narrow, nearly straight. Aedeagus, *a*, unusually narrow, terminating in a small oval blade, the genital openings on the sides.

HABITAT – India. Holotype: ♂, Bombi La, Kameng, North East Frontier Agency, Assam (now Arunachal Pradesh), 7,200 - 8,000 feet, September 19, 1961 (Fernand Schmid). Paratopotype, ♀, September 15, 1961.

The present fly is distinct in venation, including the great recession of vein Sc_2, and in hypopygial structure, as the recurved tip of the dorsal dististyle. The recession of Sc_2, leaving an unusually long Sc_1, is found in various other members of the subgenus, including *Limonia (Dicranomyia) chorea* (Meigen) and *L. (D.) mitis* (Meigen), of Europe. The venation of the Oriental subgenera of *Limonia* has been discussed in detail in another paper by the writer – (Insects of Micronesia, 12, no. 8: 744-748, 778; 1972), and in an earlier report (Philippine Journal of Science, 93: 427-478, 54 figs.; 1964).

Helius (Helius) arunachalus, NEW SPECIES

Size medium (wing 7 mm.); general coloration of thorax and abdomen yellow; rostrum long, about one-fourth the remainder of body; halteres light yellow, the pale stigma very small; male hypopygium with outer dististyle nearly straight, apex shallowly bidentate.

MALE – Length, excluding rostrum, about 7.5 mm.; wing 7 mm.; rostrum about 2 mm.

Rostrum dark brown, long and straight, much exceeding the antennae and about one-fourth the remainder of body. Antennae with scape light brown, pedicel obscure yellow, flagellum dark brown; proximal six flagellar segments short and crowded, subglobular, outer segments elongate, cylindrical, each with a very long delicate seta. Head gray; anterior vertex narrow, slightly exceeding the diameter of the scape.

Cervical region dark brown. Thorax uniformly yellowed, praescutum and scutum more polished yellow than the paler pleura; setae of praescutal interspaces and scutal lobes elongate, of the scutellum short and stout. Halteres light yellow, apex of knob more intensely so. Legs with coxae and trochanters light yellow; femora yellow, tips narrowly brown; remainder of legs medium brown. Wings (Fig. 2) light yellow, prearcular and costal fields more saturated yellow; stigma very small, slightly darker than the ground. Longitudinal veins beyond general level of origin of *Rs* with conspicuous black trichia, with from three to five at outer ends of both Anal veins. Venation: Branches of *R* divergent, cell R_4 at margin about three times as extensive as cell R_2; cell *1st* M_2 large; *m-cu* about one-fourth its length beyond the fork of M.

Abdomen yellow, eighth segment slightly darker. Male hypopygium (Fig. 5) with outer dististyle slender, nearly straight, apex very shallowly bidentate; inner style longer, basal three-fourths stouter, with conspicuous setae, outer end narrowed, apex obtuse, with conspicuous setae. Phallosome, *p*, as shown. Gonapophyses, *g*, distinctive in conformation.

HABITAT – India. Holotype: ♂, Amatulla, North East Frontier Agency, Assam (now Arunachal Pradesh), 1,500 - 1,800 meters, October 18, 1961 (Fernand Schmid).

In its elongate rostrum, the most similar regional species is *Helius (Helius) stenorhynchus* Alexander, of Northeastern Burma, readily distinguished by the coloration of the body and wings.

Epiphragma (Epiphragma) commoptera Alexander *Epiphragma (Epiphragma) commoptera* Alexander; Ent. News, 77: 70; 1966.

Type from Nanga, Sikkim, India. Fig. 6 male hypopygium; Fig. 9 (venation).

Epiphragma (Epiphragma) dysommata Alexander *Epiphragma (Epiphragma) dysommata* Alexander; Ent. News, 76: 213; 1965.

Type from Hkayam Boum, Manipur, Assam, India. Fig. 8 (male hypopygium); Fig. 11 (venation).

Epiphragma (Epiphragma) dysaithria Alexander *Epiphragma (Epiphragma) dysaithria* Alexander; Ent. News, 77: 71; 1966.

Type from Lingsoka, West Bengal, India. Fig. 7 (male hypopygium); Fig. 10 (venation).

Epiphragma (Epiphragma) perocellata Alexander *Epiphragma (Epiphragma) perocellata* Alexander; Ent. News, 77: 73; 1966.

Type from Kechoiperi, Sikkim, India. Fig. 12 (venation).

Epiphragma (Epiphragma) rhododendri Alexander *Epiphragma (Epiphragma) rhododendri* Alexander; Ent. News, 77: 75; 1966.

Type from Yedang, Sikkim, India. Fig. 13 (venation); Fig. 15 (male hypopygium).

Epiphragma (Epiphragma) scoptes Alexander *Epiphragma (Epiphragma) scoptes* Alexander; Ent. News, 77: 77; 1966.

Type from Simbhanjang Pass, Mahharat Range, Nepal. Fig. 16 (male hypopygium).

Epiphragma (Epiphragma) subvicina Alexander *Epiphragma (Epiphragma) subvicina* Alexander; Ent. News, 77: 77; 1966.

Type from Mount Kinabalu, British North Borneo. Fig. 14 (venation); Fig. 17 (male hypopygium).

NEW SPECIES OF *HILARIMORPHA* (DIPTERA: HILARIMORPHIDAE)[1]

Donald W. Webb[2]

ABSTRACT: Two new species of *Hilarimorpha* are described and illustrated, with keys to species of the *clavata* group.

DESCRIPTORS: Diptera; Hilarimorphidae: *Hilarimorpha ditissa, H. rivara,* new species: *clavata* group, key.

Following the revision of the genus Hilarimorpha (Webb 1974), some 20 additional specimens were sorted from unidentified material in the Canadian National Collections of Insects, Arachnids and Nematodes. Among specimens from northern British Columbia are two species new to science. Both of these species belong to the group having clavate maxillary palps. The following key separates the *clavata* group of *Hilarimorpha.* Type specimens are deposited in the Canadian National Collection (CNC) with certain paratypes retained in the collection of the Illinois Natural History Survey (INHS).

Key to the *clavata* group of *Hilarimorpha*

Males:

1. Length of body about 5.0 mm . . . . *obscura*
   Length of body less than 3.0 mm 2

2. Aedeagal sheath and basal parameres (Fig. 2) narrow 3
   Aedeagal sheath and basal parameres (Fig. 7) broad . . . . *rivara*

3. Aedeagus in dorsal view tapered basally (Fig. 2), in lateral view apex expanded ventrally (Fig. 3) . . . . *ditissa*
   Aedeagus in dorsal view tapered apically (Webb 1974, Fig. 16), in lateral view apex not expanded ventrally (Webb 1974, Fig. 17) . . . . *clavata*

Females:

1. Apex of ninth tergum deeply emarginate (Webb 1974, Fig. 18) . . . . *clavata*
   Apex of ninth tergum slightly emarginate (Fig. 4) . . . . *ditissa*

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[1] Accepted for publication: March 2, 1975

[2] Illinois Natural History Survey, Urbana, Illinois 61801

ENT. NEWS 86: 3 & 4: 80 - 84, March & April 1975

Hilarimorpha ditissa, new species

This species (Fig. 1-5) is known only from northern British Columbia and is closely related to *H. clavata, H. obscura* and *H. rivara* in having clavate maxillary palps. In males, it differs from *H. obscura* in its smaller size. The narrow aedeagal sheath and basal parameres, and the expanded apex of the aedeagus in lateral view readily separate it from *H. rivara.* In dorsal view the aedeagus is tapered basally, which separates this species from *H. clavata.* The female of *H. ditissa* differs from *H. clavata* in having the apex of the ninth tergum only slightly emarginate.

Male. Length 2.2±0.03 mm (N-10). Head dark reddish brown, pollinose. Eyes dark reddish brown. Ocelli clear, on dark reddish brown subtriangular pad, setae absent. Antennae (2:4:12) dark reddish brown; third segment 1.5 times longer than wide, twice the combined length of the first two segments, elongate setae absent; style (2:2) dark reddish brown, basal segment cylindrical, equal in length to apical segment. Maxillary palps (3:11) dark reddish brown, clavate, 3.7 times length of basal segment, 3.7 times longer than wide. Proboscis dark reddish brown, glossy. Thecae dark reddish brown, pollinose.

Humerus dark reddish brown with 6-8 short, fine setae. Mesonotum reddish brown, anterior half darker. Vittae indistinct. Posterior callus, halter, and scutellum dark reddish brown.

Wing length 2.8 ± 0.05 mm (N=10). Membranes (Fig. 1) hyaline, veins pale brown. Stigmal pigmentation absent. Humeral crossvein faint. R_1 ends proximal to fork of M_{1+2} and above tip of M_4. R_{2+3} originates 0.79 ± 0.089 (N=10) of way between R_1 and R-M, ends above fork of R_{4+5} and tip of M_2. R_{4+5} forks below tip of R_{2+3} and above tip of M_2. R_4 originates 0.67 ± 0.003 (N=10) of way between R-M and tip of R_5, ends above tip of M_1. R_5 ends slightly beyond apex of wing. M_{1+2} forks distal to tip of R_1 and M_4. M_1 originates 0.64 ± 0.006 (N=10) of way between R-M and tip of M_2, ends below tip of R_4. Pedicel of R_{4+5} 1.36±0.021 (N=10) times pedicel length of M_{1+2}. M_2 ends below tip of R_{2+3} and fork of R_{4+5} M_4 ends below tip of R_1 and proximal to fork of M_{1+2}. Anal cell closed near wing margin. A_1Cu_2 ends proximal to R-M and apex of second basal cell.

Legs uniformly dark reddish brown.

Abdomen and terminalia dark reddish brown. Aedeagal sheath (Fig. 2) narrow, tapered apically, apex truncate. Basal parameres (Fig. 2) narrow, elongate, bluntly pointed apically, extending to one-half length of aedeagal sheath. Aedeagus in dorsal view (Fig. 3) tapered basally, apex rounded, widest width 0.8 of length from base; in lateral view (Fig. 4) aedeagus curved slightly ventrally, apex rounded, expanded ventrally, base expanded.

Female. Length 2.79 mm (N=1). Head and lower part of face dark reddish brown. Eyes black. Ocelli amber, on dark reddish brown subtriangular pad, elongate setae absent. Antennae (2:3:13) dark reddish brown, pollinose; third segment 2.6 times combined length of first two segments, 2.6 times longer than wide, elongate setae absent; style (3:2) dark reddish brown, basal segment cylindrical, 1.5 times longer than apical segment. Maxillary palps (2:14) dark reddish brown, clavate, apical segment seven times longer than basal segment, 2.8 times longer than wide. Proboscis dark reddish brown, glossy. Thecae dark reddish brown, pollinose.

Humerus dark reddish brown with six short, erect setae. Mesonotum dark brown, pollinose. Vittae indistinct. Posterior calli, halters and scutellum dark reddish brown.

Wing length 3.5 mm (N=1). R_{2+3} originates at R-M. R_4 originates 0.66 (N=1) of way between R-M and tip of R_5. M_1 originates 0.64 (N=1) of way between R-M and tip of M_2. Pedicel of R_{4+5} 1.43 (N=1) times pedicel length of M_{1+2}. Other veins as in male (Fig. 1).

Legs uniformly dark reddish brown.

Abdomen and terminalia dark reddish brown. Posterior margin of ninth tergum (Fig. 4) slightly emarginate. Ninth sternum (Fig. 5) 0.75 times length of ninth tergum, apex truncate. Tenth tergum (Fig. 4) short, hemispherical, extending two-thirds length of cerci. Tenth sternum (Fig. 5) subrectangular, truncate apically. Cerci (Fig. 4) elongate, rounded apically.

Holotype ♂ (CNC) Allotype ♀ (CNC), Paratypes 14♂♂ (CNC, INHS): BRITISH COLUMBIA, Pouce Coupe, 14-VI-1961, A. & M. Brooks.

Hilarimorpha rivara, new species

This species (Fig. 6-8) from northern British Columbia is known only from the holotype. It is associated with *H. clavata, H. obscura,* and *H. ditissa* in having clavate maxillary palps. Its smaller size readily separates it from *H. obscura.* It is separated from *H. clavata,* and *H. ditissa* by the broad shape of the aedeagal sheath and basal parameres. Like *H. ditissa* the aedeagus in dorsal

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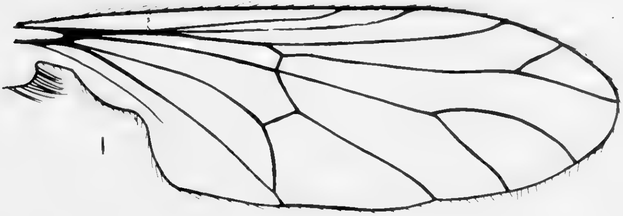
Figs. 1-5. *Hilarimorpha ditissa.* 1) Wing venation 2) dorsal view of aedeagal sheath, basal parameres, and aedeagus 3) lateral view of aedeagus 4) dorsal view of female terminalia 5) ventral view of female terminalia.

Figs. 6-8. *Hilarimorpha rivara.* 6) wing venation 7) dorsal view of aedeagal sheath, basal parameres, and aedeagus 8) lateral view of aedeagus.



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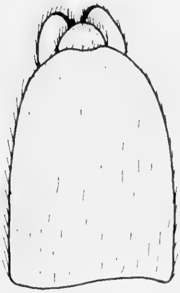

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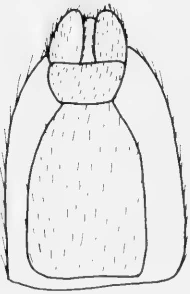

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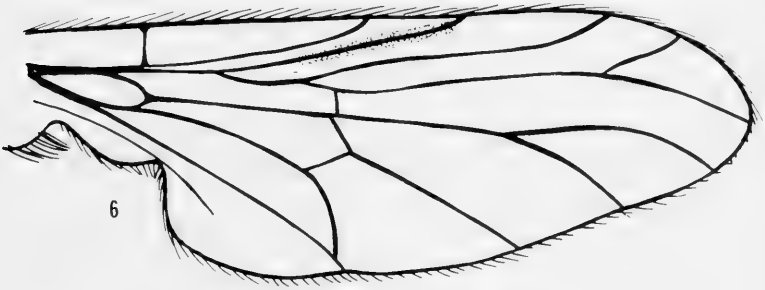

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view tapers basally although the widest width is subapical. In lateral view the apex of the aedeagus is not swollen ventrally as in *H. ditissa.*

Male. Length 3.0 mm (N=1). Head and eyes black. Ocelli amber, on distinct subtriangular pad; elongate setae absent. Antennae (2:5:15) black; third segment 1.7 times longer than wide, 2.1 times combined length of first two segments, elongate setae absent; style (2:2) black, basal segment globose, equal in length to apical segment. Maxillary palps (3:12) black; apical segment clavate, 4.0 times longer than basal segment, 3.0 times longer than wide. Proboscis and thecae black.

Humerus dark reddish black with six short, fine setae. Mesonotum black. Vittae indistinct. Posterior calli, halters, and scutellum black.

Wing length 3.5 mm (N=1). Membranes (Fig. 6) pale greyish brown, veins dark brown. Stigmal pigmentation pale brown, covering apical half of R_1. Humeral crossvein dark brown. R_1 ends distal to fork of M_{1+2} and above tip of M_4. R_{2+3} originates 0.74 (N=1) of way between R_1 and R-M, ends above fork of R_{4+5} and tip of M_2. R_{4+5} forks below tip of R_{2+3} and above tip of M_2. R_4 originates 0.66 of way between R-M and tip of R_5, ends above tip of M_1. R_5 ends slightly beyond wing apex. M_{1+2} forks basal to tip of R_1 and M_4. M_1 originates 0.53 (N=1) of way between R-M and tip of M_2 ends below tip of R_4. Pedicel of R_{4+5} 1.62 (N=1) times pedicel length of M_{1+2}. M_2 ends below tip of R_{2+3} and fork of R_{4+5}. M_4 ends below tip of R_1 and distal to fork of M_{1+2}. Anal cell closed near wing margin. A_1Cu_2 ends basal to R-M and apex of second basal cell.

Legs uniformly dark reddish brown.

Abdomen and terminalia dark reddish brown, pollinose. Aedeagal sheath (Fig. 7) broad, narrowed apically, apex truncate. Basal parameres (Fig. 7) broad, thick, rounded apically, extending along two-thirds length of aedeagal sheath. Aedeagus in dorsal view (Fig. 7) tapered basally, apex rounded, widest width subapical; in lateral view (Fig. 8) slightly curved ventrally, apex rounded, base broad, twice as wide as middle of aedeagus.

Holotype ♂ (CNC): BRITISH COLUMBIA, Kleanza Creek, 14 miles east of Terrace, 19-VII-1970, W.R. Richards.

ACKNOWLEDGEMENTS

I wish to thank Dr. H.J. Teskey and the Biosystematics Research Institute of Canada for the loan of specimens on which this paper is based.

LITERATURE CITED

Webb, Donald W. 1974. A Revision Of the Genus *Hilarimorpha* (Diptera: Hilarimorphidae). Journal of the Kansas Entomological Society 47(2): 172-222.

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VOL. 86 MAY AND JUNE 1975 NOS. 5&6

ENTOMOLOGICAL NEWS

Publication date: Oct. 15, 1975

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A NEW SPECIES OF *MAYETIOLA* (DIPTERA: CECIDOMYIIDAE) ON AMERICAN BEACHGRASS IN NEW JERSEY[1]

Raymond J. Gagné[2]

ABSTRACT: A new species of gall midge related to the Hessian fly is described. The new midge, *Mayetiola ammophilae* Gagné, occurs on American Beachgrass, *Ammophila breviligulata* Fernald, an important dune grass of the Atlantic seaboard.

DESCRIPTORS: Cecidomyiidae; *Mayetiola ammophilae* n. sp.; American Beachgrass.

Until now, *Mayetiola* (sensu stricto) has been known in North America from a single species, *M. destructor* (Say), the Hessian fly.[3] That species is thought to have been introduced to this continent during the Revolutionary War period. Over 25 species of *Mayetiola* are known from Europe on many different kinds of grasses, so it appeared that the genus did not naturally occur in the Nearctic area. Recently, Dr. P.M. Halisky of Rutgers, New Brunswick, New Jersey, reared a series of a new species of *Mayetiola* from American Beachgrass, *Ammophila breviligulata* Fernald, in New Jersey. Possibly this gall midge occurs also on *Ammophila* in Europe and is a recent immigrant, but no *Mayetiola* has been recorded from European Beachgrass.

The new species feeds in the stem bases of Beachgrass and causes rot and breakage. Dr. Halisky is preparing an article on the biology of the new species.

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[1] Accepted for publication: January 2, 1975

[2] Systematic Entomology Laboratory, Agricultural Research Service, USDA Mail address: c/o U.S. National Museum, Washington, D.C. 20560.

[3] *Mayetiola* in Stone et al. (1965, Agr. Handbook 267: 263) is a category of convenience.

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Mayetiola ammophilae Gagné, new species

Adult. Wing length: ♂ 3.0-3.2 mm.; ♀, 2.8-2.9 mm. Antenna with 16-17 flagellomeres in ♂, 16 in ♀. Claws with short teeth. Empodia much longer than claws. Male genitalia as in figures 1-3. Female tergum VIII (fig. 4) approximately 1/2 length distal half of ovipositor.

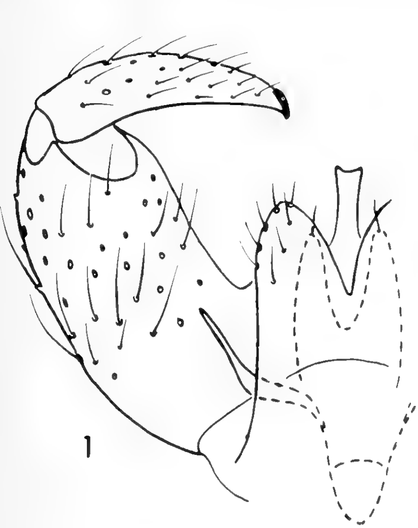
Pupa. Prothoracic setae short, approximately 3/5 length of prothoracic spiracle.

Larva. Sternal spatula short, tapering apically to single point.

Holotype, ♂, reared from beachgrass, *Ammophila breviligulata,* Island Beach State Park, Ocean Co., New Jersey, VII-1974, P.M. Halisky, USNM Type No. 66623. Paratypes: ♀, 2 pupae, same data as holotype; 4♂♂, 7♀♀, same data except VI to VII-1972. Other material: 10 larvae, 20 puparia, same data as holotype. All material in USNM except 1♂, 1♀ paratypes in British Museum (N.H.).

M. ammophilae differs from *M. destructor,* the only other *Mayetiola* (s.s.) in North America, in the following characters: the tarsal empodia are much longer than the claws; the male genitalia have characteristic differences (compare figs. 1-3 with 5-6), particularly in the elongate telomeres, apically bifid aedeagus, and deeply lobed sternum X; tergum VIII of the female is more setose; the length of the pupal prothoracic setae is 3/5 that of the prothoracic spiracle instead of the opposite case in *destructor;* and the larval sternal spatula is simple at the apex and not bifid.

Figs. 1-4, *M. ammophilae.* 1, male genitalia (dorsal); 2, same (ventral); 3, same, without parameres (mesal); 4, female abdominal tergum VIII. Fig. 5-6, *M. destructor*: 5, male genitalia (dorsal); 6, same (ventral).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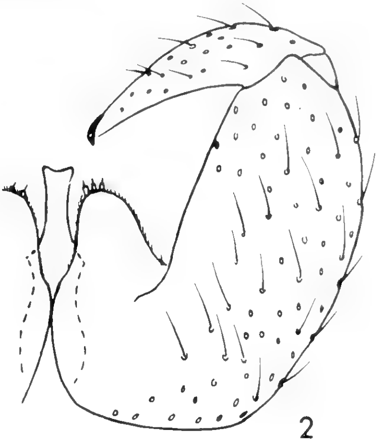
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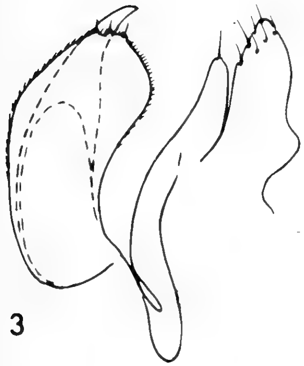
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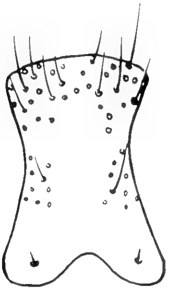
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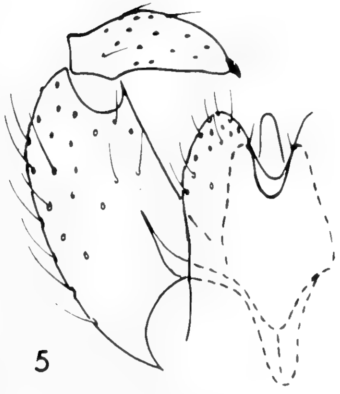
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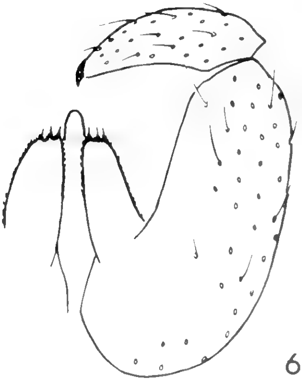
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ON THE IDENTITY OF BELFRAGE[1],[2]

Wesley R. Nowell[3]

ABSTRACT: Belfrage, Texas was cited as the Type locality in a Diptera collection record. Inquiry showed that Belfrage was not a geographical site, but rather the name of an eminent collector who lived in the State of Texas from 1867-1882. He was a prodigious collector who sold thousands of specimens to major museums in Europe and the northeastern United States. It is suggested that this finding be noted on all specimens labeled "Belfrage, Texas," to preclude misinterpretation of the identity of Belfrage.

DESCRIPTORS: Diptera; locality labels; Texas; G.W. Belfrage.

One of the relevant details associated with a new species description is the specimen collection locality. The more precisely it is established, the greater its value for subsequent recovery of the species and historical importance. Therefore, when a type specimen reference exists with a collection record that cannot be traced, the error must be corrected so that the inaccurate datum will not be perpetuated in the literature. Such a problem exists with *Dixa venosa* Loew.

In 1872, Hermann Loew described *Dixa venosa* from a single female specimen. The taxonomic data are followed by the collection note "(Texas; Belfrage)." Osten Sacken (1878), Kertesz (1902), Johannsen (1903 and 1923), Aldrich (1905), Edwards (1932), Cooper and Rapp (1944), and Hubert (1965) included *D. venosa* in their catalogs and checklists. In each of these publications the collection locality cited is simply "Texas." Cockerell (1926) and Nowell (1951) referenced *D. venosa* but did not include collection locality data. In 1966, T.M. Peters and E.F. Cook presented the type data as follows: "*Type-locality.* – Belfrage, Texas. *Location of Type.* – ♀, Mus. Comp. Zool. Type no. 10395, Mus. Comp. Zool., Harvard University." This is the first record of the type locality being expanded to include a location within the State of Texas, and Peters (1968) repeated this entry in his paper, *Dixinae Originally Described from North America.*

The addition of "Belfrage" to the type locality was of considerable interest. However, a review of several atlases of Texas communities, past and

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[1] Accepted for publication: January 24, 1975

[2] The research reported in this paper was conducted by personnel of the Epidemiology Division, USAF School of Aerospace Medicine, Aerospace Medical Division, AFSC, United States Air Force, Brooks AFB, Texas. Further reproduction is authorized to satisfy the needs of the U.S. Government.

[3] Lt Colonel, USAF, Epidemiology Division, USAF School of Aerospace Medicine, Aerospace Medical Division (AFSC), Brooks AFB, Texas 78235

ENT. NEWS, 86: 5 & 6: 88-90, May & June 1975

present, did not reveal the name, nor could the Texas State Highway Department confirm its location. The solution to the enigma came from another source.

An entry in *The Handbook of Texas* (1952) states that Gustave W. Belfrage, born in Stockholm, Sweden, immigrated to America in 1859. He began collecting insects while in Chicago, and in January 1867, he went to Texas and continued that work. By the end of 1868, he was selling large exhibits of insects to the Swedish Academy of Science at Stockholm and to other museums, and he maintained this practice until his death in 1882.

Gustave Belfrage was one of the pioneers of American entomology, and the record shows that he contributed extensively in the discovery of specimens new to science. Samuel Geiser devoted an entire chapter to Belfrage in his book, *Naturalists of the Frontier*, and Arnold Mallis (1971) associated him with Ezra T. Cresson as a collector (p. 346). Geiser defined the frontier of scientific exploration as the "boundary between the known area of the earth and the areas that have not yet been scientifically explored." This quotation describes the State of Texas during Belfrage's time. Geiser cites Belfrage's magnificent collections of Texas insects which contributed to Cresson's fine work, *Hymenoptera Texana,* and to several monographs by Professor A.S. Packard.

Belfrage collected skillfully and extensively throughout Texas. His major collecting points were Houston and Tyler in east Texas, and Norse and Clifton in Bosque County near Waco. He also collected in the pine woods of east Texas, along the Mexican border probably at Laredo, and was known to have gone on an expedition into west Texas that lasted two months. From Houston he took up his residence near Norse, a Norwegian community in western Bosque County. Geiser, who visited the area, described the home as overlooking Meridian Creek, and stated that it was in this locality that the naturalist made many of his superb collections. Belfrage is best known for his accumulations of Hymenoptera and Lepidoptera, but being a competent entomologist and thorough collector, representatives of most of the insect orders and a great many families appeared in his collections.

Belfrage was a prodigious collector who sold specimens to augment his inheritance income. The British Museum of Natural History, the Peabody Academy of Science at Salem, and the museums in Brussels, Stockholm and St. Petersburg all have valuable collections of Texan insects acquired from Belfrage. While Belfrage may have kept copious personal notes on the collection points, his specimens were apparently just labeled "Texas." Some more specific data may have been gleaned from his considerable correspondence, but that would have been totally inadequate for the volume of material he collected and sold.

According to Geiser, Belfrage published no entomological papers, but had stated in correspondence that he was working on a paper about the insects of

Bosque County. This manuscript may have contained specific locality data, but it is assumed that it was burned along with his letters by the appraisers of his estate following his death at Norse on December 7, 1882.

On the basis of these findings, Belfrage is not a locality but rather the name of the collector who contributed extensively to the early knowledge of Texas insects. Therefore, labels reading "Texas; Belfrage" or "Texas" followed by "Belfr." on the second line, should be interpreted as collected by G.W. Belfrage in the State of Texas, locality unknown, and this annotation should be applied to each of those thousands of pinned specimens from Texas which grace some of the preeminent insect collections in Europe and North America.

Dixa venosa Loew is a valid species and the type specimen is unique. Nothing is known about either its source or its biology. The type locality for *D. venosa* will have to remain simply as "Texas." Only after collectors recover additional specimens of this species can specific collection localities be listed.

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NOCTURNAL STAPHYLINIDAE OF THE SOUTHERN CALIFORNIA SEA BEACHES[1]

Ian Moore[2]

ABSTRACT: Three species of Staphylinidae, *Thinopinus pictus* LeConte, *Pontamalota opaca* LeConte and *Thinusa maritima* Casey, are nocturnal on the wet sand during an outgoing tide. The habits of their congeners north of Point Conception needs investigation.

DESCRIPTORS: Staphylinidae, seashore, nocturnal, behavior, southern California.

In 1956, (Trans. San Diego Soc. Nat. Hist. 12: 207-230, 3 pl.) I reported on the zonation of the southern California seashore as it affects the indigenous Coleoptera. The zone of the sandy beaches I subdivided into three subzones according to the reach of the tides and its effect on wrack, (1) the area of fresh seaweed, (2) the area of decaying seaweed and (3) the area of dry seaweed. Each of these subzones supports a distinctive assemblage of Coleoptera. The area of fresh seaweed is that of the reach of each daily tide and consequently varies in width with the daily tidal range. In southern California its obvious diurnal population includes the tiger beetle *(Cicindela)* flies and the commoner species of *Cafius* (Staphylinidae) all of which species are found running on the wet sand or flying. Its less apparent components are several species of flightless Staphylinidae which are often abundant but not noticeable because they are nocturnal in habits.

At least three species of Staphylinid of the sandy beaches of southern California are known to be nocturnal. Each of these species is encountered only rarely in decaying seaweed. They are *Thinopinus pictus* LeConte, *Pontamalota opaca* LeConte and *Thinusa maritima* Casey. These species can be found at night sometimes in large nmbers, on the wet sand during an outgoing tide. They are restricted in occurrence to certain beaches. I have had

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[1] Accepted for publication: January 7, 1975

[2] Department of Entomology, Division of Biological Control, University of California, Riverside 92502

an opportunity to investigate only a few beaches at night so can only surmise as to the characteristics of such beaches. They seem to be open beaches backed up by sand dunes, not narrow beaches at the bases of cliffs.

Thinopinus pictus LeConte is a large insect (15-20 mm.) relatively broader than most Staphylinids. It is pale flavate in color very similar to the color of the wet sand on which it rests. The head, pronotum, elytra and abdomen are marked with patterns of black which are variable in extent. On some beaches specimens are more or less regularly scattered a few feet apart on the upper ten or twenty feet (depending on the slope of the beach) of wet sand during a receding tide. These insects stay mostly in one place but occasionally run a few inches. *Thinopinus pictus* feeds largely on the amphipod *Orchestoidea californica.* Craig, 1970 (Ecology 51: 1012-17) said "When an amphipod lands or crawls nearby, the beetle lunges and grasps the prey in its large, sickle-shaped mandibles, but the prey must usually pass within 5 mm. before a strike is attempted. One might expect this feeding method to be ineffectual, but the number of apparently random encounters with passing beach hoppers is large."

Pontamalota opaca (LeConte) is sometimes found in great abundance on certain beaches at night. *P. bakeri* Bernhauer and *P. nigriceps* Casey are probably synonyms of this species. The genus is in need of revision. *P. opaca* is a small (3 mm.), slender, flavate insect found on the same beaches as *Thinopinus pictus.* It is usually much more numerous than the latter. It is difficult to see what they can find to eat to support their large numbers. They are usually on the move, running not very rapidly over the damp sand changing direction rather abruptly from time to time. They must spend their daylight hours buried in the sand. It is surprising on very rare occasions to find a clump of wrack in the daytime with quite a few of these insects in it when other similar clumps of wrack nearby lack them. They are seldom found in wrack even on beaches with a large population. The early stages and ecology are unknown.

Thinusa maritima (Casey) is a small (2.4 mm.) slender, dark insect which is often found at night on the wet sand with *Thinopinus pictus* and

Pontamalota opaca. The tip of the abdomen is noticeably paler than the rest of the insect. This species is often as abundant as *Pontamalota opaca* and, like that species, is usually on the move. Its life history is also unknown. It, too, is only very rarely found in wrack even on beaches where it is abundant at night.

None of the above species is attracted to light. Other, winged species of Staphylinidae (*Bledies fenyesi* Bernhauer and Schubert and *Cafius canescans* Maklin particularly) will come to light on the beach, being presumably attracted from decaying seaweed. They are not encountered commonly on the wet sand in association with the above three.

On one occasion at Estero Beach, Baja California Norte, Mexico, I encountered specimens of a small, dark *Diglotta* sp. (presumably *D. pacifica* Fenyes) in association with *Thinusa maritima* on the beach at night. They tended to spring in the air when approached and so were difficult to capture. Members of this genus are rare in collections possibly because of their nocturnal habits.

From northern California to Alaska *Thinopinus pictus* is represented by a dark subspecies, *variegatus* Motschulsky. It apparently is also nocturnal but I do not know this from firsthand experience. *Ponamalota opaca* is not known from north of Point Conception. A similar but darker species, *P. californica* Casey, takes its place. I have collected *P. californica* in seaweed, often quite fresh seaweed, on the beach at Cayucos, San Luis Obispo County and Carmel, Monterey County in the daytime but did not find it at night on the wet sand. The range of *Thinusa maritima* extends north to the state of Washington but nothing is known about its habits in the northern part of its range.

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CREPUSCULAR AND NOCTURNAL ACTIVITIES OF *PARAPONERA CLAVATA* (HYMENOPTERA:FORMICIDAE:PONERINAE)[1]

Henry R. Hermann[2]

ABSTRACT: *Paraponera clavata* workers leave their nest in the early evening, temporarily group in an area near the nest entrance and then commence their foraging individually. Material brought back to the nest is largely sap, although some plant material and insects also are collected. Workers randomly return to their nest throughout the night, the last to return often coming back with no sap or booty.

DESCRIPTORS: Foraging behavior, preforage aggregations, sap feeders, offensive stinging.

The reports of Hermann (1973) and McCluskey and Brown (1972) have pointed out several interesting features on the foraging behavior of *Paraponera clavata* (F). This ant species routinely forages in late evening and during the night. Details of its foraging habits, however, were not explained. It is the purpose of this report to reveal how and when the worker ants leave their nest and what they gather as food between the time they leave the nest in the evening and return to it the following morning.

Materials and Methods

Colonies of the ant species *Paraponera clavata* (F.) were found at Limon Cocha, Ecuador (Hermann and Blum, 1966), by following foraging ants. Their nests, always in the ground at a tree base, were marked for further examination.

Nine colonies of ants were carefully watched. Complete data on foraging activity and colony structure were obtained on two of these nests. Ants observed departing from their nests were watched throughout the night on several occasions. Estimations of colony size were later correlated with figures of ants collected while digging up the nest.

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[1] Accepted for publication: January 13, 1975

[2] Department of Entomology, University of Georgia, Athens, Georgia 30602

ENT. NEWS, 86: 5 & 6: 94 - 98, May & June 1975

Results and Discussion

Only on rare occasions did a colony of *P. clavata* ever have more than one opening. On occasion there were two openings and both were employed as an exit and an entrance. When two openings were found, it was determined that there also was a connection between the two tunnels within the nest since marked individuals entering one hole often would be found leaving through the other. The entrance hole generally measures about 2 cm in diameter.

Definite foraging rhythms were observed. Commencement of foraging activity was during the crepuscular period of early evening while cessation of foraging activity was during the crepuscular period of early morning. This data correlates well with the data reported by McCluskey and Brown (1972).

An altering of the photoperiod evidentally destroys the natural foraging behavior of this species. McCluskey and Brown (1972) destroyed routine foraging rhythms by supplying laboratory colonies with irregular photoperiods. I found an irregularity in foraging behavior on overcast days. When crepuscular conditions were approached, due to decreased illumination on overcast days, foraging went on as it would during the normal foraging period.

Preforage Behavior

Worker ants began leaving the nest between 4:30 PM and 5:00 PM (Table 1). At times a single individual would leave, while at other times several individuals would depart in single file. Most often these workers stopped in a specific "preforage aggregation" before embarking on their foraging excursions (Hermann, 1973). Such preforage aggregations were not always present (Table 1, October 4, N Ag). When aggregations were present, workers sometimes would remain in them for no more than a few minutes before commencing their foraging activities. On occasions, considerable time was spent by workers in the aggregations.

Based on the findings of Hermann (1973), preforage aggregations may have influenced the acquisition of group raiding behavior. *P. clavata* workers often leave their preforage aggregations in numbers, each individual following the other. This behavior is much like the departure of group-raiding ponerines and dorylines. The difference between *P. clavata* workers and group raiders is in the follow-through behavior in which workers of group raiders remain in groups whereas workers of *P. clavata* disperse shortly after leaving their preforage aggregations.

Number of Foraging Individuals and Materials Collected

A single nest observed through the night on Sept. 27 represents the general foraging behavior of *Paraponera* workers. Workers began to enter the preforage aggregation at 4:46 PM (see Table 1). Active foraging began at 5:32 PM and essentially ceased the following morning at 5:31 AM. This represented a 12-hour foraging period. Ninety-nine workers were recorded going up the tree from the nest and 84 were recorded to return. The remaining 15 workers drifted in between 5:31 and about 6:30 - 7:00 AM. Of the workers observed, 60 returned to the nest with sap in their spread mandibles (76.9% of the foraging workers), 13 returned with nothing (16.7%) and 5 returned with some sort of prey or solid material (6.4%) (lichen and bark, moth, palm mulch, a jelly-like material from the palm foraged upon and a cockroach ootheca).

The high percentage of sap collected was consistent in all of the colonies observed. Sudd (1967) listed sap collecting as a secondary foraging character of primitive ant species. Of primary importance is predatory and scavenger behavior in the collection of insects. This is not the case with *Paraponera clavata.* Sap appears always to be the primary material brought into the colony.

Interestingly, Krombein (1939) mentions that sap collecting also is demonstrated by tiphiid wasps. It is possible that there is some significance here.

The high number of foraging workers recorded resulted from a return to foraging by workers that came back to the nest either with nothing or with one of the materials listed above.

Number of Individuals in a Colony

The nest mentioned above in one of the foraging experiments was dissected on October 1. One hundred thirty-one workers and a queen, four alate males, 67 pupae, two prepupae and 55 larvae were taken. Although some ants were probably lost in the digging I feel confident that I got most of the colony. Dissecting a colony of this species is extremely difficult in most cases since the tunnels of the nest intermingle with the roots of the tree. Other colonies at Limon Cocha were estimated as being larger than the ones reported on here and Bequaert (1926) dissected at least one nest with as many as 500 individuals. Mann's estimation of colony size (1916) was somewhat smaller. He may have dissected a smaller colony or incompletely dissected a larger one. McCluskey and Brown (1972) collected 300-400 workers and observed an additional 100 in the nest site.

Another nest dissected on October 29 had 225 workers, a queen, no alate forms, 46 pupae, two prepupae, 57 larvae and 18 eggs. It is conceivable that a considerable number of eggs were lost in digging out the colony since the nest covers an area of a square meter or more in some cases.

Use of the Lincoln index on foraging workers proved worthless as a means of estimating colony size. The values calculated did not fit the actual colony size and adjustments in Lincoln Index values produced inconsistent results. Colony function probably determines the number of foraging workers at any one time, this number changing upon the changing needs of the colony.

Additional Behavioral Data

On occasion, workers would accept foreign individuals of their species into their colony. However, in most cases defendent ants would attack and sometimes dismember an intruder ant. The foreign ant would most often assume a passive role, retracting its legs and refusing any altercation with its attackers.

During overcast days, diurnal foraging activity often occurred. However, when it began to rain all foraging activity ceased.

On occasion, insects were offered as prey to *Paraponera* workers. Insects with an obvious odor, such as pentatomid bugs and certain abundant beetles, were rejected by the ants. Other prey items, such as lepidopterous larvae and spiders, were accepted and carried to their nest. Oddly, the ants accepted ithomiid butterflies, insects with well known affinities for distastefulness.

Upon accepting live prey worker ants readily stung them after grabbing them with their large mandibles. This points out the use of the sting in prey capture as well as in colony defense. Prey that offered no resistance to the worker ants were often accepted by the ants without stinging. However, the slightest resistance provoked rapid and efficient stinging.

On occasion, alate forms were seen aggregating at the nest entrance hole just after 7 PM and some alate forms were seen leaving the nests at about this time. Alate forms also were collected at lights at slightly later times. McCluskey and Brown (1972) reported observing a male at 6:30 PM and they collected females at lights. Bequaert (1926) also observed nocturnal flights of males. All evidence, therefore, points to definite nocturnal mating habits of this species.

Table 1. Foraging data of *Paraponera clavata*
Single Nest

Date of Observation	Time Workers First Seen-PM	Time First Worker Returned to Nest	Highest # of Workers in Preforage Aggregation	Material Collected By Workers
Sept. 24	5:03	6:07	Several	————
Sept. 25	4:58	5:28	27	insect larvae, spider, sap, nothing
Sept. 27	4:46	5:49	12	lichen, nothing, sap, palm mulch, moth, jelly, cockroach ootheca
Oct. 4	4:30	——	N Ag	————
Oct. 5	——	——	5	lepid larva
Nov. 7	——	——	56	————
Nov. 8	5:00	5:46	——	————
Nov. 8	5:39	6:01	Several	————
Nov. 12	5:25	5:45	22	————

N Ag – No aggregation was formed.

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NONHEXAGONAL OMMATIDIA ARRANGEMENT IN THE COMPOUND EYE OF EYELESS *DROSOPHILA MELANOGASTER*[1]

Robert D. Hester[2]

ABSTRACT: The compound eye of eyeless *Drosphila melanogaster* is composed of rectangularly arranged facets as opposed to the hexagonal arrangement one finds in the compound eyes in most insects.

DESCRIPTORS: compound eye, *Drosphila melanogaster,* eyeless, hexagonal, ommatidia, rectangular.

The compound eye of wild type *Drosophila melanogaster* displays the typical hexagonal arrangement of ommatidia that one finds in the compound eyes of most insects. There is a strain of *Drosophila* known as eyeless (ey). Members of the ey strain are distinguished by their greatly reduced eye size as compared to the compound eye of wild type flies. Microscopic study of the ey compound eye has revealed that the ommatidia of the ey eye are rectangularly arranged as opposed to the hexagonal arrangement that one usually expects.

ACKNOWLEDGEMENTS

I would like to thank Dr. Côté of the N.C. Brown Center for Ultrastructure Studies S.U.N.Y. College of Environmental Science and Forestry at Syracuse for the Illustrations.

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[1] Accepted for publication: January 21, 1975

[2] 100 Speach Drive, Baldwinsville, N.Y., 13027

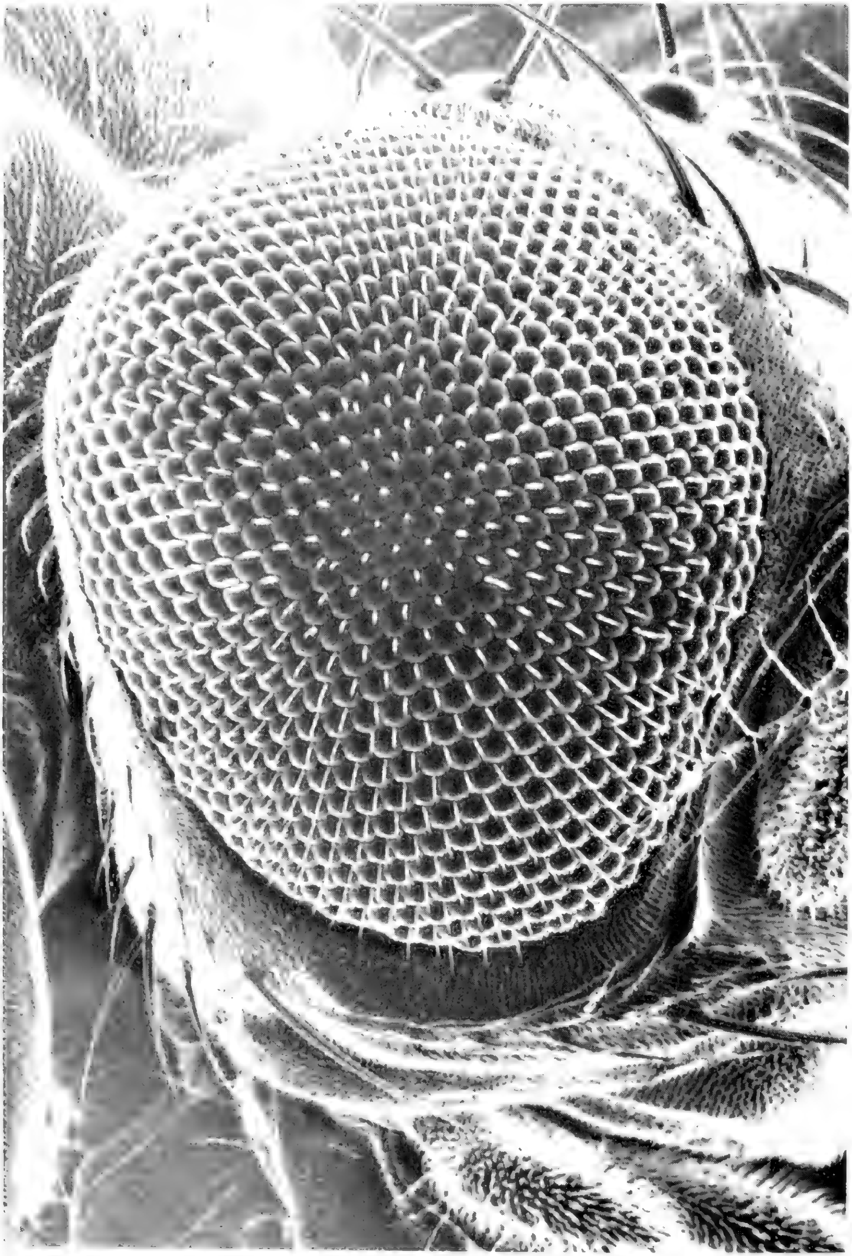

Fig. 1 Compound eye of wild type *Drosophila melanogaster* showing the hexagonal arrangement of ommatidia.

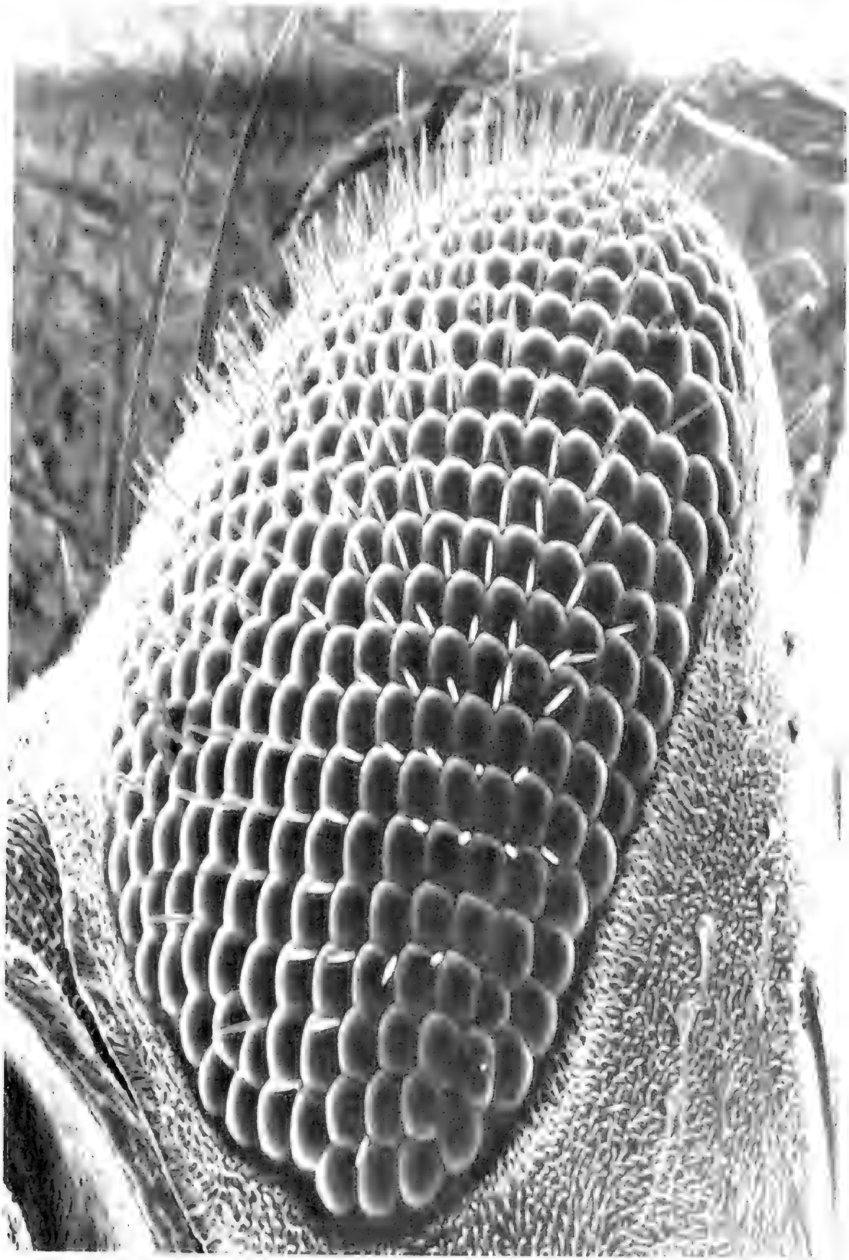

Fig. 2 Compound eye of ey fly showing the nonhexagonal ommatidia arrangement.

THE NYMPH OF *UTAPERLA SOPLADORA* RICKER (PLECOPTERA: CHLOROPERLIDAE)[1, 2]

Rebecca F. Surdick[3] and Mary R. Cather[3]

ABSTRACT: The nymph of *Utaperla sopladora* Ricker is described for the first time from a last-instar male from the Ruby Mountains, Elko County, Nevada. Figures of the complete nymph, head and pronotum, mouthparts, abdominal segments and cerci are included.

DESCRIPTORS: Plecoptera; Chloroperlidae; *Utaperla sopladora* Ricker; nymph; Nevada.

Utaperla sopladora was originally described by Ricker (1952) but the nymph has remained unknown. The species range extends from Alaska and the Yukon to Idaho, Montana and Utah (Gaufin, et al. 1966; Nelson and Hanson 1969; Ricker 1964). The collection of a nymph upon which this paper is based adds Nevada to the record.

A single, last-instar male nymph was collected by Mary and Eric Cather in Lamoille Creek at 2250 m elevation, Lamoille Canyon Road, 2 miles above Camp Lamoille, Ruby Mountains, Elko County. The date of collection was 6-VII-74. The specimen is deposited at the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

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[1] Accepted for publication: January 31, 1975

[2] Study supported by Dept. of Biol., Univ. of Utah.

[3] Dept. of Biology, Univ. of Utah, Salt Lake City, Utah 84112.

ENT. NEWS, 86: 5 & 6: 102 - 106, May & June 1975

Last-instar male:

Length of body 6.5 mm; dorsum dark with little patterning; venter light with dark patches on thorax and abdomen. Body covered with minute dark setae. Characteristics of adult male visible through cuticle (fig. 1).

Head mostly dark with narrow light band on anterior margin of frons, extending back on lateral margin of head to compound eyes. Head as wide as long, narrowing anteriorly to compound eyes.

Labium (fig. 2) with paraglossae twice as long as glossae; palpi thick, twice as long as paraglossae. Paraglossae and glossae apically pointed. Major cusp of lacinia (fig. 3) long and tapering; minor cusp small, arising at base of major cusp. Few equally-spaced setae posterior to teeth. Several densely clumped setae near base of lacinia. Conspicuous cluster of spines on stipes at base of palpus. Mandibles (fig. 4) tridentate, distal-most tooth lightly serrated on inner margin.

Pronotum (fig.5) uniformly dark, wide as long; several long setae on anterolateral angles. Setae on posterior margin sparse. Marginal groove distinct anteriorly. Femora and tibiae with scattered long setae; naked median longitudinal area present. Tarsal segments 1 and 2 small and subequal; segment 3 longer than 1 and 2 combined.

Abdomen brown with dark median stripe on terga 1-8; lateral dark markings on terga 1-7. Posterior fringe on abdominal terga interrupted mesally (fig. 6); mesolateral margins of abdominal segments bearing patches of setae (fig. 7). Cerci (fig. 8) about 3/4 length of abdomen; approximately 17 segments. Segments with long setae on posterior margin.

ACKNOWLEDGMENTS

The authors extend special thanks to Dr. B.P. Stark for his kind assistance and suggestions and to Dr. R.W. Baumann for his critical evaluation of the manuscript.

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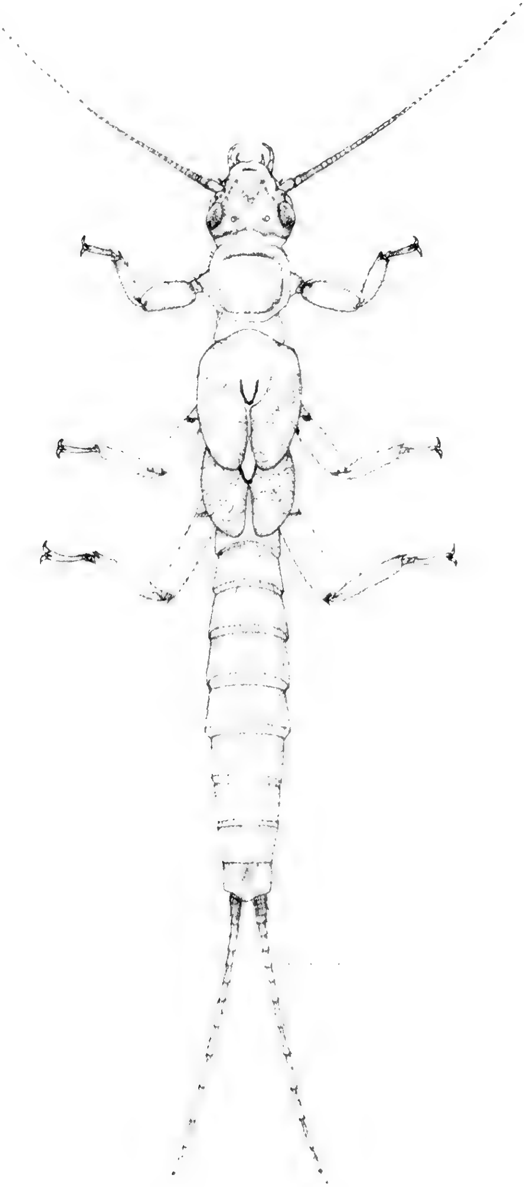

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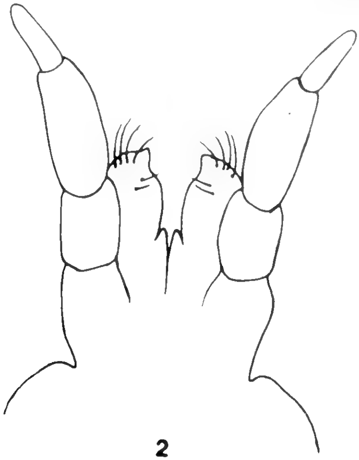
Fig. 1. *Utaperla sopladora* Ricker. Male mature nymph.



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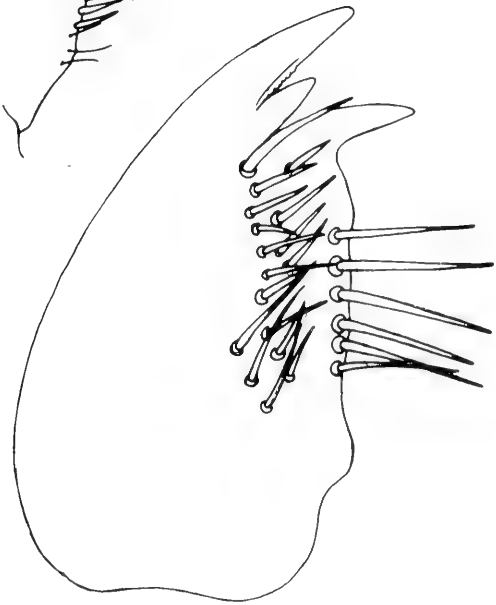

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Fig. 2. Labium. Fig. 3. Maxilla. Fig. 4. Mandible.

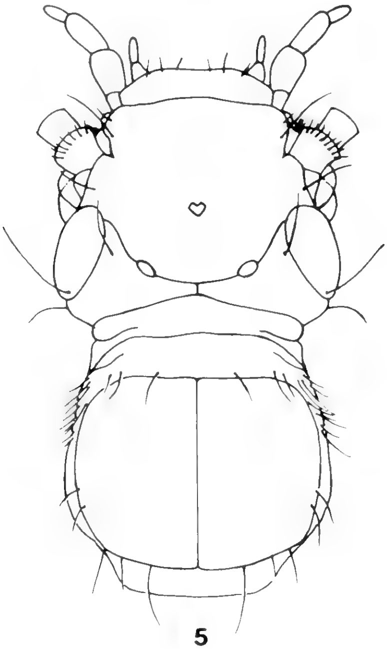

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Fig. 5. Head and pronotum.

Fig. 6. Eighth abdominal segment (dorsal view).

Fig. 7. Eighth abdominal segment (lateral view).

Fig. 8. Cercal segments.

NEW SOUTHWESTERN BOMBYLIIDAE (DIPTERA)[1]

Jack C. Hall[2]

ABSTRACT: One new genus, *Paradiplocampta* and one new subgenus of *Villa, (Diochanthrax)* are described. The following new species are described *V. (D.) morulus, V. (Thyridanthrax) melanoptera, P. tabeti, Parabombylius rutilous* and *Amphicosmus arizonicus.* All of the new forms are from the southwestern United States.

DESCRIPTORS: Diptera: Bombyliidae: *Paradiplocampta* n. gen., *Diochanthrax* n. subgen., *Paradiplocampta tabeti* n. sp., *Villa (Diochanthrax) morulus* n. sp., *Villa (Thyridanthrax) melanoptera* n. sp., *Parabombylius rutilous* n. sp., *Amphicosmus arizonicus* n. sp.

As stated in previous articles the southwestern United States is especially rich in Bombyliidae and as a consequence more and more attention is being paid to this family. The following species are therefore being described at this time in order to make the names available for other studies and also to return borrowed material. The new forms described herein were all collected in southern California and Arizona.

Villa (Thyridanthrax) melanoptera, n. sp.

This species is atypical of *Thyridanthrax* and somewhat bridges the gap between *Thyridanthrax* and *Poecilanthrax.* Were it not for the scales on the face and front *melanoptera* would on the basis of the male genitalia be considered an "aberrant" *Poecilanthrax.* On the other hand, many characteristics such as the fenestrate wing, wing venation, size and general habitus preclude placing it anywhere but in *Thyridanthrax.* There are many specimens before me and they express surprisingly little variation, even between the sexes.

Male. – Black, legs brown to testaceous, as is side of face and oral margin. Eyes separated by three times width of small ocellar tubercle. Front with course black hair, a bare horizontal depression in middle; tomentum of scattered pale yellowish scales. Basal antennal segments with black hair; first segment, in lateral view about one and one half times longer than widest portion; second segment rounded, about as wide as long; third

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[1] Accepted for publication: February 20, 1975

[2] Department of Entomology, Division of Biological Control, University of California, Riverside 92502

segment long, base elongate conical, apical styliform portion about equal in length to conical base, terminating in a small arista. Face strongly and acutely projecting with black hair and pale yellow scales. Proboscis not projecting, with narrow pointed labellae. Palpi black with black hair. Occipital tomentum pale yellowish, black, short, scattered hair on side becoming yellowish above; cervical fringe yellowish-white. Mesonotum short black pilose, hair longer laterally, that on collar and lateral margin in front of wing base whitish; tomentum pale yellowish, scattered; bristles black. Pleura with mixed black and pale yellow hair, fan-shaped tuft of black and pale hair on metapleuron in front of halter; tomentum on pleura shining yellowish. Prosternum, coxae and legs with black hair; coxae with shining testaceous scales; scales on femora black to brown; fore tibia smooth, others with black bristles. Halter stem and knob black with apex of both whitish. Squama brown with fringe of testaceous scales. Scutellum black pilose, tomentum pale yellowish, spot of black scales in middle; bristles black. Basicosta with whitish hair, black scales and setulae. Wing infuscated dark brown, hyaline spots surrounding r-m and posterior crossveins and at base of R_4, upper basal corner of third posterior cell, other hyaline areas in middle of apical portion of marginal cell, middle and apical portion of first submarginal, posterior portion of second submarginal, middle of discal and all posterior cells, color extends along posterior margin of wing from first posterior cell to base of wing, anal and axillary cells entirely colored; discal cell broadened apically; alula well developed. Abdominal dorsum with pale yellow hair, white hair on first segment, black hair on apical segments, lateral margin with white hair at base, rest entirely black haired; tomentum on dorsum black, white and pale yellow, black in middle of segments two to five decreasing in amount posteriorly, patch of white scales on side of segments three to five, segment six entirely white tomentose, yellowish scales elsewhere on abdomen particularly noticeable at side of second segment. Venter black pilose, yellowish tomentose laterally, black tomentum medially. Genitalia testaceous with black hair; epandrium short, posterior margin truncate; epiphallus straight, broad, apex in dorsal view rounded, in lateral view rounded above, flat below; aedeagus short, broad, straight not projecting beyond tip of epiphallus with a small notch near base on upper margin; basistylus broad basally tapering to bluntly pointed apex; dististyli small rather flattened, conical, curved posteriorly, not hooked apically.

Female. – Not unlike the male, pale tomentum more white than yellowish and more dense, otherwise nearly identical to male.

In some specimens the yellowish scales on the abdomen are completely wanting being replaced with white scales. When the wings are light brown in color, rather than dark brown, all the cells in the wing have their centers hyaline to subhyaline. Some specimens have black hair on the posterior margin of all the abdominal segments. Some specimens, especially females, will have the face and first antennal segment nearly entirely fulvous.

This is a spring and early summer species found primarily in the desert regions of California and Arizona. It ranges from California south to Arizona and east to Texas.

Holotype male, allotype female from 8 mi. E. Lancaster, Los Angeles Co., California, IV-30-66 (J.C. Hall). Both in California Academy of Sciences, San Francisco.

Paratypes: California: 3♂, 1♀ topotypic, collected with types (J.C. Hall, F.G. Andrews). San Bernardino Co.: 1♀ Victorville, V-5-56 (J. Powell); 1♂, 1♀ 15 mi. N. Baker, IV-15-66 (F.G. Andrews); 1♀ 5 mi. N. Baker, III-24-53 (J.W. MacSwain); 1♂, 1♀ Silver Lake, IV-20-69 (F.G. Andrews); 7♂ 20 mi. S.W. Baker, IV-15-66 (F.G. Andrews); 5♂ 13 mi. S. Shoshone, III-16-66 (F.G. Andrews); 1♀ 20 mi. S. Kelso, IV-30-66 (P.H. Timberlake); 3♂ Granite Pass, IV-27-68, 3800-4320 ft. (E.I. Schlinger). Kern Co.: 1♀ Rosamond, IV-23-54 (T.R. Haig). Inyo Co.: 1♀ Independence, IV-29-59 (R.P. Allen). Riverside Co.: 3♂, 1♀ Palm Desert, IV-8-58, IV-22-58 (H.R. Moffitt, J.C. Hall); 1♂, 1♀ Palm Springs, IV-5-48, IV-21-64 (J.W. MacSwain); 2♂ Corn Springs, Chuckwalla Mts., III-28-69 (J.C. Hall); 1♂, 1,000 Palms, III-20-63 (W.H. Ewart); 2♂, 1♀, McCoy Springs, IV-8-63 (J.C. Hall); 2♀ Cottonwood Springs, IV-5-66 (P.H. Timberlake, J.C. Hall); 1♀ Box Canyon, IV-5-66 (F.G. Andrews); 1♂, 1♀ Desert Center, IV-5-58 (F. Colley); 1♂ Palm Springs Sta., III-26-60 (M. Wasbauer) on *Encelia farinosa;* 27♂♀ Deep Canyon, vicinity of lab., IV-3 to IV-10-73 (A.B. Tabet) on *Chenactis fremonti;* 1♀ Coyote Creek, IV-17-74 (Suzy Frommer). Merced Co: 1♂ Raymond, IV-4-47 (H. Welsh). San Diego Co: 1♂ Borrego Valley, III-26-59 (L.M. Smith); 1♀ Plum Canyon, Anza St. Park, IV-5-59 (E.I. Schlinger). Imperial Co.: 1♀ 10 mi. N. Glamis, IV-1-73 (G.R. Ballmer); 1♂, 1♀ Ocotillo, III-21-66 (J.C. Hall, P.H. Timberlake). Nevada, Clark Co.: 1♀ Lake Mead, IV-18-49 (G.E. Bohart). Arizona, Pinal Co.: 3♂, 7♀ Florence Jct., IV-5-54 (T.R. Haig). Yuma Co.: 1♂ 7 mi. E. Tacna, III-23-74 (T. Plichta). Texas, El Paso Co.: 2♂, 1♀ El Paso, IV-28-27 (J.O. Martin).

Villa (Diochanthrax), n. subgen.

In present keys this group runs to *Villa (Chrysanthrax)* or *Stonyx*. It differs from both by the shape of the head, the bulbous *Anthrax*-like third antennal segment, the absence of femoral bristles, smooth front tibia, three submarginal cells in the wing and an undeveloped alula. *Diochanthrax* is possibly most closely related to *Stonyx* but the proboscis doesn't project and the fore tibiae are smooth.

Villa (Diochanthrax) morulus, n. sp.

Male. – Body 5-8 mm. long, wing 6-8 mm. long. Black, legs testaceous, especially tibiae. Front with black hair, spot on each side in middle of denser black hair making two darker spots, tomentum black with light reflections, a small patch of lighter scales above and to side of antennal base. Antennae short, third segment longer than two basal segments combined, first segment at least three times longer than second, both basal segments with black hair, base of third segment globular, abruptly tapering to apical styliform portion which is nearly twice as long as basal portion. Face conically but not acutely projecting, with black hair, black tomentum in middle, lighter toward eye. Proboscis short, not projecting, labellae narrow. Palpi brownish with black hair. Occiput with black setulae and pale scales, vertex behind ocellar tubercle deeply foveate; cervical fringe black. Mesonotum with long, thin, scattered, black hair, collar with denser white hair, whitish tomentum overall, denser along lateral margin; tuft of white hair below post-alar callus; bristles long, thin, black. Pleura mixed black and yellowish pilose, yellow tomentum on mesopleuron, propleuron entirely black haired; metapleural fringe mixed black and yellowish. Prosternum and legs with black hair, hind coxa with a few yellowish hairs; all femora with black tomentum, a few yellowish scales on posterior surface of hind femur; femora with long, abundant, black hair, bristles wanting; fore tibia smooth, mid and hind tibae with black tomentum and bristles; claws on fore leg about half length of claws on other legs. Halter stem and knob black. Squama black with yellowish fringe. Scutellum with thinly scattered black hair, white sparse tomentum, spot of black tomentum in middle at base; bristles long, thin, hair-like, black. Basicosta black with yellowish hair at base. Upper basal half of wing entirely infuscated, apical half mottled, all veins in apical half of wing broadly bordered with black; three submarginal cells; r-m crossvein well beyond middle of discal cell; first posterior cell broadly open in wing margin; medial crossvein at base of third posterior cell with a stump of a vein projecting into discal cell; posterior crossvein as long as r-m crossvein; second section of vein $M_3 + Cu_1$ (fifth longitudinal vein) longer than first section; anal cell broadly open; axillary cell as wide as anal cell; alula but little developed. Abdominal dorsum with long thin black hair, tomentum whitish, that on middle of posterior margin of first segment, median crossband on second segment, median spot on third and middle of segments four and five with shiny black tomentum; side of abdomen from above with alternating white and black tufts to fifth segment, apical segments entirely black haired; lateral margin when viewed from side entirely black haired. Venter black pilose, brownish tomentose. Genitalia brown with black hair, posterior margin of epandrium concave below middle, apical corner rounded; epiphallus short, broad, rounded apically, slightly arched downward; aedeagus short and broad; basistylus long, narrow; dististyli narrow, sides parallel or nearly so, hooked apically.

Female. – Tomentum more abundant, black abdominal tomentum more or less confined to a median row of spots on segments two to five. Otherwise as described for the male.

The black or dark tomentum, because of its reflective nature, is rather difficult to describe. It reflects whitish when it is in reality brownish to black or will reflect dark when it is in reality light. Many specimens have the abdominal tomentum with violaceous reflections, in others the lateral dark hair appears violaceous. An occasional specimen is seen which has only two submarginal cells present in the wing.

Holotype male, allotype female from Riverside, Riverside County, California, IV-13-70 (J.C. Hall). In California Academy of Sciences, San Francisco.

Paratypes: California, Riverside Co.,: 48♂♀ collected with types, 14♂, 9♀ topotypic, IV-3-70, V-2-70, IV-30-65, III-27-57, IV-10-59, III-2-55 (J.C. Hall, E.I. Schlinger); 3♂, 2♀ Box Canyon, III-21-67 (J.C. Hall); 2♂, 1♀ Berdoo Canyon, III-5-68 (J.C. Hall), on *Cryptantha;* 40♂, 4♀ Millard Canyon, IV-13-63, IV-7-74, (J.C. and E.M. Hall, E.I. Schlinger); 1♂ Whitewater, III-3-68 (E.M. Hall); 11♂, 5♀ Andreas Canyon, III-8-56 (J.C. Hall, P.H. Timberlake); 2♂, 2♀ Box Springs Canyon, IV-18-65 (P.A. Rauch); 3♀ Sunnymead, IV-16-65 (M.E. Irwin); 3♀ 7 mi. E. Sunnymead, V-9-64 (M.E. Irwin, P.A. Rauch); 13♀, 5♀ Deep Canyon, III-24-70, III-31-70, IV-14-73, III-28-63 (S.I. Frommer, L. LaPre, J.D. Pinto, M. Quillman, E.I. Schlinger). Kings Co.: 1♀ Avenal, III-6-53 (J.C. Hall). Inyo Co.: 1♂ Surprise Canyon, Panamint Mts., IV-24-57 (P.H. Timberlake). San Bernardino Co.: 1♂ 8 mi. N. Llano, IV-11-62 (J.C. Hall, E.I. Schlinger); 5 mi. W. Desert Springs, IV-11-62 (J.C. Hall, E.I. Schlinger); 1♂ Cima, IV-14-61 (W. Cronk).

Paradiplocampta, n. gen.

This new genus may be located between *Diplocampta* and *Neodiplocampta* sharing characteristics of both genera except in the shape of the wing, the configuration of the third antennal segment and male genitalia. In general *Paradiplocampta* is closest to the South American *Diplocampta* a relationship not too unexpected since other southern South American genera are found in the southeastern United States. The following diagnosis should serve to distinguish *Paradiplocampta* from all other Exoprosopinae:

Face conical but rounded apically. Eyes in male separated by width of ocellar tubercle. Basal antennal segments short, third segment elongate conical with minute terminal arista. Proboscis short not projecting. Upper portion of mesopleuron with a dense patch of scales. Fore tibiae without conspicuous bristles, mid and hind femora and tibiae with bristles; pulvilli wanting. Wing short and broad, about half as broad as long, widened apically; vein R_{2+3} double curved or strongly contorted; two submarginal cells; minute stumps of veins present at knee of vein R_{2+3} and R_4; r-m crossvein before middle of discal cell; first posterior and anal cells broadly open in wing margin; axillary cell and alula well developed. Abdomen with short hair, not dense. Male genitalia small, epiphallus simple, short, broad with rounded apex; aedeagus short, slightly turned down, gonopore apical; diststyli curved posteriorly, hooked apically.

Genotype, *Paradiplocampta tabeti,* n. sp., monobasic.

At present this genus is known from the male sex only and is based on three specimens, one from southern California and two from southern Arizona. If the same relationship exists between the sexes as does that found in *Diplocampta* then the females may be difficult to distinguish from and separate from *Villa (Chrysanthrax)* or *Villa (Exhyalanthrax),* copulating pairs need to be collected and the females studied carefully. When females are discovered it is highly likely that the generic description will be emended.

Paradiplocampta tabeti, n. sp.

Male. – Black. Eyes separated by width of ocellar tubercle. Front with black hair and pale yellow scales. First antennal segment twice length of second, second segment wider than long, both basal segments with black hair, third segment in lateral view with base conical, tapering to apical styliform half or a little more. Face with black hair and pale yellow scales. Palpi black with black hair, about half length of proboscis. Occiput with white scales on upper half, a few pale yellow hairs and scales at vertex. Cervical fringe pale yellow above, black below. Mesonotum with short black hair, longer towards scutellum, collar and side in front of wing pale yellow; tomentum of pale yellow scales, a crossband of white in front of wing bases connecting tufts of white scales on mesopleura; bristles yellowish. Pleura black pilose, upper part of mesopleuron with yellow hair and white scales; metapleural tuft yellow, a few black hairs present at bottom of tuft. Prosternum, coxae and legs black pilose and tomentose; fore tibiae smooth otherwise bristles on legs black. Halter stem pale yellow, knob white. Squama light testaceous with fringe of white scales. Scutellum with short black hair, tomentum pale yellow, white on basal half; bristles black, not strong. Basicosta with a few light testaceous scales at base and black setulae overall; prealar hook broad, bare, pale. Wing hyaline, yellowish brown along costal margin, basal half of marginal cell and all of first basal cell; veins testaceous, wing otherwise as described for genus. Abdominal dorsum with short black hair, white and longer at base; tomentum black, crossband of yellow scales at basal portion of second and fourth segments, a few yellow scales each side of middle on first segment; crossband of white scales on segments three and six, scattered white scales in middle of seventh segment; lateral margin black haired, pale yellow at base; venter black pilose and tomentose. Genitalia black with black hair; epandrium short, somewhat triangular in outline, apical corner a little projecting; epandrium short, broad, apex rounded, straight; aedeagus short, broad, bent downward apically; basal apodeme large; basistylus short, broad; dististylus short, bent outward, hooked apically.

Female. – Unknown.

Holotype male from 7 mi. E. of Portal, Cochise County, Arizona, VIII-29-67 (F.G. Andrews). In California Academy of Sciences, San Francisco.

Paratypes: 1♂ 5 mi. N. Portal, Cochise Co., Arizona, VIII-21-67 (E.I. Schlinger); 1♂ Deep Canyon, Trail from Hwy. 74, 2960-3680 ft., Riverside Co., California, IX-14-73 (A.B. Tabet).

The specimen from Deep Canyon differs from the Arizona specimens in that the wings are hyaline with only the costal cell yellowish and the yellowish scales on the second and fourth abdominal segments occupy most of the segment. There are also a few scattered yellowish scales on the upper part of the sternopleuron. Other than the above I can find no other differences between the two. Additional specimens may show the two to be distinct.

Parabombylius rutilous, n. sp.

Separated from the congeners in the male by the bright orange pile on the upper half of the body and black pile on the lower half and a patch of silver white scales at the lateral margin of segments five to seven. In the female the bright orange pile on the entire body together with the silver patches of scales on each side of the first abdominal segment in addition to others should serve to distinguish this sex.

Male. Dull black, pleural area of thorax lighter. Head and antennae black pilose, tomentum wanting except for small patch of yellowish scales opposite base of antennae next to eye. First antennal segment twice length of second, third segment longer than basal two combined, terminates in three small segments of equal length, apical one pointed. Proboscis projects ca. one and one half times head height beyond oral margin. Palpi short ca. one-eighth length of proboscis, with black hair. Occiput with orange hair on upper half, black below. Mesonotum orange pilose, a few scattered black hairs across anterior margin, in front of scutellum, on post-alar callus; tomentum wanting; bristles black. Pleura and legs entirely black pilose, femora with black tomentum; pulvilli half as long as claws. Halter stem and knob black. Squama black with fringe of black hair. Scutellum black pilose, a few scattered orange hairs mixed in; tomentum wanting, bristles black. Wing hyaline, first posterior cell closed slightly before apex; anal cell narrowly open. Abdominal dorsum orange pilose, black hair in middle of segments two and three, across posterior margin of four and five and on all of six and seven; tomentum in the form of shiny white spots in middle of posterior margin of segments two to four, side of segments four, five, six entirely shiny white tomentose. Venter black pilose and tomentose.

Female. – Body entirely golden orange pilose and tomentose, a few black hairs on scutellum and across posterior margin of segments two to apex of abdomen. Shiny silver-white spots of tomentum each side of antennae, on humeral callus extending inward but not meeting along anterior margin of thorax then extending posteriorly for short distance, spot above root of wing, above post-alar callus, two small spots on disc and a larger spot in front of scutellum; silver-white spots at side of first abdominal segment, small mid-dorsal stripe on segments two to five, at side of fifth segment. Alular fringe silver-white. All femora with orange scales on dorsal surface. Tibiae testaceous. Otherwise as described for male.

Holotype, allotype and 19 **paratypes** from Gran Quivira, Torrance County, New Mexico, 6500 ft., VIII-20-67 (H.B. Leech). In California Academy of Sciences, San Francisco. Four paratypes in author's collection.

Amphicosmus arizonicus, n. sp.

Unlike any of the congeners by virtue of the infuscations on the wing and larger size, 7-8 mm.

Female. – Black with white and yellow markings. Front shining black, two yellow spots immediately above antennae, side next to eye narrowly argenteous to ocellar tubercle, short hair black. Ocellar tubercle located a little below vertex. Antennae black, first segment light testaceous on inner apex, basal segments nearly equal in length with black hair, second segment globular, third segment longer than two basal segments combined, linear, widest near the middle. Face white, shining black in middle above, with short, fine, yellowish hair on sides. Proboscis short, not projecting, Palpi brown with pale hair. Occiput, except shining black vertex, white. Cervical fringe of pale hair. Mesonotum shining black, humeral callus white, post-alar callus and spot in front of wing base yellow, hair short, scattered, pale; bristles wanting. Pleura white, middle of mesopleuron black extending to and including propleuron; lower portion of sterno- and pteropleurae black; metapleural hair pale; prosternum black. Coxae testaceous, dusky at base, legs yellow, trochanters with a black spot at apex, hind femur black on apical two-thirds, hind tibia and all tarsi black. Pulvilli as long as claws. Halter stem and knob pale yellow to white. Squama small, pale with fringe of pale hair. Scutellum shining yellow, posterior margin black, occasionally this extends into middle of scutellum, with short, scattered pale hair. Wing hyaline, brown band extends from near apex of subcostal vein posteriorly to base of third posterior cell crossing through r-m crossvein and middle of discal cell but leaving apex of discal hyaline, width of color decreases posteriorly; venation as described for genus. Abdominal dorsum shining black, posterior margin of all segments narrowly white, dorsum with short black hair, more noticeable towards apex. Venter white, side of each segment with elongate black mark making an interrupted black stripe down each side.

Male. – Unknown.

Holotype female and three **paratype** females from 6 mi. E. of Patagonia, Santa Cruz County, Arizona, IX-17-71 (J.L. Bath). Type in California Academy of Science, San Francisco.

PROTECTING INSTRUCTIONAL INSECT SPECIMENS WITH VINYL ACETATE SPRAY[1]

D.L. Deonier[2]

One of the constant costs of entomological instruction is the high rate of damage to insect specimens used by students for keying practice. Recently, I tested the idea that a thin flexible film over appendicular joints could prevent or reduce detachment of legs, wings, etc. Three materials, a clear acrylic spray, clear latex and a clear vinyl acetate spray, were tested for this purpose. When legs, antennae, cerci, and wing bases of damselflies, mayflies, several dipterans including mosquitoes and moths were filmed and tested by striking or moving the appendages, the appendages were not detached as with untreated specimens. The film from the vinyl spray (Quelspray^{TM}) retained the greatest elasticity and flexibility after 12 hours of drying. These results prompted me to film the appendages of nearly all of the dry-mounted specimens in our 15 general entomology drawers.

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[1] Accepted for publication: March 3, 1975

[2] Department of Zoology, Miami University, Oxford, OH 45056

THE BIOLOGY OF *HOPLITIS ROBUSTA* (HYMENOPTERA: MEGACHILIDAE)[1]

Stephen L. Clement[2], Richard W. Rust[3]

ABSTRACT: The nesting biology of *Hoplitis (Formicapis) robusta* (Nylander) is described and illustrated. Six trap nests of this holarctic species were obtained from northwestern Wyoming.

Hoplitis robusta nests in existing burrows and utilizes masticated plant material for cell partitions and nest plugs. The cells are arranged in a linear series. Analysis of pollen-nectar provisions shows a single source, possibly a legume *(Trifolium* or *Astragalus).* The bee overwinters inside a cocoon as a post-defecating larvae.

DESCRIPTORS: Hymenoptera; Megachilidae; *Hoplitis robusta;* Wyoming. Biology, nesting, supersedure.

The genus *Hoplitis* Klug, as now recognized by bee authorities, contains 45 species separated into 12 subgenera in the Nearctic north of Mexico (Eickwort, 1970; Michener, 1968; Hurd and Michener, 1955). Biological information is known for eight species in six of the subgenera. The most extensively studied species are *H. anthocopoides* (Schenck) (Eickwort, 1970, 1973), *H. albifrons* (Kirby) (Fye, 1965), *H. cylindrica* (Cresson) (Fye, 1965; Hicks, 1926), and *H. producta* (Cresson) (Medler, 1961; Rau, 1928; Hicks, 1926; Comstock, 1924; Graenicher, 1905). Fragmentary accounts are available on the biology of *H. biscutellae* (Cockerell) (Stephen, et al., 1969; Linsely and MacSwain, 1943), *H. fulgida* (Cresson) and *H. hypocrita* (Cockerell) (Hicks, 1926), and *H. pilosifrons* (Cresson) (Michener, 1955). The purpose of this paper is to present biological information on *H. (Formicapis) robusta* (Nylander).

Hoplitis robusta is a holarctic species found at high elevations (2000 meters) in the mountainous regions of western North America and throughout Europe and Asia (Peters, 1970; Hurd and Michener, 1955). The bee is distinctive in both sexes with the female having a large head and a median apical snout on the clypeus. The seventh tergum of the male has a four-lobed apical margin (Hurd and Michener, 1955).

The nests reported on in this paper were kindly given to us by Professor Howard E. Evans, who conducted his studies along Pilgrim Creek in the Teton National Forest, Wyoming, and near the Jackson Hole Biological Research

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[1] Accepted for publication: April 28, 1975

[2] Department of Entomology, University of California, Davis, CA 95616.

[3] Department of Entomology and Applied Ecology, University of Delaware, Newark, DE 19711.

Station in Grand Teton National Park, Wyoming. The elevation of both study areas is about 2,077 meters. In both areas, broad fields of grasses and numerous species of wild flowers are broken by conspicuous stands of Lodgepole Pine, *Pinus contorta latifolia* Critchfield, and Quaking Aspen, *Populus tremuloides* Michx. Professor Evans put out the trap nests during the first week in July 1971 and collected them in mid-August of the same year.

Six nests were obtained from several locations near the Jackson Hole Research Station. All nests were from burrows in drilled pine blocks which were located from 0.3 to 2.0 meters off the ground and attached to dead pines and aspens or log cabins. Four of the nests were in 4.0 mm diameter burrows and the rest in 5.0 mm burrows. The cells were arranged in a linear series starting in the bottom of the burrow. The mean number of cells per nest was 9 (range 3 - 14). All cells (45) averaged 7.3 mm long (range 5.5-11 mm) with 21 female cells and 5 male cells averaging 7.6 mm and 7.0 mm in length, respectively. This sex ratio of 4♀:1♂ is not considered natural but most likely resulted from high rearing losses. Two of the nests contained all female progeny (5 and 11 celled nests) and the remaining nests contained both sexes. There was no indication from any of the nests containing both sexes that the female cells are formed first and male cells last in the burrow. Three of the nests contained vestibules following the last cell. They averaged 11.6 mm long (range 3-18 mm) and were not divided by partitions or filled with pieces of plant material or pebbles.

The cell partition was constructed of masticated green plant material. The thickness of the partition varied from 0.3-1.0 mm, and the lateral margins were smeared forward along the edge of the burrow wall giving the outer surface a concave shape (Fig. 1). The inner surface was flat. Some partitions had small pieces of wood embedded in the leaf matrix. Pebbles, large pieces of wood or plant parts were not found in any of the partitions.

The nest plug was flush with the burrow entrance in the completed nests and lacking in nests containing 5 or fewer cells. The plug was formed of multiple layers of masticated green plant material and varied from 10-14 mm in thickness. From 8 to 13 cell type partitions formed the thickness of the nest plug.

Although the nests were not examined until the winter, we were able to obtain information on pollen-nectar stores and egg position from cells containing dead eggs. The light yellow pollen-nectar store was relatively dry, cylindrical in shape and filled the bottom 3/4 of the cell. The egg was positioned on top of the rounded provision with its posterior end slightly embedded near the outer edge of the provision, and the anterior end nearly touched the center of the rounded surface of the provision. Pollen analysis showed that the pollen from a cell was from the same species of plant and possibly from a legume *(Trifolium* or *Astragalus)* but specific identification was not possible. Hurd and Michener (1955) list only one floral record, *Taraxacum,* and Peters (1970) records *Silene rupestris* from Europe.

The fecal pellets of *H. robusta* are formed singly and vary from 0.2-0.3 mm wide and 0.4-0.5 mm long and have no surface groove or depressions. The dorsal surface on many of the pellets is flattened, however this was not seen on all of the pellets. They are slightly curved with rounded ends and vary in color from dark brown to light orange. The pellets were found scattered everywhere in the cell outside of the cocoon, but is some of the cells they were concentrated in the posterior portion of the cell (Fig. 1). The pellets are not incorporated into the cocoon, but posteriorly they may stain the cocoon brown.

The cocoon of *H. robusta* is extremely thin, translucent and is formed of two layers (Fig. 1). There is no anterior nipple or any evidence of one on the interior surface of the cocoon. The outer layer is a loose network of fine, white silk threads. These threads vary in thickness from 0.008-0.01 mm and many of the fecal pellets are held in this layer. The inner layer is about 0.01 mm thick and consists of fine white threads smeared with a clear matrix. The cocoon fills the cell and conforms to the shape of the cell.

Hoplitis robusta from the Wyoming area overwinter as post-defecating larvae.

Three additional nests were collected that contained *H. robusta* in a state of supersedure. In two cases, Evans (1973) found that *Symmorphus cristatus* (Saussure) had superseded *H. robusta.* In one nest, we found that *H. robusta* had superseded *Megachile relativa* Cresson in the second cell (Fig. 2) but was superseded in the third and subsequent cells by the foundress bee *M. relativa.* The *H. robusta* cell was preceded and followed by masticated plant material partitions and lacked the solid leaf cell of *M. relativa.* The pollen in the second cell was light yellow and differed from the red-brown pollen in the *Megachile* cells. Twelve nests of *M. relativa* were obtained from the area

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Fig. 1 – Single cell of *Hoplitis robusta* (Nylander), arrow indicates concave cell partition.

2

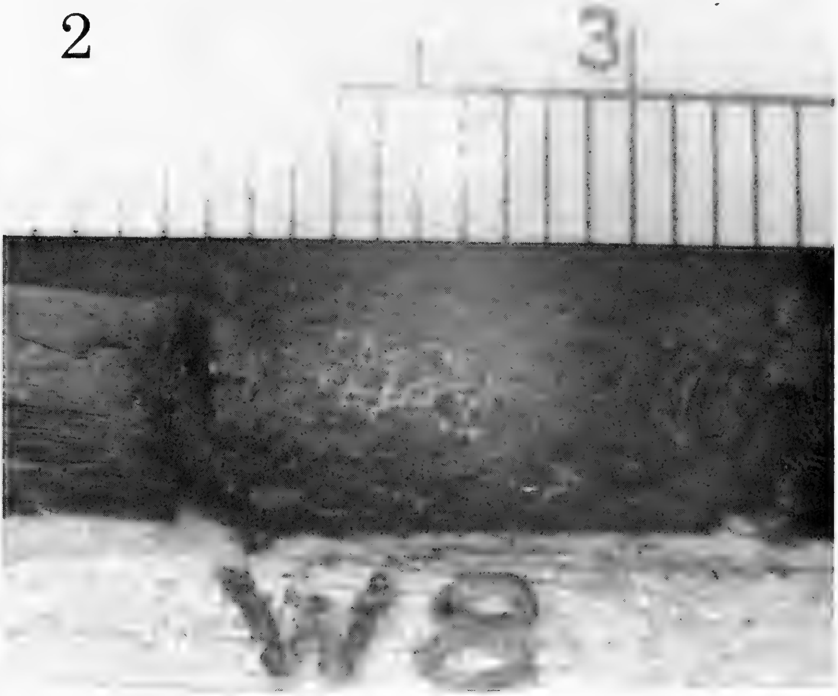

Fig. 2 – Nest of *Megachile relativa* Cresson superseded by *H. robusta* in the second cell.

around the Biological Station. All of the nests were from burrows of 5 mm or greater diameters. This suggests that there may be competition between *H. robusta, M. relativa* and *S. cristatus* for burrows with diameters around 5 mm.

ACKNOWLEDGEMENTS

We are grateful to Professor H.E. Evans of Colorado State University for generously providing us with the nests of *Hoplitis robusta.*

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OCCURRENCE IN FLORIDA OF *RHYACIONIA BUSCKANA* (LEPIDOPTERA: TORTRICIDAE, OLETHREUTINAE)[1],[2]

John B. Heppner[3]

ABSTRACT: *Rhyacionia busckana* Heinrich, not previously reported from Florida, was found at Gainesville, Alachua County, Florida on 26 February 1973 and at Cedar Key, Levy County on 21 November 1973. The known range of the moth is extended 700 miles south from Virginia.

DESCRIPTORS: *Rhyacionia busckana* Florida distribution

Rhyacionia busckana Heinrich was described from a series of moths from Long Island, New York. Heinrich (1923, Bull. U.S. Natl. Mus. 123:17) also noted a distribution west to central Pennsylvania and south to northern Virginia. Miller and Wilson (1964, J. Econ. Ent. 57:722) did not include *R. busckana* in the pine tip moth fauna of the southeastern United States. Subsequently, populations have been found in Massachusetts and Mississippi (Miller, personal communication), indicating that *R. busckana* is widely distributed in the eastern United States. Kimball (1965, Lepidop. Fla., 257) listed four species of *Rhyacionia* for Florida, but did not include *R. busckana.*

A single female *R. busckana* was collected at UV light at Gainesville, Alachua County, Florida on 26 February 1973. On 21 November 1973 a series of over 100 adult *R. busckana* were collected at UV light at Cedar Key, Levy County, Florida, which is 60 miles west of Gainesville on the Gulf Coast. The host of *R. busckana* is not known. At Cedar Key *Pinus clausa*

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[1] Accepted for publication: March 29, 1975

[2] Florida Agricultural Experiment Station Journal Series No. 5768

[3] Research Associate, Florida State Collection of Arthropods; Department of Entomology and Nematology, University of Florida, Gainesville, Florida 32611

ENT. NEWS, 86: 5 & 6: 121 & 122, May & June 1975

(Chapm.) Vasey is the dominant pine but other species, mainly *Pinus elliotii* Engelm., grow there as well. The distribution of *Pinus clausa* is disjunct, with more stands southeast and south of Gainesville, but it does not occur naturally in the Gainesville area. There are some ornamental plantings of *Pinus clausa* in Gainesville. *Pinus clausa,* however, is not found in the northern part of the range of *R. busckana,* which indicates a different host.

The new records for *R. busckana* extend its known distribution over 700 miles south from Virginia and 450 miles east from Mississippi. Although little is known of the biology of *R. busckana,* its presence in Florida may prove to be of some significance for Florida silviculture of pines. Adults of *Rhyacionia frustrana* (Comstock) are superficially similar to adults of *R. busckana* and genitalic examination may be necessary for positive determination, but the following diagnostic characters will usually distinguish the two species. *Rhyacionia frustrana:* dorsal head tuft scales dark brown with white tips, forewings with a diffuse white line at beginning of fringe scales beyond apical brown fascia, base of forewing fringe scales overlapped with black-tipped scales, and forewing central vertical fascia red-brown. *Rhyacionia busckana:* dorsal head tuft scales basally pale with red-brown tips, forewings with a distinct white line at beginning of scales beyond apical brown fascia, base of forewing fringe scales overlapped with dull-brown tipped scales, and forewing central vertical fascia gray-brown. *Rhyacionia rigidana* (Fernald) is also similar to *R. busckana* but averages 3-4 mm wider in wing spread. The other species in the genus in Florida are distinct from *R. busckana* and usually present no problem in identification.

Specimens of *R. busckana* from Cedar Key are in the Florida State Collection of Arthropods and the collections of C.P. Kimball, W.E. Miller, and the author.

ACKNOWLEDGMENTS

I wish to thank W.E. Miller (USDA, St. Paul, Minn.) for the initial determination of the moths and for providing distributional information, as well as commenting on the manuscript. T.C. Emmel, H.N. Greenbaum, and D.H. Habeck, all of the University of Florida, also kindly reviewed the manuscript.

THE PARASITIC HYMENOPTERA WITH THE LONGEST OVIPOSITORS, WITH DESCRIPTIONS OF TWO NEW ICHNEUMONIDAE[1]

Henry Townes[2]

ABSTRACT: Parasitic Hymenoptera seldom have the ovipositor longer than 1.3 the length of the head and body. A few species of Stephanidae, Braconidae, Ichneumonidae, and Callimomidae have ovipositors much longer, about 1.6 to 14.0 as long as the head and body. How these long ovipositors are managed is unknown. Two Neotropic *Dolichomitus* with unusually long ovipositors are described.

DESCRIPTORS: Long ovipositors, oviposition, parasites, Stephanidae, Braconidae, Ichneumonidae, Callimomidae, *Dolichomitus.*

Parasitic Hymenoptera are usually thought of as having long ovipositors. Many of them do, but most of the species do not. The ovipositor varies from so short that it does not protrude beyond the end of the abdomen, to around 1.0 or up to 1.3 as long as the head and body. A few species have it even longer.

There is a reason that the ovipositor is seldom more than 1.3 as long as the head and body: In the Ichneumonoidea as examples, the ovipositor is thrust in approximately perpendicularly, and to get it perpendicular the female must have the tip of the abdomen (whence the ovipositor originates) as far from the substrate as the ovipositor is long. To do this she stands on the tips of her tarsi, cocks her rear upward, and turns the ovipositor downward from the elevated tip of her abdomen. Since she stands on the tips of her legs (of which the front legs are shortest) and her body reaches upward from the base of her front legs, the total upward reach cannot be greater than the length of the front legs plus the distance from the front coxae to the tip of the abdomen,

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[1] Accepted for publication: May 13, 1975

[2] American Entomological Institute, 5950 Warren Rd., Ann Arbor, Mich. 48105

and the longest ovipositor manageable in the conventional way is equal to that total reach. But this paper concerns species with ovipositors much longer than that

One of the most familiar species with the ovipositor longer than the body plus the front legs is *Megarhyssa.* In this genus the base of the ovipositor can be looped into a membranous sac at the tip of the abdomen to take up part of the length when oviposition begins. The ovipositor can then be inserted in the usual perpendicular direction. One can recall also Orussidae and *Ibalia* (Cynipidae), which coil their unusually long ovipositors within the body and can feed them out as oviposition progresses. But there are also some parasitic Hymenoptera with extraordinarily long ovipositors and with no apparent ways to manage them. Probably in many of these cases the ovipositors are used not for actual drilling but for running into tunnels from an open entry, into which the ovipositor tip can be maneuvered. Hitting a tunnel opening with the tip of a long ovipositor would be a feat in itself, which would require sensitivity in the ovipositor tip and an ability to flex the tip in different directions. Species with shorter ovipositors often have both sensitivity and flexibility in the tip in some degree. Those with extraordinarily long ovipositors would need only some enhancement of those abilities. Although reasonable theories can be devised on how the very long ovipositors are manipulated, we need observations, and actual observations will probably bring some surprises. Whatever the methods that allow escape from the usual restriction in ovipositor length, once that restriction is evaded the ovipositor can become exceedingly long.

Below is a representative list of some of the parasitic Hymenoptera with unusually long ovipositors (omitting *Ibalia* and the Orussidae). Among the species listed only *Megarhyssa atrata* is known to have a mechanism for coping with the unusual ovipositor length. The list below is more extensive in the Ichneumonidae than elsewhere, in part because I am more familiar with this family than with the others.

Some Hymenoptera with unusually long ovipositors

(The figure after each name is the length of the ovipositor divided by the length of the head and the body).

Stephanidae
- *Schletterenius cinctipes* Cresson (western USA and Canada). 2.3

Braconidae
- **(Vipiinae)**
  - *Compsobracon* sp. (Peru) 4.1
  - *Euurobracon yokohamae* Dalla Torre (Japan). 7.7
  - *Iphiaulax?* sp. (Colombia). 14.0
  - *Rhammura filicauda* Enderlein (West Africa). 2.7
- **(Helconinae)**
  - *Eumacrocentrus americanus* Cresson (eastern U.S.A. and Canada). 3.6

Ichneumonidae
- **(Ephialtinae)**
  - *Dolichomitus bivittatus,* new species (Peru). 4.5
  - *Dolichomitus cephalotes* Holmgren (Holarctic Region). 4.5
  - *Dolichomitus hypermeces,* new species (Peru). 8.1
  - *Dolichomitus longicauda* Smith (Colombia). 4.6
  - *Dolichomitus magaloura* Morley (Brazil). 3.3
  - *Pimpla zirnitsi* Ozols (eastern Russia). 3.5
  - *Megarhyssa atrata* Fabricius (eastern U.S.A. and Canada). 3.3
- **(Labiinae)**
  - *Apechoneura longicauda* Kriechbaumer (South America). 2.7
- **(Gelinae)**
  - *Mastrus extensor* Cushman (California). 1.6
  - *Dotocryptus bellicosus* Spinola (Argentina and Chile). 3.0
  - *Mesostenus longicauda* Cresson (U.S.A.). 3.0
- **(Acaenitinae)**
  - *Procinetus vipioniformis* Schmiedeknecht (Spain). "almost 4.0"

Callimomidae
- Undetermined species (Ethiopian Region). 4.6
- Undetermined species (Brazil). 5.3

For the above list I have depended on taxonomic descriptions for the ovipositor lengths of *Euurobracon yokohamae, Rhamnura filicauda, Pimpla* *zirnitsi,* and *Procinetus vipioniformis.* The *Iphiaulax?* sp. listed was figured by Berland (1951. *In* Grasse: Traite de Zoologie 10: 918). In the other cases measurements were made directly from specimens. Within a species, there is some variation in ovipositor lengths and I tended to choose the specimens with the longest ovipositors for measurement.

Two undescribed species of *Dolichomitus* (Ichneumonidae) are listed in the above table and these are described below. In one of these, *Dolichomitus hypermeces,* the ovipositor is relatively and absolutely longer than in any other known insect, except for the *"Iphiaulax"* figured by Berland.

Dolichomitus bivittatus, new species

Male: Unknown.

Female: Front wing 17 to 19 mm. long. Head and body 19 to 20 mm. long. Body short and stout, polished, its punctures very sparse. Face wide, polished, medially protuberant, its median 0.6± with moderately small punctures that are separated by about 2.0 their diameter. Head across midlength of temples about 0.87 as wide as across eyes. Clypeus wide, strongly impressed near apex, its apex strongly concave at center. Mandible moderately short and wide, its teeth equal. Prepectal carina present on mesosternum, absent from mesopleurum. Mesopleurum polished, with medium sized sparse punctures, below subtegular ridge with a group of oblique, parallel close wrinkes that curve downward on front part of mesopleurum and reach to sternal part of prepectus. Mesoscutum polished, with numerous hairs on front corner and sparse hairs near margin, elsewhere hairless, the setiferous punctures small. Propodeum polished, its punctures small and sparse, without median dorsal carinae. Pleural carina or propodeum weak and blunt but complete. First tergite about 1.7 as long as wide, polished, with very sparse punctures, its median dorsal carinae reaching only half way to spiracle and dorsolateral carina absent. Second tergite about 0.93 as long as wide. Ovipositor sheath about 12.0 as long as hind tibia. Ovipositor 6.4 to 9.3 cm. long, 3.8 to 4.6 as long as head and body. Dorsal lobe of lower valve of ovipositor tip moderately developed, with four ridges.

Head, mandible, and antenna black. Palpi brown. Thorax, tegula, and abdomen bright fulvo-ferruginous, the propleurum, collar, small sublateral spot on apical rim of propodeum, and small apicolateral spot on tergite 2 black. Legs blackish, most of the front of front and middle femora stramienous and front and middle tibiae and tarsi fulvous or light brown. Wings yellowish, the front wing fuscous beyond center of areolet and with a fuscous band reaching from nervulus to base of stigma. Hind wing with a subapical light fuscous band.

Type: ♀, Utcuyacu, 2000± m., Prov. Tarma, Peru, March 8, 1948, Felix Woytkowski (Townes).

Paratype: ♀, same locality and collector as type, March 1, 1948 (Townes).

Dolichomitus hypermeces, new species

Male: Unknown.

Female: Front wing 19 to 22 mm. long. Head and body 18 to 21 mm. long. Body short and stout, polished, its punctures very sparse. Face wide, polished, its median 0.6± with moderately small punctures that are separated by about 5 times their diameter. Head across midlength of temples about 0.86 as wide as across eyes. Clypeus wide, weakly impressed near apex, its apex weakly concave at center. Mandible short and wide, the lower tooth almost as long as upper tooth. Prepectal carina present on mesosternum, ending opposite lower corner of pronotum. Mesopleurum polished, with small very sparse punctures. Mesoscutum polished, with numerous hairs on front corner and a very few hairs near margin, elsewhere hairless, the setiferous punctures small. Propodeum polished, its punctures small and very sparse, without median dorsal carinae. Pleural carina of propodeum present in front of spiracle, behind spiracle replaced by a groove. First tergite about 1.5 as long as wide, polished and with very sparse hairs, its dorsal carinae present only basad of spiracle and dorsolateral carina lacking. Second tergite about 0.79 as long as wide. Ovipositor sheath about 21.0 as long as hind tibia. Ovipositor 7.0 to 8.1 as long as head and body, 11.6 to 18.0 cm. long. Dorsal lobe of lower valve of ovipositor tip moderately developed, with four ridges.

Head, mandible, and antenna black. Palpi brown. Thorax black with pronotum except for collar, all of mesothorax, tegula, metanotum except for upper side of postscutellum, and often a stain on lower part of propleurum bright fulvo-ferruginous. Front and middle legs fulvous, the middle trochanters usually more or less fuscous, last segment of front tarsus often fuscous, and middle tarsus with apical 2 or 3 segments or all segments black. Hind leg black. Front wing brown, with a broad pale yellowish brown band reaching from base of stigma to apex of areolet. Hind wing irregularly light brown. Abdomen black, the first 2 segments fulvoferruginous.

This is the species figured by Bischoff as an "undetermined Pimplinae" (1927. Biologie der Hymenopteren, p. 334, fig. 148b). The specimen designated as type is the specimen figured by Bischoff.

Type: ♀, Dept. Cuzco, Peru, collected by Garlepp (Berlin).

Paratypes: 4♀, same data as type (Berlin), ♀, Hacienda Maria, 400 m., Paucartambo, Cuzco, Peru, February 28, 1952, Felix Woytkowski (Townes). I have seen also a female in the Geneva museum but this is not now at hand for inclusion in the type series.

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE ANNOUNCEMENT A.N.(S.)96

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 2, 27th June 1975)

482. *Leo* Brehm, 1829 designation of type-species: *Theranthropus* Brookes, 1828 suppression (Mammalia).

1749. *Cornufer* Tschudi, 1838, designation of type-species; suppression of *Cornufer unicolor* Tschudi, 1838 (Amphibia, Salientia).

2044. Suppression of *Acarus pseudogallarum* Vallot, 1836 and *Phytoptus coryligallarum* Targioni Tozzetti, 1885 (Acarina, Eriophyoidea).

977. *Vulpes* Frisch, 1775 (Mammalia) proposed conservation, designation of type-species and suppression of *Vulpes minimus Saarensis* Skjöldebrand, 1777.

1468. Suppression of *Amphisbaena reticulata* Thunberg, 1787 (Reptilia, Squamata).

1944. *Lyda alternans* Costa, 1859 (Insecta, Hymenoptera) proposed precedence over *Lyda inanis* Klug, 1808.

2068. *Phloiotribus* Latreille, 1796 (Insecta, Coleoptera) proposed suppression.

2084. *Macroscelosaurus* G. zu Münster *in* H.v. Meyer 1855 proposed suppression (Reptilia); *Tanystropheus* H.v. Meyer, 1855 proposed precedence over *Zanclodon* Plieniger, 1847.

2087. *Tethyum sociabile* Gunnerus, 1765 (Tunicata, Ascidiacea) proposed suppression.

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VOL. 86 SEPTEMBER & OCTOBER 1975 NOS. 7 & 8

ENTOMOLOGICAL NEWS

Publication date: October 30, 1975

THE AMERICAN ENTOMOLOGICAL SOCIETY

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TWO NEW KATYDIDS OF THE GENUS *MELANONOTUS* FROM COSTA RICA WITH COMMENTS ON THEIR LIFE HISTORY STRATEGIES (TETTIGONIIDAE: PSEUDOPHYLLINAE)[1]

David C. Rentz[2]

ABSTRACT: Two new katydids are described from Costa Rica extending the known range of *Melanonotus* northward. The contrast in life history and morphology between primary forest katydids and secondary growth or temperate species is discussed. The absence of regular nightly stridulation and morphological differences such as the extremely long antennae of the two *Melanonotus* species and other primary forest epiphyllic katydids are suggested as adaptations against bat predation.

DESCRIPTORS: Tettigoniidae; Pseudophyllinae; *Melanonotus;* Costa Rica: Bat predation; Behavior.

This paper is written to provide names for two relatively common katydids of the tropical rainforests of Costa Rica and to propose a hypothesis to explain the lack of continuous stridulatory activity by tettigoniids in the Costa Rican tropical rain forest.

The two tettigoniid species come from very different wet forest situations. One is from Finca La Selva, an Atlantic lowland research station operated by the Organization for Tropical Studies. The other is a montane forest reserve operated by the Tropical Science Center. Both species of *Melanonotus* extend northward the range of this primarily northwestern South American genus.

Melanonotus was described by Beier (1960) in his systematic review of the Pseudophyllinae, part II. The genus is a member of the Cocconotini and presently includes thirteen species (including the two described here) from northwest South America and Central America. *Melanonotus* species are characterized by their robust, bulky appearance, short tegmina which never extend beyond the apex of the abdomen, the relatively smooth, nonpunctate face, small blunt tooth on the scape of antenna, wrinkled or granulate pronotum, and the short styli of the male subgenital plate. All but the Central American species have the face and pronotum strikingly marked with black.

Melanonotus species are epiphyllic, venturing forth at dusk to forage, exposed, on leaf surfaces. The two species described here are clumsy, sluggish

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[1] Accepted for publication: June 10, 1975

[2] Research Associate, California Academy of Sciences, San Francisco, Ca., 94118

ENT. NEWS, 86: 7 & 8: 129 - 140, September & October 1975

katydids which seem restricted to understory vegetation. Both are incapable of flight but one (*M. tico*) has the second pair of wings fully developed and they could possibly be used in gliding.

The author has been impressed by the absence of stridulatory activity by these and other katydids of the primary growth rain forests in Costa Rica. At La Selva, for instance, an investigator can readily locate a half dozen species of adult male katydids in the understory and not find a single singing individual. Contrastingly, outside the forest, in secondary growth, there is continuous stridulation by nearly all individuals of all species.

In an attempt to try and isolate the answer for the peculiar behavior of forest katydids, I have looked for qualities of the life histories which primary growth forest katydids share. The most obvious similarity is that all species are epiphyllic. They seem to move about quite freely at night, fully exposed. In addition, many species are flightless and those that are fully winged make little attempt to fly when disturbed. Instead, they either drop quietly to the ground or crouch close to the leaf holding tightly by means of the sharp tarsal claws which become embedded in the leaf tissue. Under such conditions, the katydids are quite difficult to remove. The single morphological characteristic possessed by all species is the exceptionally long antennae (see figs.). Katydids of temperate regions seldom have the antennae three times as long as the body length but primary growth tropical forest species frequently have these appendages five to eight times the length of the body. Interestingly, the katydids which occupy secondary growth adjacent to the primary growth forest all lack the lengthened antennae. They are quite similar to their temperate counterparts in this respect.

The most obvious explanation for the development of the antennae among forest katydid species seems to be an adaptation against predation. And because of the contrasting nature of characteristics of primary forest katydids and those of secondary growth, one would have to look for a predator distinctive to the primary forest. A nocturnal predator would be most likely since the katydids remain secluded and inactive during the day in retreats such as hollow stems, under bark, or in unfurling *Heliconia* leaves. Most reptiles would then be eliminated from consideration and the katydids themselves are much too large for epiphyllic amphibians. The most obvious predator would seem to be bats.

D.E. Wilson (personal communication) has stated that the largest proportion of leaf-gleaning insectivorous bats are found in primary forest situations. Second growth species are almost all frugivores or omnivores and do not specialize on gleaning food from leaf surfaces. Wilson and Fleming (personal communications) further state that there are potentially ten species of bats which could be considered as possible leaf-gleaners in the primary forest at La Selva. These are phyllostomatine bats of the genera *Micronycteris, Trachops, Lonchorina, Tonatia, Mimon. Trachops cirrhosus* is known to feed on sleeping lizards and Wilson also states that he has seen them feed on katydids in captivity. Wilson (1971) studied the habits of *Micronycteris hirsuta* in primary forest in Panama and discovered that katydids make up 25% of its diet. He suggested that the bats take their prey from leaf surfaces. Fenton (1974) commented extensively on the feeding ecology of insectivorous bats.

The reduced stridulatory activity would seem to be an adaptation against a predator which would obtain its food source by sound detection. A continuously singing, exposed, insect would be an easy target for a foraging bat. However, as Wilson suggests, animals which possess a hearing system acute enough to use echolocation might well hunt by picking up sounds originating from the prey themselves. Stridulatory sounds would aid the predator but other sounds, perhaps those made by the chewing katydid could also be detected by the bat. The elongate antennae of forest katydids would seem to serve in the detection of wind currents as produced by bats and the crouching "stick tight" behavior would make them difficult to remove from the substrate, especially if the bat were to try and do so on the wing.

The author has not observed bats take katydids from leaves but has circumstantial evidence from collections of bats made near San Vito, Costa Rica (montane primary forest). Bats were mist netted during March 1973 which had large pseudophylline katydids in their mouths. Several species were captured by the bats and could be recognized as typical of forest habitats. In addition, the katydids were short-winged species incapable of flight. The most reasonable explanation is that they were picked up from their perches by the marauding bats.

Melanonotus tico Rentz, new species

(Figs. 4-7, 11, 16)

HOLOTYPE MALE. Costa Rica, Heredia Province, Finca La Selva, on Rio Puerto Viejo, 24 February 1969. D. C. Rentz collector. Holotype and allotype deposited in the Academy of Natural Sciences of Philadelphia.

Head large, poorly seated in pronotum, longer than broad, without punctation and facial carinae; frons, when viewed laterally, swollen, produced in intra-ocular region. Fastigium of vertex sloped, deeply grooved, apex acute, not attaining scrobes of antennae; scape of antenna robust, with a broadly raised, tubercle (fig. 11) on distal portion of internal margin; flagellum extremely long, fully seven times the length of body.

Pronotum dorsally and laterally granulate, with two indistinct transverse sulci, one at distal limit of prozona, the other at same of mesozona; anterior margin broadly obtuse, posterior margin truncate, rimate and slightly raised; ventral margin of lateral lobe truncate, obtusely produced in anterior third, posterolateral angle distinctly obtuse. Prosternum bearing a pair of widely spaced, elongate spines.

Appendages: fore femur strongly compressed, concave on internal (anterior) margin, bearing three evenly spaced rather elongate teeth in distal fifth, both genicular lobes unarmed; fore tibia straight, broadened distad of auditory foramen, dorsal surface unarmed, ventral surface bearing seven spines on anterior margin including apical spine, posterior margin bearing six and seven spines, on apical in position; median femur compressed with three teeth on posterior margin of ventral surface in distal quarter, anterior genicular lobe armed with a relatively elongate tooth; median tibia thickened in proximal third, unarmed dorsally, ventral surface with seven spines on both margins, distal spines apical in position; hind femur short, glabrous, slightly surpassing apex of abdomen, external margin armed on ventral surface with five large teeth in distal half; hind tibia armed on ventral surface with seven internal and external spines, apex with four short spurs; dorsal surface armed on external margin with seven spines, no apical spine or spur, internal margin bearing ten spines and one subapical spine, internal genicular lobe armed.

Tegmina abbreviate, lanceolate, scarcely attaining apex of fifth tergite; stridulatory region with distinct speculum; costal and subcostal vein very heavy, other venation reduced except for dense reticulate pattern of secondary veins; wings well developed.

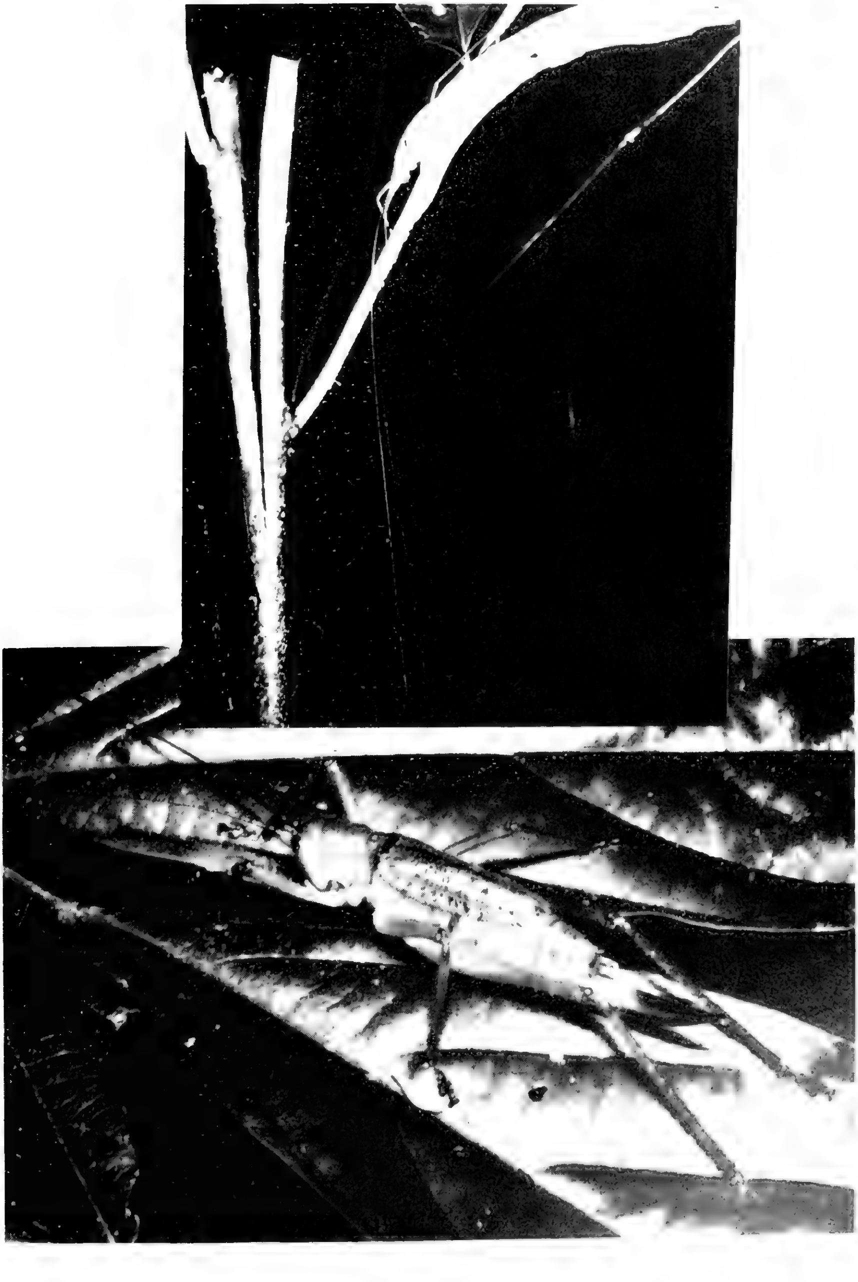
Abdomen dorsally without median carina, tenth tergite (fig. 4) basically unmodified, median portion weakly concave, supraanal plate broad, unmodified; cercus stout, cylindrical, apex narrowed with a small internal apical tooth; subgenital plate (fig. 5) short, V-shaped incision occupying about distal third or fourth of plate, styles very elongate about two thirds length of plate.

Coloration: overall ground color uniform yellow brown, no black areas distinctive of other members of the genus. External visible portion of mandible dark brown. Eye grey, fastigium of vertex and antennal scrobes dark brown, scape and pedicel dark brown; flagellum much darker brown, distal portions of first and fifth flagellar segments black; all pleurites and sternites straw brown, without black; pronotum uniformly yellow brown as body but distal one sixth of disk slightly darker; tegmina dark brown, costa and subcosta yellowish brown, similar to *Ischnomela gracilis* and *I. pulchripennis* which are present at the same locality; abdomen uniform yellow brown; legs yellow brown as ground color, without any darker areas; femoral teeth yellow, only apex dark brown, tibial spines dark brown, weakly lighter at base; abdomen somewhat darker brown than rest of body; cerci, supra-anal plate light brown, cercal tooth black.

PLATE I

Figure 1, top. Pseudophylline katydid, *Scopiorinus* sp., an inhabitant of primary forest undergrowth, illustrating extraordinarily long antennae. The insect itself is approximately 15 mm in length.

Figure 2, bottom. Allotype, *Melanonotus tico* Rentz, new species on leaf surface at night.



ALLOTYPE FEMALE. Same data as holotype except collected 17-19-March-1973. Differs from holotype in following: size much larger; supra-anal plate triangulate, unmodified; cercus slender, apex narrowed, distinctly directed inward; ovipositor short, broad basally, rather straight, weakly serrate on dorsal margin only in median portion; subgenital plate triangulate, apex acute, feebly produced; tegmina longer, attaining seventh tergite. Armature of legs as follows: hind tibia armed ventrally on external margin with eight spines on both margins not including apical spurs. Coloration very similar to male with following exceptions: flagellum of antenna black; ovipositor basically straw brown, this extending medially to apex, dorsal and ventral portions of distal two thirds dark brown.

Derivation of name. – This species is named for the friendly people of Costa Rica.

Records. – **Costa Rica:** Heredia Province, Finca La Selva, on Rio Puerto Viejo, 18, 19-II-1966 (H. R. Roberts, 1♂ 1♀, in hollow palm stem); 23-II-1969 (D. C. Rentz, 1♂); 17-19-III-1973 (D. C. Rentz, 1♂, 2♀♀, on loop trail and in arboretum, allotype); 13-16-VII-1973 (D. C. Rentz, K. R. Brodey, 3♀♀ arboretum II); 14-16-I-1975 (D. C. Rentz, 2♀♀, loop trail. Limon Province, Pandora Farm, Estrella Valley, 100 Ft. elevation, 13-IX-1923 (J. A. G. Rehn, 1♀). Paratypes deposited in Smithsonian Institution, Vienna Museum, and Academy of Natural Sciences of Philadelphia.

Karyotype. – 2N♂ = 33. All chromosomes telocentric. The X is by far the largest chromosome. There are two large class autosomes with the remaining 14 autosomes forming a gradually declining series with reference to size.

Geographic distribution. – *M. tico* is known from the Atlantic lowlands of eastern Costa Rica.

Variation. – The paratypic series reflects very little variation. The female from Estrella Valley bears shorter tegmina, attaining only the apex of the third tergite, the fore femur of the right side bears only two teeth, the other side three. In other respects, the series is quite uniform.

Discussion. – *M. tico* lives in the understory vegetation of primary growth wet forests in the Atlantic drainage of Costa Rica. Frankie et al (1974) provided a description of the site and listed references to others who have done so. Briefly, Finca La Selva is an undisturbed Lowland Rain forest located at latitude 10° 23'N at around 140 meters elevation. Considerable rainfall occurs during each month. Mean annual precipitation quoted by them was within a range of 2900 to 5600 mm. There is a single lengthy dry season from late January to April; a second less extensive dry period usually lasts from November through January.

The vegetation of La Selva is considered Tropical Rain Forest. In the Holdridge (1967) scheme, La Selva is geographically and bioclimatically overlapping the boundary between Tropical Wet Forest and Premontane Wet Forest life zones. Frankie et al (1974) listed six community types present at La Selva. From the observations of *M. tico* I find that this katydid occurs in the Wet Forest, Swamp Forest and Riparian Forest communities.

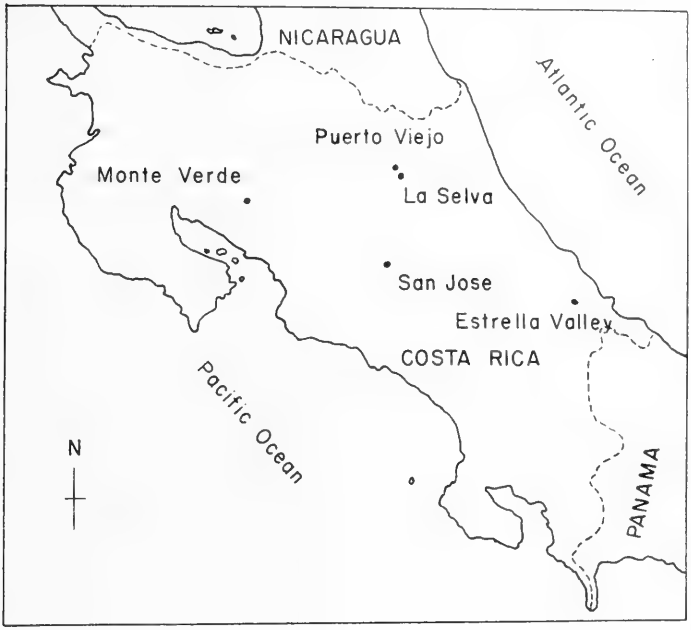


PLATE II

Figure 3. *Melanonotus* localities in Costa Rica.

Melanonotus powellorum Rentz, new species

(Figs. 8-10, 12-15, 17)

HOLOTYPE MALE. Costa Rica, Puntarenas Province, Tilarán Mountains, Monte Verde, 1580 meters elevation, Monte Verde Cloud Forest Preserve, near Powell house, 23 March 1974. D. C. Rentz collector. Holotype and allotype deposited in Academy of Natural Sciences of Philadelphia.

Head very large, protruding from pronotum, very broad, without facial punctation or carinae; frons, when viewed laterally, highly swollen, in intra-ocular region, concave dorsad of clypeus; fastigium of vertex small, deeply furrowed, apex acute, attaining only dorsal two thirds of antennal scrobes; scape of antenna robust, with a low, broad tubercle positioned subapically at internal margin; pedical half the length of scape, ventral edge of internal margin produced; flagellum of antenna very long, four times length of body.

Pronotum with lateral lobes poorly produced, dorsally and laterally weakly rugulose; dorsal surface with two distinct transverse sulci, the anterior sulcus shallow, poorly indicated, posterior sulcus broad and deep, delimiting distal third of disk; anterior margin convex, posterior margin truncate, weakly rimate; ventral margins of lateral lobe weakly undulant, posterolateral angle obtuse. Prosternum armed with a pair of close-set elongate spines.

Appendages: fore femur strongly compressed, concave on anterior margin, bearing two evenly spaced, rather elongate teeth in distal fifth, the apical tooth much the longer, both genicular lobes unarmed; fore tibia straight, hardly broadened distad of auditory foramen; dorsal surface unarmed, ventral surface with seven very small spines on internal margin, external margin with six small spines, the distal spine apical in position; median femur compressed with two and three teeth on outer margin of ventral surface positioned in distal one quarter, only internal genicular lobe armed; median tibia thickened in proximal one third, unarmed dorsally, ventral surface bearing seven spines on both margins, distal three spines apical in position; hind femur short, not attaining apex of tenth tergite, external margin of ventral surface bearing four and five large teeth in distal half, hind tibia armed on ventral surface with eight and nine spines, internal margin with five spines, apex bearing four short spurs; dorsal surface armed on external margin with five and six spines, no apical spur, internal margin with ten and eleven spines, internal genicular lobe armed.

Tegmina abbreviate, apex obtuse, shorter than dorsal length of pronotum, attaining only the basal quarter of first abdominal tergite, stridulatory region with a small but distinct speculum; costal and subcostal vein heavy, other venation reduced except for reticulate pattern of secondary veins; wings reduced.

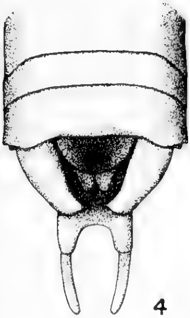
Abdomen dorsally without carina, tenth tergite (fig. 8) simple, with a broad, shallow notch, supra-anal plate broadly triangulate; cercus elongate, cylindrical with a small internal apical tooth; subgenital plate (fig. 9) short, V-shaped incision occupying about distal fifth of plate, styles elongate, gracefully incurved.

Coloration: overall ground color uniform yellow brown, distal margins of abdominal tergites somewhat darker; external visible portion of mandible red brown; eye grey, fastigium of vertex dark brown, scape and pedicel dark reddish brown, flagellum black; all pleurites and sternites straw brown; pronotum darker brown in apical portion of disk; tegmina dark brown, reticulate veins straw or yellow brown; legs yellow brown, without any markings, femoral and tibial teeth and spines yellow, only apex dark brown; cercus and supra-anal plate grey brown, subgenital plate yellow brown, apex and styles blackish.

PLATE III

Figures 4-7, 11, 16, *Melanonotus tico.* Fig. 4, dorsal view abdomen, holotype male; fig. 5, same ventral view subgenital plate; fig. 6, dorsal view abdomen, paratopotype female; fig. 7, same, subgenital plate; fig. 11, anterolateral view antenna, holotype male; fig. 16, dorsal view pronotum, holotype male.

Figures 8-10, 12-15, 17, *M. powellorum.* Fig. 8, holotype male, dorsal view abdomen; fig. 9, same ventral view subgenital plate; fig. 10, allotype female, dorsal view abdomen; fig. 12, holotype male anterolateral view basal antennal segments; fig. 13, allotype female, subgenital plate; fig. 14, lateral view head, holotype male and fig. 15, dorsal view pronotum and tegmina; fig. 17, holotype male, external view right foreleg.



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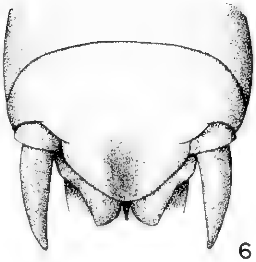

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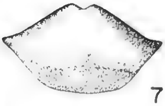

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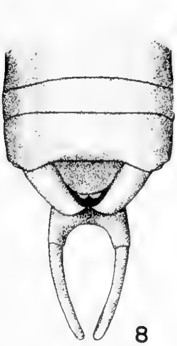

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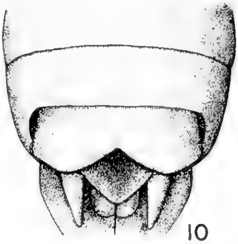

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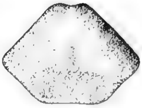

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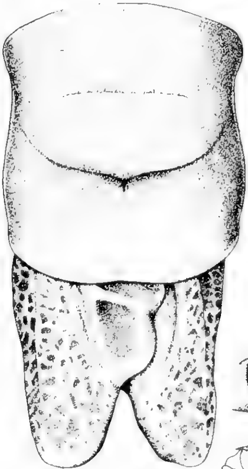

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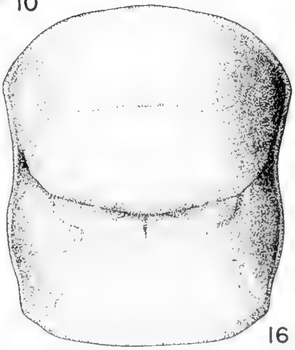

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17

ALLOTYPE FEMALE. Same data as holotype. Differs from holotype in following: size much larger; supra-anal plate triangulate, unmodified, cercus robust, straight, apex not directed inward; ovipositor short, broadest in basal third, dorsal margin very weakly serrate; subgenital plate broader than long, apex obtuse; tegmina short, ovate, barely attaining apex of first abdominal tergite, apex broadly rounded. Coloration very similar to male except ovipositor basically dark brown with a lighter straw brown medial longitudinal stripe.

Derivation of name. – This species is named for Mr. and Mrs. George Powell who together with L.R. Holdridge have had the foresight to single-handedly seek to preserve the unique habitat which is the type locality for this species.

Records. – Costa Rica: Puntarenas Province, Tilarán Mts., Monte Verde, Powell Property, 23-III-1974 (D.C. Rentz, 3♂♂, 3♀♀, holotype, allotype); 22-VII-1973 (D.C. Rentz, K.R. Brodey, 1♀). Paratypes deposited in the Smithsonian Institution and Vienna Museum.

Geographic distribution. – *M. powellorum* is known only from the type locality.

Variation. – The paratopotypic series is quite uniform in all respects. The two teneral females are somewhat lighter in color.

Discussion. – *M. powellorum* is relatively common at night in the understory vegetation near the Powell residence in the Forest Reserve. The exact location of the type locality is in the Cordillera de Tilarán, a range distinct for its lack of large peaks. Climatically the region has two seasons, a Pacific dominated rainy season with intense daily thunderstorms, and an Atlantic dominated dry-windy season. The strong winds of the dry season produce a climate that is extremely cool and wet relative to its middle elevation altitudinal position and a pronounced moisture and temperature gradient from windward to lieward over very short distances. This diversity of local climate and richly volcanic soils supports a very large number of plant and animal species, Powell (mineo undated).

The Monte Verde Reserve lies within the Lower Montane altitudinal belt, Holdridge (1967). The sharp dry season moisture gradient creates a division into Lower Montane Rain, Wet and Moist Life Zones with decreasing moisture accumulation. The Lower Montane and Wet Life Zones form the major part of this area. The katydids described here seem to prefer the Lower Montane Wet Forest of the Pacific slope, a taller community of trees dominated by large oaks *(Quercus)* and a number of Lauraceae including Yas *(Persea schiedaana)* and the wild avocado *(Persea americana)*. Also present are large stranglar figs *(Ficus)*. The understory where *M. powellorum* occurs consists of a thick dense aggregation of shrubs and small trees in the families Rubiaceae, Acanthaceae, Solanaceae, Chloranthaceae, Piperaceae, and Melostomaceae.

	Length body	Length pronotum	Length tegmina	Length fore femur	Length median femur	Length hind femur	Length ovipositor	Width ovipositor
powellorum								
Males								
Holotype	29.8	6.4	4.5	7.9	7.5	13.5		
paratype	28.5	6.4	4.4	7.5	7.4	14.0		
paratype	29.7	6.3	4.3	7.3	7.3	13.6		
Females								
Allotype	36.0	7.5	4.8	10.2	10.2	18.7	17.0	3.7
paratype	28.5	6.3	5.0	8.7	8.4	15.8	14.5	3.3
paratype	33.5	7.1	5.2	9.2	9.5	17.5	16.0	3.6
paratype	33.5	6.9	5.0	9.0	9.0	17.5	16.0	3.5
tico								
Males								
Holotype	32.8	8.2	14.0	10.0	9.1	17.5		
paratype	32.5	7.8	13.9	9.8	9.2	18.0		
paratype	37.0	8.2	15.0	10.0	9.6	X		
Females								
Allotype	38.6	8.5	19.4	11.5	11.5	22.0	19.0	4.0
paratype	39.5	8.6	19.0	11.2	11.0	22.2	18.0	3.8
paratype	41.0	8.3	20.2	11.5	11.2	22.2	18.0	4.0
paratype	36.5	8.5	18.0	11.5	11.0	22.2	19.0	4.0
paratype	40.0	8.4	18.6	11.5	10.7	22.0	18.2	3.7
paratype	40.0	8.7	19.0	11.5	11.0	22.5	19.0	4.0
paratype	42.1	8.4	20.4	11.5	11.2	22.0	19.0	3.7
Estrella Vy	41.0	8.4	15.0	11.0	10.6	21.5	19.0	3.9

Table 1. Measurements of adults of *Melanonotus tico* and *M. powellorum.*

M. powellorum extends at least down the Pacific slope into the Lower Montane Moist or Humid Forest (near Pensión) which is a more open type, temperate in climate, and harbors a considerable number of deciduous tree species which let in more light during the dry season.

ACKNOWLEDGEMENTS

I would like to thank the Organization for Tropical Studies for the opportunity to pursue entomological interests in the tropics through courses and research facilities. Similarly, I would like to thank the Tropical Science Center and Mr. George Powell for permitting me to visit Monte Verde Cloud Forest Reserve on several occasions. I would also like to thank Mr. Stephen Harty and the members of the Academy of Natural Sciences "Expeditions for Everyone" who aided the author during 1973, 1974, and 1975. I would also like to thank my wife Dorothy, Kenneth Brodey, D.E. Wilson, and T.H. Fleming for help in many ways. Thanks also to Donna M. Foster for the illustrations and David B. Weissman for karyotype information.

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GYPONANA (ZERANA) SECUNDA, A NEW SPECIES OF LEAFHOPPER FROM PANAMA AND GRAND CAYMAN ISLAND (HOMOPTERA: CICADELLIDAE)[1],[2]

Paul H. Freytag[3], Dwight M. DeLong[4]

ABSTRACT: A new species of leafhopper, *Gyponana (Zerana) secunda,* is described and illustrated, from Panama and Grand Cayman Island.

DESCRIPTORS: Homoptera: Cicadellidae; *Gyponana (Zerana) secunda;* Panama; Grand Cayman Island.

The subgenus *Zerana* was described for an unusual species of *Gyponana* known only from Peru, *G. (Z.) apicata* DeLong and Freytag (1964). A second species has now been found which extends the distribution of this subgenus to Central America and the Grand Cayman Islands. The two species can easily be separated on size, present distribution, or genitalic features.

Gyponana (Zerana) secunda n. sp.

(Figs. 1-6)

A light yellow-green species resembling *apicata* but smaller and differing in both male and female genitalia. Length of male 8 mm; female 9-9.5 mm.

Crown thickly produced; in females twice as wide between eyes as median length, in males median length two-thirds as long as width between eyes.

Color: Generally yellow-green. Eyes red. Crown around ocelli spotted with red. Forewings nearly clear with green veins.

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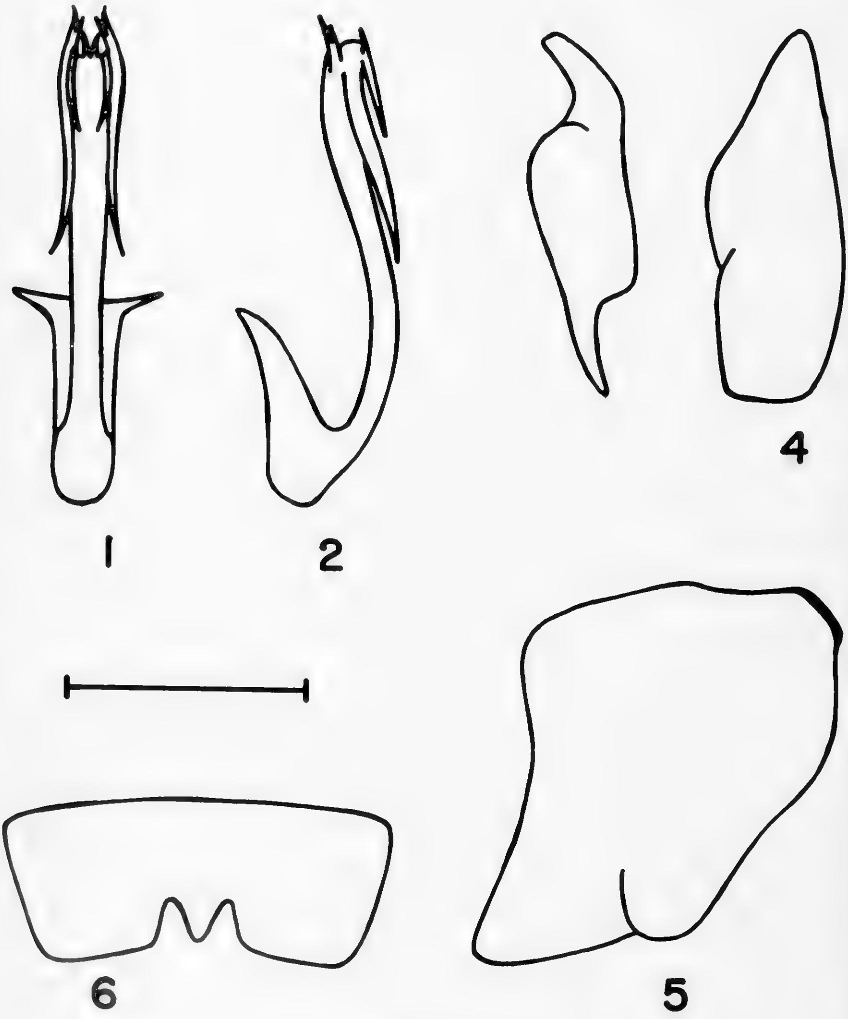
[1] Accepted for publication: May 15, 1975

[2] This paper (75-7-58) is published with approval of the Director of the Kentucky Agricultural Experiment Station at Lexington.

[3] Department of Entomology, University of Kentucky, Lexington, KY 40506

[4] Department of Entomology, The Ohio State University, Columbus, OH 43210

ENT. NEWS, 86: 7 & 8: 141 - 143, September & October 1975



SECUNDA

Male genitalia: Plates long, slightly pointed at apex. Lateral margin slightly expanded. Pygofer nearly rounded with a truncate, thickened apex. Style robust, thumb-like, apex blunt. Aedeagus, long, slender, slightly expanded at apex, bearing two pair of basially produced ventral processes one pair short and other longer (nearly half length of shaft), apex with a ventral pair of short median fork-like spines and a dorsal pair of short lateral bifurcate processes.

Female genitalia: Posterior margin of seventh sternum truncate with a fairly large indented median tooth.

Holotype male: Las Cumbres, Panama, August 23, 1974, at lights, H. Wolda, in the DeLong Collection, Ohio State University. Allotype female: Same data as holotype, except date is August 30, 1974, in the DeLong Collection. Paratypes: One male, same data as holotype, except date is July 16, 1974 in the DeLong Collection; one female, Ft. Kabbe, Panama, CZ, October 3, 1951, F. S. Blanton, in the U.S. National Museum; and one male, San Jose, Grand Cayman Is., December 1, 1958, in the U.S. National Museum.

This species is named for being the second species in the subgenus *Zerana.*

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DeLong, D. M. and P. H. Freytag. 1964. Four genera of World Gyponinae: A synopsis of the genera *Gypona, Gyponana, Rugosana,* and *Reticana.* Bull. Ohio Biol. Survey (new series) II(3): iii-227 pp, 372 figs.

Figures 1-6. *Gyponana (Zerana) secunda* n. sp.

Fig. 1. Ventral view of aedeagus. Fig. 2. Lateral view of aedeagus. Fig. 3. Ventral view of style. Fig. 4. Ventral view of plate. Fig. 5. Lateral view of pygofer. Fig. 6. Ventral view of female seventh sternum.

Scale equals one half millimeter for male drawings and one millimeter for the female drawing.

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.

THE MITES *PROCTOPHYLLODES PICAE* (KOCH) AND *P. ORIENTALIS* GAUD ON THE BIRD MYNA IN INDIA[1]

V.C. Kapoor, Patwant Kaur[2]

Proctophyllodes belongs to the family Proctophyllodidae which includes feather mites. This genus was so far known in India by only one species i.e. *P. orientalis* on House sparrow in Madras. Here it has been recorded for the first time from Northern India on the same host. It shows its wide occurrence throughout from North to South India.

P. picae was first described by Koch (1840) from Europe on the bird *Pica pica* (L.). Since then it has been described from Macedonia on *Anas acuta* (Vitzthum, 1922), Fr. Morocco on *Pica pica* (Gaud, 1957), Bulgaria on *Corvus corone sardonium* Klein. (Vassilev, 1959) and *Nucifraga caryocatactes* (L.) (Vassilev, 1960). It has been described here for the first time from India on new hosts *Acridotheres tristis* L. and *Acridotheres ginginianus* Latham.

ACKNOWLEDGEMENT

The authors are grateful to W.T. Atyeo, University of Georgia, Athens, U.S.A., for identifying the feather mites.

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Vassilev, I.D. 1960. Ibid. 9: 434.
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[1] Accepted for publication: August 16, 1975

[2] Department of Zoology, Punjab Agricultural University, Ludhiana, India.

NOTES ON A COLLECTION OF MAMMAL-FLEAS FROM NEW HAMPSHIRE[1]

David A. Lovejoy,[2] Pamela J. Gaughan[3]

ABSTRACT: As a portion of an ecological study of small mammals in New Hampshire, 605 fleas representing 19 species were collected and identified. These data include four new species from New Hampshire and numerous new host records for both New Hampshire and New England.

DESCRIPTORS: Fleas, small mammals, New Hampshire, Hystrichopsyllidae, Ceratophyllidae, Leptopsyllidae.

Main (1970) listed 28 species of fleas from New Hampshire. However, few data are available on collections of fleas from this state (Cressey, 1961; Fuller, 1943) and no substantial recent surveys have been reported. In 1968 and 1969, fleas were collected from live and snap-trapped small mammals as a portion of an ecological study of small mammal succession following logging in the White Mountain National Forest of New Hampshire (Lovejoy, 1970). Additional specimens were collected from the White Mountain region and from Mount Monadnock in southwestern New Hampshire from 1970-1973. The collection reported here totals 605 fleas representing 19 species; approximately 3200 hosts (13 species) were examined. Fleas were preserved in 70% alcohol and were later mounted on glass slides using the technique of Holland (1949). Four new records for New Hampshire are included here *(Catallagia borealis, Corrodopsylla curvata curvata, Stenoponia americana, Orchopeas caedens).* In the following account, an asterisk (*) indicates the first New Hampshire record on a particular host and a double asterisk (**) indicates the first New England record on that host.

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[1] Accepted for publication: May 21, 1975

[2] Department of Biology, Westfield State College, Westfield, MA. 01085

[3] 32 Randall Drive, Suffield Ct., 06078

ENT. NEWS, 86: 7 & 8: 145 - 149, September & October 1975

Pulcidae

Hoplopsyllus glacialis lynx (Baker), 1904

All specimens were taken on one *Lepus americanus,* which along with its predator, *Lynx canadensis,* are the preferred hosts of this flea (Main, 1970).

Specimens Taken: 5♀, 8♂

Host Preferences: *Lepus americanus** (1)[1]

Previous New Hampshire Records: Fuller (1943), Hopkins and Rothschild (1953), Cressey (1961).

Hystrichopsyllidae

Catallagia borealis Ewing, 1929

This species has been reported only twice in New England (Main, 1970). Holland and Benton (1968) reported this flea to be most frequently taken on *Clethrionomys gapperi* and between October and April in Pennsylvania. All of the present specimens were taken in October or May.

Specimens Taken: 14♀, 8♂

Host Preferences: *C. gapperi** (10), *Blarina brevicauda*** (1), *Synaptomys cooperi*** (1).

Previous New Hampshire Records: None

Epitedia wenmanni (Rothschild), 1904

This flea has previously been taken throughout New England on a wide variety of hosts (Main, 1970).

Specimens Taken: 5♀, 6♂

Host Preferences: *C. gapperi* (7), *B. brevicauda** (3), *Peromyscus maniculatus* (1)

Previous N.H. Records: Fox (1940), Fuller (1943).

Tamiophila grandis (Rothschild), 1902

Both specimens were taken on *Tamias striatus,* the host with which this flea is closely associated (Benton and Cerwonka, 1960).

Specimens Taken: 1♀, 1♂

Host Preferences: *T. striatus* (2)

Previous N.H. Records: Fuller (1943)

Corrodopsylla curvata curvata (Rothschild), 1915

This flea, which is typically associated with shrews (*Blarina* and *Sorex*) (Benton and Cerwonka, 1960), has been collected only three times in New England (Main, 1970). Those collections and the specimens reported here include males only.

Specimens Taken: 4♂

Host Preferences: *S. cinereus*** (2), *S. fumeus*** (2)

Previous N.H. Records: None

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[1] Refers to the number of parasitized individuals of each host.

Ctenophthalmus pseudagyrtes pseudagyrtes Baker, 1904

This flea is often one of the most abundant and least host-specific fleas taken in the northeast (Benton and Cerwonka, 1960; Holland and Benton, 1968). *C. p. pseudagyrtes* was the least host-specific flea taken in the present survey.

Specimens Taken: 46♀, 18♂

Host Preferences: *B. brevicauda* (23), *C. gapperi** (14), *Microtus pennsylvanicus** (6), *Napaeozapus insignis** (5), *Sorex palustris*** (1), *Microtus chrotorrhinus*** (1), *P. maniculatus** (1).

Previous N.H. Records: Fox (1940), Fuller (1943), Hopkins and Rothschild (1966).

Doratopsylla blarinae Fox, 1914

This flea is strongly associated with *B. brevicauda* and occurs infrequently on their ecological associates (A.H. Benton, personal communication; Main, 1970). In our study, 70 of 78 individuals parasitized *B. brevicauda.*

Specimens Taken: 42♀, 36♂

Host Preferences: *B. brevicauda* (46), *N. insignis*** (3), *C. gapperi*** (1), *P. maniculatus* (1), *Ovis aries*** (1), *S. cinereus*** (1).

Previous N.H. Records: Fuller (1943).

Nearctopsylla genalis genalis (Baker), 1904

All specimens of this flea, a typical mole and shrew parasite, were collected in October. Holland and Benton (1968) reported that this flea is seldom taken in the warm months.

Specimens Taken: 22♀, 15♂

Host Preferences: *B. brevicauda* (16), *C. gapperi** (2)

Previous N.H. Records: Fox (1940).

Stenoponia americana (Baker), 1899

This flea is frequently associated with *Peromyscus,* but has also been taken on a wide variety of other small mammals (Benton and Cerwonka, 1960; Main, 1970).

Specimens Taken: 7♀, 4♂

Host Preferences: *C. gapperi** (4), *S. cooperi*** (1), *T. striatus*** (1).

Previous N. H. Records: None

Megabothris acerbus (Jordan), 1925

Previous records indicate this flea to be closely associated with *T. striatus* (Benton and Cerwonka, 1960).

Specimens Taken: 8♀, 9♂

Host Preferences: *T. striatus* (11), *P. maniculatus*** (1)

Previous N.H. Records: Fuller (1943).

Megabothris asio asio (Baker, 1904)

This flea is commonly associated with *M. pennsylvanicus.*

Specimens Taken: 1♀

Host Preferences: *M. pennsylvanicus* (1)

Previous N.H. Records: Fuller (1943).

Megabothris quirini (Rothschild), 1905

Previous studies have indicated *M. quirini* to be relatively rare in the New England region (Benton and Cerwonka, 1960; Main, 1970). Benton and Cerwonka (1960) found this flea to be closely associated with *C. gapperi* and suggested that it might be primarily a nest flea. In our study, all specimens were taken on the hosts themselves and no nests were examined.

Specimens Taken: 67♀, 24♂

Host Preferences: *C. gapperi*** (46), *N. insignis*** (21), *M. pennsylvanicus* (4), *T. striatus*** (1), *S. cooperi*** (1), *P. maniculatus* (1), *S. palustris*** (1).

Previous N.H. Records: Fuller (1943).

Monopsyllus vison vison (Baker), 1904

This flea is most commonly associated with *Tamiasciurus, T. striatus* and their predators (Main, 1970; A. H. Benton, personal communication).

Specimens Taken: 1♀, 1♂

Host Preferences: *T. striatus** (1), *P. maniculatus*** (1).

Previous N.H. Records: Cressey (1961)

Orchopeas caedens durus (Jordan), 1929

This flea is most commonly associated with *Tamiasciurus* (Main, 1970; Benton and Cerwonka, 1960).

Specimens Taken: 1♂

Host Preferences: *T. striatus*** (1)

Previous N.H. Records: None

Orchopeas leucopus (Baker), 1904

O. leucopus was the most abundant flea taken in the present survey. A typical *Peromyscus* parasite, this flea was closely associated with *P. maniculatus* (98 of 102 specimens) in our study.

Specimens Taken: 59♀, 43♂

Host Preferences: *P. maniculatus* (51), *N. insignis*** (1), *B. brevicauda** (1), *C. gapperi** (1), *T. striatus** (1).

Previous N.H. Records: Fox (1940), Fuller (1943).

Leptopsyllidae

Peromyscopsylla catatina (Jordan), 1928

This flea has been collected from several hosts, but seems to be most closely associated with *C. gapperi* (Main, 1970; Benton and Cerwonka, 1960).

Specimens Taken: 54♀, 38♂

Host Preferences: *C. gapperi* (42), *B. brevicauda* (4), *P. maniculatus* (1), *M. pennsylvanicus* (1), *T. striatus*** (1), *S. cooperi*** (1).

Previous N.H. Records: Fox (1940), Fuller (1943), Johnson and Traub (1954).

Peromyscopsylla hamifer hamifer (Rothschild), 1906

This relatively rare flea appears to be closely associated with voles and their predators (Benton and Cerwonka, 1960; Main, 1970).

Specimens Taken: 3♀

Host Preferences: *M. pennsylvanicus* (1)

Previous N.H. Records: Johnson and Traub (1954).

Peromyscopsylla hesperomys hesperomys (Baker), 1904

This flea is most common on *Peromyscus*, but is also taken on other hosts (Benton and Cerwonka, 1960; Holland and Benton, 1968; Main, 1970). Our study showed a strong association between this flea and *P. maniculatus*.

Specimens Taken: 30♀, 23♂

Host Preferences: *P. maniculatus* (30), *C. gapperi*** (1).

Previous N.H. Records: Baker (1904), Fox (1940), Fuller (1943), Johnson and Traub (1954), Hopkins and Rothschild (1971).

Ischnopsyllidae

Myodopsylla insignis (Rothschild), 1903

This flea occurs commonly on *Myotis* and on other bats (Main, 1970).

Specimens Taken: 1♀

Host Preferences: *Myotis lucifugus* (1)

Previous N.H. Records: Fuller (1943).

ACKNOWLEDGEMENTS

We wish to thank Dr. Allen H. Benton for confirming the identifications of approximately half of the specimens included in the study and for making several valuable suggestions which have been included in the manuscript. Mr. Frank Bates assisted with some of the generic identifications and with slide-making.

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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

FAUNA ENTOMOLOGICA SCANDINAVICA. Volume 1 by R. Rozkosny. The Stratiomyidae of Fennoscandia and Denmark, 1973. 140 pgs, Volume 2 by M. Fibiger and N.P. Kristensen. The Sesiidae of Fennoscandia and Denmark, 1974. 91 pgs, Science Press Ltd., Gadstrup, Denmark. Vol. 1 DKr. 58 ($10.73), vol. 2 DKr. 40 ($7.40).

These two volumes inaugurate a series of publications which will eventually treat the entomofauna of the whole of North Europe including Britain. The editor, Leif Lyneborg, promises that the more than 50 volumes will be completed within ten years. The first two volumes are in English. He presently anticipates the publication of 2-5 volumes a year. In volume 1, 19 genera and 50 species of Stratiomyidae and Solvidae are treated. The attention to detail and accuracy are quite apparent. The line drawings are clear and excellent and keys to adults and known larvae are provided. Distributional information is also given in detail. Volume 2 on the Sesiidae (= Aegeriidae) treats 17 species. All species are keyed and illustrated in color. Genitalic figures of both sexes are provided as are photographs of the larval habits of many of the species. This volume includes more detail on the bionomics and collecting techniques than given in volume 1 because the sesiids are less known and in need of further investigation. Tables of the known local distribution of each species are given at the end of the text.

D.C. Rentz

BOOKS RECEIVED AND BRIEFLY NOTED

THE STINK BUGS OF OHIO (HEMIPTERA: Pentatomidae). George David Furth. 1974. Bulletin, Ohio Biological Survey. New Series. Vol. 5, No. 1. 60 p. 5 pl. $2.50 / .25 postage & handling.

A PICTORIAL KEY TO THE HAWKMOTHS (LEPIDOPTERA: Sphingidae) OF EASTERN UNITED STATES (except Florida). Charles L. Selman. 1975. Biological Notes No. 9. Ohio Biological Survey. 31 p. 5 pl. $1.00 / .10 postage & handling.

Send check or money order made payable to Ohio Biological Survey to: University Publications Sales, Ohio State University Press, 316 Hitchcock Hall, 2070 Neil Ave., Columbus, Ohio, 43210.

PHLOEOXENA NEWTONI NEW SPECIES, AND NOTES ON *P. NIGRICOLLIS* BALL AND *P. GENICULATA* CHAUDOIR FROM MEXICO (COLEOPTERA: CARABIDAE: LEBIINI).[1]

George E. Ball[2]

ABSTRACT: The type locality of *Phloeoxena (Oenaphelox) newtoni* is Nuevo Leon, Chipinque Mesa (1219m), near Monterrey. This new species is distinguished from other members of the genus, is described, and elytral microsculpture, pronotum and male genitalia are illustrated. *Phloeoxena newtoni* is thought to be the sister species of *P. undata* Chaudoir, and closest to the ancestral stock of the *Phloeoxena signata* species group. The first record of *Phloeoxena (sensu stricto) nigricollis* Ball from Oaxaca is cited. Males of a population sample of *Phloeoxena (Oenaphelox) geniculata* Chaudoir from the lower slopes of Volcan Colima differs from the Cuernavaca, Morelos sample in details of the median lobe and in number of spines on the internal sac.

DESCRIPTORS: Insecta; Coleoptera: Carabidae: Lebiini; *Phloeoxena newtoni* n. sp., *P. nigricollis* Ball, *P. geniculata* Chaudoir; Mexico; systematics, zoogeography.

This paper is based on material that became available too late to be included in a revision of the species of *Phloeoxena* (Ball, 1975).

SYSTEMATICS

The key (Ball, 1975: 182) is modified as follows for inclusion of the new species:

20 (19') Specimen from Mexico; male genitalia with spines in internal sac . . . 20A.
20' Specimen from West Indies; internal sac without spines . . . . 21.
20A (20) Metepisternum with lateral margin distinctly longer than anterior margin, hind wings fully developed; eyes large (value for Hw/P1 greater than 1.15); pronotum with sides markedly rounded, *Agonum*-like in form; legs uniformly pale, or mainly pale with apices of femora and bases of tibiae dark . . . . *P. (Oenaphelox)* geniculata

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[1] Accepted for publication: June 5, 1975

[2] Department of Entomology, University of Alberta, Edmonton, Alberta, Canada T6G 2E3

ENT. NEWS, 86: 7 & 8: 151 - 156, September & October 1975

20A' Metepisternum with lateral margin only slightly longer than anterior margin, hind wings short stubs; eyes moderate in size (Hw/P1 0.96); pronotum with sides less rounded, not *Agonum*-like in form (Fig. 2) legs uniformly pale . . . . *P. (Oenaphelox) newtoni*, new species.

Phloeoxena (Oenaphelox) newtoni, new species

Large spines of the internal sac place this species in the *P. signata* species group, of subgenus *Oenaphelox.* The uniformly piceous dorsal elytral surface distinguishes the holotype of this species from members of other species of this group except those of *P. geniculata.* The above key distinguishes between *P. geniculata* and *P. newtoni.* Dark color of legs and distinctly sinuate sides of the pronotum distinguish specimens of otherwise similar brachypterous *P. picta unicolor* Chaudoir from the holotype of *P. newtoni.*

Description. – Standardized body length 4.36 mm. Values for diagnostic ratios are: head width/maximum width of pronotum (Hw/Pwm), 0.77; head width/medial length of pronotum (Hw/P1), 0.96; width of pronotum at apex/width of pronotum at base (P: Aw/Bw), 0.96; medial length of pronotum/elytral length (P1/E1), 0.33.

Color. Piceous, except following flavous (pale): antennae, palpi, proepipleura, elytral epipleura, and legs; pronotum laterally flavo-piceous.

Microsculpture. Head dorsally and pronotum laterally with meshes isodiametric, beaded; disc of pronotum with meshes slightly transverse, flat. (Elytra (Fig. 1) anteriorly with meshes elevated, keeled, oriented longitudinally but not aligned in recognizable rows; in posterior 0.20, meshes flat, isodiametric.

Luster. Dorsum generally dull, except apical area of elytra slightly shiny.

Head. Eyes moderately bulged.

Prothorax. Pronotum as in Fig. 2; anterior margin moderately deeply concave; lateral margins oblique, not sinuate posteriorly; anterior angles prominent, rounded; posterior angles almost rectangular, slightly obtuse; sides moderately reflexed; lateral grooves broad, continuous with posterior-lateral impressions; disc slightly convex: two pairs of setae laterally, on margins. Metepisternum subquadrate, lateral margin only slightly longer than anterior margin.

Elytra. Humeri broadly rounded; sides subparallel, slightly flared; narrowly reflexed apical margins sinuate-subtruncate. Striae broad, intervals slightly convex. Discal setae of each elytron three, umbilical series broadly interrupted medially.

Hind wings. Short stubs, each not much longer than one abdominal tergum.

Male genitalia. Median lobe as in Figs. 3A and B, apical portion more tapered and slender than in other species of *Oenaphelox* (see Ball, 1975: Figs. 96, 98, 101 and 107-110). Internal sac with spines of two sizes: three large, and one small, latter apicad with sac infolded (Fig. 3A). Left paramere as in Fig. 3C.

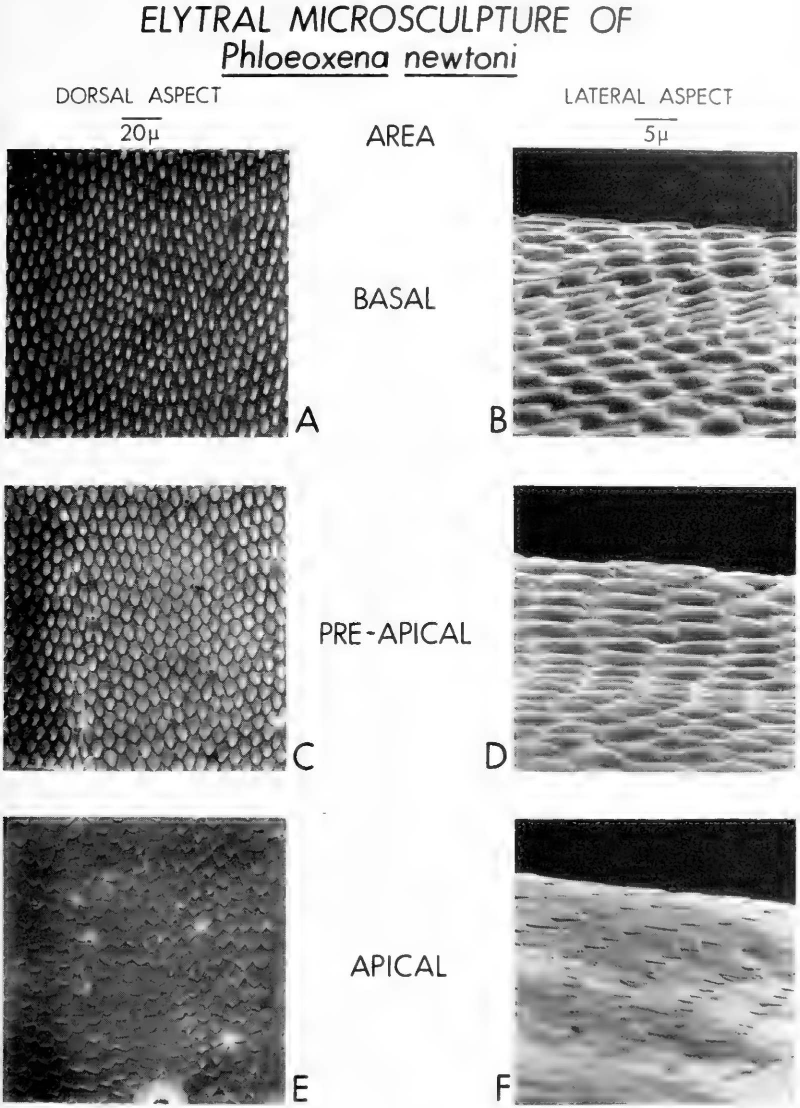


Fig. 1. "Stereoscan" photograph of elytral microsculpture of *Phloeoxena newtoni*, new species, taken with a Cambridge Mark IV Scanning Electron Microscope.

Type material. – Holotype (only known specimen) labelled: MEXICO. Nuevo Leon, Chipinque Mesa, nr. Monterrey, 4000' [=1219m], V.25-26.1971, under oak bark; A. Newton. [Museum of Comparative Zoology, Harvard University].

Derivation of specific epithet. – From the surname of the collector, A.F. Newton, a staphylinid specialist with a penchant for finding fine carabids.

Habitat note. – The forest on Chipinque Mesa, type locality of *P. newtoni,* is pine-oak. Howden (1966: 20) notes that the area represents the northern limit for many of the Mexican mesic forest insects.

Geographical affinities. – The type locality is in the northern part of the Sierra Madre Oriental about 300 km. northwest of the range of *P. undata* (Ball, 1975: Fig. 103), the only other species of *Oenaphelox* to occur on the higher slopes of this mountain system. Thus, these two species are probably allopatric. Probably *P. newtoni* and *P. signata* Dejean are parapatric, with the latter species at lower elevations in the vicinity of Chipinque Mesa.

Relationships. – *P. newtoni* and *P. undata* share the following apotypic character states (Ball, 1975: Table 21): intermediate value for the ratio P1/E1; and elytral microsculpture keeled scales, ridges narrow and high (Males of both species have both large and small spines in the internal sac, a feature that is apotypic in relation to the *P. (O.) pluto* species group, but plesiotypic within the *P. signata* group). *P. newtoni* shares no unique apotypic character states with any other species of *Oenaphelox,* so the new species and *P. undata* are quite clearly most closely related. Concolorous elytra and few spines in the internal sac suggest that of these two species, *P. newtoni* is the more plesiotypic.

Overall, *P. newtoni* seems to be the most plesiotypic, and I think closest to the ancestral stock of the *P. signata* species group. Wing reduction and occurrence in mountain forest rather than lowlands are consistent with the species being relatively old.

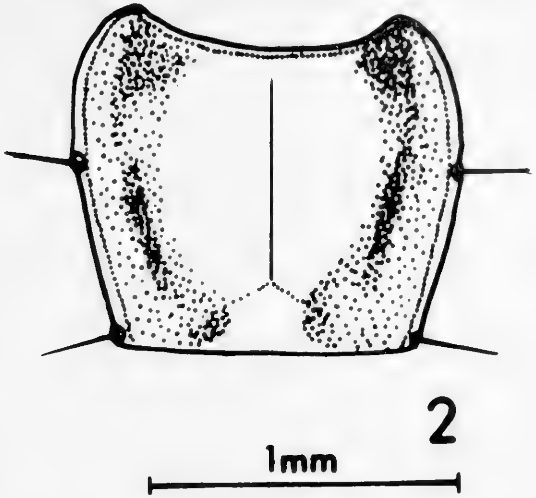
Phloeoxena (sensu stricto) nigricollis Ball

A male, labelled: "2000', 6 mi. s. Valle Nacional, Oax. Mex., V.18-20. 1971, H. Howden" (Strickland Museum, University of Alberta).

This locality is north of the Isthmus of Tehuantepec, and is about 500 km. north of the previously known northern record (Ball, 1975:196). This range extension is not surprizing, and offers further confirmation that the species lives at relatively low altitudes, and is parapatric with the higher altitude *Phloeoxena picta* Chaudoir, represented in the Valle Nacional area by *P. p. apicalis* Ball, specimens of which were collected at 3600' (=1097m).

Fig. 2. Pronotum, dorsal aspect, of *Phloeoxena newtoni,* new species.

Fig. 3. Male genitalia of *Phloeoxena newtoni,* new species: A, median lobe, left lateral aspect and inverted internal sac; B, median lobe, ventral aspect; C, left paramere, ventral aspect.



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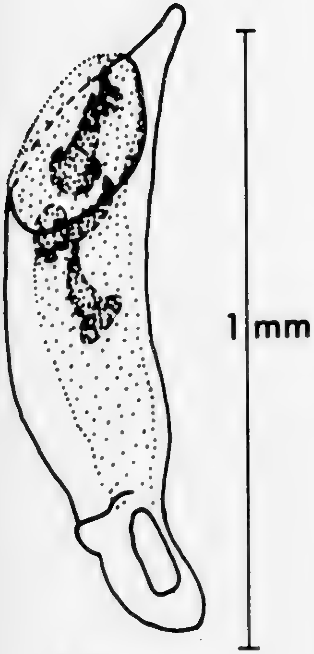
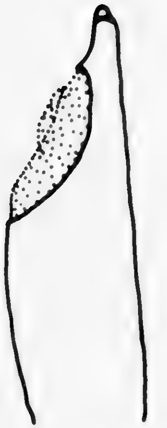


3A



3B

3C

Phloeoxena (Oenaphelox) geniculata Chaudoir

The California Academy of Sciences has 11 specimens collected by H.B. Leech, near the Volcan de Colima, at unspecified altitudes on the southern slopes of the Trans-Volcanic Sierra: three males, six females, SE slope, Mt. Colina, XII.2.1948; female, 7 mi. NE Colima, XII.3.1948; female, Jalisco, 17 mi. S. Mazamitla, XII.5.1975.

These localities are about 400 km. WNW of Cuernavaca, Morelos, the type locality, and the only other area from which more than one specimen has been collected. In external diagnostic characteristics (size and proportions, as determined by measurements; and color) the samples from these two areas are virtually identical, but males differ in structure of the genitalia: those from the Colima area have a well developed carina on the right ventral surface of the median lobe, and the internal sac has three spines (one large, two small); males from the Cuernavaca area have a much less evident carina on the median lobe, and the internal sac has four spines (one large, three small) (For details, see Ball, 1975:209). The differences are clear, but probably they are bridged by structural intermediates from geographically intermediate localities. Thus, the differences are not likely to be of taxonomic significance, but they are likely to be of value in understanding intra-specific relationships.

ACKNOWLEDGEMENTS

The holotype of *Phloeoxena newtoni* was loaned to me by Janice C. Scott and John H. Lawrence, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts. Henry Frania drew to my attention the specimen of *P. nigricollis,* and the series of *P. geniculata* was sent to me for study by David H. Kavanaugh, Department of Entomology, California Academy of Sciences, San Francisco, California.

In my Department, the stereoscan photographs were taken by George Braybrook, the plates were prepared by John S. Scott, and Twyla Gibson typed the manuscript. A preliminary draft of the latter was reviewed by W.G. Evans.

Publication costs were met with Grant No. 1399, National Research Council of Canada.

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RECENT RECORDS OF TICKS, *IXODES COOKEI* PACKARD AND *DERMACENTOR VARIABILIS* (SAY) (ACARINA : IXODOIDEA) IN SOUTHWESTERN ONTARIO[1]

W.W. Judd[2]

ABSTRACT: Two records of *Ixodes cookei* and 6 of *Dermacentor variabilis* are reported from man and dogs. *D. variabilis* appears to be concentrated mainly in the Carolinian Zone in southwestern Ontario.

DESCRIPTORS: *Ixodes cookei; Dermacentor variabilis;* man and dog; southwestern Ontario.

During the last two decades a number of specimens of ticks have been accumulated in the Department of Zoology, University of Western Ontario, London, Ontario, contributed by citizens of southwestern Ontario who have found them on humans, dogs and in houses. They have been identified with keys in Gregson (1956) and are deposited in the collections of the Department.

Ixodes cookei Packard

1. 1 engorged ♀ behind the ear of a 2½-year old boy, Lot 16, Concession I, West Nissouri Township, Middlesex County, Janet Gozzard, May 7, 1964.
2. 1 engorged ♀ on floor of a farmhouse west of Port Stanley, Elgin County, Mrs. R. Ketchum, September, 1958.

Gregson (1956) gives several records of this tick occurring on man in Ontario and elsewhere in eastern Canada.

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[1] Accepted for publication: June 10, 1975

[2] Department of Zoology, University of Western Ontario, London, Ontario, Canada.

Dermacentor variabilis (Say)

1. 1 ♀ on the neck of an 8-year old boy, Dunn Township, Haldimand County, W.W. Judd, June 4, 1957.
2. 2 ♀♀ (one engorged) on the back of a dog, West Lorne, Michael Vojin, May 15, 1962.
3. 2 ♀♀ (one engorged) on the back of the ear of a collie dog, Lambeth, K. Burtwistle, May 23, 1962.
4. 1 ♀ on the head of a girl, Delaware Township, Middlesex County, Dr. R.W. Morris, May, 1965.
5. 1 ♀ on the abdomen of a woman, Hyde Park, Lois Veen, May 26, 1975.
6. 1 ♂, 1 ♀ on a man, London, Eileen Taylor, May 29, 1975.

Previously published records of occurrence of *D. variabilis* in southern Ontario include: 7. Tillsonburg (Judd, 1956); 8. Grimsby, 9. Brampton, 10. Vineland, 11. Byron, 12. Walpole Island, 13. Guelph, 14. Brantford, 15. Chatham, 16. Scotland, 17. Strathroy (Gregson, 1956).

Gregson (1956) gives several records of *D. variabilis* on dogs and man in Canada from Manitoba eastward and Hall and McKiel (1961) record it from Nova Scotia.

The distribution of the seventeen records noted above for Ontario is presented in Fig. 1. They are concentrated in a strip north of Lake Erie and western Lake Ontario. Wilkinson (1967) reports that there are numerous reliable Ontario records south of 44° latitude and that this species appears to be limited to areas with more than 2500 degree-days exceeding 43°F. and to areas with high summer humidity.

Soper (1955) studied the location of the northerly limit of the Carolinian Zone in Ontario, based upon distribution of several plants restricted to that Zone. He concluded that the limit is shown by a line extending from Grand Bend on Lake Huron and following a sinuous course through southwestern Ontario to Toronto on Lake Ontario. This line has been added (A -- A) to Fig. 1. All the records of *D. variabilis* shown are close to this line or south of it, indicating that in southern Ontario this species is concentrated mainly in the Carolinian Zone.

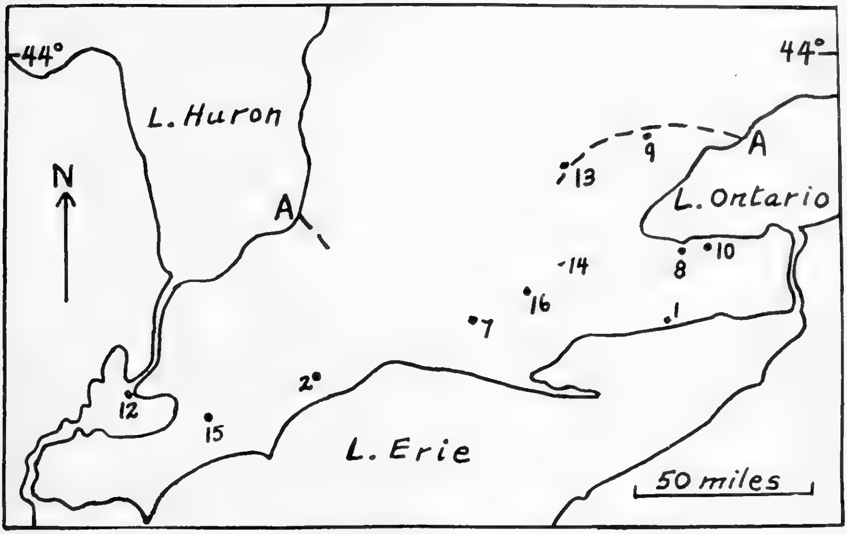

Fig. 1. Distribution of *Dermacentor variabilis* (Say) in southern Ontario. A – A: northern limit of Carolinian Zone (Soper, 1955).

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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 ODONATA OF CANADA AND ALASKA, Edmund M. Walker and Philip S. Corbet Volume 3, Part III: The Anisoptera - three families. University of Toronto Press. $25.00

This work completes the monumental work of Dr. Walker on the Canadian and Alaskan Dragonflies, the first volume of which appeared over twenty years ago.

This part completed by Dr. Corbet covers the superfamily Libelluloidea containing the Families Macromiidae, Corduliidae and Libellulidae carries on in the same foremat as the previous works. The Tillyard-Fraser system of wing venation adopted in Volume 2 is fully illustrated in this edition and for the beginning student will be found much less complicated than the system used by Needam and Westfall and more in line with that used for the other orders.

Each species has a complete description of the male and female including detailed measurements; the nymphs are similarly treated so there can no doubt as to identification if the specimen is compared to the descriptions.

The range and habitats given for each species covers both the United States and Canada while the accompanying field notes though strictly Canadian give a good account of the habits and habitats of the particular species.

The illustrations are excellent and clearly illustrate the characters needed for identification to species.

An addendum section at the end of the book lists records of species new to Canada that were omitted from the previous volumes and also lists extensions of the geographical range both north and south of species covered in the earlier volumes.

This book should be a welcome addition to the libraries of odonatists in Canada and the Upper half of the states.

Lewis P. Kelsey, Department of Entomology and
Applied Ecology, University of Delaware.

SEXUAL BEHAVIOR OF *HEMITAXONOUS DUBITATUS* (NORTON) (HYMENOPTERA: TENTHREDINIDAE)[1]

Gordon Gordh[2]

ABSTRACT: Sexual behavior of this primitive tenthredinid sawfly is described. The male genitalia are illustrated.

DESCRIPTORS: *Hemitaxonous dubitatus* (Norton), Tenthredinidae, sawfly, courtship, sexual behavior, male genitalia.

The Holarctic sawfly genus *Hemitaxonous* Ashmead consists of 16 species, four of which occur in North America (Smith, 1969). The Old World representatives of the genus were revised by Naito (1971 a,b) who noted that they feed on ferns (except Aspidiaceae) and are generally monophagus. *Hemitaxonus* is a member of the Selandriinae, which, on the basis of morphological criteria, Ross (1937) considers the most primitive subfamily of the Tenthredinidae.

Little is known of the biology or behavior of *Hemitaxonus.* Recently, D.R. Smith collected larvae of *H. dubitatus* (Norton) on *Onoclea sensibilis* Linnaeus near Beltsville, Maryland. The following observations on the sexual behavior of this species are based on the material collected by Smith.

Materials and Methods – After feeding, the larvae dropped from the plant and crawled between laminae of cardboard provided for a pupation site. This species does not spin a cocoon, but it does seal the aperture through which it has crawled. A few days after all the larvae had dropped from the host plant, the cardboard was split, and the pupae were individually placed in # 000 gelatin capsules. All adults emerged within a 48 hour period and were *bona fide* virgins. Males and females were placed together in pairs in petri dishes and observed with the aid of a stereomicroscope. The duration of coitus was timed with a stopwatch. Nineteen coital episodes were observed, and over fifty courtship attempts were observed.

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[1] Accepted for publication: August 18, 1975

[2] Systematic Entomology Laboratory, Agr. Res. Ser., IIBIII, USDA, c/o U.S. National Museum, Washington, D.C. 20560.

ENT. NEWS, 86: 7 & 8: 161 - 166, September & October 1975

Results – Adults were removed from their gelatin capsules with a pair of forceps and placed in the petri dish. Females were always introduced into the dish first. I noticed that when the sawflies were touched with the forceps, or otherwise disturbed, they emitted a strong musky scent and did not struggle. After being released they often remained motionless up to 20 seconds.

Copulation always occurred on the side of the petri dish nearest the point of greatest illumination. Male approach was not complicated and consisted of the male's encountering the female on the substrate. He then climbed on the female's dorsum and vibrated his wings rapidly. During wing vibration the wings were held partly open and canted approximately 40-50 degrees. The time spent on the female's dorsum was 7.69 ± 3.14 seconds for 28 observations. With his wings still vibrating, the male then quickly moved off the female and assumed a position perpendicular to the long axis of the female's body and at the level of her thorax. The male's front and middle legs were on the substrate, but his hind legs were still on the female's thoracic notum.

The male then initiated genitalic probing of the female's mesosternum. During probing the aedeagus was exerted and the male's abdomen appeared "S"-shaped in profile. The dorsal margin of the middle terga of the male's abdomen conformed to a cross section of a contour of the female's thoracic venter and he continued to vibrate his wings. The duration of mesosternal probing was not established, but it was less than two seconds.

Next, the male began to move toward the apex of the female's abdomen, maintaining a right angle to the female's longitudinal body axis, continuing the genitalic probing near the female's sternal midline and holding the hind tarsi on the female's folded wings. At this point many courtship attempts were broken off when the female moved away. However, if the male reached the apex of the female's abdomen, he pivoted the longitudinal axis of his body 90 degrees so that the pair established a straight line with the apices of their abdomens appressed and their heads facing opposite directions. Insertion of the male's aedeagus into the female' bursa copulatrix was from this stance. During aedeagal insertion the male held his hind tarsi on the apical segments of the female's abdomen or on the anterior margins of her wings. The female's wings were held in repose over her abdomen, but the male continued to vibrate his wings. After insertion of the aedeagus, which often took several seconds, probably depending upon female arousal, the male removed his hind tarsi from the female, placed them on the substrate and ceased vibrating his wings.

Coitus lasted 70.63 ± 22.84 seconds for 19 pairs. During coitus each pair remained quiescent. The coital stance was such that each participant was a mirror image of the other: antennae were held parallel to the substrate, were motionless, and subtended an angle of approximately 80-100 degrees.

The male appeared to exert considerable control over the duration of coitus because several females were observed dragging males backwards around the container after the pair had been *in copulo* for over thirty seconds. I also noted females attempting to dislodge the males by pressing the hind basitarsi or apex of the hind tibiae against the male aedeagus, but this action was usually unsuccessful.

During insemination the female's pygostyli touch the male's eighth tergal plate apically. After disengagement the pair did not demonstrate interest in one another. Recently mated males did not exhibit sexual arousal (wing vibration and mounting) when placed with virgin females. However, 24 hours after mating, two males did mate with virgin females. Similarly, one female that had copulated with a male a few hours earlier, and was presumably inseminated, did allow a second male to copulate with her.

One male was rejected repeatedly by a virgin female, although she did permit him to mount several times. This female was subsequently killed in absolute alcohol, dried for several minutes and then placed in the container with the rejected male. The pair was observed continuously for 15 minutes and during that period the female's body elicited no sexual arousal from the male. The male was then placed with a live virgin female and copulation was observed after the pair had been together less than five minutes. Males have also been observed walking over thanatotic females and copulating with them several minutes later.

The genitalic embrace deserves comment. The female's ovipositor is short, less then 1/8th the length of the abdomen. The gonopore, which leads to the bursa copulatrix, is situated at the base of the ovipositor shaft (first and second valvulae combined) and at the level of the spiracles of the eighth tergum. During coitus the shaft of the ovipositor is elevated slightly and the base of the shaft is lowered and moved posteriorly slightly.

According to Snodgrass (1941), tenthredinoid male genitalia are characterized by the absence of parameral cupping discs. The parameres of *H. dubitatus* lack discs, but they are broad and their inner surfaces are concave. During coitus the parameres are pressed against the posterior margin of the female's seventh sternum, but they do not appear completely responsible for maintaining the strong genitalic grasp I observed. The strength of the genitalic grasp is probably due to the large spoon-shaped cuspis that is opposable to the enlarged toothlike digitus. The apical portion of the cuspis bears several denticles which probably aid in maintaining the grasp. (See figure).

I do not know what the digitus and cuspis grab because observation of their action was obscured by the male's seventh sternum. I attempted to kill pairs *in copulo* with alcohol and with ethyl acetate, but in each instance the insects separated before I could examine the genitalic embrace. However, dissection of several females revealed a lightly sclerotized membrane that was

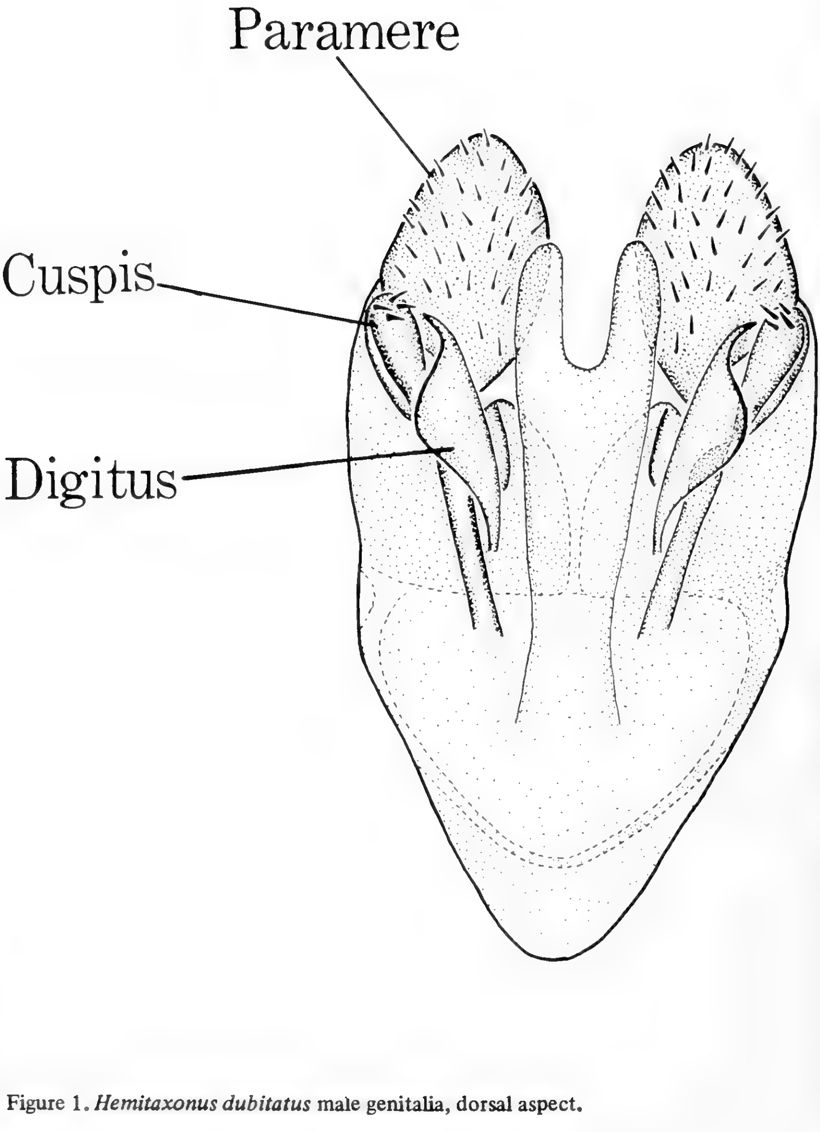

Figure 1. *Hemitaxonus dubitatus* male genitalia, dorsal aspect.

freely manipulatable, attached near the pygostyli and whose posterior margin conformed to the posterior margin shape of the female's pygostylar plate. Quite possibly the male maintains his grasp by opposing the digitus to the cuspis on the apical margin of this membrane.

DISCUSSION

Discussion – Although these notes are incomplete, they are intended to provide basic information about the courtship repertoire in the Symphyta and at the same time stimulate similar investigations of related taxa. Knowledge of sexual behavior in the Symphyta is woefully incomplete and as a consequence it is not possible to determine evolutionary patterns of courtship behavior for the Hymenoptera.

On the basis of male genitalia position, a fundamental dichotomy appears in the sawflies. Crampton (1919) and Boulangé (1924) have shown that male tenthredinid genitalia have rotated 180 degrees on the median axis. This condition also exists in *Xyela* (Xyelidae) and collectively these insects have been called "strophandrous" by Crampton. All other sawflies are called "orthandrous" because the male genitalia are not rotated.

Rotation of the male genitalia has caused modifications of sexual behavior. The tandem (back-to-back) coital stance appears commonly in the Tenthredinoidea and *Xyela* (Rohwer, 1915; Burdick, 1961). However, the orthandrous *Cephalcia fascipennis* (Cresson) (Pamphiliidae) male mounts the female, inserts his aedeagus, then rotates his body and assumes a tandem position (Eidt, 1965).

The evolutionary significance of genitalic rotation is unclear. Rotation has an effect on the copulatory stance and position of the male during aedeagus insertion. Additional and more careful observations of courtship in the Strophandria may provide clues as to the significance of rotation, especially when variations in the courtship repertoire, in male insertion stance, and in the tandem copulatory stance are determined for tenthredinoids. Male genitalia rotation and tandem copulation in *Xyela* suggests a polyphyletic origin of the phenomena, but careful investigations are needed before any conclusions are reached regarding the presumed aberrancy of *Xyela*.

The absence of intensive male antennal vibrations in *H. dubitatus* suggests that antennae do not play an active role in mediating sexual behavior in this species. Antennae are actively used in parasitic Hymenoptera (Gordh and DeBach, in prep.).

The conspicuous wing vibration pattern is stereotyped in this species, but it is not certain what function wings serve in sexual behavior. They may be acting as visual, tactual or chemical (pheromone dispersal) stimuli used to arouse the female. Wing vibrations are common in the courtship patterns of parasitic Hymenoptera (Gordh and DeBach, in prep.).

The duration of coitus in the Symphyta is highly variable. Ries (1926) reported that copulation lasts 10 minutes in *Cephus pygmaeus* (Linnaeus), whereas Dahlsten (1961) reported that *Neodiprion* sp. remains *in copulo* for 100 minutes. *Hemitaxonus dubitatus* remains *in copulo* less than 90 seconds. It seems likely that insects are more vulnerable to predation during copulation because they are less mobile and therefore more susceptible to capture. Selection should thus operate to reduce the amount of time a pair spends copulating. However, this selective pressure would be modified if there were a functional necessity operating to prolong the copulation period. Manufacture and transfer of a spermatophore would be one instance in which prolonged copulation would be more beneficial than a short-duration copulation in which sperm transfer is incomplete or ineffective. I was unable to find a spermatophore when I dissected mated females of *H. dubitatus.*

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A NEW SPECIES OF SMICRAULAX FROM MEXICO, WITH KEY TO SPECIES OF THE GENUS (COLEOPTERA:CURCULIONIDAE)[1, 2]

Horace R. Burke[3]

ABSTRACT: A new species of *Smicraulax* Pierce is described from northcentral Mexico, increasing to three the number of species now known in the genus. These three weevils have all been found to be associated with species of *Phoradendron.* The generic description is modified to include the new species. A key is provided for identification and illustrations of diagnostic characters are provided.

DESCRIPTORS: *Smicraulax* Pierce, new species, generic description, key.

A third species of the anthonomine genus *Smicraulax* Pierce is described herein. The two previously known species are *Smicraulax tuberculatus* Pierce from Texas and *Smicraulax arizonicus* Sleeper from Arizona. The biology and taxonomy of the genus were reviewed by Burke and Hafernik (1971).

Smicraulax piercei n. sp.
(Figs. 1, 2, 4, 5, 8)

Body elongate-oval; length 2.70-3.07 mm, width 1.03-1.33 mm. Elytra moderately densely covered with white, yellowish, ochreous and black slender scales, forming distinct patterns as follows: triangular area of yellowish to ochreous scales at base of elytra bordered posteriorly on each elytron by a faint line of white scales extending obliquely from humerus to intersect suture near middle of elytra; elongate spot of black scales on each of intervals 1, 3 and 5 and another larger dark spot of scales on sutural intervals at about basal 1/3 of elytra; line of white scales on each elytron, each beginning on suture at declivity and extending obliquely forward to reach lateral edge of elytron just behind humerus. Broad, irregularly margined band of black scales extended across elytra at declivity behind which elytra are rather uniformly and densely covered with yellowish and ochreous scales. Pronotum with diamond-shaped patch of whitish and ochreous scales on disc; elsewhere on prothorax scales less densely distributed and not forming patterns. Ventrally scales not as densely arranged as above. Integument rufescent, somewhat mottled with darker areas. Bases of meso- and metafemora, apical 1/3 to 1/2 of all tibiae, and tarsi flavescent.

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[1] Accepted for publication: August 26, 1975

[2] Technical Contribution No. 12047. Department of Entomology, Texas Agricultural Experiment Station, Texas A&M University, College Station 77843.

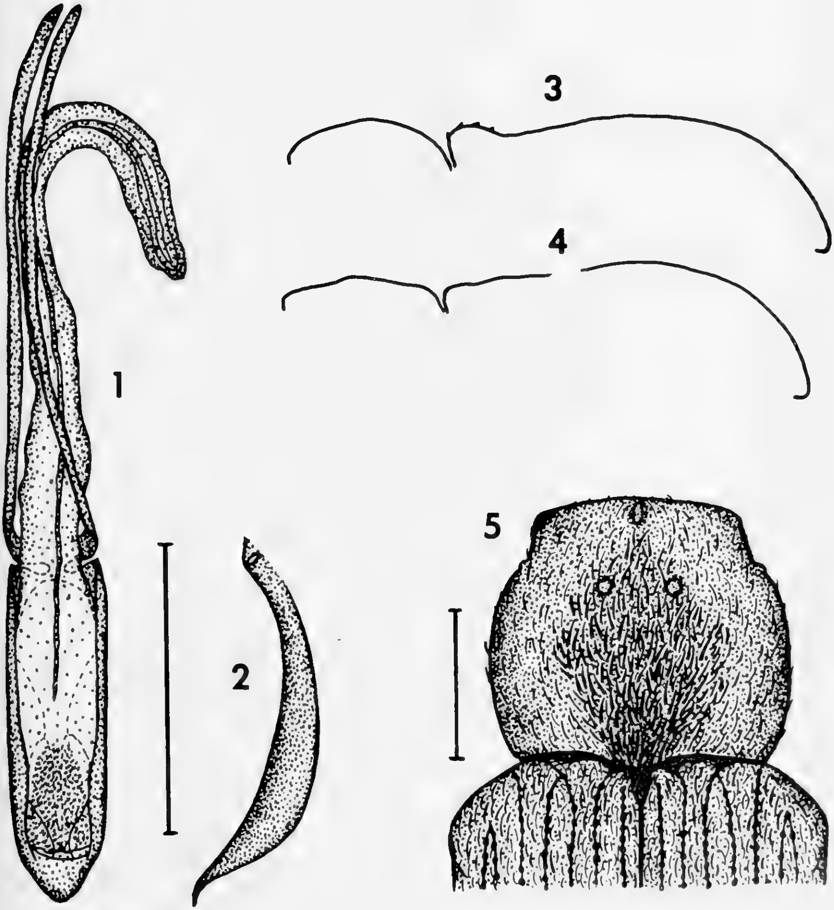
[3] Department of Entomology, Texas A&M University, College Station, Texas 77843.

ENT. NEWS, 86: 7 & 8: 167 - 171, September & October 1975

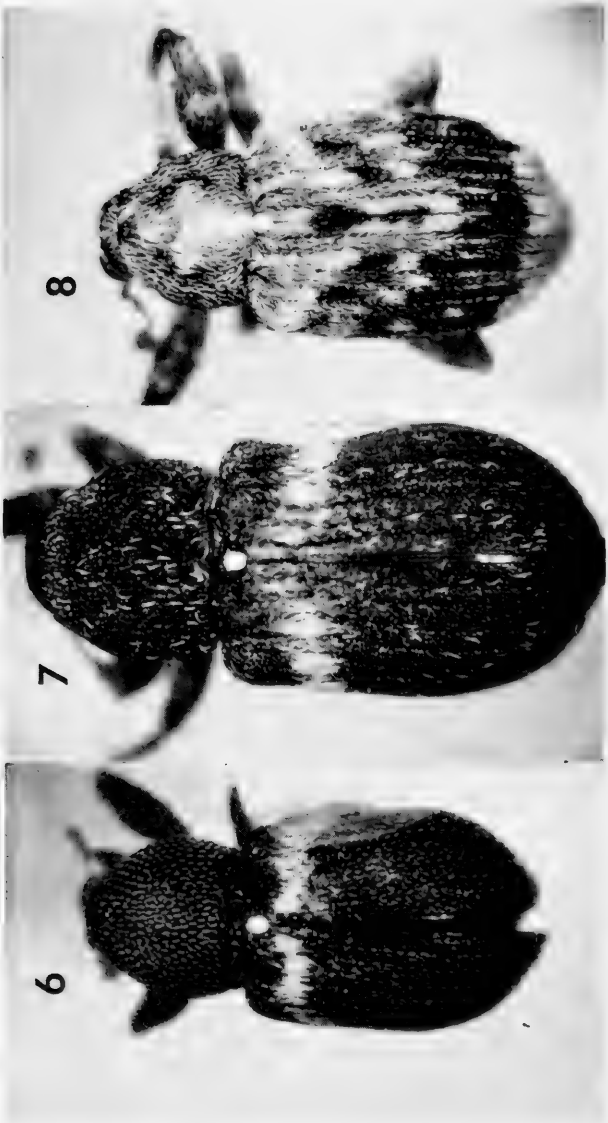
Rostrum stout, length equal to or slightly longer than prothorax, moderately and evenly curved; punctate-striate in basal 1/2, more strongly so in male, median carina in male; apical 1/2 of rostrum remotely and finely punctate in both sexes, more strongly shining in female, slender yellowish scales sparsely arranged along sides of basal 1/3 of rostrum; lateral rostral groove with entire upper margin and anterior 1/3 of lower margin well defined. **Antenna** of male attached just before middle and that of female nearer middle of rostrum; apical 1/3 of scape strongly clavate and bent outward, sparsely covered with pale recumbent scales. **Funicle** 7 segmented; segment 1 strongly clavate, length equal to approximately 2χ width, moderately densely covered with fine yellowish pubescence; segment 2 one-fourth longer than wide; 3 stouter with length equal to width, segments 4, 5 and 6 equal in size, each slightly wider than long; 7 same length as 6 but distinctly wider. **Club** stout, equal in length to preceding 6 funicular segments combined. **Head** sparsely clothed with elongate ochreous and a few intermixed white scales; scales more densely placed along dorsal margins of eyes and on vertex adjacent to anterior margin of prothorax; integument granulate-punctate; frons with deep median sulcus, concave between eyes. **Eyes** prominent, encroaching upon frons; separated in front by distance equal to about 1/2 width of rostrum at base. **Prothorax** (Fig. 5, 8) at widest point (just before middle) about 1.2χ wider than long; sides rounded gently from base to rather strong subapical constriction; bearing a median apical prominence which is shining and impunctate; also prominence on each side of the midline just before middle and another on each lateral margin at subapical constriction; occasionally other slightly raised areas present; elsewhere pronotum coarsely and closely punctate. **Elytra** (Fig. 5, 8) distinctly wider than prothorax at base; humeri oblique; sides parallel to about middle, then broadly rounded to apices; intervals moderately to strongly convex, 1, 3, 5 and 7 distinctly wider than others; striae deeply impressed. **Procoxae** contiguous. **Mesocoxae** separated by distance equal to about 1/3 width of a mesocoxa. **Abdominal sterna** only slightly convex; sternum 1 at middle 1.7χ longer than 2; sternum 2 about 1.7χ longer than 3; sterna 3 and 4 equal in length; sternum 5 slightly shorter than 4 in male, the two approximately the same length in the female. **Pygidium** with apex exposed in male, hidden in female. **Legs** short and stout; femora rather strongly clavate; profemur about 1.3χ width of either meso- of metafemur; femora each bearing a broad triangular tooth which is largest on profemur; protibia stout, slightly curved, inner margin moderately strongly sinuate; mesotibia less strongly sinuate on inner margin; metatibia with inner margin straight; meso- and metatibia each bearing a curved, sharply pointed uncus; metatibia mucronate. **Tarsi** with third segment broadly bilobed; tarsal claws each with a short tooth which extends to about middle of claw. Male genitalia as in Figs. 1, 2.

Type Material. Male holotype, female allotype and 4 male paratypes labeled as follows: Mexico, Nuevo Leon, 3 mi. S. Pacheco, July 3-4, 1974, W.E. Clark. This location is approximately 60 km. S.W. of Linares on Highway 61. These specimens were collected on **Phoradendron** sp. growing on **Juniperus** sp. The holotype and allotype are deposited in the U.S. National Museum of Natural History and the paratypes in the collection of the Department of Entomology, Texas A&M University.

This species is named for Dr. W. Dwight Pierce (1881-1967) in recognition of his contributions to the knowledge of North American Curculionidae. Specimens of the type series of *S. piercei* are fairly uniform in size, color and



Figs. 1-5 (line accompanying Figs. 1 and 2, and Fig. 5 equals 0.5 mm): 1. *S. piercei*, male genitalia, dorsal view; 2. lateral view of median lobe of same; 3. lateral view of dorsal outline of prothorax and elytra of *S. tuberculatus;* 4. same of *S. piercei;* 5. dorsal view of prothorax and base of elytra of *S. piercei.*



Figs. 6-8: Dorsal views of species of *Smicraulax*. 6. *S. tuberculatus*; 7. *S. arizonicus*; 8. *S. piercei* (holotype male).

arrangement of scales. This species is quite distinct from the other two members of the genus as indicated in the following key. In addition to the characters presented in the key, the male genitalia of *S. piercei* differ from those of *S. tuberculatus* and *S. arizonicus* by having the basal apodemes longer than the median lobe. *S. piercei* also has a flagellum which is present in *S. tuberculatus* and absent in *S. arizonicus*. Although these three species are obviously congeneric, *S. piercei* appears not to be closely related to the other two.

The inclusion of *S. piercei* in *Smicraulax* necessitates modification of some of the generic characters as presented by Burke and Hafernik (1971). The procoxae of *S. piercei* are contiguous while they are slightly separated in *S. arizonicus* and more widely separated in *S. tuberculatus*. Also, *S. piercei* does not have the base of the third elytral interval strongly elevated as in *S. arizonicus* and *S. tuberculatus*. The difference in the male median lobes was mentioned above. Otherwise, *S. piercei* possesses the characters of the genus as defined by Burke and Hafernik (1971).

The distributions of the three species of *Smicraulax* are allopatric. All three are known to be associated with species of *Phoradendron*, although only *S. tuberculatus* has definitely been shown to develop on plants of this genus.

Key to Species of Smicraulax

1. Prebasal transverse narrow elytral band of white to yellowish scales; elsewhere on elytra scales sparsely distributed and not strongly variegated in color; third elytral interval strongly elevated at base (Fig. 3); prothorax without low rounded prominences on anterior 1/2; procoxae slightly to widely separated . . . . 2.
Without narrow band of elytral scales; elytral scales dorsally moderately dense, with variegated color pattern; third elytral interval only slightly elevated at base (Figs. 4, 8); prothorax with low, rounded prominences on anterior half of prothorax (Fig. 5); procoxae contiguous; northcentral Mexico . . . . *piercei* n. sp.

2. Dorsal surface of body with scales uniform in size (Fig. 6); elytral fascia extending posteriorly along lateral edge of elytron; profemoral tooth narrow; procoxae moderately widely separated; central Texas . . . . *tuberculatus* Pierce.
Dorsal surface of body with broad and narrow scales intermixed (Fig. 7); elytral fascia not extending posteriorly along lateral edge of elytron; profemoral tooth broad; procoxae less widely separated; southeastern Arizona . . . . *arizonicus* Sleeper.

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The Entomologist's Library

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BOOK REVIEW

GENE-ENZYME SYSTEMS IN *DROSOPHILA*. Beermann, W., J. Reinert, and H. Ursprung. 1975. Springer-Verlag, New York, Heidelberg, Berlin. 163 p. $21.45.

In 1910 T.H. Morgan described the first mutation recorded for *Drosophila* - *white eye* (*w*). In the years that followed, Morgan, Bridges, and their students discovered and described many additional mutations. In doing so they helped to bring the genetic study of *Drosophila* to the high level of sophistication it is at today. In fact, during the past dozen or more years there has been increased worldwide interest in the very specialized study of gene-enzyme systems in *Drosophila*, and the authors have brought together, reviewed, and summarized much of this literature (almost 400 references) in this excellent volume.

In the preparation of "Gene-Enzyme Systems in Drosophila," Beerman, Reinert, and Ursprung fulfilled three objectives. They described each gene-enzyme system that had been described to date, they presented methods for research on gene-enzyme systems, and they presented information concerning the range of problems that can be studied using gene-enzyme systems.

Enzymes discussed in great detail include several Dehydrogeneases, enzymes of Tyrosine Metabolism, Amylase, and non-specific Hydrolytic Enzymes. The authors present the biochemistry, genetics, and developmental biology of these enzymes. Other enzymes are presented in less detail, since less is known about them.

Fewer than a dozen typographical errors were noted in the text. Considering the technical nature of the material these few errors were not serious and can be overlooked.

In the last paragraph of the Preface, the authors tell us, "The present volume is an up-to-date account of gene-enzyme systems in *Drosophila.*" This certainly appears to be a valid claim and the authors should be commended for their accomplishment. In this last paragraph the reader is also informed that the volume has been written "...for biochemists, molecular biologists, and cell biologists..." It should be noted that any entomologist conducting serious research on the genetics of insects would also find this book a most valuable addition to his or her working library.

Paul P. Shubeck
Montclair State College

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Mortimer Demarest Leonard

(1890 - 1975)

Dr. Mortimer D. Leonard, a long-time member of this Society, died on August 26. "Mort" earned his B.S. (1913) and Ph.D. (1921) at Cornell. During a long career, he was an entomologist for the USDA, several states, and several insecticide companies. One of his best known publications, "A List of the Insects of New York", was prepared while he was Acting State Entomologist in New York. Dr. Leonard retired in 1961 from Shell Chemical Corporation, and devoted most of his time thereafter to Aphididae, publishing many papers which added considerably to plant host and geographic distribution records. Mort's colorful personality helped him to successfully encourage several young people to pursue careers in entomology, and to stimulate fellow entomologists to aid with his many aphid collections. He is survived by his wife, a brother, and several nieces and nephews.

–W.H.D.

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Wanted: A CATALOGUE OF THE DIPTERA OF AMERICA NORTH OF MEXICO. USDA agric. Handbook No. 276, by Alan Stone *et. al.* William Downing, 173 Ireland Ave. Cincinnati, Ohio. 45218.

Wanted: DRAGONFLIES OF NORTH AMERICA by Needham and Westfall. Please contact James H. Kennedy, 24 Walnut Lane, Camp Hill, Pa. 17011.

For Sale: Entomological literature (new and secondhand books) on Lepidoptera, Coleoptera, etc. Jacques Rigout - Sciences Nat. 45, rue des Alouettes - Paris 75019.

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.

For Sale: East African Lepidoptera. Contact J. Kielland, 4916, Boroy, Norway.

For Sale: Lepidoptera, Coleoptera and other groups, expecially Carabidae, from France and neighboring countries. Write Remi Aulnette, 16 rue Jousselin, 28.100 Dreux, France.

Wanted: Water striders of the genus *Trepobates* (Hemiptera: Gerridae) for monograph of the genus. Send loan material to: Mr. Paul Kittle, Dep't. of Zoology, Univ. of Arkansas, Fayetteville, Ark., 72701.

Wanted: Gerridae (water striders) with complete collection data (locality and date) in alcohol or pinned; all loan specimens identified to species and almost all returned. Diane M. Calabrese, Bio Sci Group, U-43, Univ. of Conn., Storrs, Conn., 06268.

Exchange: Coleoptera of all families from Arizona. Ask for list and send yours. Dr. Rudolph Lenczy, 126 Los Robles, Green Valley, Arizona, 85614.

Wanted: Living females of large Dynastidae. They must be sent by air mail, rolled in a sheet of newspaper, put in a wooden box. I shall pay a very good price for all specimens recieved. Jacques Rigout, Sciences Nat., 45, rue des Alouettes, 75019, Paris, France.

VOL. 86 NOVEMBER AND DECEMBER NOS. 9 & 10

ENTOMOLOGICAL NEWS

Publication date: December 15, 1975

THE AMERICAN ENTOMOLOGICAL SOCIETY

ENTOMOLOGICAL NEWS is published bi-monthly except July and August by The American Entomological Society at the Academy of Natural Sciences, 1900 Race St., Philadelphia, Pa., 19103, U.S.A.

Previous editors: 1890-1910 Henry Skinner (1861-1926); 1911-1944 Philip P. Calvert (1871-1961); 1945-1967 R. G. Schmieder (1898-1967); 1968-1972 R. H. Arnett, Jr.; 1973-4/1974 R. W. Lake.

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SPRING BEHAVIOR OF *POLISTES EXCLAMANS* (HYMENOPTERA: VESPIDAE: POLISTINAE)[1]

Henry R. Hermann, Robert Barron, Len Dalton[2]

ABSTRACT: *Polistes exclamans* most often is haplometrotic in its nest founding. Yet, pleometrotic nest founding appears to result in a greater reproductivity. Nest founding commences after intermittent movements back and forth from their winter hibernaculum. Periods of slow and rapid nest enlargement are evident because of the presence of a single founding female.

Polistes exclamans (Vierech), commonly known in Georgia as the Guinea Wasp, is generally a haplometrotic species, second in apparent abundance in the Athens area to *Polistes annularis* (L.) (Hermann and Dirks 1975). On occasion, more than one female founds a nest, resulting in some behavioral difficulties.

The behavior of *P. exclamans* has been studied extensively, the latest accounts of which are those of Eberhard (1969), Eickwort (1969), Gillaspy (1973), Rabb (1960) and West (1968). Our study primarily was undertaken during the spring and early summer of 1975, although scattered observations on this species have been made for several years.

Materials and Methods

A total of 33 nests were observed over a 10-week period. Observation sites included storage buildings, barns, vacant houses, beneath eaves and awnings of houses, carports, porches and building entrances. Nests and wasps were marked in the same manner as that outlined by Hermann and Dirks (1975).

Results and Discussion

Post-Hibernation Behavior

Following the hibernation of fertile females (Hermann, Gerling and Dirks 1974), individuals of *P. exclamans* emerge from their hibernaculum about mid-April. Selection of a nest site begins at

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[1] Accepted for publication: September 18, 1975

[2] Department of Entomology, University of Georgia, Athens, Georgia 30602

this time, although the females of this species intermittently return to their hibernaculum until warm weather prevails. Most nests were initiated during the last week of April. Even after the initiation of nest building, females of *P. exclamans* enter their hibernaculum on cool nights and return to their nest when the temperature rises. We found no pre-nesting aggregations in this species as was found for *P. annularis* (Hermann and Dirks 1975). At the time of nest initiation by *P. exclamans, P. annularis* is most often already a month into colony founding (Hermann and Dirks 1975) in the Athens area.

The slowness with which colony founding takes place may be due to the haplometrotic behavior of the founding queen. The prenesting aggregations found in posthibernating *Polistes annularis* females apparently stimulates the regrouping of sibling females and the initiation of nest-building behavior. Such prenesting behavior is absent in *P. exclamans.*

Nest Initiation and Foundress Associations

Of the 33 nests observed in 1975, only two were attended by more than one female; on each of these two nests were two foundresses. During the spring of 1974, following an unusually warm winter (Hermann, Gerling and Dirks (1974), Krispyn (1975) observed up to four females on a single nest. West (1968) observed more than one foundress on nests of *P. exclamans* in Texas but found only single foundresses of this species in other areas (Oklahoma, Kansas).

Of the two nests founded by two foundresses in our study area in 1975 one female left her nest shortly after initiation while the second nest remained occupied by two females for almost two weeks. Of all observations for several years on *P. exclamans,* we have never seen colony founding continue for more than two weeks with more than one female.

During the period in which both females occupy the same nest the distinction between dominant and subordinate females is evident; one female moves around the face of the nest and assumes a dominant posture in encounters with other wasps while the other female remains chiefly on the side of the nest and demonstrates a distinctly subordinate "crouching" posture.

Nest Growth and Survival

Many nests of *P. exclamans* are unsuccessful, possibly due to the presence of a single founding queen. Of the 33 nests observed in 1975, 14 were abandoned between 1-6 weeks after colony initiation. If pleometrosis were practiced by this species there is a possibility that the success of each nest would be more likely. Most *P. annularis* nests that become defunct are founded by a single female.

Pleometrosis, therefore, appears to be an advantage to social insects and likely to be developed in more species with time. However, Michener (1964) indicated that haplometrosis is a beneficial condition in social insect colonies by pointing out the fact that a greater reproductivity per female is attained in haplometrotic colonies. Subsequently, Spradbery (1971) stated that greater reproductivity per female may be responsible for the presence of haplometrotic colonies in eusocial insects. This may not be the case, however, as we will point out in the following paragraphs.

Later survival of this species in the Athens area depends largely on the prevalence of parasites and on predation by the summer tanager, *Piranga rubra.* On several occasions Krispyn (1975) has witnessed the complete destruction of *P. exclamans* and *P. metricus* nests by these birds. A bird hovers by the nest, sometimes grabbing adult wasps in its beak. Some adult wasps escape and the bird then pecks at the nest and feeds on wasp immatures, resulting in a shredding of the nest and termination of the colony. We also have seen nests of *P. annularis* that were riddled and torn in this fashion.

Successful *P. exclamans* nests showed a steady growth until the nests had 5-8 capped cells (Table I). At this point the queen appeared to concentrate on the care and feeding of the remaining larvae. Nest construction slowed considerably. The data in Table I points out early rapid nest growth (through May 18), a slow period (May 20-June 11) and a period of increased nest construction (June 15) after the emergence of the first workers. Compared to Table II for *P. annularis* in the spring of 1970 we may point out several similarities and differences between the two species. Time of colony initiation should not be correlated since weather factors were different in each case: 1) more cells are produced per nest by *P. annularis,* although more cells per female are produced by *P.*

exclamans; 2) the appearance of capped cells takes about the same length of time in both colonies; 3) the length of time for the emergence of adults is much the same in both colonies; 4) there is not as obvious a decrease in cell building in *P. annularis* colonies as there is in colonies of *P. exclamans;* 5) at the time of worker emergence in both cases there is an immediate increase in cell number. In the latter case, however, 30 cells are present at the onset of new cell building by *P. exclamans* workers (June 15, Table I), whereas 80 cells are present in colonies of *P. annularis* (June 16, Table II). In spite of the very distinct dominance-subordination reactions on a *P. exclamans* nest founded pleometrotically, Krispyn (1975) has shown that such nests grow very much more rapidly than haplometrotic ones.

It is apparent, then, with more cells per nest and less of a decrease in cell building after the first caps appear in nests of *P. annularis,* that nests of *P. exclamans* suffer in worker output because the species is haplometrotic.

TABLE I.

AVERAGE DATA FROM 10 *P. EXCLAMANS* NESTS WITH ONE FOUNDRESS (ATHENS, GEORGIA, 1975).

Date	#of cells present	# of capped cells	# of workers
April 24	3	–	–
29	7.2	–	–
May 4	12.7	–	–
10	19.0	–	–
12	19.8	.1	–
13	20.1	1.4	–
14	20.4	3.7	–
16	21	4	–
18	21.5	4.3	–
20	22	5	–
22	22.3	5.7	–
24	22.5	5.7	–
26	22.9	6	–
28	23.3	6	–
30	23.4	6.6	–
June 1	23.8	7.5	–
5	24.1	7.6	–
7	24.6	7.9	–
11	25.3	7.7	.4
15	30.2	5.2	3.6

TABLE II.

AVERAGE DATA FROM THREE *P. ANNULARIS* NESTS (1970) WITH AN AVERAGE OF 2.3 COFOUNDRESSES PER NEST (FROM HERMAN AND DIRKS 1975).

Date		# of cells present	# of capped cells	# of workers
April	16	13.33	–	–
	17	14	–	–
	18	16	–	–
	22	21	–	–
	23	24	–	–
	26	24	–	–
May	1	32.33	–	–
	13	41.5	0.33	–
	20	44.33	8	–
	22	46	11.33	–
	27	50	16	–
June	16	80	14	16
	17	–	13.5	13.5

Tail Wagging

Rapid movement of the gaster by the queen is evident in early colony life by *P. exclamans* and demonstrated to a lesser degree by workers. Such movements, known as tail wagging (Eberhard 1969, Hermann and Dirks 1975), are usually thought of as a demonstration of hierarchical dominance (= peck order, dominance-subordination relationship); since *P. exclamans* is generally haplometrotic in its nest founding it is difficult to understand what the function of tail wagging is in early nest founding in this species. It may play a role in the later establishment of a dominance hierarchy among the workers of the colony, possibly in the determination of what workers will lay eggs for the production of males late in colony life.

Tail wagging in colonies of *P. annularis* (Hermann and Dirks 1975) appears to produce several important results: 1) it establishes the whereabouts of the dominant female and subordinate cofoundresses; 2) it appears to assist the dominant female in maintaining her position in the hierarchy; 3) it appears to increase nest acitivity either audibly or visually 4) it indicates that workers enter the dominance reactions and succeed in holding a dominant position over subordinate cofounding females.

There is also the possibility that pheromones or defensive compounds may be produced in the abdomen (Hermann and Dirks 1974) and dispersed with the lateral wagging movements. This possibility has not been investigated although it offers a reasonable explanation for tail wagging in a haplometrotic female.

Aggression and Colony Protection

Unlike the queens of *P. annularis,* those of *P. exclamans* do occasionally attack an intruder without much provocation. We have been aggressively approached by a *P. exclamans* queen from a distance of 18 feet from the nest.

Attack by workers after provocation often is not *en masse* but by a single individual. Threatening posture of raised abdomen and fluttering wings, as described by Eberhard (1969) is commonly demonstrated by the queen and workers.

When group stinging was evident it appeared that nest vibrations, initiated by alarmed individuals, alerted other workers on the nest. This means of communication also was reported by Eberhard (1969). When disturbance was enough to cause a group exodus from the nest the first individual to return to the nest was the queen.

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CALLING CHIRPS IN *TROPISTERNUS NATATOR* (D'ORCHYMONT) AND *T. LATERALIS NIMBATUS* (SAY) (COLEOPTERA: HYDROPHILIDAE)[1]

Lee C. Ryker[2]

ABSTRACT: Males of two species of *Tropisternus* responded to underwater broadcasts of conspecific female calling chirps by emitting calling chirps and by searching behavior. Male *T. natator* did not give phonoresponses to broadcast female stress chirps or male courtship buzzes, and male *T. lateralis nimbatus* did not give phonoresponses its own male ticking sounds. This is the first substantiation of underwater acoustic signal discrimination and function in aquatic beetles.

DESCRIPTORS: Coleoptera, Hydrophilidae; *Tropisternus;* acoustic behavior; calling signal; phonoresponse; signal discrimination.

Charles Darwin (1881) discussed the phenomenon of sound production by stridulation (friction of one specialized body part against another) in Coleoptera and suggested that this behavior may have a sexual function. Arrow (1942) pointed out that hearing organs are unknown in Coleoptera and hypothesized that beetles stridulate merely for pleasure. Since 1950, research has shown that acoustic signals are important in the mating behavior of many Orthoptera, Heteroptera, and Homoptera (Walker, 1957; Busnel, 1963; Alexander, 1967; Otte, 1970; Jansson, 1973). Specific sound emissions were associated in these taxa with situations such as stress, aggression, courtship, copulation, and "calling" (signals produced by either sex, often by individuals when alone, that bring male and female together for mating). Aggressive and/or courtship sounds have been described for beetles in several families, for example Trogidae (Alexander, Moore and Woodruff, 1963), Hydrophilidae (Van Tassell, 1965; Ryker, 1972), Cerambycidae (Michelsen, 1966), Passalidae (Schuster and Schuster, 1971; Schuster, 1975), and Scolytidae (Rudinsky, 1968; Rudinsky and Michael, 1972, 1974), but the calling signals of

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[1] Accepted for publication: September 18, 1975

[2] Entomology Department, Oregon State University, Corvallis, Oregon 97331

beetles were commonly found to be chemicals called pheromones (Karlson and Butenandt, 1959; Schneider, 1966; Wood, 1970). It was suggested that acoustic signals in Coleoptera are generally limited to low-amplitude, short-range sounds and that longer-range calling signals represent a more recent evolutionary innovation in Orthoptera and Cicadidae not found in most Coleoptera (Alexander, Moore and Woodruff, 1963; Alexander, 1967). This report indicates that two species of aquatic beetles use waterborne acoustic calling signals.

Possible acoustic calling signals were reported in *Trox suberosus* (Alexander, Moore and Woodruff, 1963), and several species of *Tropisternus* (Ryker, 1972, 1976). Males and females of the plum curculio, *Conotrachelus nenuphar,* were shown experimentally to move to cages containing stridulating beetles of the opposite sex and not to cages containing silenced beetles (Mampe and Neunzig, 1966), but it is not known how such acoustic signals facilitate mate-finding in nature.

Beetles of the genus *Tropisternus* spend most of their lives (nearly a year) as adults, living underwater among emergent vegetation and detritus at the edges of ditches and ponds. They surface only to renew their air supply. Females lay clutches of eggs every few days, and apparently mate about every three weeks during the spring and summer breeding season. Each species produces several distinctive sounds in stress, courtship, copulation, or aggressive contexts (Ryker, 1972, 1976). Male and female *T. natator* (D'Orchymont) produce similar calling chirps (which are of much shorter duration than their stress chirps) when alone or with other beetles (Fig. 1b). Males call more often than females. In addition, males buzz in several situations: as they approach a female, move through a ritualized courtship dance while mounted dorsally on the female, and copulate (Fig. 1c). Male and female *T. lateralis nimbatus* produce similar calling chirps that are of longer duration than those of *T. natator,* but shorter than their own stress chirps. Males also emit ticking sounds when alone and trills during mounted courtship (Ryker, 1972). Sounds produced by beetles when alone were previously termed "calling chirps" on the basis of context. Therefore, an experimental method to demonstrate this calling function was devised.

Methods and Materials

Acoustic signals of beetles were recorded underwater with a Uher 4000L tape recorder and a rubber-coated Instrument Contact Microphone (European Crafts Co., Hollywood, CA). The frequency response for the Uher and microphone was essentially

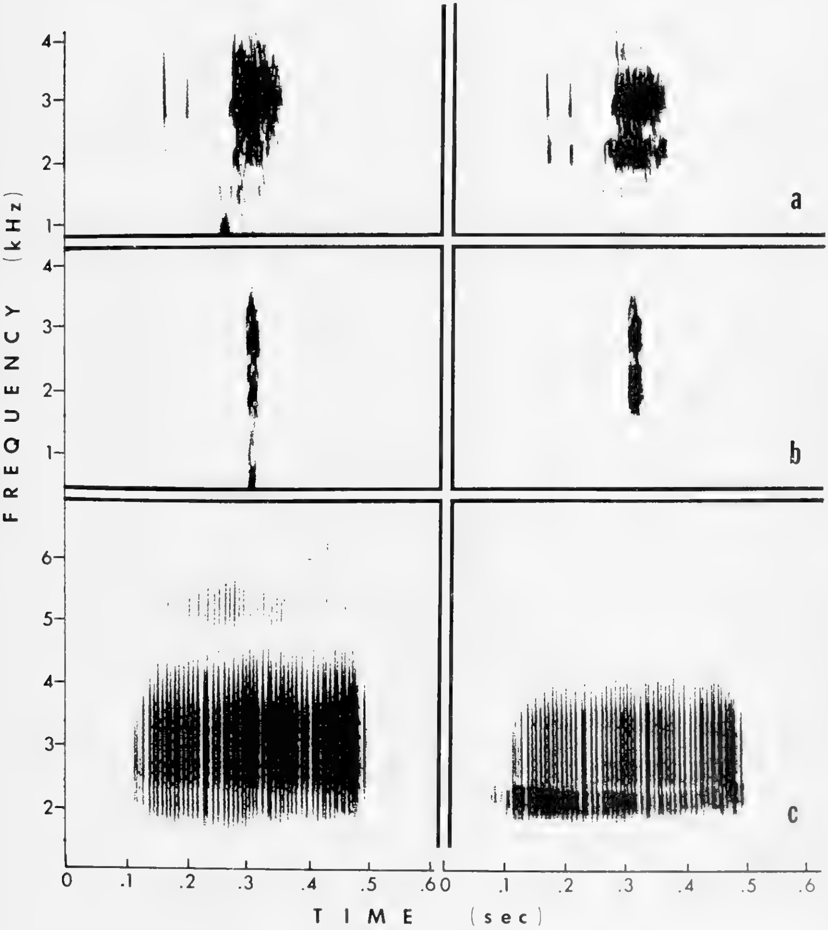

Fig. 1. Sonagraphs of stridulations of *Tropisternus natator*. Left sound of each pair: sounds of live beetles. Right: re-recorded broadcasts. a) female stress chirp; b) female calling chirp; c) male courtship buzz.

flat from 0.05-10 kHz at 19 cm/sec. Tape recorded sounds were broadcast underwater through a rubber-coated Stenorette earphone, with a beetle exoskeleton glued over the opening to produce a broad band of frequencies, similar to stridulations of live beetles (Fig. 1). Recordings and experiments were carried out in a plexiglas chamber, 8.5 X 16.5 X 6 cm (depth). To dampen sound reflections, the floor and one side wall were covered with two layers of asbestos screening oriented at 45° to each other, and the chamber was screen-partitioned into three chambers, with one end filled with aquatic plants. Tests were carried out in the opposite end. The speaker and microphone were in the central chamber.

Tape loops of female stress chirps, female calling chirps, and male courtship buzzes were broadcast underwater to individual *T. natator* males (six repetitions). Tape loops of female calling chirps and male ticking sounds were broadcast to *T. lateralis nimbatus* males (16 repetitions). Relative amplitudes of broadcast stridulations were monitored on the Uher VU meter and adjusted to closely approximate the amplitudes of live beetle stridulations. Each male was allowed one or more hours to acclimate to the chamber before testing. Only males that would approach females that day were used. The series of controls and tests were run sequentially, once on each *T. natator* male and two or three times (on different days) on each *T. lateralis nimbatus* male. Each series was completed within 4 hours to avoid day to day changes in behavior noted in individuals. The sequence of presentation of test stimuli was randomized. Each 5 minute test was preceded by a 5 minute control period. An interval of 10-15 minutes between tests allowed any previous responses to extinguish and the beetle to resume feeding. The number of stridulations by the male during test and control periods was counted, and comparisons were made utilizing the Wilcoxon matched pairs, signed ranks test.

Results

The phonoresponse of *T. natator* males to broadcast female calling chirps was significantly greater than response during the control period, and also greater ($P < 0.05$) than response to broadcast female stress chirps and male courtship buzzes (Fig. 2a).

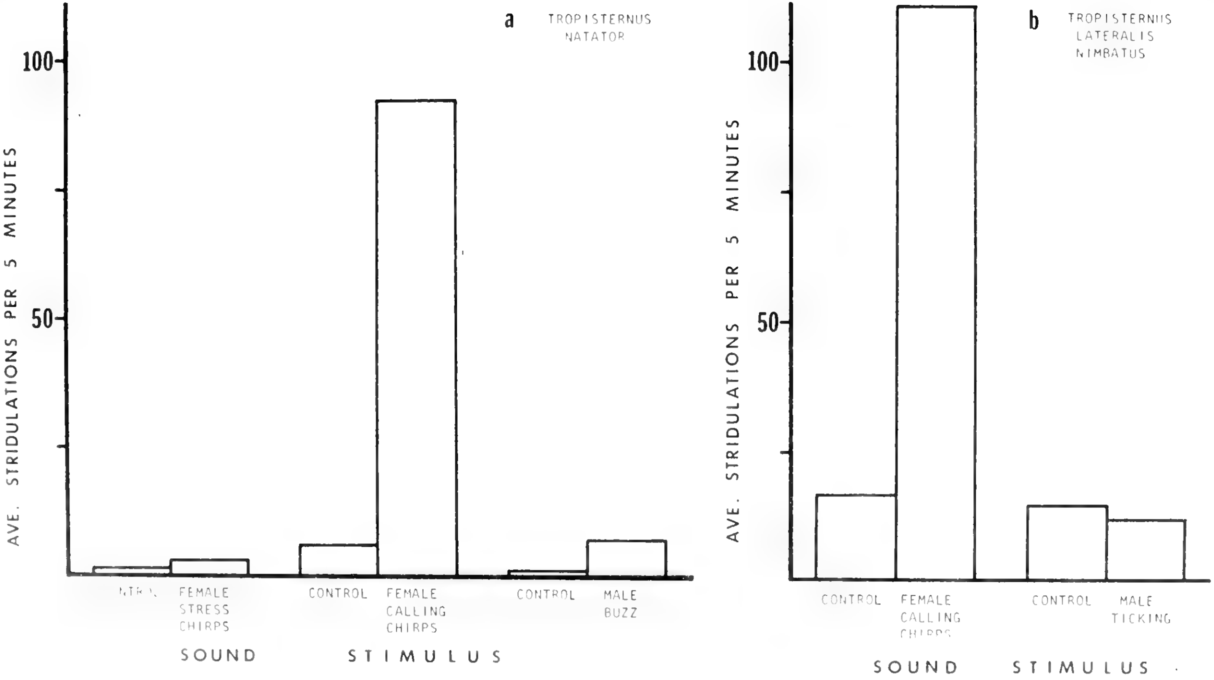

Figure 2. Average number of stridulations of males of two species of *Tropisternis* during 5 minute broadcasts of tape recorded conspecific stridulations or silent control periods. Each column in a) represents six males; in b) 16 males.

While calling chirps were being broadcast, males chirped (calling chirps) frequently, but sometimes buzzed. They also spent less time feeding, and most of the time walking and swimming around in the chamber, especially while stridulating (Table 1). In the control and other test periods, the activity of males was divided between feeding, resting, cleaning, walking, and swimming.

Test beetles were presented with a plastic-coated dead beetle, glued to the tip of a slender glass rod, immediately after each broadcast period (three trials each). *T. natator* males often buzz, approach, and mount beetle models; however,all six test beetles invariably responded by stridulating and approaching the model after being stimulated by female calling chirp broadcasts. Males also showed increased tendency to approach, but not to stridulate while approaching, after stress chirp broadcasts, but not after male courtship buzz broadcasts (Table 1).

TABLE 1.

RESPONSES (%) OF MALES OF TWO SPECIES OF *TROPISTERNUS* TO BEETLE MODEL PRESENTATIONS FOLLOWING 5 MINUTE PERIODS OF ACOUSTIC SIGNAL BROADCASTS OR SILENCE (CONTROLS), AND PER CENT OF TIME MALES SWAM DURING EACH PERIOD.

Type of response	Response to model presentation after various broadcast stimuli				No. trials
	Control	Calling chirp	Male sound	Stress chirp	
		Tropisternus natator			
Swam	6	85	10	15	30
Approached model	78	100	61	100	18
Approach stridulation	67	100	61	72	18
		Tropisternus lateralis nimbatus			
Swam	5	60	10	–	25
Approached model	57	100	100	–	30
Approach stridulation	30	87	77	–	30

The phonoresponse of *T. lateralis nimbatus* males to broadcast female calling chirps was significantly greater ($P < 0.01$) than response during either control or male ticking broadcast periods (Fig. 2b). Stridulations during control and ticking broadcast periods were either calling chirps or ticking sounds, but only calling chirp responses were given during calling chirp broadcasts. As with *T. natator,* males of *T. lateralis nimbatus* spent more time walking and swimming during calling chirp broadcasts. Males were more likely to approach and to stridulate while approaching a beetle model after broadcasts of either female calling chirps or male ticking sounds than after a control period (Table 1).

Discussion

Though auditory receptors are yet unknown in beetles, this study confirms that these two species of *Tropisternus* can hear water-transmitted sounds. Males discriminated the female calling chirp from other conspecific acoustic signals and responded with "searching" behavior, i.e., once stimulated by a calling signal, the male ceased feeding, began swimming and chirping, and approached and mounted any beetle it encountered. Broadcasts of sounds other than calling chirps also stimulated males to approach other beetles, but not to cease feeding and begin swimming.

Similar tests utilizing broadcast acoustic signals were carried out with females, which have calling chirps indistinguishable from those of males, but their responses were not different in test and control periods (Ryker, 1976). This data, not presented here, indicates that it is probably the male that moves to the female during calling and pairing. The searching and calling response of males to the calling chirp of females substantiates previous casual observations suggesting that species of *Tropisternus* use calling signals. Acoustic calling signals would seem very useful for mate location in the heavily vegetated, three-dimensional underwater pond edge habitat of these beetles.

ACKNOWLEDGEMENTS

I thank R.D. Alexander and T.E. Moore, Museum of Zoology, University of Michigan for use of acoustic laboratory facilities. This study is part of a Ph.D. thesis, Oregon State University.

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SEASONAL DISTRIBUTION OF PROTURA IN THREE DELAWARE FORESTS[1],[2]

Gary L. Walker, Richard W. Rust[3]

ABSTRACT: Three forest sites were sampled bimonthly from May 1974 to April 1975 to determine the seasonal distribution and age structure of Protura. Two species were found, *Eosentomon vermiform* Ewing was present in all sites and *Acerella* species was present in two of them. Populations at two sites fluctuated with peak densities in the late summer (July-August) to early winter (September-December). Stable populations at the other site most likely relate to the habitat stability and forest age. Population age structure showed a predominance of adults throughout the year with most immatures occurring in July-August.

DESCRIPTORS: Protura; *Eosentomon, vermiforme* Ewing; *Acerella* sp.; seasonal distribution; population density; deciduous forests.

Protura are members of the soil fauna, a diverse assembledge of animals inhabiting the top few centimeters of the earth's surface. Ecologically these animals are detritivores and their predators. They exist in a region of high humidity, relative absence of air movement and more stable temperatures than surrounding areas (Kuhnelt 1961). Ewing (1940) referred to proturans as creatures of darkness, entirely defenseless and requiring humid conditions for survival. Protura are found under bark, in peat and moss, under stones and logs (Williams 1913), in permanent grasslands and pastures (Salt *et al.* 1948, Raw 1956, Lussenhop 1973), in oak and pine forests (Pearse 1946, Price 1973) and expressway margins (Lussenhop 1973). Much is known about their taxonomy, morphology and geographical distribution (Ewing 1940, Tuxen 1964, and Janetschek 1970), but their population structure and seasonal abundance has received limited attention (Pearse 1946, Raw 1956 and Price 1973).

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[1] Accepted for publication: September 18, 1975

[2] Published as Misc. Paper No. 735 with the approval of the Director of the Delaware Agric. Exp. Stn. Publication No. 441 of the Dept. of Entomology and Applied Ecology.

[3] Coauthors, Undergraduate and Assistant Professor, Department of Entomology and Applied Ecology, University of Delaware, Newark, DE 19711

This paper presents results of a study on the seasonal abundance and population structure of Protura from three different forest areas in Delaware.

Methods and Materials

Three forest sites in Delaware were each sampled six times from May 1974 to April 1975. A core sampler with an 11.3 cm diameter was used. Ten cores were taken per site for each sampling period. Core depths varied from 8 cm to 12 cm depending on roots and the thickness of the humus layer. A plot was circular with six equally spaced radii along which the cores were removed at one meter intervals. One randomly selected radius was sampled at a sample time. Three additional samples were taken from each site for pH, organic content and chemical analysis.

Eight modified Burlese funnels with 25 watt light bulbs were used for collecting the proturans (Tuxen 1964, Phillipson 1971). Samples remained in the funnels for 72 hours. Samples that could not be run simultaneously were placed in refrigeration at 3.3-5.5°C for no more than 7 days. The proturans were separated into immatures, those with less than 12 abdominal segments, and adults, those with 12 abdominal segments.

Soil tests were done by the Soil Testing Laboratory at the University of Delaware. Temperature and rainfall data were taken from the closest reporting weather station. The Newark site was less than 1 km away, Woodside site 8.0 km and Georgetown site 4.8 km.

Site Description

All three study areas were located on the coastal plain of the Delmarva peninsula. Site one was located in the University of Delaware woodlot, Newark, Delaware. The forest is a maturing deciduous forest being approximately 100 years old and composed of white oak *(Quercus alba)*, tulip-tree *(Liriodendron tulipifera)*, hickories (*Carya* spp.), and sweet gum *(Liquidambar styraciflua).* The understory is composed of ironwood *(Ostrya virginiana)*, dogwood *(Cornus florida)* and *Viburnum dentatum.* The dominant ground cover was mayapple *(Podophyllum pelatum).* Soil type was Keyport silt loam (USDA 1970). The plot was located on a high mound and was well drained. Litter depth was approximately 2 cm and the humus was approximately 4 cm deep. The pH ranged from pH 4.1-4.6. Organic content ranged from 8-11 percent.

Site two was located in a predominately loblolly pine *(Pinus taeda)* forest approximately 3.2 km east of Woodside, Delaware. The forest was determined to be approximately 60 years old by tree core measurements of the loblolly pines. Other trees were sweet gum, tupelo *(Nyssa aquatica)*, holly *(Ilex opaca)* and white oak. A heavy stand of poison ivy *(Rhus radicans)* covered much of the ground in and around the plot. The soil was Woodstown loam (USDA 1971) with poor drainage and a 2-4 cm litter depth and a 4-6 cm humus layer. The pH ranged from pH 3.6-4.3 and the organic content varied from 8-19 percent.

Site three was located 5.6 km southwest of Georgetown, Delaware in an approximately 25 year old deciduous forest. The dominant species were red maple *(Acer rubrum)*, sweet gum, holly, a few oaks (*Quercus* spp.) and some loblolly pine. The predominate ground cover was scattered poison ivy. The soil was Fallsington sandy loam and was poorly drained (USDA 1974). Litter depth was approximately 2 cm and the humus 3-4 cm deep. The pH ranged from pH 3.4-4.0. The organic content was approximately 30 percent.

Magnesium (Mg) ranged from 16.7-21.9 ppm, phosphorus (P_2O_5) from 0.9-2.5 ppm and potash (K_2O) from 15.6-18.8 ppm in the three areas. No seasonal or site variations were observed. The pH at the three sites showed only a slight seasonal pattern. The highest pH occurred in July-August and March-April and the lowest in January-February.

Results

A total of 933 specimens was collected from the three sites. Two species, *Acerella* sp. (Acerentomidae) and *Eosentomon vermiforme* Ewing (Eosentomidae), were collected at sites one and two. Site three contained only *Eosentomon vermiforme*. Tuxen (pers. comm.) informed us that the *Acerella* species was very close to *A. canadensis* Tuxen but differed in some important points. We have decided to refer to it as *Acerella* species.

The population of *Eosentomon vermiforme* at Newark showed little seasonal change and had a mean density of 141/m^2 (range 71-190/m^2) (Fig. 1) and the adults remained dominate with the immatures reaching a peak in July-August (47.1%) (Table 1). The

Acerella sp. from Newark also showed a fairly uniform population with a mean density of $66/m^2$. This population reached a low during the winter with $20/m^2$ in November-December and $10/m^2$ in January-February. Immatures were found present only in the first two samples for *Acerella* sp. (Table 1).

At Woodside the *Acerella* sp. showed a high population density in late summer to early winter with a high in November-December of $2330/m^2$ (Fig. 2). This population high was preceded by a low of $86/m^2$ (May-June) and followed by a low of $188/m^2$ (March-April). *Eosentomon vermiforme* population also peaked in November-December ($130/m^2$) and then declined rapidly afterwards ($12/m^2$). The Woodside population had immatures present until the January-February sample when the populations were declining. The highest percentage of immatures for *Acerella* occurred in May-June (25%) and July-August (25.9%) and *E. vermiforme* contained 50% immatures in July-August and 28.6% immatures in November-December (Table 1).

The Georgetown population of *E. vermiforme* reached highs of $1390/m^2$ in September-October and $1050/m^2$ in November-December, these were preceded by a low ($30/m^2$) and followed by a low ($40/m^2$) (Fig. 3). The March-April samples at Georgetown were saturated with water. When cores were removed from the ground, water seeped into the holes. These samples did not provide any proturans in the 72 hours of collecting. The January-February sample at Georgetown was represented by four immatures, the May-June by four adults and July-August by two adults and one immature (Table 1).

The individual bimonthly samples and totals for the three sites all show clumped distributions of the proturans (Table 2). The distributions approach the Poisson but the coefficient of dispersion (CD) (Sokal and Rohlf 1969) in all but three of the samples (Newark, March-April; Woodside, July-August and March-April) is > 1 or < 1 indicating clumping or repulsion of the proturans from a random distribution as indicated by the Poisson distribution.

The rainfall per month fluctuated, being low in July, October and November and high in August, January and March for the three sites (Figs. 1, 2 and 3). The mean monthly temperatures for the three areas differ only by a degree or two. July and August temperatures were highest and January and February were lowest (Figs. 1, 2 and 3).

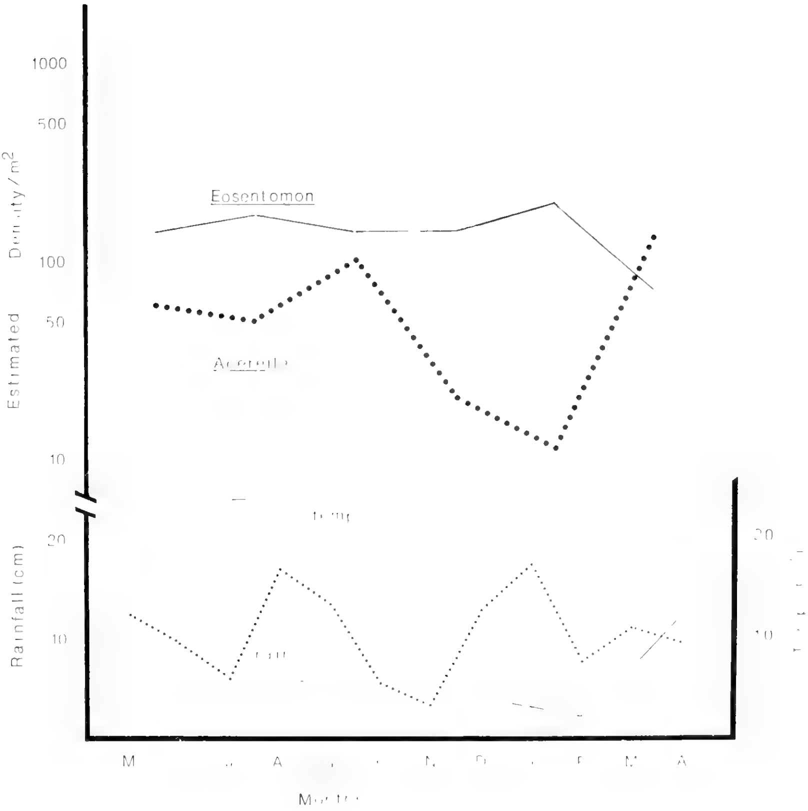

Figure 1. Estimated population density of *Eosentomon vermiforme* Ewing and *Acerella* sp. collected from Newark, DE from May 1974 to April 1975 (above). Total monthly rainfall (below, left) and mean monthly temperature (below, right).

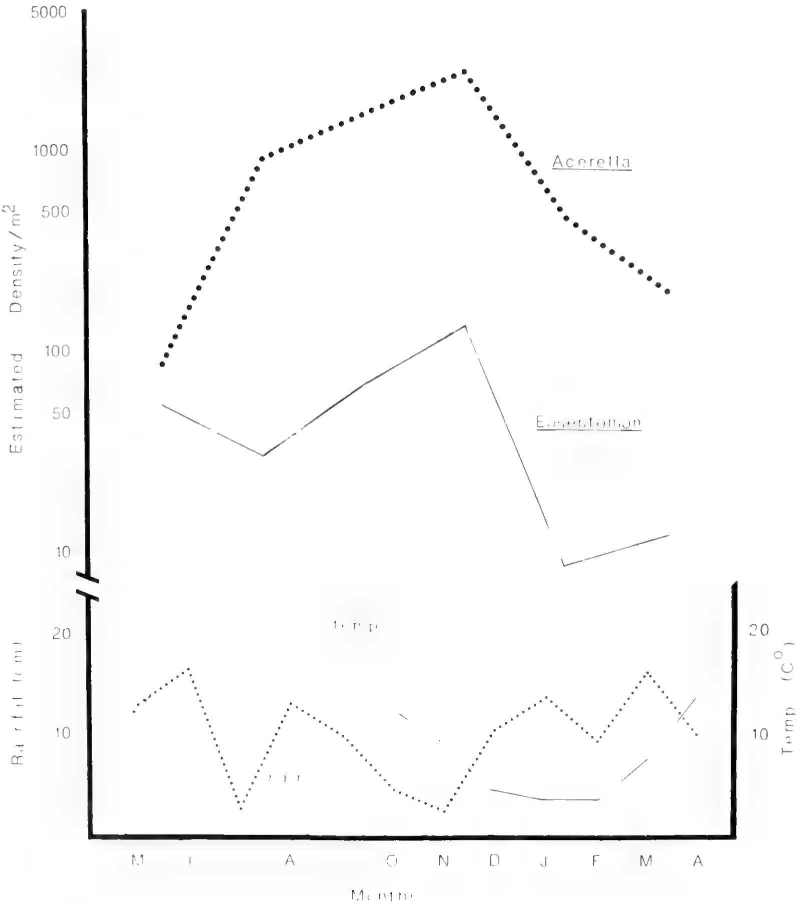

Figure 2. Estimated population density of *Eosentomon vermiforme* Ewing and *Acerella* sp. collected from Woodside, DE from May 1974 to April 1975 (above). Total monthly rainfall (below, left) and mean monthly temperature (below, right).

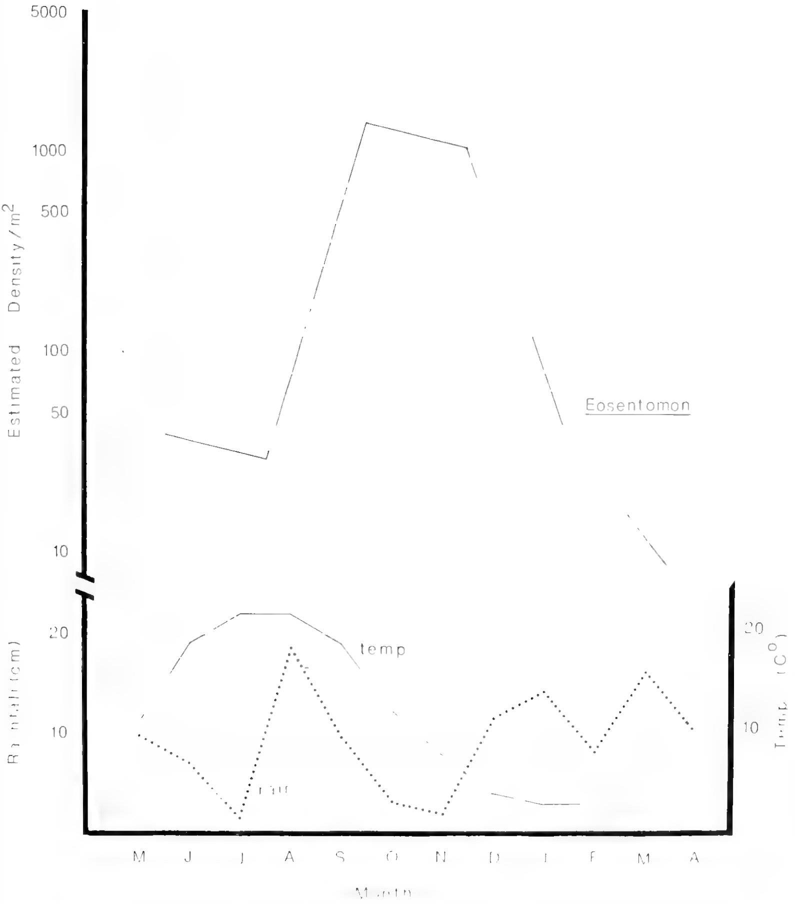

Figure 3. Estimated population of *Eosentomon vermiforme* Ewing collected from Georgetown, DE from May 1974 to April 1975 (above). Total monthly rainfall (below, left) and mean monthly temperature (below, right).

Discussion

The clumped distribution of the proturan species in the three forest areas is characteristic of many soil arthropods (Cole 1946). Price (1973) found highly aggregated distribution of a proturan species in coniferous forest soil and Raw (1956) found *Proturentomon minimum* (Gisin) and a species of *Eosentomon* from grasslands were aggregated and concluded that the degree of aggregation appeared to be independent of the population density. The aggregations observed are probably the result of highly favorable "micro" conditions within the structure of the soil (spaces, soil moisture, food, etc.) and slow dispersal rates from reproductive centers.

The uniformity of the Newark populations as compared to the eruptive populations at the other sites may relate to the stability of that habitat. The Newark site is well drained and never with standing water. The soil type (silt loam) will hold more moisture over a longer period of time and this coupled with the fairly uniform rainfall (Fig. 1) would provide a more constant environment. The age of the forest and maturity of trees would also provide a uniform litter fall to the soil. The population increases at Woodside and Georgetown correspond to the period of lowest total rainfall over a three month period (Sept., Oct., Nov.) (Figs. 2 and 3). This is also a period of declining average temperature from the summer mean maximum. However, this temperature phase continues until February. Pearse (1946) found that *Eosentomon pusillum* Ewing from an oak-pine forest in North Carolina showed no noticeable seasonal trends, but fluctuated irregularly. Price (1973) found a very definite seasonal trend for a proturan from a California pine forest. That unnamed species showed a peak population corresponding to the wet-winter months. The numerical dominance reversal of *Acerella* sp. between Newark and Woodside may be explained by the switch from a decidious litter at Newark to a coniferous litter at Woodside or a factor associated with this change. The reason for the absence of *Acerella* sp. from Georgetown is unknown to us.

Sturm (1959) observed *Acerentomon* sp. piercing the hyphae of a mycorrhizal fungus growing on oak and hornbeam *(Carpinus)* roots and a species of *Eosentomon* fed on both mycorrhizal fungi and free hyphae. Mycorrhizal fungi which are in association with the roots of all plants would be either dormant if on non-coniferous plants or less active if on conifers in the fall of the year (Harley 1969). This dormant or reduced activity period corresponds to the population increase at Woodside and Georgetown (Figs. 2 and 3). The mycorrhizal fungi on pines when active produce large amounts of toxins that have an inhibitory effect on numerous organisms (Marx 1972). The fungi on non-conifers *(Endogone)* do not produce any known toxins; however, they form sporocarps and have different ectocarpic resting spores of which most occur in the top 15 cm of the soil (Mosse 1973). These fungi in their dormant stage or reduced activity stage may serve as an added food source along with the decaying leaves on which they have been observed feeding (Ewing 1940).

The stability of the Newark populations may also be related to the food availability. The ground cover (mayapple) and amount of roots in the humus layer in Newark was less than at Georgetown and Woodside which probably resulted from a greater amount of ground cover (poison ivy). The mycorrhizal fungi at Newark would not be as abundant as at the other sites which may account for the lower abundance of Protura (Fig. 1) as compared to Woodside or Georgetown (Figs. 2 and 3).

We found immature proturans mainly in the late spring (May-June) and summer (July-August) samples at all sites for both species. The remaining samples contained relatively few immatures, with the spring (March-April) samples containing none (Table 1). The greatest percentage of immatures in any population corresponds to the period of highest mean temperatures and the period of most food production. The presence of immatures in other sample periods indicates either an annual life history (Phillipson 1971) or continued reproduction into the cooler months.

TABLE 1.

POPULATION AGE STRUCTURE OF PROTURA FROM THREE FOREST AREAS IN DELAWARE COLLECTED FROM MAY 1974 TO APRIL 1975.

Species	Collection Date and % of Adults/Immatures May-June	July-Aug	Sept-Oct	Nov-Dec	Jan-Feb	March-April
			Site One: Newark			
E. vermiforme	78.0/22.0	52.9/47.1	100/-	92.8/7.2	88.9/11.1	100/-
Acerella sp.	66.7/33.3	80.0/20.0	100/-	100/-	100/-	100/-
			Site Two: Woodside			
E. vermiforme	80.0/20.0	50.0/50.0	100/-	71.4/28.6	-/-	100/-
Aceralla sp.	75.0/25.0	74.1/25.9	90.6/9.4	92.8/7.2	100/-	100/-
			Site Three: Georgetown			
E. vermiforme	100/-	66.7/33.3	97.8/2.2	93.0/7.0	-/100	-/-

TABLE 2.

POPULATION STATISTICS FOR PROTURA FROM THREE FOREST AREAS IN DELAWARE COLLECTED FROM MAY 1974 TO APRIL 1975.

	Collection Date						Total
	May-June	July-Aug	Sept-Oct	Nov-Dec	Jan-Feb	March-April	
			Site One: Newark				
Mean	2.0	2.2	2.4	1.6	2.0	1.7	1.9
S.D.	4.83	4.42	1.71	2.22	2.67	1.77	3.06
C.D.	2.14	2.00	0.71	1.38	1.33	1.04	1.56
			Site Two: Woodside				
Mean	1.4	9.2	14.8	24.6	4.5	1.7	9.3
S.D.	2.37	9.25	20.08	30.17	5.34	1.64	17.11
C.D.	1.69	1.00	1.35	1.22	1.18	0.96	1.82
			Site Three: Georgetown				
Mean	0.4	0.3	13.9	10.5	0.4	–	3.9
S.D.	0.97	0.48	12.08	7.96	0.69	–	8.03
C.D.	2.42	1.60	0.86	0.75	1.72		2.04

ACKNOWLEDGEMENTS

We would like to thank Professor S.L. Tuxen for his help in identification of the specimens and his encouragement to continue the project. The comments and suggestions of Drs. D.F. Bray, P.P. Burbutis, L.R. Hawf and L.P. Kelsey are appreciated and helpful.

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A PRELIMINARY REPORT ON THE SYRPHIDAE (DIPTERA) OF BELIZE, WITH THE DESCRIPTION OF A NEW SPECIES[1]

Yale S. Sedman[2]

ABSTRACT. The results of three syrphid fly collecting trips to Belize are summarized. Keys are provided for identification of the twelve genera and 39 species recognized, including one new species which is described.

Knowledge of the insect fauna of Belize is fragmentary and widely scattered in the literature. The program of the Associated Universities for International Education in Tropical Biology, which completed its sixth year of operation in Belize in 1975, has stimulated interest in developing more detailed information concerning the biota of this poorly studied country.

The following report summarizes the results of collections of Syrphidae made by me in Belize during brief collecting trips in 1969, 1970, and 1973, as well as information available from the literature relating to the syrphid fauna. The 39 species recorded may represent but a small sample of the total syrphid fauna but adds much to our knowledge. Only two species of Syrphidae have been recorded from Belize, and both were described as new species by Hull (1941; 1942).

The nomenclature utilized is based primarily on the revisionary work of Thompson (1972) which alters the names of a number of common Neotropical genera. Keys for the separation of the genera, as well as keys to species, are presented so as to facilitate identifications. The specimens listed will be deposited in the Insect Collection of Western Illinois University and duplicates with St. John's College, Belize City, Belize.

The following key will separate the genera of Syrphidae presently known to occur in Belize:

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[1] Accepted for publication: September 25, 1975

[2] Dept. of Biological Sciences, Western Illinois University, Macomb, Illinois 61455.

ENT. NEWS, 86: 9 & 10: 199 - 206, November & December 1975

Key to Genus

1. Face evenly convex; with a stump of vein extending from 4th longitudinal vein . . . . *Mixogaster*
1' Fact tuberculate or concave 2

2. Humeri bare 3
2' Humeri pilose 7

3. Head, thorax, and abdomen multipunctate . . . . *Nausigaster*
3' Body lacking punctures 4

4. Metasternum pilose . . . . *Allograpta*
4' Metasternum bare 5

5. Abdomen emarginate . . . . *Toxomerus*
5' Abdomen not emarginate 6

6. Epistoma projecting forward . . . . *Pseudodoros*
6' Epistoma not projecting beyond facial tubercle or middle of face . . . . *Ocyptamus*

7. Third longitudinal vein straight; without a dense patch of black setae on base of hind femora 8
7' Third longitudinal vein looped into 1st posterior cell; with dense patch of black setae on base of hind femora 10

8. Arista bare . . . . *Sterphus*
8' Arista pilose 9

9. Face with three tubercles . . . . *Ornidia*
9' Face with one tubercle . . . . *Copestylum*

10. Marginal cell open . . . . *Quichuana*
10' Marginal cell closed 11

11. Eyes bare; thorax with opaque tomentum . . . . *Meromacrus*
11' Eyes pilose; thorax without opaque tomentum . . . . *Palpada*

Mixogaster Macquart

Mixogaster sp. CAYO DIST.: Millionario, 9 July 1973, 1 male. Thompson (in litt.) suggests that this is a new species close to *M. rarior* Shannon.

Nausigaster Williston

N. meridionalis Townsend. CAYO DIST.: 7 mi. N. of Blancaneaux Lodge, 11 July 1973, 2 males.

Allograpta Osten Sacken

A. obliqua (Say). BELIZE DIST.: Sibun River, 1 mi. N. of mile 19, 5 July 1973, 2 males.

Key to *Toxomerus* Macquart

1. Scutum black laterally, humeri and posterior calli sometimes yellow 2
1' Scutum yellow laterally 3

2. Anterior four femora black on basal 3/4; male and female with black facial stripe . . . . *anthrax*
2' Anterior four femora yellow on basal 3/4; male face yellow, female with abbreviated black facial stripe . . . . *basilaris*

3. Pteropleura yellow 4
3' Pteropleura black 5

4. Abdominal tergites 3 and 4 with broadly yellow fascia basally, with faint indications of black spots or geminate vittae . . . . *azurlineus*
4' Abdominal tergites 3 and 4 with black geminate vittae which are expanded laterally on the basal 1/3 of the segments to form an interrupted linear black fascia . . . . *politus*

5. Scutellum black with yellow margin 6
5'. Scutellum yellow, disc often brownish 8

6. Yellow spot above anterior coxae . . . . *floralis*
6' No yellow spot above anterior coxae 7

7. Apex of posterior tibiae yellow, basal 2/3 black . . . . *pictus*
7' Posterior tibiae black . . . . *confusus*

8. 2nd costal cell without microtrichiae on basal 3/4, few scattered microtrichiae in apex of cell . . . . *laciniosus*
8' 2nd costal cell with dense microtrichiae, at least in apical 1/2 9

9. Scutellum with dense black setae; basal cells of wing generally without microtrichiae . . . . *productus*
9' Scutellum with yellow setae mixed with scattered black setae; basal cells of wing with dense microtrichiae . . . . *musicus*

T. anthrax (Schiner). TOLEDO DIST.: Columbia Forest Sta., 5 July 1970, 2 males; 9 July 1970, 1 fem.; 30 July 1970, 1 fem.; 2 Aug. 1970, 1 fem.; 3 Aug. 1970, 1 fem.

T. basilaris (Wiedemann). CAYO DIST.: Central Farm, 24 July 1970, 10 males, 1 fem.; TOLEDO DIST.: Columbia Forest Sta., 5 July 1970, 1 male.

T. azurlineus (Hull). CAYO DIST.: Cayo, 21 Feb. 1909, 1 male, F. Knab, Coll.; 7 mi. N. of Blancaneaux Lodge, 11 July 1973, 1 fem.; TOLEDO DIST.: Columbia Forest Sta., 8 July 1970, 1 male.

T. politus (Say). CAYO DIST.: Spanish Lookout, 26 July 1970, 1 male, 3 fem.

T. floralis (F.) TOLEDO DIST.: Columbia Forest Sta., 2 July 1970, 1 male.

T. pictus (Macquart). TOLEDO DIST.: Columbia Forest Sta., 1 July 1970, 1 male, 1 fem.; 3 July 1970, 1 male; 4 July 1970, 2 males; 2 Aug. 1970, 1 fem.; CAYO DIST.: Spanish Lookout, 24 July 1970, 1 fem.

T. confusus (Schiner). BELIZE DIST.: Sibun River, 1 mi. N. of mile 19, 5 July 1973, 1 fem.; CAYO DIST.: Millionario, 9 July 1973, 2 males.

T. laciniosus. (Loew). STANN CREEK DIST.: Lynum School, 24 July 1970, 1 fem.; TOLEDO DIST.: Columbia Forest Sta., 1-8 July 1970, 14 males, 6 fem.

T. productus (Curran). CAYO DIST.: Rio Frio Cave, 8 July 1973, 1 male.

T. musicus (F.). CAYO DIST.: Spanish Lookout, 1 July 1970, 1 male; STANN CREEK DIST.: Lynum School, 24 July 1970, 2 fem.

Pseudodoros Becker

P. clavatus (F.). CAYO DIST.: Rio Privassion, 12 July 1973, 1 fem.

Key to *Ocyptamus* Macquart

1. Second abdominal segment broader than long 2
1' Second abdominal segment longer than broad 3

2. Pteropleura white pilose; posterior basitarsi yellow . . . . *gastrotactus*
2' Pteropleura black pilose; posterior basitarsi dark brown . . . . *dimidiatus*

3. Face black 4
3' Face yellow 5

4. Abdomen with yellow spots on black background, one pair of spots on tergite 2, two pair on tergites 3, 4 and 5 . . . . *adspersus*
4' Abdomen black . . . . *panamensis*

5. Mesopleura black on anterior half . . . . *arx*
5' Mesopleura yellow . . . . *lepida*

O. gastrotactus (Wiedemann). TOLEDO DIST.: Columbia Forest Sta., 4 July 1970, 1 fem.

O. dimidiatus (F.). TOLEDO DIST.: Columbia Forest Sta., 5 July 1970, 1 male; 30 July 1970, 2 fem.

O. adspersus (F.). TOLEDO DIST.: Columbia Forest Sta., 5 July 1970, 1 male; 1 Aug. 1970, 1 fem.

O. panamensis (Curran). TOLEDO DIST.: Columbia Forest Sta., 5 July 1970, 1 male.

O. arx (Fluke). TOLEDO DIST.: Columbia Forest Sta., 3 July 1970, 1 fem.

O. lepida (Macquart). TOLEDO DIST.: Columbia Forest Sta., 1 July 1970, 1 male; 2 Aug. 1970, 1 fem.; 4 Aug. 1970, 1 male.

Sterphus Philippi

S. (Crepidomyia) coarctatus (Wiedemann). TOLEDO DIST.: Columbia Forest Sta., 1 July 1970, 2 males.

Ornidia Lepeletier and Serville

O. obesa (F.). CAYO DIST.: Blancaneaux Lodge, 22 July 1970, 1 fem.; TOLEDO DIST.: Columbia Forest Sta., 1 Aug. 1970, 1 fem.; 3 Aug., 1 fem.

Key to *Copestylum* Macquart

1\. Scutellum elongate, with 2 distinct lateral roughened areas . . . . *tricinctum*
1' Scutellum borader than long, without lateral roughened areas 2

2\. Scutellum without pre-apical depression 3
2' Scutellum with pre-apical depression 4

3\. Abdomen black with violet reflections; wings black on basal ½; large robust species, 14 mm. long . . . . *dispar*
3' Abdomen pale yellow basally; wings without black markings; smaller species, 8-10 mm. long . . . . *correcta*

4\. Wings marked with brown spots, medially on anterior margin and apically; scutellar depression shallow and brown, contrasting with remainder of yellow scutellum . . . . *tympanitis*
4' Wings without apical spots 5

5\. Abdomen pale yellow with 3 pair of lateral black spots on tergites 2, 3 and 4; wings without microtrichiae . . . . *.pallens*
5' Abdomen without black spots; wings with microtrichiae 6

6\. Face black . . . . *belizensis*, n. sp.
6' Face yellow 7

7\. Hind femora blackish except on apical 1/5 . . . . *musicana*
7' Hind femora yellow on basal 4/5 . . . . *mocana*

C. tricinctum (Bigot). TOLEDO DIST.: Columbia Forest Sta., 1-9 July 1970, 5 males, 6 fem.; 18 July 1970, 1 fem.; 30 July 1970, 2 males.

C. dispar (Macquart. CAYO DIST.: Mt. Baldy Beacon, 12 July 1973, 1 fem.

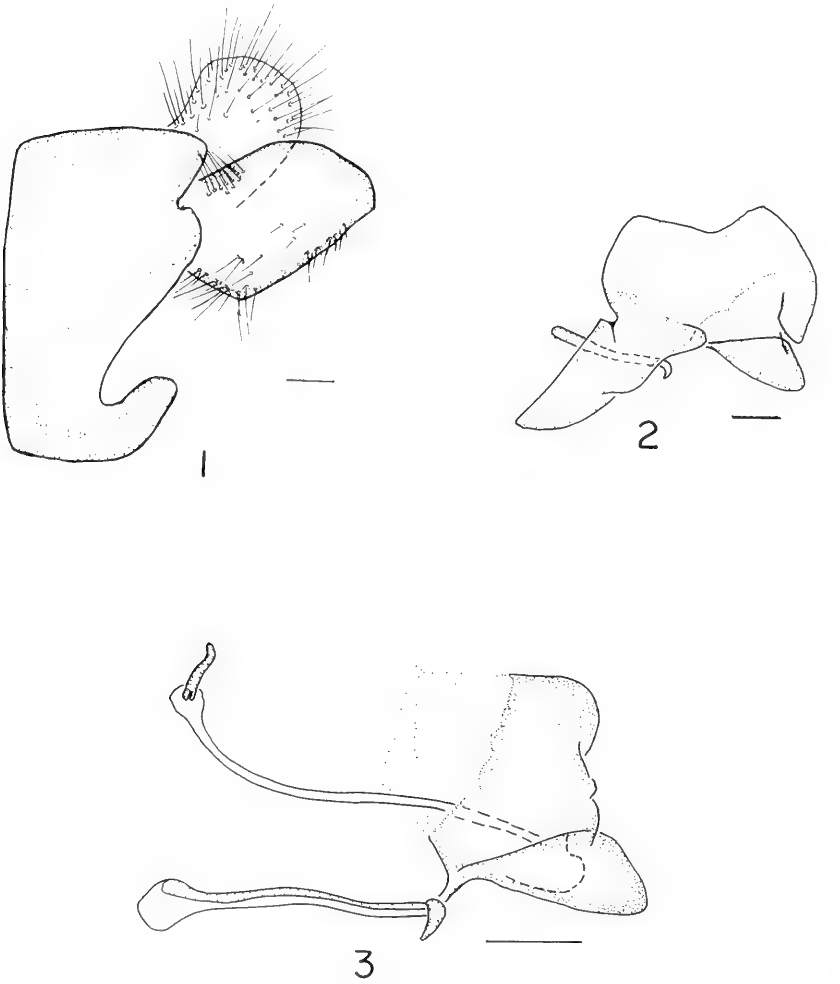
C. correcta (Curran). TOLEDO DIST.: Columbia Forest Sta., 18 July 1970, 1 male; 1 July 1970, 1 male.

C. tympanitis (F.). TOLEDO DIST.: Columbia Forest St., 1-9 July 1970, 6 males, 15 fem.; 18 July 1970, 2 fem.; 1 Aug. 1970, 2 fem.

C. pallens (Wiedemann). TOLEDO DIST.: Columbia Forest Sta., 2 July 1970, 1 fem.; 1 Aug. 1970, 2 males; 2 Aug. 1970, 1 fem.

C. belizensis, NEW SPECIES

Male. Face shining black, broadly silver pollinose below antennae; whitish pile on lateral slopes, on tubercle and on epistoma, absent above tubercle; facial tubercle prominent, projecting beyond antennal prominence. Cheeks shining black with golden pile, separated from face by broad pale brown stripe which is expanded distally. Front



Figures 1-3. *Copestylum belizensis*, n. sp. 1. Tergite 9, male genitalia. 2. Sternite 9, male genitalia. 3. Axial System, male genitalia.

small, shining black with short white pile. Antennae brown, basal two segments shining; third segment 3X length of second and gradually tapered apically. Eyes broadly joined, almost 2/3 length of face; upper medial facets enlarged; densely black pilose on upper 5/6. Vertical triangle very small, only slightly raised; pile long, black. Occiput with short black bristles above, yellowish on white pollinose areas below. Mouthparts 2X length of face.

Scutum shining black with opalescent blue pattern of 4 narrow stripes, the medial pair united broadly anterior to scutellum; humeri and posterior calli light tan; bristles black; pile golden, dense and short, with longer pale brown pile; no prescutellar bristles. Pleurae brown with pale pollen; pile black on pteropleurae, paler elsewhere; a single black bristle on the mesopleuron. Legs black except for reddish apex of femora and base of tibiae, all basitarsi, and 2nd tarsal segment on mesothroacic and metathoracic legs. Halteres yellow with white knob. Scutellum shining brown, with pebbled transverse depression; dense golden pile short, intermixed with longer brown and black pile; apex of scutellum with 3 pair of delicate long black bristles, medial 1/3 without bristles; sub-scutellar fringe black, isolated laterally. Wings with sub-marginal cell broadly open; microtrichiae evenly distributed on apical 1/2 of wing, absent in most cells basally; marked with blackish clouds on most cross veins.

Abdomen short and broad, tergum shining black except for medial yellow spots on tergite two; with short, dense, golden pile on tergite two except for a narrow black band posteriorly; third and fourth tergites with black pile. Sternite two translucent yellow, narrow yellow bands on sternites three and four, elsewhere shining black. Male genitalia (figs. 1-3) with well-developed superior lobes, no inferior lobes.

Female. Similar to male except for the following: front shining black with a pair of raised dilute yellow sub-triangular spots next to eyes situated in a depressed area between raised areas above antennae and below vertical triangle; eyes without enlarged facets; opalescent blue pattern of scutum more distinct, stripes broader; abdomen with blue opalescent cast.

Length of the holotype and allotype is 7 mm., while the paratypes measure 5 mm.

MATERIAL EXAMINED: TOLEDO DIST.: Columbia Forest Sta., 5 July 1970, 1 male (holotype), 3 fem. (allotype and 2 paratypes).

This species will trace to *C. obscurior* (Curran) in Curran (1939). Curran's key can be modified as follows to separate *C. belizensis* from closely related species:

34. Lower half of the face reddish in the middle . . . . *plaumanni* (Curran)
Face black or reddish 34a

34a Face and front reddish yellow; scutum brownish . . . . *bellula* (Williston)
Face and front black; scutum shining black 34b

34b Yellow stripe separating face from cheeks narrow; scutellum with dense basal patches of pile . . . .*obscurior* (Curran)
Yellow stripe separating face from cheeks broadened near oral opening; pile of scutellum evenly distributed . . . . *belizensis,* n. sp.

C. musicana (Curran). TOLEDO DIST.: Columbia Forest Sta., 30 July 1970, 1 fem.
C. mocana (Curran). TOLEDO DIST.: Columbia Forest Sta., 3 Aut. 1970, 1 fem.

Quichuana Knab

Q. picadoi Knab. TOLEDO DIST.: Columbia Forest Sta., 1 July 1970, 1 fem.

Meromacrus Rondani

M. currani Hull. "BRITISH HONDURAS", 1 female, C. L. Lundell, coll.

Key to *Palpada* Macquart

1\. Scutum black vittate on grey background . . . . *furcata*
1' Scutum fasciate or without conspicuous markings 2

2\. Scutum uniformly dull reddish brown . . . . *obsoleta*
2' Scutum fasciate 3

3\. Scutellum black on basal 1/4, yellow on remainder . . . . *scutellaris*
3' Scutellum brown or yellow 4

4\. Wings without microtrichia 5
4' Wings with microtrichia 6

5\. Posterior calli black pilose . . . . *albifrons*
5' Posterior calli yellow pilose . . . . *rufiventris*

6\. Hind tibiae black ciliate . . . . *fasciata*
6' Hind tibiae with short sparse pile . . . . *aemula*

P. furcata (Wiedemann). STANN CREEK DIST.: Lynum School, 26 July 1970, 2 males.

P. obsoleta (Wiedemann). CAYO DIST.: Mt. Baldy Beacon, 12 July 1973, 2 males, 6 fem.; Blancaneaux Lodge, 22 July 1970, 1 fem.; Rio Privassion, 12 July 1973, 3 fem.; TOLEDO DIST.: Columbia Forest Sta., 3 Aug. 1970, 1 fem.

P. scutellaris (F.). CAYO DIST.: Mt. Baldy Beacon, 12 July 1973, 1 fem.; TOLEDO DIST.: Columbia Forest Sta., 8 July 1970, 1 male, 2 fem.

P. albifrons (Wiedemann). BELIZE DIST.: St. Johns College, 2 July 1973, 2 males; TOLEDO DIST.: Columbia Forest Sta., 18 July 1970, 1 male.

P. rufiventris (Wiedemann). TOLEDO DIST.: Columbia Forest Sta., 1 July 1970, 1 fem.; 3 July 1970, 1 male, 1 fem.; 8 July 1970, 1 male, 2 fem.

P. fasciata (Wiedemann). BELIZE DIST.: St. Johns College, 3 July 1973, 1 male, 1 fem.; STANN CREEK DIST.: Lynum School, 26 July 1970, 5 males, 3 fem.

P. aemula (Williston). TOLEDO DIST.: Columbia Forest Sta., 30 July 1970, 1 fem.

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A STUDY OF GRASSHOPPER SPECIES COMPOSITION IN PRIMARY AND SECONDARY GROWTH IN COSTA RICA[1]

Kenneth Brodey[2]

ABSTRACT: Three tropical communities in Costa Rica were studied to determine if there were distinctive kinds of grasshoppers peculiar to each. The three communities sampled were mature tropical forest, transition or "edge", and secondary or cleared areas. Samples were taken at a lowland tropical rainforest at sea level and at a Pacific highland forest, 1500 meters in elevation. Preliminary results indicate that there are few, if any, species in the mature forest, a number in the "edge" and the greatest majority present in the secondary growth.

DESCRIPTORS: Costa Rica; grasshopper ecology; tropical communities.

The purpose of this study is to determine if the abundance and variety of grasshoppers are different in three adjacent communities. These three communities are: mature tropical forest; recently cleared tropical forest; and the area where tropical forest and cleared area come together. This third community is called "edge". Edge contains species of flora and fauna from the two communities; it may also have species distinct to itself. The field work for this study was done during July 1973 (rainy season) at two localities in Costa Rica. One locality in Heredia Province was at the Organization for Tropical Studies Research Station "Finca La Selva" near Puerto Viejo; and the other in Puntarenas Province at Monte Verde. The former is a rich Atlantic lowland rain forest near sea level, the latter is a montane situation on the Pacific side at an altitude of 1500 meters.

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[1] Accepted for publication: September 30, 1975

[2] 601 Maple Lane, Flourtown, Pa., 19031.

ENT. NEWS, 86: 9 & 10: 207 - 211, November & December 1975

METHODS

Collecting was done by hand and with a butterfly net. All specimens were caught after they were seen; no general sweeping with the net was done to secure specimens. Grasshoppers were killed in a jar with cyanide and preserved dry.

Areas to be sampled were selected that had a broad contact of forest and cleared area. Once an area was selected to be sampled, a transect was run 37 meters into the cleared area, then through the edge to the forest where it was continued for another 37 meters. Collecting of grasshoppers was done 1 meter on either side of this transect.

RESULTS

The study was performed on July 5, 1973 at La Selva. The sampling was done just after a rain and it was partly cloudy. This area is Atlantic Lowland Tropical Rainforest, Frankie et al (1974).

The cleared area had scattered trees among the secondary growth; this secondary growth consisted of thorny bracken fern 1 meter tall, low shrubs and emergence growth to 4 meters high. The transition area had some plants from both the cleared area and forest, but no plant species of its own. The forest was a typical lowland tropical rain forest with tall buttressed trees and an understory of mostly palms. The forest floor had little leaf litter. It was dark inside the forest by about 3:30 P.M.

There were distinct changes in species composition and numbers of grasshoppers indicated by sampling. Table 1 shows that 4 species were common in the second growth, but grasshopper variety and numbers decreased in the edge, although a new species was collected. The forest was void of grasshoppers except for a first or second instar eumastacid.

The second site of study was Monte Verde which is Pacific Highland forest at 1500 meters elevation, Rentz (1975). The cleared area was on a hillside and consisted of grass and other low vegetation to 1 meter in height. The vegetation in addition to the grasses consisted of low shrubs, bracken and low forbs. Blackberry was the most common shrub. The edge, as at La Selva, contained no distinct species of flora, only species of the cleared area and the forest. This edge was about one half meter wide. The was composed of trees not exceeding 10 meters in height.

In this situation, only in the cleared area were grasshoppers found. The edge and forest were both void of grasshoppers. In other collecting, a grasshopper of the genus *Rhichnoderma* was caught at Monte Verde in an edge situation. This grasshopper may be an edge species.

DISCUSSION

From the data I presented, the most important conclusion to be drawn is that acridoids of the understory decrease in numbers as one goes into the forest. There is also indication that species may change as the habitat changes from cleared area, to edge, to forest. In past literature there is mention of grasshoppers in cleared areas to edge situations, Hebard (1924), Rehn (1929), Rehn and Rehn (1934). However, there is also some mention of acridoids being in forest situations, particularly eumastacids, Rehn and Rehn (1934). Many tropical acridoids appear to be inhabitors of forest glades, cleared forest, or edge. These situations could occur naturally when a large tree falls, causing a break in the forest. Along with this understory fauna of grasshoppers, there is evidence of a treetop fauna of grasshoppers, Roberts (1973).

There are probably many reasons for this seemingly limited fauna of the tropical forest understory. One reason might be that many grasshoppers that feed on grasses find forest grasses not suitable for food or not extensive enough to survive on, Jago (1973). Lack of places to oviposit in the forest understory, or lack of sufficient sunlight may be other explanations for the paucity of grasshoppers in the forest understory. Grasshoppers have not been completely excluded from inhabiting the tropical forest understory; some groups like the eumastacids may even be adapted to the understory. However, this study and past literature records indicate that in Central America, tropical acridoids seem to live more in open situations than forest understory.

TABLE 1.

THIS TABLE LISTS THE SPECIES AS FOUND WITH NUMBERS OF INDIVIDUALS FROM THREE REPETITIONS IN PARENTHESES. NO SUITABLE "EDGE" WAS LOCATED AT MONTE VERDE.

	Forrest understory	Edge	Secondary Growth
La Selva	eumastacid nymph (1)	*Eumastax* sp. (1)	*Rhachicreagra aeruginosa* (2)
		Microtylopteryx (1)	*Leptomerinthroprora* sp. (6)
			Microtylopteryx sp. (3)
		Osmilia sp. (1)	*Lithoscirtus bimaculatus* (2)
			Taenipoda Nymph
Monte Verde	no species found	no species found	*Schistocerca* sp. (2)
			Silvitettix sp. nr. communis (24)
			Dichroplus sp. (3)
			unidentified nymphs (7)
			unidentified acridine (1)

ACKNOWLEDGEMENTS

I would like to thank the member of the Jessup Committee of the Academy of Natural Sciences of Philadelphia who provided funds for travel and subsistence while in Costa Rica. I would also like to thank Dr. D.C. Rentz for guidance in the field and review of the manuscript. The Organization for Tropical Studies and its Resident Director, Mr. J.R. Campabadal, were most hospitable and made our stay a pleasant one. Mr. and Mrs. George Powell of the Monte Verde Cloud Forest Reserve were similarly helpful and encouraging. I would also like to thank Dr. W.W. Middlekauff and Dr. D.B. Weissman and my mother, Mrs. Jean L. Brodey for comments on the manuscript.

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ERRATUM

In my paper on New Southwestern Bombyliidae, ENTOMOLOGICAL NEWS, 86:112, in the publication of the name *Parabombylius rutilous* there was an inadvertent error in the spelling of the species name *rutilous*. I had intended the Latin adjective *rutilus*, but for some now inexplicable reason the paper was submitted with the mispelling and was not caught on page proofs. My thanks to Mr. George C. Steyskal for pointing out this error.

–Jack C. Hall, Division of Biological Control, University of California, Riverside, California, 92502.

AN ANOMALY IN THE WING OF *BOMBYLIUS ERECTUS* BRUNETTI (DIPTERA: BOMBYLIIDAE)[1]

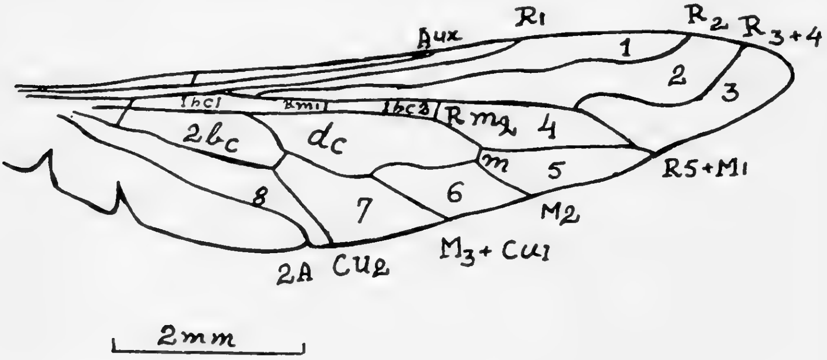
V.C. Kapoor[2]

Five specimens (all males) of *Bombylius erectus* were received from Mr. K.D. Ghorpade (Entomology Dept., Agric. Univ., Bangalore) for identification. The specimens collected by him from Bangalore on weeds.

During identification, the wing of one of the specimens was found to have two anterior cross-veins (rm_1 and rm_2) in stead of the normal one (i.e. rm) (fig.) otherwise the whole morphology of the wing was the normal one.

The presence of rm_2 has divided the first basal cell (1 bc) into two, i.e. 1 bc_I and 1 bc_{II} which becomes a very important feature if one relies totally on the morphology of wings.

The taxonomy of Bombyliidae is mainly based on the wing structure, i.e. the longitudinal veins, cross-veins and the cells (fig.). One must, therefore, be very cautious in studying the wing characters and supplement them with those of other body characters including genitalic characters.



Abbreviations

Aux. - Auxiliary vein; R_1, R_2, R_{3+4} - Radial one, two and three plus four veins (first to 3rd longitudinal veins); R_5+M_1 - Radius five plus Media one (fourth longitudinal vein); M_2 - Media two (fifth longitudinal vein); M_3+Cu_1 - Media three and cubitus one (sixth longitudinal vein); Cu_2 - Cubitus two (seventh longitudinal vein); 2A - Anal two (eighth longitudinal vein); rm - radio-medial cross vein (rm_1 and rm_2); m - medial cross-vein; 1bc - first basal cell (1bc_I and 1 bc_{II}); 2bc - second basal cell; dc - discal cell; 1 - marginal cell; 2,3 - submarginal cells; 4-7 - posterior cells; 8 - anal cell.

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[1] Accepted for publication: Sept. 6, 1975.

[2] Department of Zoology, Punjab Agricultural University, Ludhiana, India.

ON A COLLECTION OF ODONATA FROM MANIPUR, INDIA[1]

Tridib Ranjan Mitra[2]

The present note is based on a small collection of adult odonates brought back by Dr. R.P. Mukherjee and his party from the localities near Loktak lake, Moirang (Lat. 24° 25′N, Long. 93° 45′E), Ithai village (Lat. 23° 35′N, Long 81° 15′E), and Keibul Lamjao Wild Life Sanctuary during two trips to the areas in the months of May, 1974 and December, 1974 to February, 1975. Manipur valley is isolated from Assam, and it lies on the eastern fringe of the Indian Union, zoogeographically it lies in the Indo-chinese subregion. Annandale (1921, in Annandale *et al.*) described the ecology of Loktak lake as follows:

> "The Loktak lake is little more than a large, deep swamp. In places the water is as much as 10 feet deep, but even in such spots it is blocked up almost to the surface with submerged vegetation, while a very large part of this area is covered with floating islands formed of living and decayed plants. The bottom is composed of evil smelling soft mud containing much rotten vegetable matter. In the dry weather the lake is normally about 8 miles long by 5 miles broad, but its extent probably varies greatly in different years."

He also reported the existence of Libellulid and Agrionid larvae in the lake. Although Fraser (1933, 1934, 1936) referred to species of odonata from some localities of Assam (previously Manipur was in Assam), there is no mention of any locality in Manipur, from where the only odonate specifically recorded is *Ischnura annandalei* by Bhasin (1953).

The collection though small quantitatively (with only 29 specimens) is rich in variety, containing 11 species spread over 10 genera of 3 families and two suborders.

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[1] Accepted for publication: Sept. 6, 1975

[2] Zoological Survey of India, 8, Lindsay Street, Calcutta, 700016, INDIA.

ENT. NEWS, 86: 9 & 10: 213 - 216, November & December 1975

Systematics

Suborder : Zygoptera
Family : Coenagrionidae
Genus : *Ceriagrion* Selys.

Ceriagrion coromandelianum (Fabr. 1798).

Material examined: 1 ♀, 3 ♂♂, Moirang, 25. 5. 1974. *Coll.* R.P.M., 1 ♀, 2 ♂♂, Moirang, 28. 5. 1974. *Coll.* R.P.M.

It is a common Indian odonata distributed, "Throughout India, Ceylon, Burma, Malayasia, Indochina and South China" (Fraser, 1933).

The specimens differ from the description given by Fraser (1933) and from specimens of Calcutta and its metropolis as well as Maharastra and Assam examined by me, in having reddish mark on the dorsum of the abdominal segments 1 to 4. Further studies may help in the erection of a new subspecies for the Manipur population and which may act as an additional proof for the Indo-chinese connection of the ancestors of Indian species.

Ceriagrion olivaceum **Laidlaw, 1914.**

Material examined: 1 ♀, Moirang, 25. 5. 1974. *Coll.* R.P.M.

The species was reported earlier from Assam and other localities of India. The specimen shows similarity with the Western Ghat specimens described by Fraser (1933).

Genus : *Ischnura* Charpentier.

Ischnura mildredae **Fraser, 1927.**

Material examined: 1 ♂, Keibul, 26. 1. 1975, 2 ♂♂ (7 to 10 abdominal segments lost in one specimen), Keibul, 6. 2. 1975, 1 ♀, Keibul, 7. 2. 1975, *Coll.* S. Chaudhuri.

The species was so far known only from Upper Burma. This is the first record of its occurrence in the Indian Union.

Genus : *Onychargia* Selys.

Onychargia atrocyana **Selys, 1865.**

Material examined: 1 ♀, Moirang, 25. 5. 1974, *Coll.* R.P.M.

Known from Assam and all other parts of India.

Suborder	:	Anisoptera
Family	:	Macrodiplactidae
Genus	:	*Urothemis* Brauer

Urothemis signata signata (Rambur, 1842).

Material examined: 2 ♀♀, 3 ♂♂, Moirang, 29. 5. 1974. *Coll.* R.P.M.

It is common Macrodiplactid dragonfly of India. It had been reported from several localities in the country.

Family	:	Libellulidae
Genus	:	*Crocothemis* Brauer

Crocothemis servilia servilia (Drury)

Material examined: 1 ♀, 1 ♂, Ithai village, 29. 5. 1974. *Coll.* R.P.M. and 1 ♀, Keibul, 7. 2. 1975, *Coll.* S. Chaudhuri.

It is a very common dragonfly, visible almost all parts of India.

Genus : *Brachythemis* Brauer.

Brachythemis contaminata (Fabricius, 1798).

Material examined: 1 ♀, Moirang, 29. 5. 1974, *Coll.* R.P.M.

A common species, occurring in almost every part of India.

Genus : *Rhodothemis* Ris.

Rhodothemis rufa (Rambur, 1842)

Material examined: 1 ♂, 2 ♀♀, Moirang, 29. 5. 1974, *Coll.* R.P.M.

A common libellulid dragonfly of India, occurring from the west coast to other parts of India.

Genus : *Diplacodes* Kirby

Diplacodes trivialis (Rambur, 1842)

Material examined: 1 ♀, Keibul, 30. 12. 1974, 1 ♀, Keibul, 7. 2. 1975, *Coll.* S. Chaudhuri.

A common libellulid dragonfly of India.

Genus : *Rhyothemis* Hagen

***Rhyothemis variegata variegata* (Linn. 1763).**

Material examined: 1 ♀ (damaged), Ithai village, 29. 5. 1974, *Coll.* R.P.M.

A common odonata of India.

Genus : *Tholymis* Hagen

***Tholymis tillarga* (Fabr. 1798).**

Material examined: 1 ♂ (damaged), Ithai village, 29. 5. 1974, *Coll.* R.P.M.

A common libellulid dragonfly of India.

ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India for facilities, to Dr. K.K. Tiwari, of the same department and to Dr. D.N. RayChaudhuri, Dept. of Zoology, Calcutta University, for guidance, to Dr. R.P. Mukherjee and Shri S. Chaudhuri for the collection and Shri S.M. Ali of Zoological Survey of India for encouragement.

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AN INDEX TO THE INSECTS AND SPIDERS FEATURED ON AUDUBON'S BIRD PLATES[1]

S.W. Frost[2]

ABSTRACT: The title reveals the nature of this article. References are made to Audubon's bird plates reproduced by The Macmillan Company, 1937 and The American Heritage Company, 1966. In each case the birds, insects, insect injuries, and spiders are indicated.

This discussion is based on the insects and spiders featured on the 500 plates reproduced by The Mac Millan Co., 1937 and the 421 plates reproduced by the American Heritage Publishing Co., 1966. Although Audubon's Sketch Book, brought to light by Alice Ford illustrates many excellent insect and spider paintings by Audubon, few or none were used on the final bird plates. They are not included in the present discussion. Edwin Teale and Alice Ford have discussed Audubon's insects and other animals, however, some have been missed and the injuries by insects have not been considered. Their papers will compensate for the lack of illustrations in the present article.

Forty nine insects and 13 spiders are distinctly represented on Audubon's plates. These include 28 Lepidoptera, 14 Coleoptera, 7 Diptera, and 7 insects of miscellaneous orders. Eighteen objects, difficult to identify, may be insects or spiders. Not only the adult insects are featured but often the immature forms, eggs, larvae, pupae, and nymphs are represented. The inclusion of leaf miners, gall makers, work of boring insects and foliage feeders add many species to the list.

While most of the insects and spiders are well delineated, some are sketchy, represented in black and white and often small or minute, making specific identification difficult.

The birds are often associated with suitable backgrounds including leaves and flowers of many plants, insects, spiders and other animals. These were often executed by artists other than Audubon. George Lehman of Lancaster, Pennsylvania is responsible for many of the backgrounds. Maria Martin, a sister-in-law to

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[1] Accepted for publication: September 25, 1975

[2] Frost Entomological Museum, The Pennsylvania State University, University Park, Pennslyvania 16802

ENT. NEWS, 86: 9 & 10: 217 - 226, November & December 1975

John Bachman and later his wife, contributed many drawings of insects and spiders. Audubon's son, John, assisted in collecting specimens and made a few paintings of insects and spiders. His close friend and protege, Joseph Mason, also contributed sketches of flowers and plants.

In referring to Audubon's plates, the original numbers used by MacMillan Co., 1937, appear first, followed by those in parenthesis used by the American Heritage Co., 1966. The subject matter of the two sources may differ greatly, these differences are described in detail.

The only way to truly appreciate Audubon's bird plates is to view them in their entirety; the birds, their backgrounds, including trees, flowers, insects, and other animals. These usually reveal the habits of the birds. This is the reason for the index. Let us consider in detail the plates that feature insects and spiders.

A SUMMARY OF THE INSECT AND SPIDERS INVOLVED

*2(22) YELLOW-BILLED CUCKOO. A pair of birds with leaves and fruit of pawpaw is featured. The leaves show some injury by a caterpillar. The bird to the right has a life like swallow-tail butterfly *Papilio glaucus* in its mouth.

3(39) PROTHONOTARY WARBLER. On plate (39) a four-winged green insect with an elongate body, probably a neuropteran, is faintly represented below in the background. No insect occurs on plate 3.

5(6) CANADA WARBLER. No insect is represented on either plate, however, considerable injury by a caterpillar occurs on the foliage of Magnolia.

10(58) AMERICAN PIPIT (WATER PIPIT). The birds are attracted by a small insect in flight, apparently a hymenopteran.

14(260) PRARIE WARBLER. A coccinellid beetle is represented on the sedge.

15(10) PARULA WARBLER. A small looper, Geometridae, is feeding on the edge of a leaf of red iris.

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*First number from Macmillan 1937, second number in parenthesis from American Heritage, 1966.

18(240) BEWICK'S WREN. There seems to be a cluster of eggs, probably Tabanidae, on the upper leaves of winged elm.

19(200) LOUISIANA WATER THRUSH. A small spider occurs on the edge of the leaf of the jack-in-the-pulpit, which is attracting the attention of one of the birds.

20(230) BLUE-WINGED WARBLER. The tip of the leaf below the upper bird shows a minute indistinguishable insect.

25(256) SONG SPARROW. A small spider is dropping from a silken thread attached to a leaf of hackberry, which is minute in (256).

26(223) CAROLINA PARAKEET. The Cocklebur seems to be draped with the cocoons of the Promethia moth.

27(267) RED-HEADED WOODPECKER. The lower bird is offering the larva of the milkweed butterfly, *Danaus plexippus* to a young bird. Also the excavations of a wood-boring Coleoptera are evident.

32(15) BLACK-BILLED CUCKOO. The birds are featured with Magnolia, the leaves of which show feeding by a caterpillar. The bee fly *Anthrax tigrinus* (DeG.) is one of the largest of the Bombyliidae and known from Florida, Kansas, Pennsylvania and California.

34(379) WORM-EATING WARBLER. A spider which is shown on the berries of poke weed has been identified by specialists as the black widow. If so, it is entirely out of place. The leaves of the plant show considerable feeding by a caterpillar.

35(256) YELLOW WARBLER. A fly *Lucilia* sp., is at the end of a leaflet of coffee wood.

37(264) FLICKER (YELLOW-SHAFTED FLICKER). The lower bird has the larva of a wood-borer in its mouth.

38(90) KENTUCKY WARBLER. A spider, faintly executed, is suspended on a silken thread attached to the umbrella tree (magnolia). This is more clearly illustrated in 38.

39(298) TUFTED TITMOUSE. The upper bird is pecking at some object, probably an insect pupa on the bark of white pine.

40(365) AMERICAN REDSTART. A nest of a species of *Polistes* with six wasps is figured. The paper nest is attached to hop horn-beam. The leaves, especially in 40, show cox-comb aphid galls.

44(269) SUMMER TANGER. The male on wild grape is swallowing a June beetle, *Phyllophaga.*

46(188) BARRED OWL. Plate 46 has a squirrel sitting on a limb. The squirrel is absent in (188). The wood shows the engravings of a scolytid beetle.

48(415) CERULEAN WARBLER. A jumping spider, *Attidae,* is shown on the edge of a yellow leaf of *Ilex cassine.* 48 figures a second bird below attracted by a small flying insect. The second bird is missing on (415) and there is no flying insect.

58(344) HERMIT THRUSH. The two birds are resting on bearberry. A small insect to the right of the upper bird is probably a neuropteran.

63(77) WHITE-EYED VIREO. A spider *Gasterocantha cancriformis* is suspended on a silken thread from flowering cranberry.

66(181) IVORY-BILLED WOODPECKER. A spider is figured on a portion of the limb devoid of bark, the engravings of a scolytid beetle are also shown.

73(279) WOOD THRUSH. The lower bird is reaching for an insect, apparently a homopteran at the end of the leaf petiole.

74(316) INDIGO BUNTING. On (316) the golden garden spider *Miranda aurantia* is featured. The spider is missing on 74.

79(100) KING BIRD. A pair on a poplar tree, the lower bird has seized a bumblebee, not a honeybee as mentioned for (100).

82(218) WHIP-POOR-WILL. Three insects are figured with a branch of oak. The larva of a sphinx moth *Sphecodina abbotti* is resting on a leaf, adults of *Samia cecropia* and *Automeris io* are also figured in minute detail.

83(4) HOUSE WREN. One parent is feeding a spider to a young bird.

87(13) FLORIDA OR SCRUB JAY. No insect, but considerable foliage injury by some caterpillar.

96(53) MAGPIE JAY. Perched on a dead limb entwined with poison ivy, the upper bird is pecking at an object? a nut or the body of a large spider. It is interesting to note that this plate was used on the U.S. Air Mail stamp, the Columbia Jay, C71, 1967.

103(46) CANADA WARBLER. Great laurel shows considerable insect feeding on the leaves. A tiny insect to the right at rest and one to the left, flying, both in black and white, probably Neuroptera. These insects are absent on (46).

107(24) GRAY JAY. The nest of the white-faced hornet *Vespula maculifrons* is attached to a white oak branch. This association may reveal the carrion-feeding habits of this bird. The color of the leaves indicate fall, the time when the colonies usually die and the dead insects might attract the birds.

108(213) FOX SPARROW. The wing of a saturniid moth seems to be tucked beneath dead leaves in front of the left bird, pronounced in (213) but not in 108.

109(246) SAVANNAH SPARROW. Two straws, cut by the wheat joint worm, *Cephus tabidus* (Fab.), appear in the grass below.

111(208) PILEATED WOODPECKER. Associated with fox grape, the upper bird with the larva of a wood-boring beetle in its mouth.

113(342) EASTERN BLUE BIRD (AZURE BLUE BIRD). The male is offering the female a tussock moth larva.

117(384) MISSISSIPPI KITE. 117 shows two birds, a decapitated beetle in the mouth of upper one, (384) shows one bird with beetle in its mouth.

118(203) WARBLING VIREO. A leaf of Magnolia to the right center distinctly shows the work of the leaf-cutting bee *Megachile* sp.

119(85) YELLOW-THROATED VIREO. One bird is reaching for a wasp *Gorytes (= Elis) quinquecinctus* on Hydrangea.

121(60) SNOWY OWL. The stump shows borings by the larva of a Coleoptera.

124(378) WILSON'S WARBLER. No insect is shown however the leaves of *Chelone glabra* shows injury by a sawfly larva. This species, to my knowledge, has never been identified. The conspicuous black and white larvae are common on this plant.

131(50) ROBIN. The robin to the left, on chestnut oak, is feeding a caterpillar of the tussock moth to its young. The caterpillar on (50) seems to be a different species than on 131.

134(250) BLACKBURNIAN WARBLER. 134 shows, very indistinctly, a lady beetle, Coccinnelid, on the tip of one of the seeds of mountain maple. This does not appear on (250).

137(243) YELLOW-BREASTED CHAT. The bird at the edge of the nest is feeding its young a caterpillar, only two birds appear in the air. (243) shows three birds in the air.

140(211) PINE WARBLER. A tiny morsel on one of the needles of loblolly pine is attracting the attention of both birds.

142(184) SPARROW HAWK. A small moth of the family Ageriidae occurs in the lower right background. No insect on (184), only injury to leaves by a caterpillar.

143(356) OVEN BIRD. A bee or fly is indicated in the right background. No insect on (356).

144(408) ACADIAN FLY CATCHER. A moth is represented in the upper left background. No insect on (408).

147(351) NIGHT HAWK. Two beetles shown in flight, the upper one the spotted pelidnota, *Pelidnota punctata,* the lower one apparently another scarab beetle.

150(180) RED-EYED VIREO. An orb-weaving spider is figured with web attached to a branch on honey locust. Although identified as *Phidippus* by specialists, this spider does not spin an orb web.

159(398) CARDINAL. No insect is featured but the leaves of choke cherry show injury by a caterpillar.

160(377) BLACK-CAPPED (CAROLINA) CHICKADEE. What appears to be the cocoon of *Telea polyphemus* is attached to a branch of Rattan vine.

167(135) KEY-WEST QUAIL-DOVE. A dead insect is figured on the upper center leaf of morning glory.

183(236) GOLDEN-CROWNED KINGLET. A minute insect with two wings and long tails, apparently a mayfly, is figured. (236) shows no insect.

185(419) BLACKMAN'S WARBLER. The foliage of Franklinia is rather severely eaten by a caterpillar (419) shows a tiny speck, an insect? in front of the upper bird.

187(131) BOAT-TAILED GRACKLE. A pair of birds on live oak. No insect is featured but considerable insect feeding is shown on the leaves.

192(173) NORTHERN SHRIKE. A tiny long-horned grasshopper occurs in front of the middle bird. No grasshopper on (173).

195(416) RUBY-CROWNED KINGLET. One leaf of sheep laurel apparently figures a leafminer, also injury by a caterpillar on another leaf.

198(153) SWANSON'S WARBLER. Two butterflies *Precis lavinia* above, *Eumaeus atala* below, both associated with flame azalea and quite accurately represented.

201(94) CANADA GOOSE. One leaflet of the sedge appears to have a colony of aphids, questionably identified.

205(338) VIRGINIA RAIL. One bird is eyeing a wheel bug *Arilus cristatus* in the bend of a grass leaf.

210(339) LEAST BITTERN. On (339) two birds are investigating what appears to be a mass of eggs, this does not appear on 210.

227(187) PINTAIL. On (187) the birds are attracted by a noctuid moth in flight, on 227 the moth is replaced by a species on Diptera.

233(292) SORA. Apparently a larva of some sort is figured in a bent leaf. On (292) the same insect is featured but the grass is drawn differently.

249(56) RED-SHOULDERED HAWK. Although many plates show birds looking for insects, the lower bird on this plate, is obviously searching for insects in the spanish moss on white oak. Entomologists frequently search for insects in such locations.

301(238) CANVAS BACK. The bird to the left on (238) is eyeing some creature, spider? No spider figured on 301.

303(329) UPLAND PLOVER. Two birds are in pursuit of an ichneumon fly.

318(270) AMERICAN AVOCET. 318 a tiny insect on the ground in front of the bird. No insect on (270), instead a snail.

327(287) SHOVELLER. 327 A pair eyeing a green scarab beetle on leaf above. The insect on (287) is replaced by the caterpillar of a tussock moth.

333(78) GREEN HERON. The bird to the left is eyeing a luna moth on an unidentified plant.

352(239) WHITE-TAILED KITE. The bird above is pursuing a scarab beetle, well drawn but not in flying position. The beetle is lacking on 352.

354(370) TANAGERS. No insect featured, the leaves of red-bay are severely injured by the larvae of *Urodus parvulus*, a species of Hyponomeutidae common in Florida.

355(345) SEASIDE SPARROW. Two butterflies *Anartia jatrophae* are featured, one flying, the other resting. Both, the work of Maria Martin, are beautifully illustrated.

359(288) FLY CATCHERS. Three different species on the branch of the umbrella tree. Two birds at the top viewing a sarcophagid fly on the wing. Also two magpie moths *Pseudohazis* sp. are featured.

373(220) EVENING AND BLACK-HEADED GROSBEAKS. The hop merchant *Polygonia comma*, by Maria Martin, is featured but missing on (220). The arrangement of the birds are somewhat different on the two plates.

383(390) LONG-EARED OWL. 383 No insect, (390) a minute insect in flight at left, winged with long tails, probably a mayfly.

393(186) WARBLERS AND BLUE BIRDS. The two plates are very different. Both figure strawberry shrub. On 393 there is 1 warbler and 4 blue birds, (186) shows 11 birds including 4 blue birds. Both plates figure a coleopteran, *Brachyrhinus* probably *sulcatus* (Fab.) on one of the branches.

394(359) CHESTNUT-COLLARED LONGSPUR. The two plates are very different. The background of 394 is detailed with a spider dropping on a silken thread from the flower of Bergamot. (359) has no background and no spider.

375(360) RED POLL. A sphinx larva upper lefthand corner.

399(327) MACGILLVRAY'S WARBLER. The two plates are very different. No insect on either plate. (327) shows considerable insect injury. 399 shows no insect injury.

406(7) TRUMPETER SWAN. The two plates are very different, 406 has detailed water and sky; a Catocala moth is drifting in the water. In (7), the background is entirely blue and no insect is figured.

410(210) GULL-BILLED TERN. 410 has a small winged insect, Neuroptera, *Chauliodes* in front of the tern. No insect is figured on (210).

413(142) CALIFORNIA (VALLEY) QUAIL. Both show a spider in front of the left bird. 413 has a distinct background, (142) has no background.

416(333) WOODPECKERS. The two plates differ in the arrangement of the birds, especially in the upper right hand corner. No insect is figured on 416, the upper red-bellied woodpecker on (333) is after the pupa of a lepidoptera exposed by the broken branch.

437(204) VIOLET-GREEN SWALLOW. Two birds on 437 after a small insect in flight, probably a neuropteran. On (204) the two swallows are in approximately the same position at the top of the plate, below the three bank swallows but no insect.

438(288) ARKANSAS (WESTERN) KING BIRD. 438 shows a pair with a moth *Pseudohazis* sp. in the background. This is the same as the lower right hand portion of (288).

450(288) SAY'S PHOEBE. A pair of birds on the branch of the Magnolia tree, which are attracted by a tabanid fly above. (288) shows the pair of phoebes together with two western king birds, the scissor-tailed flycatcher and two moths, *Pseudohazis* sp. The 2 moths are not figured on 450.

462(327) CAPE MAY WARBLER. 462 is the lower left hand portion of (327). No insect is figured on either plate but considerable insect injury occurs on water oak.

464 CHESTNUT-COLLARED LONGSPUR. Similar to the right hand portion of 394, shows a spider dropping from a silken thread attached to the flower of Bergamot.

465(186) MOUNTAIN BLUE BIRDS. Plate 465 shows a pair viewing a beetle above. (186) figures the same pair in a slightly different position on the lower right hand side of the plate with 8 other birds, the blue birds are viewing two beetles on a branch, a rhynchophoran and a green chrysomelid.

466(186) WESTERN BLUE BIRDS. 466 shows a small beetle, a coccinellid on a leaf petiole below the lower bird. The same pair is represented on the lower left hand part of the plate (186) but no insect is shown.

471 NORTHERN WATER THRUSH. The birds are associated with jack-in-the-pulpit. A very small insect seems to be poorly indicated on one of the lower leaves.

472 LARK SPARROW. A single bird eyeing a small insect in front of its bill.

478 ROUGH-WINGED SWALLOW. A pair of birds are flying after a moth, apparently a pyralid, also on the wing.

482 MORTON'S FINCH. A single bird on an elm branch. No insect is shown however one of the leaves show coxcomb galls produced by insects which are common on elm.

REFERENCES

Audubon, John James 1821. The Sketch Book. An unpublished manuscript, 15 pp. Originally given to Mrs. Charles Bachman, passed through the hands of three families, finally acquired by Mrs. Kirby Chambers.

Audubon, John James 1937. The birds of America with an introduction and description text by William Vogt. The MacMillan Company.

Audubon, John James 1966. The original water-color paintings for the birds of America, reproduced in color from the collection at the New York Historical Society. American Heritage Publishing Co., Inc.

Ford, Alice 1952. Audubon's butterflies, moths and other studies. The Studio Publications, Inc., in association with Thomas Y. Crowell Company.

Teale, Edwin Way 1947. Audubon's insects. Audubon Magazine 49(6) 313-331.

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

MODERN CLASSIFICATION OF INSECTS by M. S. Mani, 1974. Publisher: Satish Book Enterprise, Moti Katra: Agra - 282003, India. 331 pages with 658 simple, diagrammatic, line-drawing figures. RS 40.00

It is difficult to understand, especially in this modern era of well developed taxonomic entomology, why and how any one individual would take upon himself the task of developing and presenting keys to the identification of all of the families in all of the recognized orders of insects. Yet, this is exactly what the author presents in his Modern Classification system. He indicates this is based on a series of identification charts prepared by him for the use of his students in the School of Entomology, St. Johns College, Agra, India, over the past twenty years.

The author recognizes 33 orders arranged under 12 superorders and 5 subclasses. Following an introductory conspectus of orders and a synoptic key to the orders, a separate chapter is devoted to each order. Within each chapter, the order is treated in 3 parts: (1) a description of diagnostic characters; (2) a conspectus or classification listing and (3) a synoptic key to the families. These analytical, dichotomous keys consist of serially numbered couplets of contrasting characters.

It would be beyond the ability of this reviewer to test all the classification listings and/or to run all or even a major part of the keys in a work as extensive as this. However, in an order (Coleoptera) familiar to me, several discrepancies with generally accepted authorities were noted. Among these were (1) the elevation of a good number of tribes and subfamilies to family status as, for example, Omophronidae and Paussidae in the Caraboidea and Aphodiidae, Geotrupidae, Rutelidae and many others in the Scarabaeoidea; (2) the use of outdated generic names (Tetracha for Megacephala in Cicindelidae) and (3) numerous mispellings (Ahphodiidae, Ochoaeus, etc.). Binding and pagination also appear to be weak points as the copy originally furnished for review purposes is poorly bound and the signatures are out of order. Overall, however, the work appears to be basically accurate and generally in good order. It should be most useful to students of entomology.

The book contains a substantial listing of selected references of monographic value. The index appears to be very complete as it certainly should be in a work of this type.

H.P.B.

BOOKS RECEIVED AND BRIEFLY NOTED

A CATALOGUE OF THE STAPHYLINIDAE OF AMERICA NORTH OF MEXICO (COLEOPTERA). Ian Moore and E.F. Legner, Division of Biological Control. University of California, Riverside.

An unusual feature of this catalogue is that illustrations are also listed in detail, giving page, plate and figure number of each. An indication is also given as to whether the illustration is in toto or of a part of a sexual nature of either the male or female.

BIBLIOGRAPHY (1758 to 1972) TO THE STAPHYLINIDAE OF AMERICA NORTH OF MEXICO (COLEOPTERA) and KEYS TO THE GENERA OF THE STAPHYLINIDAE OF AMERICA NORTH OF MEXICO EXCLUSIVE OF THE ALEOCHARINAE (COLEOPTERA: STAPHYLINIDAE), both also by Ian Moore and E.F. Legner.

Single copies of these publications may be obtained free from: Publications, Division of Agricultural Sciences, University of California, 1422 So. 10th Street, Richmond, CA., 94804

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

1. Title of publication: *ENTOMOLOGICAL NEWS*

2. Date of filing: September 29, 1975

3. Frequency of issue: Bimonthly (every other month) except July and August

4. Location of known office of publication: Oak Shade Rd., Tabernacle Twp., RD 4, Box 617, Vincentown PO, New Jersey, 08088

5. Location of the headquarters or general business offices of the publishers: 1900 Race St., Philadelphia, Pa., 19103

6. Names and addresses of publisher, editor and managing editor:
   Publisher: American Entomological Society, 1900 Race St., Philadelphia, Pa., 19103. Editor: Howard P. Boyd, Oak Shade Rd., Tabernacle Twp., RD 4, Box 617, Vincentown PO, New Jersey, 08088

7. Owner: American Entomological Society, 1900 Race St., Philadelphia, Pa., 19103

8. Known bondholders, morgagees and other security holders owning or holding one percent or more of total amount of bonds, mortages or other securities: None

9. For optional completion by publishers mailing at the regular rates: signed

10. For completion by nonprofit organizations authorized to mail at special rates:

    The purpose, function and nonprofit status of this organization and the exempt status for Federal income tax purposes:

    Have not changed during preceding 12 months (checked)

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 Filling Date
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2. MAIL SUBSCRIPTIONS		
C. TOTAL PAID CIRCULATION	735	722
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G. TOTAL	1000	1000

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INDEX: VOLUME 86

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PUBLICATION AND MAILING DATES
VOLUME 86, 1975

No.	Date of Issue	Pages	Pub. Date	Mailing Date
1 & 2	Jan. & Feb.	1 - 44	Sept. 30, 1975	Oct. 9, 1975
3 & 4	Mar. & Apr.	45 - 84	Oct. 8, 1975	Oct. 15, 1975
5 & 6	May & June	85 - 128	Oct. 15, 1975	Oct. 23, 1975
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Wanted: A CATALOGUE OF THE DIPTERA OF AMERICA NORTH OF MEXICO. USDA agric. Handbook No. 276, by Alan Stone *et. al.* William Downing, 173 Ireland Ave. Cincinnati, Ohio. 45218.

Wanted: DRAGONFLIES OF NORTH AMERICA by Needham and Westfall. Please contact James H. Kennedy, 24 Walnut Lane, Camp Hill, Pa. 17011.

For Sale: Entomological literature (new and secondhand books) on Lepidoptera, Coleoptera, etc. Jacques Rigout - Sciences Nat. 45, rue des Alouettes - Paris 75019.

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.

For Sale: East African Lepidoptera. Contact J. Kielland, 4916, Boroy, Norway.

For Sale: Lepidoptera, Coleoptera and other groups, expecially Carabidae, from France and neighboring countries. Write Remi Aulnette, 16 rue Jousselin, 28.100 Dreux, France.

Wanted: Water striders of the genus *Trepobates* (Hemiptera: Gerridae) for monograph of the genus. Send loan material to: Mr. Paul Kittle, Dep't. of Zoology, Univ. of Arkansas, Fayetteville, Ark., 72701.

Wanted: Gerridae (water striders) with complete collection data (locality and date) in alcohol or pinned; all loan specimens identified to species and almost all returned. Diane M. Calabrese, Bio Sci Group, U-43, Univ. of Conn., Storrs, Conn., 06268.

Exchange: Coleoptera of all families from Arizona. Ask for list and send yours. Dr. Rudolph Lenczy, 126 Los Robles, Green Valley, Arizona, 85614.

Wanted: Living females of large Dynastidae. They must be sent by air mail, rolled in a sheet of newspaper, put in a wooden box. I shall pay a very good price for all specimens received. Jacques Rigout, Sciences Nat., 45, rue des Alouettes, 75019, Paris, France.

VOL. 87 JANUARY & FEBRUARY 1976 NOS. 1 & 2

ENTOMOLOGICAL NEWS

THE AMERICAN ENTOMOLOGICAL SOCIETY

ENTOMOLOGICAL NEWS is published bi-monthly except July and August by The American Entomological Society at the Academy of Natural Sciences, 1900 Race St., Philadelphia, Pa., 19103, U.S.A.

Previous editors: 1890-1910 Henry Skinner (1861-1926); 1911-1944 Philip P. Calvert (1871-1961); 1945-1967 R. G. Schmieder (1898-1967); 1968-1972 R. H. Arnett, Jr.; 1973-4/1974 R.W. Lake.

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(Continued on inside of back cover)

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NEW EXOTIC CRANE-FLIES (TIPULIDAE: DIPTERA)
PART XXVI [1]

Charles P. Alexander[2]

ABSTRACT: Nine new species from Ecuador are described, these being *Zelandotipula daedalus, Zelandotipula hirtistylata, Orimarga (Orimarga) coracina, Orimarga (Orimarga) melanopoda, Shannonomyia gurneyana, Erioptera (Erioptera) acucuspis, Molophilus (Molophilus) coryne, Molophilus (Molophilus) diacaenus,* and *Molophilus (Molophilus) parvispiculus.*

All species described as new at this time were included in materials collected in various provinces of Ecuador by Dr. Ashley B. Gurney, esteemed friend and former student of mine at the University of Massachusetts. Ecuador is very rich in species of this group of flies and students will be aided in their study by consulting the Alexander and Alexander, Catalogue of the Diptera of the Americas south of the United States, Family Tipulidae, pp. 1 - 259, published by the Museu de Zoologia, Universidade de Sao Paulo, in 1970. This volume includes slightly more than 3000 species in this family of flies, many of which are from Ecuador. I wish to express my deep thanks to Dr. Gurney for supplying me with this further important series of flies. The types of the novelties are preserved in the Alexander Collection, now the property of the Smithsonian Institution.

Zelandotipula daedalus, new species

General coloration of body dark brown, thoracic praescutum virtually covered by four obscure yellow stripes; posterior sclerites of notum patterned with brown and yellow, pleura chiefly light yellow; halteres with stem light brown, the small knobs brown; wings conspicuously patterned with dark and paler areas, as described; longitudinal veins posterior to vein *R* without major trichia; male hypopygium with tergite transverse, posterior border shallowly emarginate, with abundant blackened pegs; outer dististyle broad basally, outer third narrowed; inner style with beak slender, disk with abundant blackened spinoid points, in the region of the lower beak concentrated into a dense mass.

Male – Length about 15 mm.; wing 17 mm.

Wing and hypopygium on slide. Rostrum brown, nasus long and slender; proximal three segments of palpi black, terminal segment yellow. Antennae with scape and pedicel

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[1] Accepted for publication: November 22, 1975

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

ENT. NEWS, 87: 1 & 2: 1 - 10, January & February 1976

yellow; flagellum broken. Head brown; eyes large, anterior vertex relatively narrow, about three times the diameter of scape.

Pronotum brownish yellow, scarcely patterned. Mesonotal praescutum virtually covered by four obscure yellow stripes that are scarcely differentiated from the ground, margined by very narrow pale brown lines; scutum with lobes dark brown, vaguely patterned laterally by obscure yellow, median line narrowly obscure yellow; scutellum brownish yellow, parascutella clearer yellow; mediotergite chiefly dark brown, with an obscure yellow longitudinal stripe on either side of midline, posterior border darkened; pleurotergite chiefly yellowed, dorsal fourth brown. Pleura chiefly light yellow, very vaguely darker on the anepisternal and sternal regions. Halteres with stem light brown, base clear yellow, knob small, brown. Legs with coxae and trochanters light yellow; remainder of legs broken. Wings conspicuously patterned with dark and paler brown areas, the subequal ground pattern white; cell *C* chiefly light yellow, *Sc* pale brown, slightly darker at either end; ground color of wing white, including most of cells *R, M,* R_1 and R_5, and basal two-thirds of *Cu*; conspicuous brown areas in bases of cells *R* and *M*, at arculus extended more narrowly backward over bases of cubital and anal cells; brown areas at near one-third cell *R* and at origin of *Rs*, at near midlength and at outer end of cell *M*; other clearly defined markings at tip of *Sc* and beyond the cord as broad seams in the radial field; cells R_5, outer medial cells and M_4 chiefly pale; outer ends of cells *Cu* and *2nd A*, with most of cell *1st A*, pale brown; veins brown. Veins posterior to vein *R* without major trichia. Venation: Distal section of $R_{4\&5}$ strongly sinuous at near midlength, conspicuously narrowing cell R_3: petiole of cell M_1 nearly three times *m; m-cu* beyond midlength of $M_{3\&4}$.

Basal abdominal segments brownish yellow, outer segments more uniformly dark brown, lateral borders yellowed. Male hypopygium (Fig. 1) with the tergite, *t,* having the posterior border broadly and shallowly emarginate, with abundant blackened pegs, shorter and more crowded on the conspicuous lateral extensions, near the midline replaced by more sparse strong setae. Outer dististyle, *d,* broad basally, outer third narrowed; inner style, *id,* with beak slender; disk with abundant blackened spinoid points, outwardly more scattered, in region of lower beak concentrated to form a dense blackened mass. Phallosome with gonapophyses, *g,* as shown; aedeagus very long and slender, filiform.

Habitat – Ecuador. Holotype ♂: Manabi Province, about 3.5 km east of Portoviejo, near a waterfall, May 10, 1975 (A.B. Gurney).

Other generally similar regional species include *Zelandotipula acutistyla* (Alexander), *Z. cristifera* (Alexander), and *Z. vivida* (Alexander), all of Ecuador, *Z. retrorsa* (Alexander), Colombia, and *Z. sinuosa* (Alexander), Peru, all differing most evidently in hypopygial characters, including especially the tergite and both dististyles.

Zelandotipula hirtistylata, new species

General coloration of body dark brown; antennae and legs brown; wings uniformly light gray, without evident pattern; veins R_3 and $R_{4\&5}$ scarcely sinuous, nearly parallel; male hypopygium with tergite short and broad, lobes very low, with abundant long black setae; outer dististyle subrectangular in outline, with abundant very long dark setae; inner style posterior border strongly emarginate, the outer end larger than the base, with compact groups of small spinoid setae.

Male – Length about 15 mm.; wing 17.5 mm.; antennae about 3.3 mm.

Head and hypopygium on slide. Rostrum and palpi brown; terminal segment of maxillary palpus about one-third longer than the basal three combined. Antennae brown; about one-half longer than the palpi; flagellar segments short-cylindrical, the intermediate segments about twice as long as broad, terminal segment slender; antennal vestiture very small and abundant. Head brown.

Prothorax brown. Mesonotal praescutum dark brown with four paler brown stripes that become confluent at the suture; posterior sclerites of notum pale brown, scutellum with sparse yellow setae. Pleura dark brown. Halteres yellow, elongate, knobs small. Legs brown; claws long and slender, smooth. Wings uniformly light gray, without a clearly evident pattern, stigma barely differentiated; very vague small more whitened areas in cells M_1, *2nd* M_2 and M_3, and in cell *1st A* near termination of vein *2nd A*; veins pale brown. Macrotrichia on Rs, R_3 and $R_{4\,\&5}$; vein M with about six very small scattered trichia on base of vein *2nd A* before the arculus. Venation: Veins R_3 and $R_{4\,\&5}$ nearly parallel to one another, scarcely sinuous as in most other species of the genus; petiole of cell M_1 about one-third longer than *m*; *m-cu* at near two-thirds $M_{3\,\&4}$.

Abdomen of type distorted and details difficult to see; segments light brown, posterior borders darker brown, more extensive on outer segments.Male hypopygrium (Fig. 2) with the tergite, *t,* very short and broad; posterior border shallowly emarginate, lobes very low, with abundant long black setae. Outer dististyle, *d,* subrectangular in outline, gradually narrowed outwardly, apex truncate; surface with very abundant long dark setae, especially on posterior and apical portions; inner style about as shown, posterior border strongly emarginate, the outer end of style larger than the base; beak a stout extension of remainder of style, without emargination; a compact oval group of small blackened spinoid points, the lower beak with a comparable linear row. Phallosome with apophyses, *g,* obtusely rounded.

Habitat – Ecuador. Holotype ♂: Pichincha Province, 41 km east of Quito, May 15, 1975 (A.B. Gurney).

The present fly is most readily told from other generally similar species by the gray virtually unpatterned wings, and in the structure of the hypopygium, especially the tergite and outer dististyle. Other regional species with the wings only slightly patterned include *Zelandotipula bisatra* (Alexander), of Bolivia; *Z. calvicornis* (Edwards), Ecuador; *Z. corynostyla* (Alexander), Colombia; *Z. monostictula* (Alexander), Peru; and *Z. nigrosetosa* (Alexander), Peru, all differing among themselves in body coloration and in hypopygial structure.

Orimarga (Orimarga) coracina, new species

General coloration intensely black; head gray; thoracic pleura with two narrow silvery longitudinal stripes; wings strongly blackened, more intensely in the radial field; Rs and $R_{1\,\&2}$ unusually long; male hypopygium with gonapophyses distinctive, as described.

Male – Length about 8 mm.; wing 6 mm.
Female – Length about 8 mm.; wing 5.9 mm.

Rostrum and palpi black. Antennae black throughout. Head above light gray medially, darker gray on sides.

Thorax intensely black, laterally with two narrow silvery longitudinal lines, the dorsal one extending from the cervical region to the wing root along lateral border of praescutum, ventral stripe slightly broader, occupying the dorsal part of the very extensive sternopleurite and the meral region. Halteres with stem dark brown, knob black. Legs with coxae and trochanters blackened; remainder of legs broken. Wings strongly blackened, more intensely in the radial field; prearcular field and extreme bases of cells R and M more whitened, together with a narrower whitened line along outer end of vein M and along $M_{1\,\&2}$ to apex, less evident on veins M_3 and M_4. Veins beyond cord with long black trichia, including veins $R_{1\,\&2}$ to M_4, inclusive. Venation: R_s very long, slightly exceeding the veins beyond it; $R_{1\,\&2}$ long, nearly twice the basal section of $R_{4\,\&5}$; *m-cu* distal in position, about opposite the outer sixth of Rs; cell M_3 slightly longer in male, more than twice vein $M_{3\,\&4}$.

Abdomen very long, especially in male, intensely black. Male hypopygium (Fig. 3) about as shown; dististyles, *d*, nearly as long as the basistyle. Phallosome complex in structure, especially the gonapophyses, *g*, as shown. This has the apical setuliferous lobule of the longer arm microscopic in size; lateral hinged blade shaped about as shown, broadly subtriangular in outline.

Habitat – Ecuador. Holotype ♂: Napo Province, 72 km east of Baeza, altitude 4200 feet, May 16, 1975 (A.B. Gurney). Allotype: ♀, on pin below the holotype.

Other similar blackened regional species include *Orimarga (Orimarga) chionopus* Alexander, *O. (O.) saturnina* Alexander, and *O. (O.) scabriseta* Alexander, of Ecuador, and *O. (O.) funerula* Alexander, of Peru. Some of these generally similar species have the tarsi white while others are dark throughout. All such species are most readily separated by hypopygial characters, including the unusually complex gonapophyses. I have included in this paper illustrations of four of these Ecuadorian species, *Orimarga (Orimarga) melanopoda,* Fig. 4; *O. (O.) chionopus,* Fig. 5 A; *O. (O.) saturnina,* Fig. 5 B; *O. (O.) scabriseta,* Fig. 5 C.

Orimarga (Orimarga) melanopoda, new species

General coloration intensely black; head gray; thoracic pleura with two relatively broad silvery longitudinal stripes; wings blackened; Rs very long, exceeding the outer radial branches beyond it; $R_{1\,\&2}$ relatively short, about one-fourth Rs; male hypopygium with phallosome complex in structure, especially the gonapophyses, the lateral arm of which is relatively short and stout, without a modified setuliferous lobe.

Male – Length about 6.5 - 7.5 mm.; wing 5.4 - 5.5 mm.

Female – Length about 8 mm.; wing 5 mm.

Rostrum and palpi black. Antennae black, pedicel slightly paler. Head black, light gray pruinose.

Thorax intensely polished black, laterally with two conspicuous silvery longitudinal stripes, the ventral one broader. Halteres black. Legs with coxae black; trochanters slightly paler; remainder of legs black. Wings strongly blackened, costal border more intensely so; prearcular cells whitened; a narrow whitened line along outer end of *Rs* and vein $M_{1\,\&2}$ to margin. Trichiation of veins much as in *coracina*. Venation: *Rs* very long, exceeding the veins beyond it; $R_{1\,\&2}$ relatively short, about one-fourth *Rs*, much shorter than in *coracina*.

Abdomen very long, black. Male hypopygium (Fig. 4) with details of structure about as shown. Dististyles, *od*, slightly shorter than the basistyle, the outer end very slender, sinuous. Gonapophysis, *g*, as shown, the longer arm blackened, relatively short and stout, without a modified apical lobe as in allied species; lateral hinged blade with outer portion expanded basally, outer half a strong blackened spine.

Habitat – Ecuador. Holotype ♂: Manabi Province, 79 km west of Santo Domingo, near spring seepage, May 8, 1975 (A.B. Gurney). Allotopotype, ♀, pinned with type. Paratopotypes, 3♂♀, with types.

A list of the generally similar regional species and references concerning the various allies is given under the preceding species.

Shannonomyia gurneyana, new species

Size medium (wing of female 9 mm.); general coloration of body brown, thoracic praescutum with three vague light brown stripes; legs black; wings whitened, veins light yellow, cord and apices of marginal veins blackened; *Rs* very long; cell *1st* M_2 long, nearly twice the distal section of vein $M_{1\,\&2}$.

Female – Length about 9 mm.; wing 9 mm.

Rostrum brownish gray; mouthparts small, black. Antennae broken. Head brownish gray with a very narrow darker central line on vertex.

Pronotum gray, with scattered black setigerous punctures. Mesonotal praescutum gray with three vague light brown stripes, the central area narrow on anterior third, behind divided into two lines, lateral stripes very pale brown; posterior sclerites of notum brownish gray, centers of scutal lobes vaguely light brown, postnotum light gray. Pleura light gray, dorsopleural membrane pale brown. Halteres light yellow, apex of knob weakly darkened. Legs with coxae gray, trochanters yellowish brown; remainder of legs black. Wings (Fig. 6) whitened, prearcular and costal fields vaguely light yellow; veins light yellow, those comprising the cord and the broad apices of veins $R_{1\,\&2}$, R_2, R_3, R_4, M_3, M_4, *Cu* and both Anals broadly black; further darkenings include origin of *Rs* and outer end of cell *1st* M_2. Venation: *Sc* long, Sc_1 ending shortly before fork of *Rs*, Sc_2 removed from tip; *Rs* very long, exceeding the veins beyond it, at origin nearly perpendicular, with a conspicuous spur beyond base; elements of cord oblique, tips of veins R_3 and R_4 slightly upcurved; cell *1st* M_2 long, nearly twice the distal section of vein $M_{1\,\&2}$; *m-cu* about its length beyond the fork of *M*.

Abdomen uniformly dark brown, slightly pruinose. Ovipositor with valves long and slender, nearly straight.

Habitat – Ecuador. Holotype ♀: Pichincha Province, 41 km east of Quito, May 15, 1975 (A.B. Gurney).

This distinct species is dedicated to my dear friend, Dr. Ashley B. Gurney. The most similar regional members of the genus include *Shannonomyia austrolathrea* Alexander, of Ecuador and Bolivia, and *S. vocator* Alexander, Ecuador, differing evidently in the wing pattern and details of venation, including the radial and medial fields.

Erioptera (Erioptera) acucuspis, new species

Size relatively large (wing of male about 6.5 mm.); general coloration of body dark brown to brownish black, thorax sparsely pruinose; halteres with stem yellow, knob blackened; legs black; wings almost uniformly light brown, stigma scarcely evident; male hypopygium with apex of inner dististyle terminating in a low blackened point.

Male – Length about 7 mm.; wing 6.5 mm.

Rostrum and palpi black. Antennae with scape and pedicel black; flagellum broken. Head brownish black, lateral borders of vertex narrowly paler gray.

Prothorax dark brownish gray, pretergites clear light yellow. Mesonotum almost uniformly dark brownish gray, praescutum anteriorly slightly darker, postonotum more uniformly blackened; posterior border of scutellum narrowly obscure yellow. Pleura and sternum brownish gray. Praescutal interspaces, median region of scutum, scutellum and dorsal pleurotergite with sparse long pale setae. Halteres with stem light yellow, knob small, blackened. Legs with coxae brownish gray; trochanters yellowish brown; femora black, posterior pair slightly paler basally; remainder of legs black. Wings almost uniformly light brown, stigma scarcely evident, prearcular field more yellowed; veins brown, trichia relatively long. Venation almost as in *andina*; vein *2nd A* at midlength strongly sinuous.

Abdomen black, sparsely pruinose. Male hypopygium (Fig. 7) with median area of tergite, *t*, produced, apex shallowly emarginate, the border with abundant microscopic tubercles. Outer dististyle, *d*, long and slender, apex acute; inner style distinctive, as shown; base broad, narrowed at midlength, outer margin with a slender acute black spine, apex of style narrowed, terminating in a low blackened point. Interbase, *i*, with apical half an acute spine. Phallosome, *p*, with arms of aedeagus, *a*, strongly recurved, outer margin at bend with a low expansion. The dististyles of *Erioptera (Erioptera) andina* are shown for comparison (Fig. 7 B); apex of inner dististyle, *d*, a simple suboval blade, without apical armature.

Habitat – Ecuador. Holotype ♂: Pichincha Province, 41 km east of Quito, May 15, 1975 (A.B. Gurney).

The most similar regional species is *Erioptera (Erioptera) andina* Alexander (1913), described from Colombia, ranging south to northwestern Argentina. This is most readily told by hypopygial structure, as discussed above.

Molophilus (Molophilus) coryne, new species

Size medium (wing male, 5 mm.); general coloration brown; male hypopygium with apical spine of basistyle surrounded at base by numerous strong setae; inner dististyle a blackened club, outer half expanded, apex with a compact mass of black setae and with a long ventral spine; aedeagus very long and slender, pale; phallosome small, suboval in outline, apex rounded.

Male – Length about 4.5 mm.; wing 5 mm.

Described from type mounted on slide. Rostrum and palpi light brown; remainder of head dark brown. Antennae broken at fifth segment, brown; proximal flagellar segments long-subcylindrical; fifth segment almost identical in size and conformation to the terminal segment of the maxillary palpi.

Thorax almost uniformly dark brown. Legs with coxae and trochanters pale; remainder of legs broken. Wings pale gray, base and costal border slightly more yellowed; vicinity of cord in radial field with a broad somewhat darker suffusion; veins pale.

Abdomen dark brown. Male hypopygium (Fig. 8) with apical spine of basistyle, *b,* straight, black, its base surrounded by numerous strong setae. Outer dististyle, *d,* with inner apical point broad; basal dististyle distinctive, appearing as a blackened clavate structure, the basal half more slender; apex with very abundant black setae forming a compact mass, lower apical angle of style extended into a long stout spine; surface of more than outer half of style with scattered setae, on lower face on weak tubercles. Aedeagus, *a,* very long and slender, pale, narrowed very gradually outwardly, its total length slightly exceeding that of the basistyle. Phallosome, *p,* an unusually small suboval lobe, the apex rounded.

Habitat – Ecuador. Holotype ♂, on slide: Napo Province, 22 km west of Baeza, 8000 feet, May 15, 1975 (A.B. Gurney).

Other regional Andean species that have the basal dististyle of the hypopygium generally similar to that of the present fly but differing in details include *Molophilus (Molophilus) grus* Alexander, of Peru, *M. (M.) pallatangae* Alexander, Ecuador; *M. (M.) perseus* Alexander, Colombia; *M. (M.) piger* Alexander, Peru, Bolivia; *M. (M.) platyphallus* Alexander, Ecuador, and *M. (M.) walkeri* Alexander, Colombia.

Molophilus (Molophilus) diacaenus, new species

General coloration of body black, slightly pruinose, especially the thorax; antennae short; halteres and legs brownish black; male hypopygium with apical spine of basistyle straight, black; inner dististyle with outer arm a strong spine, with a smaller appressed lateral point.

Male – Length about 5 mm.; wing 5 mm.; antenna about 1.0 mm.

Rostrum and palpi black. Antennae black; proximal flagellar segments long-cylindrical, the longest verticils exceeding the segments; outer segments progressively shorter, subcylindrical, the verticils short. Head dark gray.

Thorax almost uniformly dark gray, praescutal stripes vaguely more darkened; pretergites narrowly light yellow. Pleura black, sparsely pruinose. Halteres brownish black, apex of knob vaguely paler. Legs with coxae and trochanters blackened, remainder of legs brownish black. Wings weakly darkened, prearcular and costal fields slightly more yellowed; veins light brown. Trichia of veins longer than those comprising the costal fringe.

Abdomen brownish black. Male hypopygium (Fig. 9) with apical spine of basistyle, *b*, straight, black, the setae surrounding its base slender, pale and inconspicuous. Outer dististyle, *d*, with arms blackened, outer arm long and more slender; inner or basal dististyle with proximal two-thirds stout, outerly with two spines, the axial one long, gently curved to an acute point, lateral spine short, acute. Aedeagus, *a*, long and slender, yellow, slightly sinuous, about one-half longer than the inner dististyle.

Habitat - Ecuador. Holotype, ♂, Pichincha Province, 41 km east of Quito, May 15, 1975 (A.B. Gurney).

Other regional Andean species that have the basal dististyle of the hypopygium generally similar to that of the present fly include *Molophilus (Molophilus) perstrictus* Alexander, of Peru, and *M. (M.) subappressus* Alexander, Chile, all differing among themselves in details.

Molophilus (Molophilus) parvispiculus, new species

Size medium (wing of male 4.2 mm.); general coloration of body brown; halteres yellow; male hypopygium with apical spine of basistyle slender, near its base with sparse yellow setae; inner dististyle at apex with about five spines of different sizes, upper surface of style more dilated, with several

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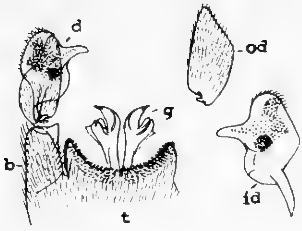
Fig. 1, *Zelandotipula daedalus*, n. sp; male hypopygium.
Fig. 2, *Zelandotipula hirtistylata*, n. sp; male hypopygium.
Fig. 3, *Orimarga (Orimarga) coracina*, n. sp; male hypopygium.
Fig. 4, *Orimarga (Orimarga) melanopoda*, n. sp; male hypopygium.
Fig. 5A, *Orimarga (Orimarga) chionopus* Alexander, male hypopygium.
Fig. 5B, *Orimarga (Orimarga) saturnina* Alexander, male hypopygium.
Fig. 5C, *Orimarga (Orimarga) scabriseta* Alexander, male hypopygium.
Fig. 6, *Shannonomyia gurneyana*, n. sp; venation.
Fig. 7, *Erioptera (Erioptera) acucuspis* n. sp; male hypopygium.
Fig. 7B, *Erioptera (Erioptera) andina* Alexander; male hypopygium.
Fig. 8, *Molophilus (Molophilus) coryne*, n. sp; male hypopygium.
Fig. 9, *Molophilus (Molophilus) diacaenus*, n. sp; male hypopygium.
Fig. 10, *Molophilus (Molophilus) parvispiculus*, n. sp; male hypopygium.

(Symbols: *a*, aedeagus; *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *i*, interbase; *id*, inner dististyle; *od*, outer dististyle; *p*, phallosome; *t*, 9th tergite.)



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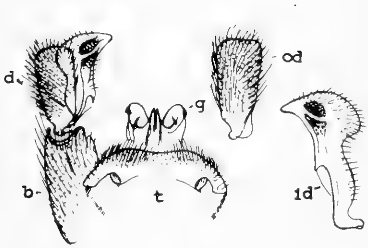

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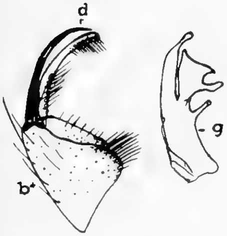

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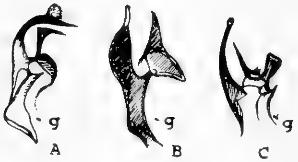

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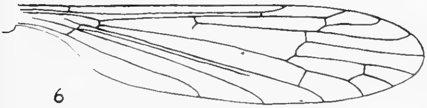

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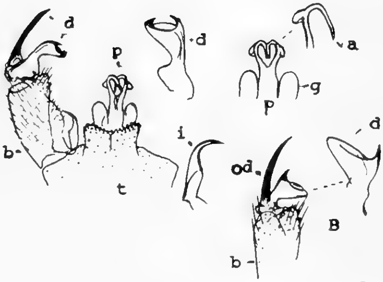

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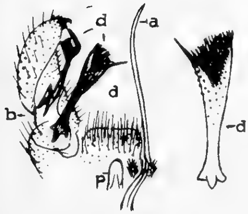

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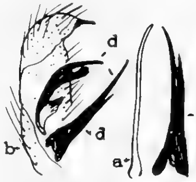

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denticles and microscopic tubercles; aedeagus moderately long, straight, shorter than the basistyle.

Male – Length about 4.5 mm.; wing 4.2 mm.

Rostrum and palpi black. Antennae black; flagellar segments long-oval, with delicate erect pale setulae, upper face with two or three long black verticils, the more basal one very long, exceeding twice the length of the segment. Head black, sparsely pruinose.

Prothorax and anterior end of praescutum dark brown, remainder of notum paler brown, more yellowed laterally. Pleura almost uniformly dark brown anteriorly, posterior sclerites paler brown. Halteres yellow. Legs with coxae and trochanters yellowed; remainder of legs pale yellowish brown, outer tarsal segments only slightly darker. Wings pale brown, stigma more suffused, prearcular region slightly more yellowed; veins pale brown.

Abdomen dark brown. Male hypopygium (Fig. 10) with apical spine of basistyle, *b*, slender, near its base with sparse weak yellow setae. Outer dististyle, *d*, with inner apical point broad, outer arm long and slender, gently sinuous. Inner dististyle, *d*, distinctive, subequal in length to the outer style; apex slightly dilated, bearing about five spines of different sizes, two being larger; upper surface of apex more protuberant, with several low denticles and microscopic tubercles. Aedeagus, *a*, moderately long, straight, slightly widened before midlength, shorter than the basistyle.

Habitat – Ecuador. Holotype, ♂, Napo Province, 110 km west of Lago Agrio, 5400 feet, May 18, 1975 (A.B. Gurney).

Other regional Andean species that have the inner dististyle of the hypopygium generally similar to that of the present fly, differing in important details, include *Molophilus (Molophilus) avitus* Alexander, of Ecuador; *M. (M.) brownianus* Alexander, Ecuador; *M. (M.) panchrestus* Alexander, Peru, and *M. (M.) tucumanus* Alexander, Argentina.

EDITORIAL COMMENT

The preceding article is especially noteworthy because Dr. Alexander indicates it is his 1000th paper. His first paper on insects was published in ENTOMOLOGICAL NEWS in 1910 and over the past 66 years, he has had papers published in 33 different countries. He indicates he is still working on further papers. Both he and we hope his health will allow him to continue working on his favorite family, the Tipulidae, for many years to come. ENTOMOLOGICAL NEWS congratulates Dr. Alexander on his tremendous contributions to the study of crane flies and is proud to have had a long standing association with this great entomologist.

A NEW SUBSPECIES OF ACILIUS (COLEOPTERA: DYTISCIDAE) FROM THE SOUTHEASTERN UNITED STATES[1]

James F. Matta,[2] Andrew G. Michael[3]

ABSTRACT: *Acilius fraternus dismalus* n. subsp. is described from Virginia and North Carolina and the intergradation with typical *A. fraternus* is discussed.

DESCRIPTORS: Aquatic insect, Coleoptera, Dytiscidae, distribution, intergradation.

The members of the genus *Acilius* are moderately large aquatic beetles which may be separated from closely related genera by the dense punctation on both the dorsal and ventral surface. The body is broadened and flattened in the posterior third and the elytra usually have a subapical yellow fascia. Members of the genus are characteristic of shaded woodland pools and are only occasionally found in other habitats.

The *Acilius* occuring in northeastern United States were discussed by Hilsenhoff (1975) and a new species from the northern United States and Canada was described. In Hilsenhoff's treatment of the genus, *Acilius fraternus* was characterized as "a southern species ranging north to Massachusetts, southern Ontario, southern Michigan, southern Wisconsin and Iowa. A key and supplementary characters were presented for separating the species of *Acilius* found in the northeastern North America.

Extensive collecting in eastern Virginia and North Carolina has revealed the existence of a population of *Acilius* distinct in several respects from typical *A. fraternus* and that form is herein described as a new subspecies.

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[1] Accepted for publication: October 30, 1975

[2] Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23508

[3] Navy Environmental and Preventive Medicine Unit #2, Norfolk, Virginia. 23511

ENT. NEWS, 87: 1 & 2: 11 - 16, January & February 1976

Acilius fraternus dismalus, new subspecies

Holytype female: Length 15.3 mm, width 8.4 mm. widest at the second abdominal segment. Size range of type material: length 12.4 to 16.0 mm, width 6.8 to 8.7 mm. **Head:** Entire ventral surface rufus; area between the eyes with an obscure rufopiceous M mark; posterior border narrowly obfuscate; dorsum of head densely covered with fine punctures, the punctures of the posterior margin somewhat courser. **Pronotum:** Lateral margins forming a continuous line with elytra; the margins without an enlarged rim. Antereolateral angles projecting forward to the level of the eyes; rufus, with two transverse black lines on disc; anterior one longer, extending posteriorly parallel to the lateral margin to the level of the posterior line; the lines separated from the margin by a distance slightly greater than their width; the posterior line only extending over the middle two-thirds of the disc. The disc densely covered by the irregularly spaced punctures; the area between the punctures with reticulate sculpturing. **Elytra:** Not sulcate; ground color rufotestaceous; with many dark spots which are so closely applied that they overlap and are broadly interconnected, especially on the disc. A posterior pale fascia occurs but is partially obliterated. The disc of the elytra is densely punctate, the punctures separated by a distance of less than one-half the width of a puncture, gradually becoming more widely spaced laterally and less distinct posteriorly. The area between the punctures microreticulate. **Venter:** Head rufopiceous, prosternum piceous, anterior half of the prosternal process rufus, posterior half infuscate; pro and mesothoracic legs rufotestaceous. Metasternum and coxal plates pisceous without a reddish cast. The coxal lobes rufopiceous, hind trochanter rufus, femora piceous with a narrow basal rufus area. Abdomen piceous, segments 3-5 with small rufus spots laterally, posterior margins with a rufus tinge. Entire ventral surface (except head) densely punctate; the area between the punctures microreticulate. **Allotype male:** Similar to the female in color and body form except as follows: 1) postmedian pale fascia of the elytra distinct, 2) prosternal process broadly margined in black but not completely infuscated in the posterior portion, 3) length 13.5 mm, width 8.1 mm. **Male tarsi:** Anterior protarsal claw unmodified, tarsal expansion with one large and two small adhesion discs; the small discs subequal in size and slightly greater than half the diameter of the large disc. The first three mesotarsal segments with a small inconspicuous tuft of golden cilia on the inner apical margin. **Male genitalia:** (Figure 1) length 1.8 mm, parameres slightly longer than the aedeagus; the ventral and inner margins with large fleshy lobes which partially enclose the aedeagus; the dorsal and outer sides well sclerotized to the tip. Aedeagus enlarged basally, rod-like for the distal three-fifths, with small lateral flanges which are poorly sclerotized, with a dorsal groove and a U shaped notch at the tip. **Types:** The holotype female and the allotype male were collected from a large woodland pool in the Dismal Swamp, City of Suffolk, Virginia on August 6, 1970. Paratypes are designated from the following localities: Dismal Swamp, 23 females, 27 males; Chesapeake, Va. 3 females, 4 males; Virginia Beach, Va. 1 female; Gates Co., N.C. 1 male; Pungo Lake, N.C., 1 female; Havelock, N.C. 3 females, 3 males. Collection dates range from March 2 to December 31. The primary types are retained in the authors'

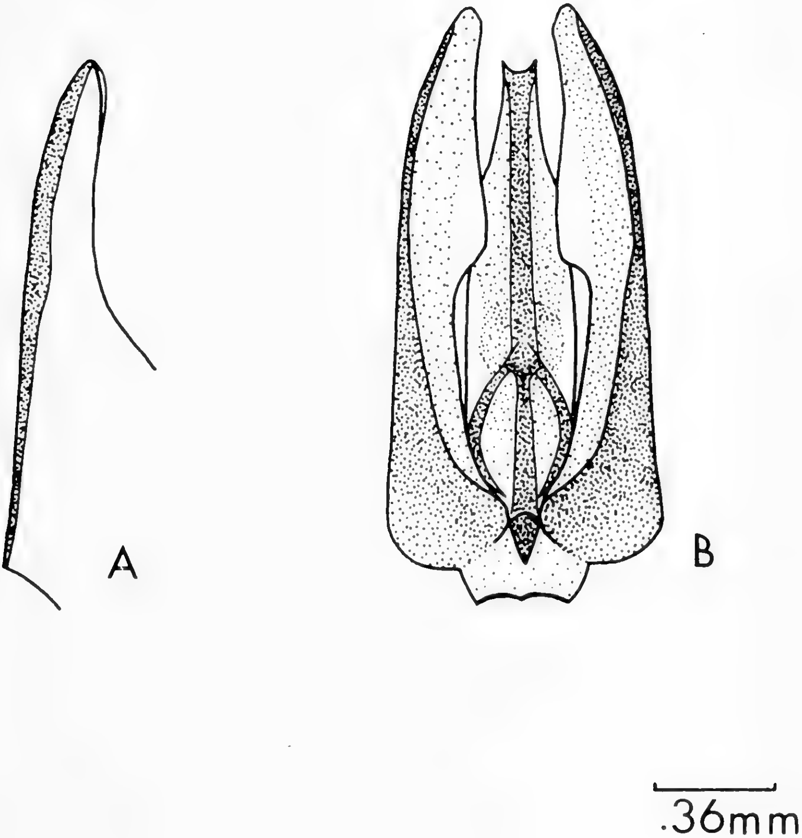

Figure 1. Male genitalia of *Acilius fraternus dismalus.* A. Dorsal view of left paramere. B. Ventral View of parameres and aedeagus.

collection; paratypes have been deposited with the National Museum of Natural History, the Harvard Museum of Comparative Zoology, The Canadian National Collection, the California Academy of Science, and North Carolina Department of Agriculture Museum.

Acilius fraternus dismalus will key out to *Acilius fraternus* in Hilsenhoff's (1975) key to the northeastern species and may be distinguished from typical *A. f. fraternus* by the following comparative characters:

A.f. fraternus	*A.f. dismalus*
1. Approximately 50% of the females with elytral sulci	1. Females never sulcate
2. Prosternal process usually narrowly margined with black, rarely infuscate at apex	2. Prosternal process more broadly margined, usually with the apex partially infuscated, occasionally more broadly infuscated.
3. Dorsum lighter, with a reddish brown cast	3. Dorsal surface darker, with a dark brown cast
4. Postmedian pale fascia usually distinct	4. Postmedian pale fascis usually indistinct, occasionally almost completely obliterated.
5. Coxal plate and metasternum reddish brown, occasionally piceous but with a reddish cast	5. Coxal plates and metasternum piceous, without reddish cast
6. Abdomen reddish brown	6. Abdomen piceous, the distal margins of each abdominal segment with a reddish brown tinge.

The known distribution of *Acilius fraternus dismalus* is the southeastern coastal plain of Virginia and the coastal plain of North Carolina; however, the characteristics of *A. f. dismalus* are similar to those described by Young (1954) for Florida specimens

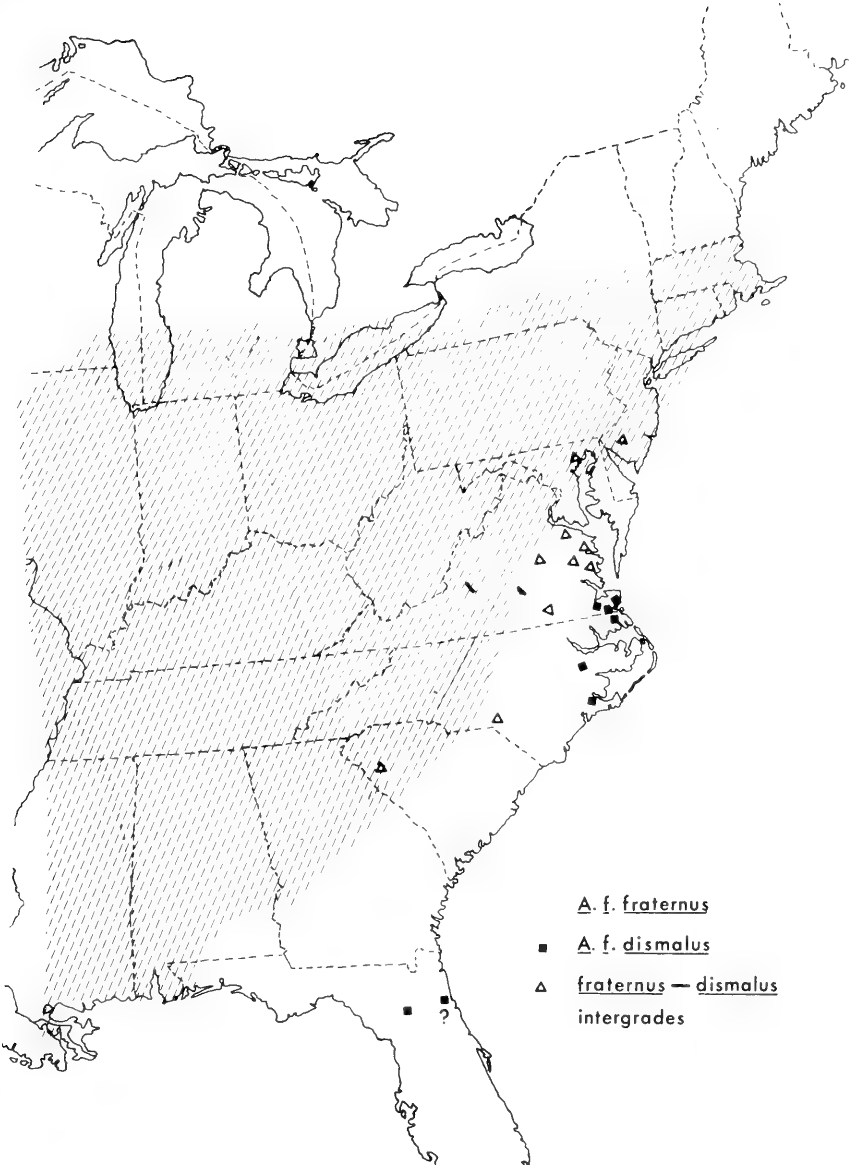

Figure 2. Distribution of *Acilius fraternus fraternus, A. f. dismalus* and *fraternus-dismalus* intergrades.

of *fraternus.* It is probable that Young was dealing with *dismalus,* and that the subspecies ranges from southeastern Virginia to Florida. It is probable that the origin of this subspecies is similar to the origin of *Matus ovatus blatchleyi* as described by Young (1954). Ancestral stock, isolated in Florida during the Pleistocene glaciation, evolved away from the typical subspecies. This new subspecies has gradually expanded northward in recent times and has developed a broad zone of intergradation with the typical subspecies.

Intergrades between the typical *fraternus* and *dismalus* typically have a slightly reddish cast to the metasternum and coxal plates. Occasionally females from intergrade populations will be sulcate. Figure 2 shows the distribution of *Acilius fraternus fraternus, A. fraternus dismalus* and intergrade populations in the eastern United States.

An examination of the distribution of intergrades indicates that the zone of intergradation consists of the eastern Virginia coastal plain north of Hampton Roads and south of Fredricksburg with minor salients to the northeast into Maryland and New Jersey, and the area adjacent to the fall line in southern Virginia and the Carolinas. Additional collecting in the Gulf coast states is needed in order to determine the relationship between typical *fraternus* and *dismalus* in that area.

ACKNOWLEDGEMENTS

The authors wish to thank the following individuals and institutions for the loan of specimens. Dr. Paul J. Spangler, U.S. National Museum; Mr. J.F. Green, North Carolina Department of Agriculture; Dr. John C. Morse, Clemson University; and Mr. Stephen O. Swadener, Illinois Natural History Survey. The authors also wish to thank Dr. William Hilsenhoff for a manuscript copy of his paper describing *Acilius sylvanus.*

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DISTRIBUTION OF THE SUPERFAMILY NEMOUROIDEA IN WEST VIRGINIA (INSECTA: PLECOPTERA)[1]

Randall G. Farmer,[2] Donald C. Tarter[3]

ABSTRACT: The distribution of the stonefly superfamily Nemouroidea in West Virginia was studied from September 1973 to June 1974. Forty-three species, representing four families, were recorded during the study. Twenty-one new state records were found.

DESCRIPTORS: Stoneflies, Taxonomy, Distribution, Superfamily Nemouroidea, State and County Records.

There is a paucity of information regarding stonefly distribution in West Virginia. Recent work by Burrows (1971), Farmer (1974), and Steele (1974) has added to our knowledge of Plecoptera from this state. Sporadic records of specimens taken from West Virginia have appeared in the literature (Ricker and Ross, 1968; Ricker and Ross, 1969; Ross and Ricker, 1964; Ross and Ricker, 1971). The records of the superfamily Nemouroidea listed here are a compilation of various literature records, West Virginia Department of Natural Resources and United States Department of Interior Surveys, unpublished United States National Museum records, and individual collecting efforts.

The state may be divided into seven main river systems containing dendritic and trellised drainage systems (Janssen, 1944) (Fig. 1). Area I comprises the Ohio River drainage in the extreme Western portion of the state. There is extensive industrialization in parts of this area as well as farming. The Monongahela River embraces area II and flows through mountain areas of the state. Area III is a large farming region of the state drained by the Potomac River. The Little Kanawha River is the largest waterway found in area IV and meanders through this region.

Area V contains the Kanawha River in the industrialized western portion of this area and the New and Greenbrier Rivers in

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[1] Accepted for publication: October 24, 1975

[2] Department of Biology, University of Louisville, Louisville, Kentucky. 40208

[3] Department of Biological Sciences, Marshall University, Huntington, West Virginia. 25701

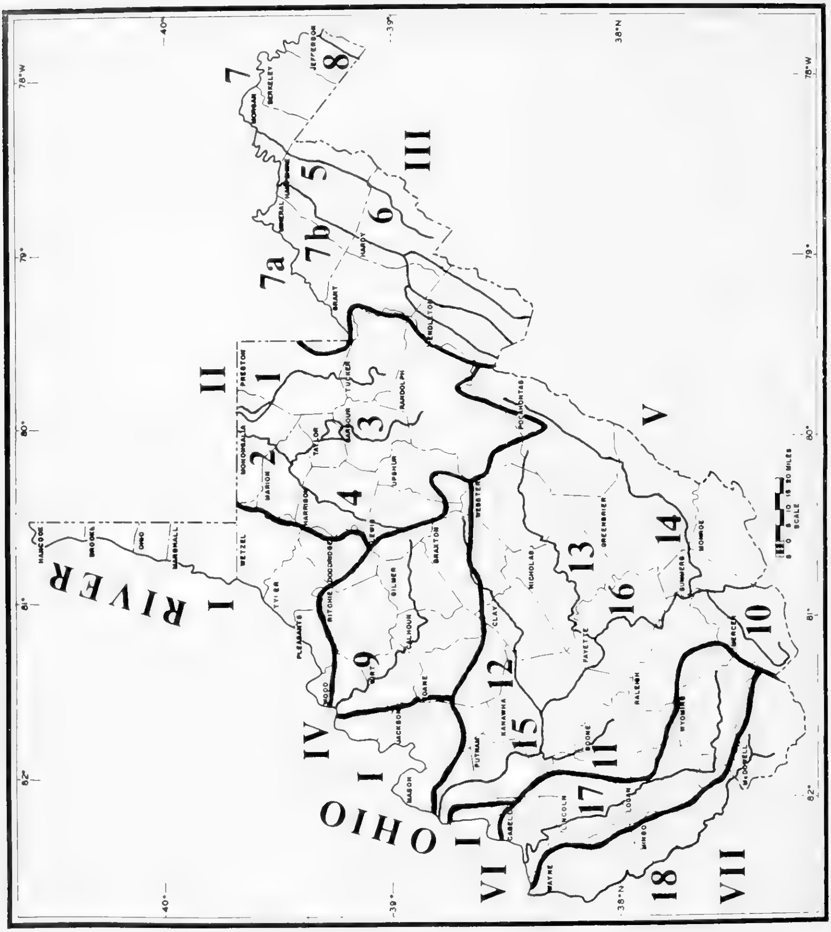

Figure 1. Drainages Basins and Major Rivers in West Virginia.

I. Ohio River; II. Monongahela River: 1) Cheat River, 2) Monongahela River, 3) Tygart River, 4) West Fork River; III. Potomac River: 5) Cacapon River, 6) Lost River, 7) Potomac River, a) North Branch, b) South Branch, 8) Shenandoah River; IV. Little Kanawha River: 9) Little Kanawha River; V. 10) Bluestone River, 11) Coal River, 12) Elk River, 13) Gauley River, 14) Greenbrier River, 15) Kanawha River, 16) New River; VI. Guyandot River; VII. Big Sandy River.

the higher elevations in the east. The Guyandot and Coal Rivers of area VI move through the coal operations of this area. Finally, the Big Sandy River and Twelve Pole Creek flow through area VII which contains farmland and coal mining operations.

This work brings the total member of Nemouroidea species occurring in West Virginia to forty-three. The classification scheme used by the authors follows that of Illies (1966) and Zwick (1973).

Family Nemouridae

Members of the genus *Amphinemura* Ris are generally distributed throughout the state, being absent only from area VII. *Ostracerca* and *Soyedina* species are restricted to areas II, III and VI.

Amphinemura delosa **(Ricker)**

Areas: I-VI. Tyler Co., Cow Hollow Run. Preston Co. Harrison Co., Elk Creek. Tucker Co., Blackwater River. Pendleton Co., Seneca Creek; Lower White's Run; Upper White's Run; South Branch Potomac River; Smoke Hole Camp. Grant Co., South Branch Potomac River, Wirt Co., Right Fork Tucker Creek. Mercer Co., Elkorn Creek. Cabell Co., Miller Fork. Lincoln Co., Middle Fork.

A. nigritta **(Provancher)**

Areas: I-VI. Tyler Co., Cow Hollow Run. Tucker Co. Hampshire Co., Cacapon River. Ritchie Co., Isaacs Creek. Pocahontas Co., Cranberry Glades, Cabell Co., Miller Fork.

Ostracerca albidipennis **(Walker)**

Areas: II. Tucker Co.

O. complexa **(Claassen)**

Areas: II and III. Randolph Co., Seneca Creek. Pendleton Co., Spruce Knob.

O. prolongata **(Claassen)**

Areas: II and III. Tucker Co., Red Creek. Pendleton Co., Spruce Knob.

O. truncata **(Claassen)**

Areas: II and III. Tucker Co., Red Creek. Pendleton Co., Spruce Knob.

Soyedina carolinensis **(Claassen)**

Areas: II and VI. Randolph Co., Seneca Creek. Logan Co., Dairy Hollow.

Family Taeniopterygidae

Except for *Taeniopteryx burksi* and *T. maura* members of this family are restricted to only one or two areas in the state. Species of the subfamily Taeniopteryginae are found in areas II, III, V, VI, and VII with area V containing five of the eight species occurring in the state. The three species of Brachypterinae in the state are more restricted but two are found in area V.

Taenionema rossi **Frison**

Area: VII. Wayne Co., Beech Fork.

Taenionema nov. sp. **Ricker and Ross**

Areas: II and V. Randolph Co., Gandy Creek, Fayette Co., Smithers Creek.

Strophopteryx fasciata **(Burmeister)**

Areas: III and V. Hampshire Co., Romney. Jefferson Co., Shenandoah River. Pendleton Co., Lower White's Run. Nicholas Co., Cherry River. Pocahontas Co., Greenbrier River. Webster Co., Elk River.

Taeniopteryx burksi **Ricker and Ross.**

Areas: III, V and VI. Hampshire Co. Hardy Co. Clay Co. Kanawha Co. Nicholas Co. Fayette Co. Cabell Co.

T. maura **(Pictet)**

Areas: III, V, VI, VII. Grant Co. Hampshire Co. Augusta; Romney. Mineral Co. Clay Co. Nicholas Co. Fayette Co. Pocahontas Co. Raleigh Co., Little Beaver Creek. Little Cabell Creek. Wayne Co., Beech Fork of Twelvepole Creek, Greenbrier Co., Cherry River.

T. metequi **Ricker and Ross**

Area: V. Clay Co., Elk River. Greenbrier Co. Nicholas Co. Pocahontas Co.

T. nivalis **(Fitch)**

Area: VI. Cabell Co., Little Creek Creek.

T. parvula **Banks**

Area: V. Clay Co.

T. ugola **Ricker and Ross**

Areas: II and V. Preston Co., Fellowville. Greenbrier Co., Cherry River. Mercer Co.

Family Leuctridae

Six of the eight species of *Leuctra* are found in area II and restricted to only one other area in the state. *Leuctra tennis* and *L. truncata* have somewhat more extensive ranges in the state.

Leuctra biloba **Claassen**

Areas: II and III. Tucker Co., Red Creek. Pendleton Co., Big Run.

L. carolinensis **Claassen**

Area: II. Tucker Co., Red Creek.

L. duplicata **Claassen**

Areas: II and III. Tucker Co., Red Creek. Pendleton Co., Big Run.

L. ferruginea **(Walker)**

Areas: II and V. Randolph Co., Red Creek. Tucker Co., Red Creek. Pocahontas Co., Island Lick Run; Cummings Creek.

L. maria **Hanson**

Areas: II and VI. Tucker Co., Red Creek. Lincoln Co., Mud River.

L. sibleyi **Claassen**

Area: II. Tucker Co., Red Creek.

L. tennuis **(Pictet)**

Areas: III, V and VI. Mineral Co., Elk Garden. Pocahontas Co., Island Lick Run. Logan Co., Trace Fork.

L. truncata **Claassen**

Areas: II, V, and VI. Upshur Co., Middle Fork. Greenbrier Co., thru Falls Hill Creek. Lincoln Co., Mud River.

Paraleuctra sara **(Claassen)**

Areas: II and VI. Tucker Co., Red Creek. Logan Co., Trace Fork of Copperas Mine Fork.

Zealeuctra claasseni **(Frison)**

Areas: IV and VI. Ritchie Co. Cabell Co.

Z. fraxina **Ricker and Ross**

Area: III. Hardy Co.

Family Capniidae

Of the seventeen members of this family found in the state, only seven are generally distributed throughout the state. *Allocapnia nivicola. A. recta,* and *A. rickeri* are found throughout all seven drainage areas. *Allocapnia forbesi* (area I), *A. indianae* (area VI) and *A. pygmaea a* (area V) are restricted to only one area in the state.

Allocapnia curiosa **Frison**

Areas: II, III, V, and VII. Randolph Co., Huttonsville. Hampshire Co., Kanetown. Grant Co., Mount Storm. Pendleton Co., Brandywine; Circleville. Pocahontas Co., Greenbrier River.

A. forbesi **Frison**

Area: I. Wood Co., Volcano; East Deer Walk.

A. frisoni **Ross and Ricker**

Areas: II, IV, V, and VII. Preston Co., Buffalo Creek. Randolph Co., Intersection Rt 15-219. Ritchie Co., North Harrisville, Calhoun Co., North Grantsville. Kanawha Co., Nitro. McDowell Co., Horse Creek, Mingo Co., West Holden.

A. granulata **(Claassen)**

Areas: I, II, III, V. and VI. Wood Co., Volcano. Preston Co., Buffalo Creek. Hampshire Co., Cacapon River. Mineral Co., Newcreek. Pendleton Co., Circleville. Pocahontas Co., Knapps River, Logan Co. Track Fork, Mine Fork.

A. indianae **Ricker**

Area: VI. Logan Co., Trace Fork.

A. loshada **Ricker**

Areas: II and VI. Randolph Co., Seneca Creek, McDowell Co., Horse Creek.

A. maria Hanson

Areas: II and III. Preston Co., Cheat River. Hardy Co., Petersburg.

A. mystica Frison

Areas: IV and VI. Calhoun Co., Grantsville, Ritchie Co., North Harrisville; South Harrisville; Cabell Co., Guyandot Creek; Tyler Creek.

A. nivicola (Fitch)

Areas: I-VII. Doddridge Co., West Salem. Preston Co., Cheat River; Wolf Creek; Fellowsville; Buffalo Creek; Little Sandy Creek; Bructon Mills. Randolph Co., Tygart Valley River; Elk Water; Monterville. Hampshire Co., Romney; Little Cacapon River; Cacapon River. Pendleton Co., Circleville, Mineral Co., New Creek. Calhoun Co., Grantsville. Pocahontas Co. Greenbrier River; Frost; Boyer; Greenbank; Minnehaha Springs; Knapps River; Thornwood. Lincoln Co., Guyandot Creek; North Harts. McDowell Co., Horse Creek. Mingo Co., Holden

A. pygmaea (Burmeister)

Area: V. Pocahontas Co., Knapps River.

A. recta (Claassen)

Areas: I-VII. Mason Co., Ashton, Preston Co., Fellowsville; Little Sandy Creek; Evansville, Randolph Co., Tygart Valley River; Monterville; Huttonsville; Beverly. Hampshire Co., Augusta; Little Cacapon River. Mineral Co., New Creek. Grant Co., North Fork; Patterson Creek; Pendleton Co., Circleville, Roane Co., Cotton. Summers Co. Forest Hill; Monroe Co., Indian Creek. Clay Co., Indoor; Lizemores. Lincoln Co., Guyandot Creek. Mingo Co., Holden.

A. rickeri Frison

Areas: I-VII. Doddridge Co., Arnolds Creek; Salem; West Union. Ohio Co., Valley Grove. Barbour Co., Century. Preston Co., Fellowsville; Little Sandy Creek; Pendleton Co., Circleville. Ritchie Co., Goose Creek. Calhoun Co., Grantsville. Roane Co., Spencer. Gilmer Co., Normantown; Mercer Co., East River; Oakvale. Putnam Co., Hurricane. Kanawha Co., Wellford. Pocahontas Co., Buckeye. Greenbrier Co., Renick. Monroe Co., Indian Creek. Cabell Co., Guyandot Creek; Ona Pond. Wayne Co., Lynn Creek.

A. vivipara (Claassen)

Areas: I, II, IV, V, VI, and VII. Wood Co., Volcano. Doddridge Co., Arnold's Creek; Salem; West Union. Ohio Co., Valley Grove. Preston Co., North Valley, Ritchie Co., North Harrisville; Deerwalk. Calhoun Co., Grantsville. Lewis Co., Weston. Roane Co., Spencer. Putnam Co., Hurricane. Cabell Co., Guyandot Creek; Tyler Fork. McDowell Co., Horse Creek.

A. zola Ricker

Areas: II, V, and VI. Preston Co., Little Sandy Creek; Bructon Mills. Mercer Co., Flattop. Pocahontas Co., Boyer. Clay Co., Blackmore; Indoor. Lincoln Co., Guyandot Creek.

Paracapnia angulata Hanson

Areas: II and V. Randolph Co., Shaver's Fork; Cherry River. Webster Co., William River.

P. opis (Newman)

Areas: II and III. Preston Co., Cheat River. Hampshire Co., Little Cacapon River. Grant Co.

ACKNOWLEDGEMENT

A special thanks to Dr. Richard Baumann, United States National Museum, for helping with the identification of the stoneflies.

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FIRST RECORDS OF THE PREDACEOUS MIRID *PHYTOCORIS TILIAE* (F.) FROM THE UNITED STATES[1]

A.G. Wheeler, Jr., Thomas J. Henry[2]

ABSTRACT: The predaceous mirid *Phytocoris tiliae* (F.) is widely distributed in Europe and in the 1920s was reported as a possible introduced species at Vancouver, British Columbia. *P. tiliae* is here recorded from both coasts of the United States. Records are cited from eastern Long Island, New York and three port cities in Washington. A diagnosis of *P. tiliae* is included.

DESCRIPTORS: Hemiptera, Miridae; *Phytocoris tiliae;* new United States record; European introduction; Washington; New York.

Mr. Roy Latham has collected insects on eastern Long Island, New York, mainly at black light and by sweeping, for more than 60 years. Recently, he donated his collection to Cornell University. From a cursory examination Pechuman (1969) suggested that the collection "... contains a number of species not previously known to occur in New York." We have borrowed the Latham mirid collection and have examined his specimens that were retained for the National Museum of Natural History collection. Mr. Latham's material contains a high proportion of "Holarctic" species, including *Phytocoris tiliae* (F.), a common Palearctic mirid known previously in North America only from Vancouver, British Columbia. Among determined and undetermined material in the NMNH collection, we have found specimens of *P. tiliae* collected at Seattle and two other port cities in Washington.

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[1] Accepted for publication: October 28, 1975

[2] Bureau of Plant Industry, Pennsylvania Department of Agriculture, Harrisburg, Pa. 17120

ENT. NEWS, 87: 1 & 2: 25 - 28, January & February 1976

Phytocoris tiliae (F.)

Distribution and Biology in Europe: This mirid occurs throughout the British Isles and most of continental Europe and ranges south to Algeria and Morocco (Carvalho 1959). *P. tiliae* is a variable species ranging from grayish-white to green, and Reuter (1896) recognized 5 varieties in addition to the typical form. Butler (1923) described the egg and last-instar nymph. Collyer (1953) figured the egg; Saunders (1892), Reuter (1896), and Southwood and Leston (1959), among others, have figured the adult.

Butler (1923) noted that *tiliae* is often taken on trunks of deciduous trees and cited collections from several genera, including *Acer, Alnus, Betula, Castanea, Corylus, Populus, Prunus, Quercus, Salix,* and *Ulmus.* Collyer (1953) collected this mirid in both neglected and commercial apple orchards in England, and Ward (1969) recorded it from plum orchards in England. *P. tiliae* is mainly predaceous and attacks European red mite, *Panonychus ulmi* (Koch); caterpillars; and many other insect and mite species (Collyer 1953).

According to Southwood and Leston (1959), eggs are deposited in young wood of the host tree and hatch from early June to early August. Adults first appear in late June and have been taken until late October. There is a single generation each season (Collyer 1953).

Occurrence in North America: Downes (1924) was the first to report *tiliae* from North America. He found *tiliae* commonly on trunks of trees along boulevards in Vancouver, British Columbia, in 1921 and noted that the species probably had been introduced from Europe. *P. tiliae* apparently became established in the Vancouver area because Downes (1957) stated that the species was abundant on 2 trees in Vancouver during 1954.

Mr. Latham stated *(in litt.)* that he first collected *P. tiliae* at Orient, N.Y., in 1965 and that on Oct. 1, 1966 he took 12 specimens at light. Two of the specimens were sent to Dr. R.C. Froeschner and were identified as *P. tiliae.* Mr. Latham noted that he has not taken this mirid at light since 1966.

The NMNH collection has specimens of *tiliae* from 3 localities in Washington. The following represent the first records from the western United States: Port Angeles, Wash., VIII-4-44, S.S. 18334, on apple, 44-20820 (2 adults, 2 fourth- and 2 fifth-instar nymphs); Kent, Wash., 8-17-43, S.S. - 2147, on apple trees, 43-14877; Seattle, Wash., 8-21-44, P.G. Avery #34, Lot. No. 44-26367.

The Port Angeles and Kent specimens were collected as part of the USDA, Bureau of Plant Quarantine's "Special Survey in the General Vicinity of Ports of Entry" conducted from June 1943 to June 1945. Some of the Port Angeles specimens were originally misidentified as *P. calli* Knight and were correctly determined by R.C. Froeschner in 1967. Specimens from Kent and Seattle and additional ones from Port Angeles were found among undetermined material in the NMNH collection.

P. tiliae may easily be distinguished from all other eastern North American *Phytocoris* by the grayish-white to green coloration and the black lateral margins of the pronotum. This species will key to *P. palmeri* Knight in Knight (1923) and to *P. minutulus* Knight or *P. sulcatus* Knight in Knight (1941).

The following brief descriptions based on specimens from New York and Washington should facilitate recognition of *P. tiliae* in the North American fauna:

Male: length 6.42 mm, width 2.25 mm (N.Y. specimen); pale testaceous to grayish. *Head:* white, small fuscous mark on lorum. *Rostrum:* testaceous, dark on apical 3rd, reaching 3rd or 4th abdominal segment. *Antennae:* I, fuscous to black with 4 dorsal spots; II, fuscous, a narrow white band at base and a larger one at middle; III, fuscous, white band at base; IV, fuscous. *Pronotum:* pale to grayish, lateral margins fuscous, a broken fuscous line on basal margin. *Scutellum:* pale, with distinct spot on either side of apical 3rd. *Hemelytra:* pale to grayish, marbled with fuscous, stronger on clavus; a transverse fuscous mark across apical and basal 3rd of corium; cuneus pale, apex fuscous; membrane transparent and conspurcate, spots coalescing inside large areole. *Venter:* pale, upper half of pleura, sternum, lateral margin of abdomen and genital segment fuscous. *Legs:* coxae pale, femora pale, marked with fuscous; tibiae pale, with 3 fuscous bands.

Female: length 6.67 mm, width 2.33 mm (Wash. specimen). Lighter in color than male.

Discussion: Although the genus *Phytocoris* is well represented in both the Palearctic and Nearctic regions, only two Palearctic species, *P. dimidiatus* Kirschbaum and *P. ulmi* (L.), are known to occur in northeastern North America (Knight 1923; Slater 1974). The distribution of *P. tiliae* along both North American coasts fits that of an introduced species. Separate introductions with nursery stock could have given this distribution.

Slater (1974) analyzed the derivation of the northeastern heteropteran fauna and listed 43 "Holarctic" mirids (introduced or true Holarctic species) in the Northeast. With the two species reported after Slater's paper went to press (Henry and Wheeler

1974), the record of *P. tiliae* from New York brings to 46 the number of "Holarctic" mirids known from the Northeast. We would be interested in learning of additional records or seeing specimens of *P. tiliae* from North America.

ACKNOWLEDGEMENTS

We thank Mr. Roy Latham for corresponding with us about *P. tiliae,* Dr. J.L. Herring for loaning us specimens of *tiliae* from the NMNH collection, and Mr. P.M. Schroeder for supplying information about the USDA's "Ports of Entry" survey.

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A NEW *SAILERIA* FROM EASTERN UNITED STATES (HEMIPTERA: MIRIDAE)[1]

Thomas J. Henry[2]

ABSTRACT: *Saileria irrorata* n. sp. is described from Indiana, U.S.A. This mirid was collected on red elm, *Ulmus fulva* Michx. and taken in association with the woolly elm aphid, *Eriosoma americanum* (Riley). A figure of the adult female and a key to the species of the genus are provided.

DESCRIPTORS: Hemiptera, Miridae, *Saileria irrorata,* new species, Indiana, *Ulmus fulva*

Hsiao (1945) erected the genus *Saileria* for Van Duzee's *(Hyalochloria) bella* described from California. Later Carvalho (1953) recognized the misplacement of his *(Hyalochloria) almeidai* from Brazil and transferred it to *Saileria;* he also described the third species *youngi* from Panama. Carvalho (1958) listed these three species in his catalog.

The following description represents the fourth known species of *Saileria.* I have included a modified version of Carvalho's (1953) key to separate the species.

Saileria irrorata new species
(Fig. 1)

Female Holotype: length 3.00 mm, width 1.20 mm. General color yellow to sulphurescent; clothed with simple, pale setae; eyes granulate. *Rostrum:* length 1.12 mm, reaching beyond metacoxae to 2nd abdominal segment. *Antennae:* pale to yellowish; segment I, 0.28 mm, clothed with simple, recumbent, black pubescence, apical half with 3-4 stout black setae; II, 1.00 mm, slender, slightly enlarged at apex, clothed with pale recumbent setae; III, 0.50 mm; IV, 0.44 mm. *Pronotum:* length 0.32 mm, width at base 0.76 mm; yellowish to sulphurescent with three greenish blotches across disk and a few green spots at basal angles; calli indistinct, separated from disk by a shallow, impressed line; clothed with long, pale, semierect pubescence; mesoscutum and scutellum yellowish to sulphurescent, without green markings. *Hemelytra:* hyaline, marked with many small green irrorations or blotches, some of these combining to form larger blotches; clothed with simple semierect pubescence. *Membrane:* smoky yellow; veins same color; inside of areoles spotted with green and minutely punctate or coriaceous; a

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[1] Accepted for publication: November 25, 1975

[2] Bureau of Plant Industry, Pennsylvania Department of Agriculture, Harrisburg, Pa. 17120

clear quadrate spot posterior to cuneus, inner margin bordered with brown. *Venter:* pale to yellowish; sparsely clothed with pale setae. *Legs:* pale to greenish-yellow; hind femora with a few greenish spots near apex and on ventral aspect; spines on middle and hind tibiae black.

HOLOTYPE: ♀ White Co., Indiana, Monticello, Tall Timbers Marina, July 9, 1975, T.J. Henry coll., on red elm, *Ulmus fulva* Michx., infested with woolly elm aphid, *Eriosoma americanum* (Riley) (NMNH Type No. 73663). PARATYPES: 4 ♀♀, same data as for holotype (1, NMNH; 1, PDA, BPI; 2, author's collection).

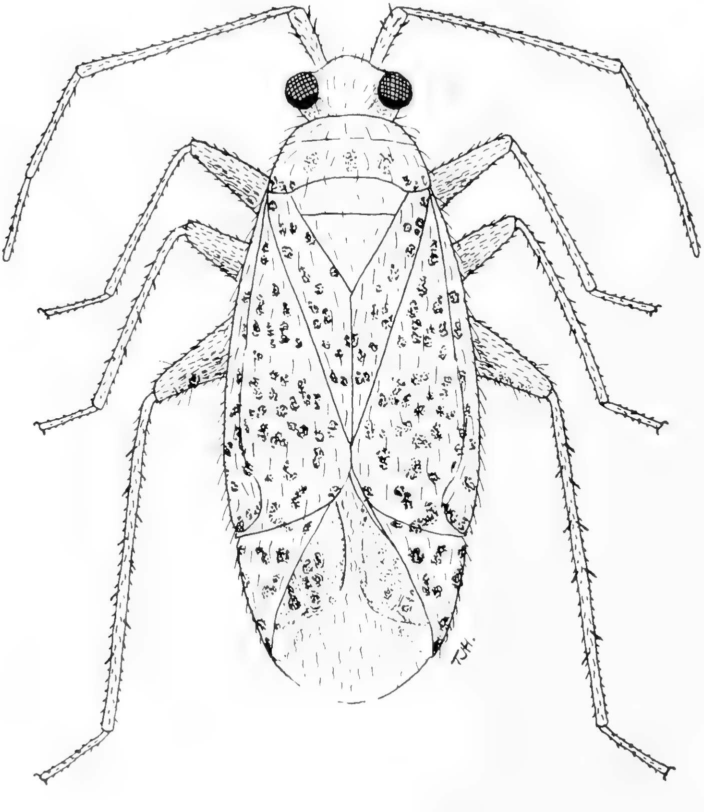

Fig. 1. *Saileria irrorata* n. sp., adult female.

Remarks: This pretty and rather delicate mirid may be easily separated from all other species in our eastern fauna by the small size and the many small, green blotches on the dorsum. It most closely resembles *youngi* from Panama and can be distinguished from all other species of *Saileria* by the black setae on the 1st antennal segment, the longer 2nd antennal segment and rostrum, and the black spines on the middle and hind tibiae.

Five females of *irrorata* were taken on one large red elm in northern Indiana that had 80-90% of the leaves curled by the woolly elm aphid. No males were taken, indicating that the peak adult population probably occurred one or two weeks before the collection date.

Key to the species of *Saileria* Hsiao

1. Corium with a few round green spots and clavus with two median greenish spots; second antennal segment 1.4 mm long; Brasil . . . . *almeidai* (Carvalho)
   Hemelytra with numerous greenish spots; second antennal segment 1 mm or less. 2

2. Rostrum reaching posterior coxae; third and fourth antennal segments fuscous; Panama . . . . *youngi* Carvalho
   Rostrum reaching beyond posterior coxae; third and fourth antennal segments pale 3

3. Spots of hemelytra distinctly quadrate; second antennal segment less than 1.00 mm long; California, U.S.A. . . . . *bella* (Van Duzee)
   Spots of hemelytra not quadrate; second antennal segment 1.00 mm long; Indiana, U.S.A. . . . . *irrorata* n. sp.

ACKNOWLEDGEMENTS

I wish to thank Dr. Jon L. Herring, NMNH, for allowing me to examine specimens of *Saileria* housed under his care; also I thank Dr. Karl R. Valley, PDA, BPI, for his helpful comments in preparing this manuscript.

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NEW RECORD OF THE ALDERFLY *SIALIS ITASCA* ROSS FOR WEST VIRGINIA (MEGALOPTERA: SIALIDAE)[1]

D.C. Tarter, D.L. Ashley, C.K. Lilly[2]

ABSTRACT: The alderfly *Sialis itasca* Ross is reported for the first time for West Virginia.

DESCRIPTORS: *Sialis itasca,* Alderfly, Megaloptera, New distribution record for West Virginia

These authors are reporting the alderfly *Sialis itasca* Ross for the first time in West Virginia. On 3 May 1975 one adult (female) alderfly was captured at "Coon Pond" in Wayne County near Huntington, West Virginia. Three males and three females were reared in the laboratory (24-26 April) from larvae collected from the pond. Previously, three alderflies have been reported from West Virginia. Ross (1937) reported *S. velata* Ross from Millville (Jefferson County) near the Shenandoah River. More recently, Tarter (1973) and Tarter and Woodrum (1973) reported *S. joppa* Ross (Pendleton County) and *S. aequalis* Banks (Wayne County), respectively, from West Virginia.

The genus *Sialis* Latreille contains 23 Nearctic species (Ross, 1937; Townsend, 1939; and Flint, 1964). Ross (1937) described *S. itasca* in a monograph of Nearctic alderflies of the genus *Sialis.* The holotype male and allotype female were collected at Momence, Illinois, along Kankakee River on 1 June 1937 by B.D. Burks. *Sialis itasca* is known from Georgia, Illinois, Kansas, Maryland, Michigan, Minnesota, Missouri, New York, North Dakota, Ohio, Ontario, Pennsylvania, Quebec, Virginia and Washington, D.C. (Ross, 1937 and Flint, 1964).

A special thanks to Dr. Oliver S. Flint, Jr., United States National Museum, Washington, D.C., for identification of the alderfly.

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[1] Accepted for publication: November 14, 1975

[2] Department of Biological Sciences, Marshall University, Huntington, West Virginia 25701

NESTING BEHAVIOR OF *TRICHOGORYTES COCKERELLI* (ASHMEAD) (HYMENOPTERA, SPHECIDAE, NYSSONINAE)[1],[2]

Howard E. Evans[3]

ABSTRACT: Notes are presented on the behavior of *Trichogorytes cockerelli* (Ashmead) in an area of sand dunes 20 miles north of Socorro, N. Mex. Digging behavior is described in detail. The nests are from 23 to 28 cm deep and are provisioned with paralyzed leafhoppers of several species.

DESCRIPTORS: Sphecidae; *Trichogorytes cockerelli;* nesting behavior.

Trichogorytes is a poorly known genus containing only two species, both confined to the southwestern United States. Neither species has been often collected, and nothing has been reported regarding the prey or nesting behavior. During June, 1975, I found *T. cockerelli* (Ashmead) to be reasonably common in sand dunes bordering the Rio Grande Valley at the LaJoya Waterfowl Preserve, 20 miles north of Socorro, New Mexico. Specimens were taken in a Malaise trap set up in the dunes, and paralyzed males and females were taken from nests of *Philanthus psyche* Dunning, which nested close beside *T. cockerelli.* Four *Trichogorytes* nests were found, and two of these were excavated. Females were compared with the type of *T. cockerelli* (from Mesilla Park, N. Mex.) in the U.S. National Museum, and found to resemble it very closely.

All four nests were in gently sloping, fine-grained sand in parts of the dunes where there were sparse herbs and bushes and relatively little moving sand. The nests were widely spread, in fact 3-10 m apart, and interspersed with nests of sand-nesting wasps of

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[1] Accepted for publication: November 10, 1975

[2] Part of a study of the comparative behavior of solitary wasps, supported by the National Science Foundation, grant GB43790.

[3] Department of Zoology and Entomology, Colorado State University, Fort Collins, Colo. 80523.

ENT. NEWS, 87: 1 & 2: 33 - 37, January & February 1976

such genera as *Bembix, Philanthus, Ammophila,* and *Plenoculus.* In general, there proved to be nothing unexpected about the nests and prey of *T. cockerelli* (as compared to related genera such as *Gorytes* and *Hapalomellinus;* see Cazier and Mortenson, 1965, Evans, 1966.) However, the digging behavior was unusual and is here described in some detail.

The first female was observed in an early stage of nest construction at 0900 on 27 June (my note no. 2455). The appearance of the nest was striking, since there was a pronounced groove leading from the entrance to a nearly circular mound of sand, well removed from the hole (Fig. 1). The groove was 4 cm long, about 0.5 cm wide and 0.5 cm deep; it led to a mound measuring 3 x 3 cm and about 0.3 cm deep in the center. The wasp invariably emerged from the burrow head first, walked the length of the groove, then turned around and retraced her steps to and into the burrow while scraping sand behind her. Since she turned around each time at one of several different points on the mound, the sand tended to be spread in a circular pattern. As the wasp walked out the groove, she moved her abdomen up and down 3-5 times; then after she turned around and began moving toward the hole scraping sand, she moved her abdomen up and down much more rapidly, synchronously with the spurts of sand that passed beneath the body. At no time was the wasp seen to take flight. All movements seemed very mechanical, and I found it possible to watch and to photograph the behavior closely without

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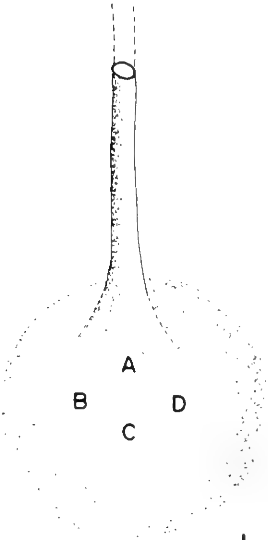
Figures 1-4, nests of *Trichogorytes cockerelli* (Ashmead). Fig. 1, External appearance of nest in process of being dug; A-D, points at which female stopped when emerging from nest (see text). Fig. 2, Same nest, diagramatic representation of some of movements of closure and leveling; heavy black lines indicate movements while scraping sand, dashed lines, walking while not scraping. Fig. 3, lateral view of nest, note no. 2455. Fig. 4, lateral view of nest, note no. 2461; stippled portions filled, dashed lines parts of burrow that could not be traced.



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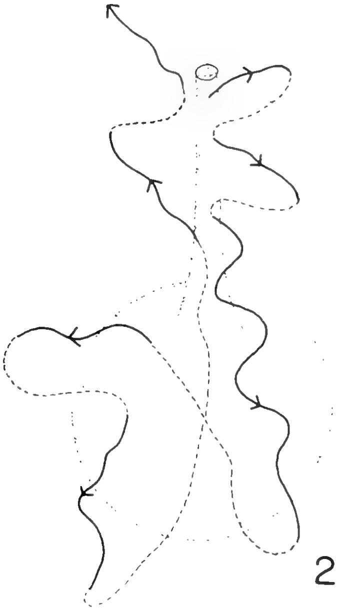

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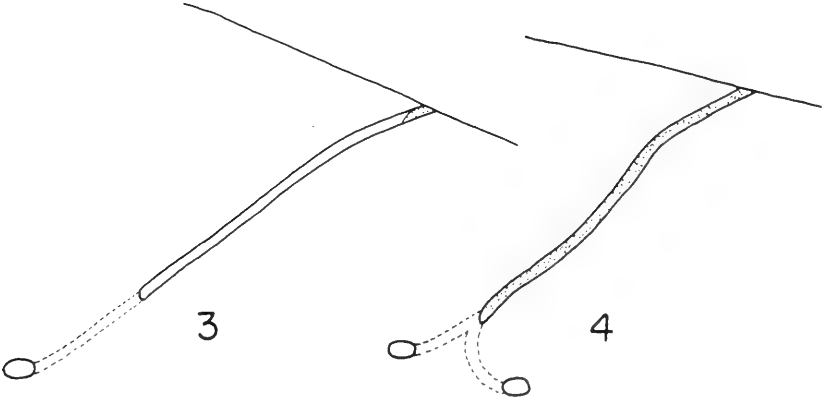

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disturbing her. The following is an account of her movements over a 9 minute period.

0908:00 wohf to A, tste, re-entered at 0908:25[4]
0908:45 wohf to B, tste, re-entered at 0909:05
0909:30 wohf to D, tste, re-entered at 0910:02
0910:30 wohf to C, tste, re-entered at 0910:45
0911:15 wohf to D, tste, re-entered at 0911:30
0911:56 wohf to D, tste, re-entered at 0912:25
0912:50 wohf to B, tste, re-entered at 0913:10
0913:30 wohf to D, tste, re-entered at 0913:50
0914:14 wohf to D, tste, re-entered at 0914:30
0915:05 wohf to D, tste, re-entered at 0915:20
0916:05 wohf to B, tste, re-entered at 0916:25
0916:50 wohf to D, tste, re-entered at 0917:10

Thus the wasp each time spent 15-32 seconds ($\bar{x}$ = 21) outside the nest, a slightly greater amount of time inside the nest (20-45 seconds, $\bar{x}$ = 27.5). I rechecked this nest at 0935 and found the female engaged in identical behavior except that the periods inside the nest had lengthened to an average of about a minute.

At 0938 this behavior ceased abruptly and was replaced by a series of movements serving to close the entrance and flatten the groove and mound (Fig. 2). In this instance the wasp proceeded away from the entrance or groove scraping sand behind her, to a distance of up to 10 cm, then turned around and walked toward the entrance or groove without scraping sand; at some point near the center she then turned around again and proceeded away. Movements away from the entrance or groove were often very irregular, somewhat zigzag, and were accompanied by rapid up and down movements of the abdomen. This behavior ceased after 7 minutes, when the wasp flew off, leaving the next entrance flat and well concealed, the entrance well filled.

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[4] wohf = walking out head-forward;
tste = turning around and scraping while moving toward entrance.

Two days later, at another nest 10 m away, both digging and leveling behavior were again observed in some detail, at about the same time in the morning and following an identical pattern. The typical groove and mound were observed at still a third nest. At the fourth nest, the surface had already been leveled and the female was provisioning when first discovered (note no. 2461). The leafhopper prey was carried in the usual manner of wasps of this group, that is, the wasp grasped it with her middle legs and allowed it to dangle slightly beneath the abdomen. As she landed at the covered nest entrance she scraped it open with her front legs and pulled in the prey behind her with her hind legs.

The two burrows excavated both passed into the slope at about a 60 degree angle with the surface. I excavated one nest in the late afternoon (1800 hours) and found the female in the burrow at a vertical depth of 21 cm. A single fully provisioned cell was found beyond her at a depth of 28 cm (no. 2455; Fig. 3). The second nest was excavated after it had received a final closure (no. 2461; Fig. 4). The burrow had been completely filled with sand although it could be traced to a depth of about 22 cm. Two cells were found, about 3 cm apart, at depths of 23 and 24 cm, both about 40 cm from the entrance.

The three cells found were filled with paralyzed leafhoppers, venter-up and head-in, numbering 8 to 10 per cell. All but one were adults, and belonged to three species: *Exitianus exitiosus* (Uhler), *Circulifer tenellus* (Baker), and *Norvellina* sp. [det. J.P. Kramer]. In one cell I found a newly hatched wasp larva lying longitudinally along the venter of a leafhopper. Evidently the egg is laid in this position, as is common in related genera such as *Gorytes* (Evans, 1966, Fig. 39).

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AN UNUSUAL REARING OF *SOLVA PALLIPES* (LOEW) (DIPTERA: STRATIOMYIDAE)[1]

William Downing[2]

ABSTRACT: *Solva pallipes* (Loew) (Diptera: Stratiomyidae) was reared from larvae found in a decayed fruit of *Maclura pomifera* (Rafinesque) at Cincinnati, Ohio. Previous rearings reported for this species were from larvae found under the bark of trees or in rotten logs.

DESCRIPTORS: Diptera, Stratiomyidae larvae, *Solva pallipes,* Diptera larvae habitat.

The larvae of *Solva* have received considerable attention because of the disparity between the apparent family affinities of the larva and imago. McFadden (1967) discusses the literature and morphology of the larva. The larva is of the stratiomyid type but the imago differs from other Stratiomyidae in wing venation and the presence of tibial spurs.

Several investigators, Townsend, 1893; Malloch, 1917; Johansen, 1922; Green, 1926; Peterson, 1951; and Hennig, 1952, as reported in McFadden (1967) found larvae of *Solva pallipes* (Loew) beneath the loose bark of trees or in rotten logs. Adults are reported by McFadden to frequent trees in June, July, and August. On August 23rd. the author collected a decayed fruit of *Maclura pomifera* (Rafinesque) containing many stratiomyid larvae and puparia. Between 6 September and 12 September thirty *Solva pallipes* imago were reared from the decayed fruit.

This rearing indicates that in addition to their aboreal habitat, *Solva pallipes* larvae can inhabit other decayed vegetative matter.

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[1] Accepted for publication: October 30, 1975

[2] 173 Ireland Avenue, Cincinnati, Ohio 45218

THE *MUSCA SORBENS* WIEDEMANN COMPLEX IN KWAJALEIN ATOLL, MARSHALL ISLANDS[1],[2]

E.F. Legner[3]

ABSTRACT: Flies of the *Musca sorbens* Wiedemann complex, possessing characteristics of both the narrow and broad frons forms, were detected in Kwajalein Atoll, Marshall Islands in 1972. However, only the narrow frons form is thought to reproduce there, the broad frons form probably being excluded competitively from the islands during sporadic invasions. The narrow frons form present is probably the Australian, *M. vetustissima* Walker. A comparison with other Pacific Islands where either one form or the other occurs, suggests that sympatry between the African broad frons and Australian narrow frons forms is impossible presently. The pattern of female setulae on the lower parafrontalia rather than their number might be a more reliable female characteristic to distinguish the two major forms.

DESCRIPTORS: Diptera, *Musca sorbens* Wiedemann complex, Kwajalein Atoll, Marshall Islands.

Flies of the *Musca sorbens* Wiedemann complex became prominent in Kwajalein Atoll, Marshall Islands after a presumed invasion in the middle 1960's. Investigations were made in 1971 into the biological-integrated control of this complex and other lesser important flies, and a noticeable reduction was achieved through the introduction of natural enemies, the curtailment of breeding habitats, and the use of poisoned baits (Legner *et al.*, 1974). Considerable numbers of adult specimens were collected during the course of these studies, and the present investigation was made to characterize the biotypes of the *M. sorbens* complex present in the atoll with the criteria of Paterson and Norris (1970). According to these authors, two distinct forms exist in Africa, the

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[1] Department of Entomology, University of California Riverside, 92502

[2] This study was supported in part by grants-in-aid and assistance of Global Associates, Oakland, California.

[3] Professor of Biological Control and Entomologist, University of California, Riverside 92502.

ENT. NEWS, 87: 1 & 2: 39 - 48, January & February 1976

broad and narrow frons forms which are ethologically and partially cytologically isolated from each other and from the Australian form. The latter resembles the African narrow frons form most closely in structure, but is distinct in chromosome morphology (Boyes et al., 1964). Typically, the broad frons form is predominant in the more tropical portions of Africa, although some overlap occurs (Paterson and Norris, 1970).

MATERIALS AND METHODS

Adult flies were either trapped with rotting egg baits or reared from larvae collected in dog and pig faeces. Collections were made between April 1971 and November 1973, during 3 trips on several islands in Kwajalein Atoll. This atoll, the largest in the world, is about 120 km long by an average 23 km wide, and contains 93 islets grouped between 166-167° E. longitude and 8-9° N. latitude in an irregular ring around a central lagoon (Legner et al., 1974). Kwajalein, the largest island, lies at the extreme south of the atoll. A comparison collection was also obtained from Red Bluff, Western Australia in 1971.

Male and female specimens were mounted on points. In the males, the least width of the frons and the greatest width of the head were measured. An accurate alignment of the heads was assured before measurement. In females, the number and arrangement of the setulae on the lower part of the parafrontalia, below the proclinate bristles situated near their middle, were recorded. Measurements and counts were made with an eyepiece micrometer on a stereomicroscope. All specimens keyed out to *M. sorbens* as recognized by van Emden (1939).

Collections made in the course of this study were probably very representative of the *M. sorbens* population in any given locality, as it was shown previously that almost the entire adult population on the largest island, Kwajalein, could be eliminated with poisoned baits in 48 hr (Legner et al., 1974).

RESULTS AND DISCUSSION

Existence of *M. sorbens* Forms in Kwajalein

Figure 1 diagrams frequency distributions of the male frons/head ratios for 11 collections and Figure 2 the number of setulae on female parafrontalia for 12 collections in Western Australia and Kwajalein Atoll. Figure 3 shows the combined frequency distribution of the frons/head ratios and number of setulae from all collections in Kwajalein Atoll. Statistical details of these measurements are shown in Tables I and II.

The total distribution of the male frons/head ratios (Fig. 3a) fits the Australian form diagrammed in Paterson and Norris (1970) most closely, with a low frequency of individuals showing African broad-frons form characteristics. The size of these flies as judged by head and frons measurements, was similar in all collections (Table II). The distribution of female setulae tends to support an intermediate form or one most closely related to the broad frons form (Fig. 3b).

A low frequency of broad frons males is apparent in only two of the collections on Kwajalein Island made in November 1972 and in October 1973 (Fig. 1, Table I). This form, as judged by the frons/head ratio, was apparently absent from other islands of the atoll. Females of the broad frons male form characteristically possess fewer setulae than the narrow frons form, and these are arranged in two distinct rows (Paterson and Norris, 1970). The value of this character was not positively assessed by these authors, and it appears that at least the numerical count is not reliable (Fig. 2).

The frons/head ratio data from males does not appear to indicate any hybridization between the two forms (Fig. 1), although admittedly the frequency of the broad frons form being as low as it is would make hybrid detection difficult. The existence of hybrids would appear more probable in the data of female setulae (Table I and Fig. 2), although the variable nature of this characteristic makes interpretation doubtful. Although the

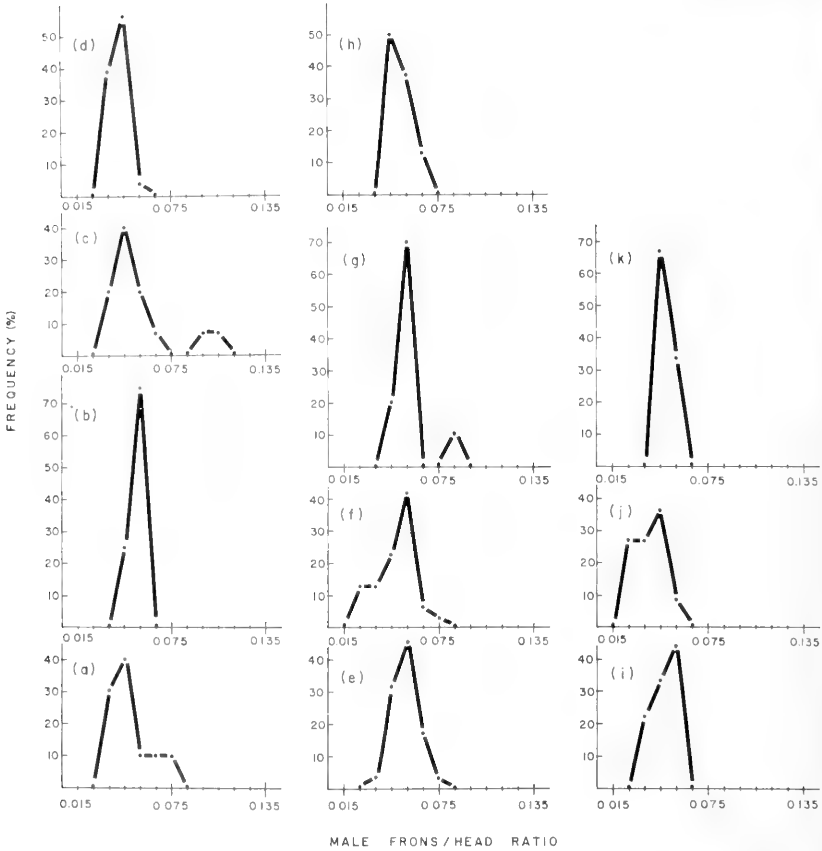

Fig. 1. Frons/head ratio frequency distribution for wild-caught and reared males of the *M. sorbens* complex in Western Australia and Kwajalein Atoll, Marshall Islands: (a) 10 males from Red Bluff, W. Aust., 11/7/71; (b) 4 males from Ennylabegan, Marshall Islands, 4/17/71; (c) 15 males from Kwajalein Is., M.I., 11/15/72; (d) 23 males reared from larvae collected in dog dung, Kwajalein Is., 11/16/73; (e) 63 males attracted to baits at 1000 hrs on Kwajalein Is., 11/9/73; (f) 31 males baited at 1700 hrs; (g) 10 males baited at 0900 hrs on Kwajalein on 10/31/73; (h) 8 males baited at 1300 hrs; (i) 9 males baited on Kwajalein on 11/9/73; (j) 11 males reared from larvae collected in pig dung on Ennubirr, M.I., 11/7/73; (k) 6 males baited on Roi-Namur, M.I., 11/8/73.

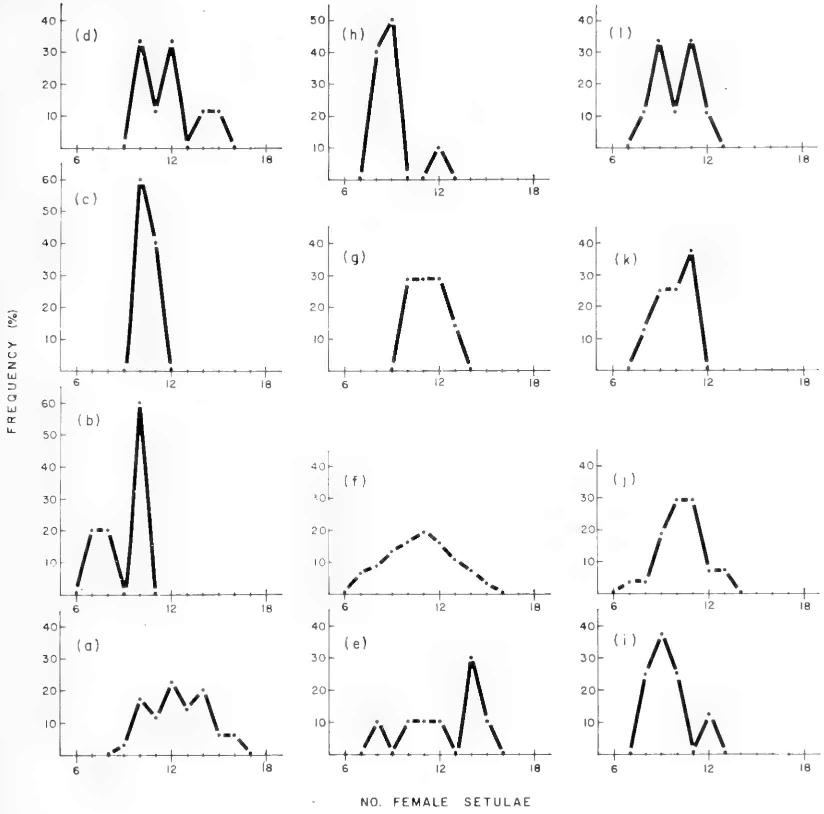

Fig. 2. Frequency distribution of number of setulae on lower parafrontalia in wild-caught and reared females of the *M. sorbens* complex in Western Australia and Kwajalein Atoll, Marshall Islands: (a) 35 females from Red Bluff, W. Aust., 11/7/71; (b) 5 females from Kwajalein Is., Marshall Islands, 4/26/71; (c) 4 females from Ennylabegan, M.I., 4/17/71; (d) 9 females from Kwajalein Is., 11/18/72; (e) 10 females reared from larvae collected in dog dung, Kwajalein Is., 11/15/73; (f) 97 females attracted to baits at 1000 hrs on Kwajalein Is., 11/9/73; (g) 7 females baited at 1700 hrs; (h) 10 females baited at 0900 hrs on Kwajalein on 10/31/73; (i) 8 females baited at 1300 hrs; (j) 27 females baited on Kwajalein on 11/9/73; (k) 8 females reared from larvae collected in pig dung on Ennubirr, M.I., 11/7/73; (l) 9 females baited on Roi-Namur, M.I., 11/8/73.

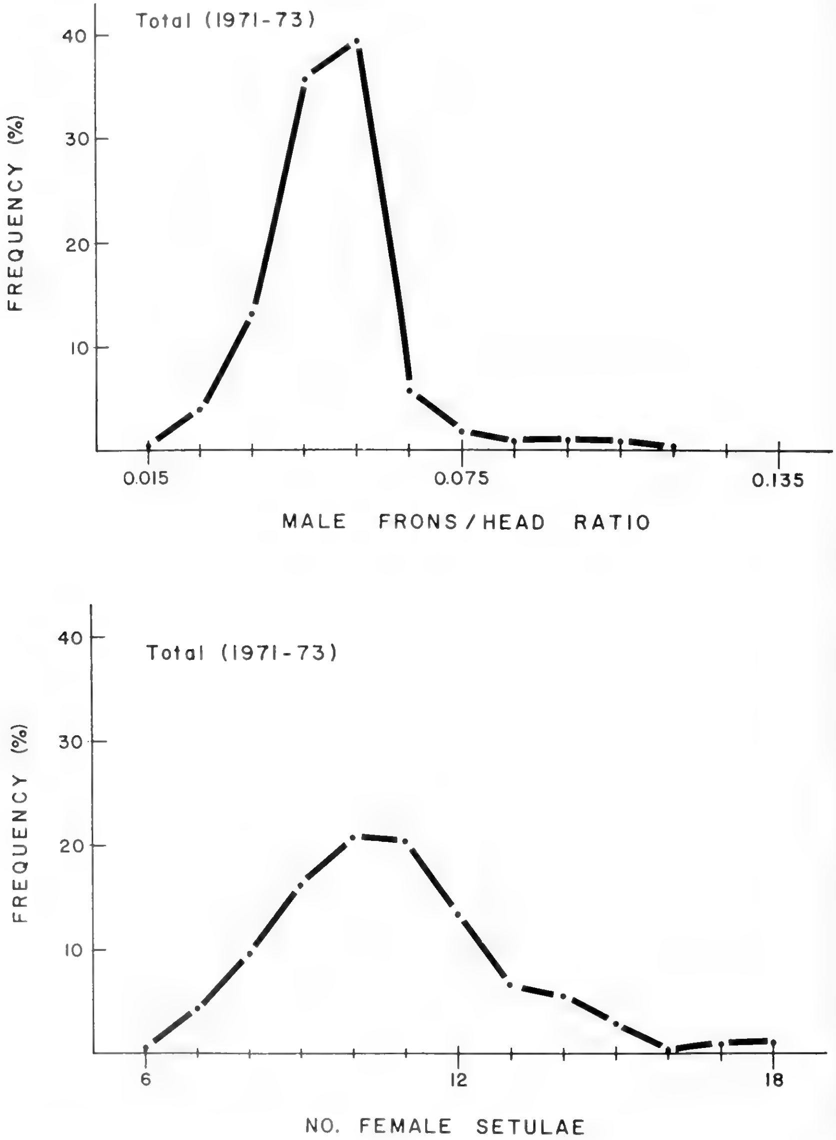

Fig. 3. Frequency distributions determined for all adults of the *M. sorbens* complex collected in Kwajalein Atoll, Marshall Islands from April 17, 1971 through November 16, 1973: (a) frons/head ratio of 181 males; (b) number of setulae on lower parafrontalia in 195 females.

means of the number of setulae fall much closer to the Salisbury (broad-frons males) form than they do to the Canberra colony (narrow-frons males) studied by Paterson and Norris (1970) (Table 1), in most cases they were distinctly scattered on the examined specimens, rather than being arranged in distinct rows, thus fitting the pattern of the form where males have a narrow frons/head ratio. Therefore, the *pattern* of setulae and not their number might be the more reliable female characteristic to distinguish the two major forms.

Hours of Flight Activity

Comparisons of flight activity in the morning hours with later hours of the day did not reveal any significant differences among the individuals collected (Table I and Figs. 1 and 2). The narrow frons form was prevalent in all collections.

Breeding Habitats

Flies that were collected as larvae in dog and pig faeces and reared to adults belonged to the narrow frons form. Moreover, there were no significant differences between the reared adults and those collected simultaneously on baits in the same area (Table 1). Dog and pig faeces were previously found to be the principal breeding habitats of these flies in the atoll (Legner et al., 1974).

Possible Origin of Flies of the *M. sorbens* Complex in Kwajalein

Although most of the flies in Kwajalein probably had their origins in Australia as judged by the male frons/head ratio data (Paterson and Norris 1970; Fig. 1, Table I), the existence of the broad frons type in low frequencies suggests another invasion source, possibly from Hawaii or Malaysia, where only the broad frons form has been reported (Paterson and Norris, 1970).

The stability of the broad frons form in Kwajalein is questionable, however, as it was only detected on Kwajalein Island on two collection dates in 1972 and 1973 (Fig. 1c, g). Kwajalein is the only island in the atoll which receives direct international flights and shipping. Thus, it would be the logical invasion site. However, the apparent lack of persistence of this form on the island as judged by its sporatic collection over 3 years may indicate an inability for sustained reproduction. Repeated invasions from abroad may explain its sporadic appearance.

Where the two forms meet on Kwajalein Island, there is no conclusive evidence of hybridization. Paterson and Norris (1970) inferred from crossing and choice experiments that the two narrow frons forms would be completely reproductively isolated were they to overlap in nature. They already knew from areas of sympatry in Africa that the narrow and broad frons forms did not hybridize. Assuming that the narrow frons form in Kwajalein is of Australian and not African origin, a probability evidenced by the similarity of the frons/head frequency distribution curves to an Australian population (Paterson and Norris, 1970 and Figs. 1 and 3a), then there also appears to be no hybridization between broad frons African and narrow frons Australian forms. Indeed, the two may never be capable of exhibiting sympatry, as competitive exclusion by the Australian narrow frons form may occur repeatedly in Kwajalein. Similarly, competitive exclusion favoring the broad frons form may occur in Hawaii and Malaysia.

The available evidence suggests that African broad frons form *M. sorbens* and Australian narrow frons form *M. vetustissima* Walker may inhabit Kwajalein atoll, but only the latter form breeds successfully there.

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Table I. Statistical details of male frons ratios and number of female setulae in samples from Kwajalein Atoll and Red Bluff, Western Australia

Sample[1]	Date	Measurement[2]	n	$\bar{x}$	s	$s_{\bar{x}}$	
Red Bluff, W. Aust.	11/7/71	f.r.	10	0.047	0.012	0.004	0.036-0.071
		s.	35	12.4	1.834	0.310	9-16
Ennylebegan, M.I.	4/17/71	f.r.	4	0.050	0.002	0.001	0.048-0.053
		s.	4	10.3	0.500	0.250	10-11
Kwajalein Is., M.I.	4/26/71	f.r.	–	–	–	–	–
		s.	5	9.0	1.414	0.632	7-10
Kwajalein Is., M.I.	11/15/72	f.r.	15	0.055	0.021	0.005	0.030-0.105
		s.	9	11.8	1.787	0.596	10-15
Kwajalein Is.	10/31/73	f.r.	10	0.055	0.010	0.003	0.040-0.081
0900 hrs	10/31/73	s.	10	8.9	1.197	0.379	8-12
1300 hrs	10/31/73	f.r.	8	0.052	0.007	0.003	0.042-0.062
		s.	8	9.4	1.302	0.460	8-12
08-1700 hrs	10/31/73	f.r.	9	0.049	0.007	0.002	0.039-0.059
		s.	27	10.3	1.382	0.266	7-13
Kwajalein Is.	11/9/73	f.r.	63	0.052	0.008	0.001	0.039-0.800
1000 hrs		s.	97	10.7	2.084	0.212	7-15
1700 hrs		f.r.	31	0.048	0.012	0.002	0.022-0.071
		s.	7	11.3	1.113	0.421	10-13
Kwajalein Is.	11/16/73	f.r.	23	0.042	0.006	0.001	0.033-0.051
reared dog dung		s.	10	13.3	3.093	0.978	8-18
Enubuj, M.I.	11/7/73	f.r.	11	0.038	0.009	0.003	0.027-0.054
reared pig dung		s.	8	9.9	1.126	0.398	8-11
Roi-Namur, M.I.	11/8/73	f.r.	6	0.048	0.004	0.002	0.041-0.053
		s.	9	10.1	1.537	0.512	8-13
Total Kwajalein	4/17/73	f.r.	181	0.049	0.011	0.001	0.022-0.105
(all localities	to	s.	195	10.6	2.031	0.145	7-18
& collections)	11/16/73						

[1] Collected with rotting egg baits unless otherwise indicated.

[2] f.r. = male frons/head width ratio; s. = No. female setuale on lower parafrontalia.

Table II. Average measurements of male frons and head width in samples from Kwajalein Atoll and Red Bluff, Western Australia

Sample[1]	Date	Width Measured	n	$\bar{x}$ (in mm)	s	$s_{\bar{x}}$	Range
Red Bluff, W. Aust.	11/7/71	frons	10	.079	.015	.005	.063 - .100
		head		1.740	.327	.103	1.300 - 2.200
Ennylebegan, M.I.	4/17/71	frons	4	.078	.008	.004	.067 - .083
		head		1.578	.156	.078	1.40 - 1.70
Kwajalein Is., M.I.	11/15/72	frons	15	.097	.039	.010	.05 - .200
		head		1.781	.153	.039	1.50 - 2.10
Kwajalein Is.	10/31/73	frons	10	.101	.027	.008	.067 - .170
		head		1.823	.144	.046	1.650 - 2.100
1300 hrs	10/31/73	frons	8	.095	.014	.005	.072 - .117
		head		1.829	.143	.050	1.7 - 2.1
08-1700 hrs	10/31/73	frons	9	.089	.007	.002	.083 - .100
		head		1.841	.214	.071	1.5 - 2.15
Kwajalein Is. 1000 hrs	11/9/73	frons	63	.099	.019	.002	.083 - .163
		head		1.941	.190	.024	1.550 - 2.450
1700 hrs	11/9/73	frons	31	.095	.028	.005	.046 - .150
		head		1.99	.199	.036	1.675 - 2.300
Kwajalein Is. reared dog dung	11/16/73	frons	23	.087	.013	.003	.067 - .113
		head		2.149	.149	.031	1.9 - 2.375
Enubuj, M.I. reared pig dung	11/7/73	frons	11	.072	.018	.006	.050 - .109
		head		1.89	.089	.027	1.750 - 2.000
Roi-Namur, M.I.	11/8/73	frons	6	.090	.016	.007	.071 - .117
		head		1.883	.244	.099	1.65 - 2.35
Total Kwajalein (all localities & collections)	4/17/71 to 11/16/73	frons	181	.089	.022	.022	.046 - .200
		head		1.859	.214	.017	1.30 - 2.45

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[1] Collected with rotting egg baits unless otherwise indicated.

A REDESCRIPTION OF *DIPLOCENTRUS WHITEI* (SCORPIONIDA)[1]

Herbert L. Stahnke[2]

ABSTRACT: A study of the type specimen of *Diplocentrus whitei* indicates that contemporary descriptions of this species must have been made from material representing another taxon. *D. whitei* is redescribed. This includes a detailed description plus a table consisting of about ninety measurements of the specimen, two figures consisting of six photographs and two line drawings presenting the trichobothrial systems of the pedipalp chela and patella. A discussion includes diagnostic features that compare this taxon to closely related forms.

DESCRIPTORS: Scorpionida, Diplocentridae, *Diplocentrus whitei* redescribed.

A study of the type specimen of *Diplocentrus whitei* (Gervais) makes one suspect that the more contemporary descriptions of this species were made by observing another taxon and that, in general, this species is poorly understood. This seems to stem from the inadequacy of the original description and the lack of a contemporary study of the type specimen. Consequently, a more detailed account of this taxon seems to be in order.

Gervais (1844) states: "I observed in the collection of the British Museum . . . the species of scorpion here in question and which I have named after Mr. Adam White, one of the zoological assistants in this establishment." Gervais named this species *Scorpio whitei.* Later it was placed in the genus *Diplocentrus* and at one time was incorrectly considered as the type-species of this genus. For a detailed discussion of this problem see Stahnke (1975). Unfortunately only the female is known and the only locality given is Mexico.

DESCRIPTION

GENERAL APPEARANCE. Trunk, cauda and pedipalps dorsally and ventrally very dark (not blackish) brown; legs and pectines somewhat lighter brown. Faint indications of fuscous, variegated pattern. Trunk smooth, glossy and nonpunctate; in general, entire animal agranular except for caudal keels and small areas as later indicated.

PROSOMA. Depth of anterior median carapacial notch reaches to level of posterior margin of second pair of lateral eyes. The arrangement of the three pair of lateral eyes is such that the third lateral eye is separated by a distance greater than its diameter from

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[1] Accepted for publication: October 14, 1975

[2] Arizona State University, Tempe, Arizona 85281

second eye and forms approximately a 120° angle with other two. Carapace surface agranular except for a very few, scattered, median sized granules and posterio-lateral patches of very fine granules. Frontal lobes well developed. Median ocular tubercle agranular, bearing smooth supercilliary crests and moderately elevated above surrounding area. ***Carapacial furrows: Anterior median*** deep and broad anteriorly but becoming broad and shallow posteriad; ***median ocular*** weakly developed; ***lateral ocular*** and ***central median*** broad, shallow but distinct; ***posterior median*** deep, narrow almost slit-like; ***posterior marginal*** deep, narrow but not slit-like and with anterior and posterior margins at same elevation. Carapace posterior width slightly greater than length and an anterior-posterior taper of 0.40 mm/mm of length. ***Sternum*** sides subparallel; without median posterior pit but with deep, median furrow that widens anteriorly into a depressed diamond-shaped area; length slightly greater than width.

APPENDAGES. ***Chelicera.*** Movable finger forked, inferior tine about two and one-half times length of superior tine; superior edge bearing three teeth: A large median flanked by two smaller teeth whose bases do not join that of the median tooth. Fixed

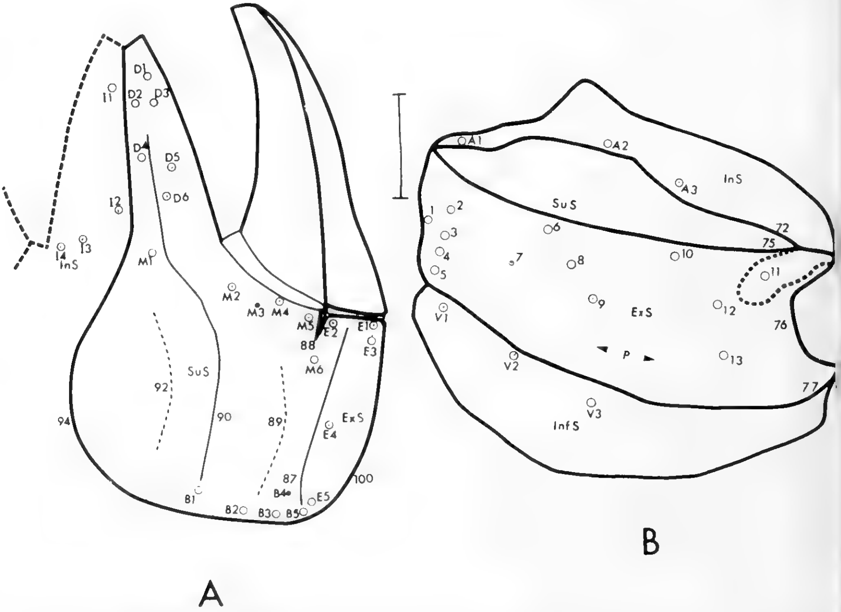

Fig. 2. *Diplocentrus whitei:* Stereograms of A. Pedipalp chela showing (circles with dot) trichobothrial systems (I, D, M, B & E) and B. Pedipalp patella with trichobothrial systems (A, P & V). Diameter of circles represent relative diameters of trichobothrial alveoli. (See Stahnke, 1974).

Abreviations: ExS = Exterior surface, InS = Inner surface, InfS = Inferior surface, SuS = Superior surface.

Numbers: 72 = Dorso-interior keel, 75 = Dorso-exterior keel, 76 = Exterior-median keel area, 77 = Ventro-exterior keel, 87 = Superior marginal keel, 89 = Superior exterior secondary keel (vestige), 90 = Superior digital keel, 92 = Superior inner secondary keel (vestige), 94 = Interior marginal keel.

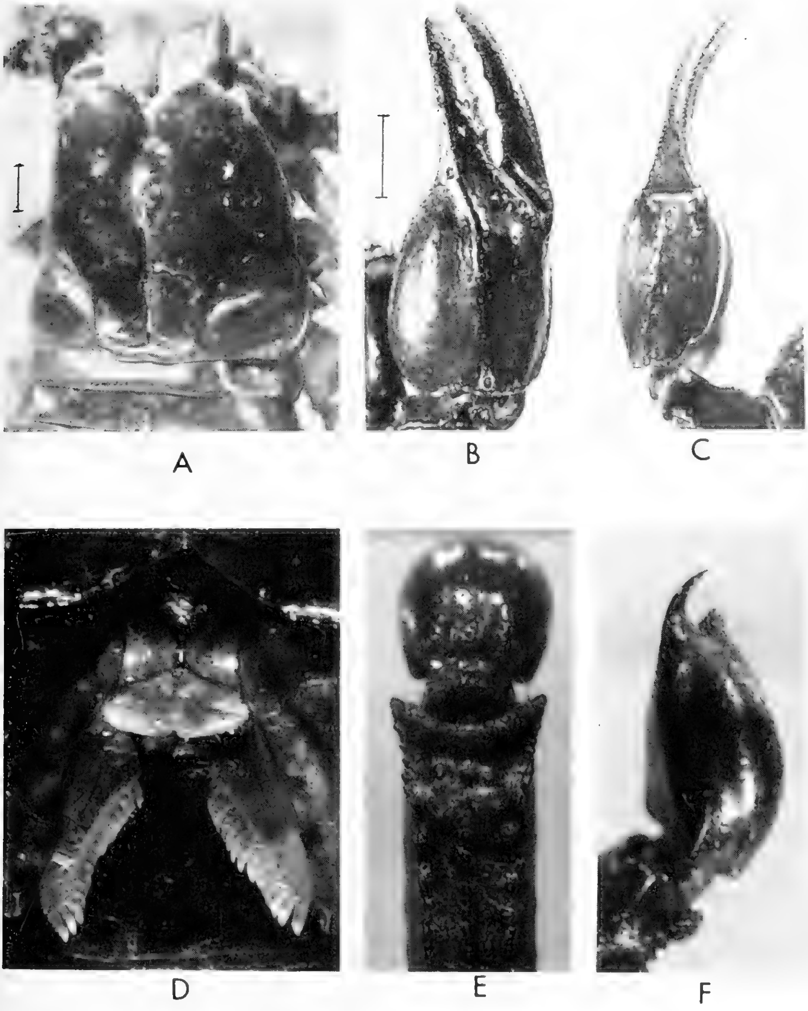

Fig. 1. *Diplocentrus whitei:* A. Carapace; B. Pedipalp chela superior surface; C. Chela exterior surface; D. Sternum, genital operculum and pectines; E. Inferior surface of caudal segment V showing "crscentic area" and inferior surface of telson; F. Lateral view of telson.

finger not forked; bears two teeth on superior edge, basal one with two cusps of which anterior one is largest.

Pedipalps. Chela (fig. 1C). The cutting edge of tarsus and tibial finger with four scallops; basal one bearing a somewhat large, rounded tooth. Tarsus with cluster of four moderately large teeth at terminus. Trichobothria: (fig. 2) A total of 26 which consist of 4 I, 6 D, 6 M, 5 B and 5 E. I3 proximal to a straight line between I2 and I4. D1, 2 & 3 and D4, 5 & 6 form scalene triangles. M1 at commissure level. B3, 4 & 5 form isosceles triangle of which B3 & 4 = B4 & 5. Manus lightly hirsute, agranular except inner margin; superior surface very weakly costate reticulate. Keels: (fig. 2A) External marginal strongly developed, agranular and diagonal, reaching about 0.4 distance to E1 (fig. 1C); seondary accessory vestigial; superior exterior secondary vestigial but area convex; superior digital well developed and extends along tibial finger; superior inner secondary vestigial; interior marginal weakly developed but broadly and coarsely granular over distal two-thirds. Patella. Keels: Dorso-inner strongly developed and agranular; dorso-exterior vestigial and agranular; exterior median moderately developed and agranular; ventral inner well developed with scattered, very large somewhat cone-shaped granules; ventral exterior lacking on distal half but well developed and agranular on proximal half. Surfaces: Dorsal shiny and agranular; inner moderately covered with small to large granules and four extra large granules on dorso-proximal margin; ventral smooth, shiny with slight costate reticulation; exterior shiny and agranular. Trichobothria: (fig. 2B) P1, 2 & 3 form isoceles triangle; P 6, 8 & 9 in straight line as are also P3, 9 & 13 and P7 is just touching the latter line. V1, 2 & 3 are also in line. Femur. Keels: Dorso-inner well developed with very large, irregularly arranged blunt granules extending along proximal margin; dorso-exterior well developed with very large, blunt granules on proximal third; exterior median vestigial and agranular; ventral inner well developed and bearing irregular row of very large granules; ventral exterior lacking and area agranular. Surfaces. Dorsal sparsely granular with cluster of granules on slight convexity at proximal third; inner covered with very large, somewhat blunt granules; ventral inner third covered with large granules; exterior bearing only few large granules. Trichobothria: Three–one on dorso-proximal margin of inner surface, second near proximal margin on exterior edge of dorsal surface, third about one-third length of femur from proximal margin and on dorsal edge of exterior surface.

Walking legs. Lightly hirsute except for relatively dense covering on tarsomeres. Agranular except for scattered small granules on lateral surfaces of femurs and moderately large granules along inferior edge of femurs. Median lobe of tarsomere II well developed and bearing the following machrochaetes: one on apex, two on superior surface and two at base of median lobe. Tarsomere II lateral lobe strongly developed, with three spines on curvature and the following spine formula: 55/66 6?/7? 77/88 88/88.

OPISTHOSOMA. ***Mesosoma:*** Tergites I-VI very sparsely hirsute, smooth, shiny and agranular except for granules located mainly along posterior margins. Tergit VII with posterior two thirds well covered with large granules. Only slight vestiges of median keels on II to VII; VII also with vestiges of lateral keels in form of broad protuberances covered with large, coarse granules. Sternites very sparsely hirsute and agranular. Keels only on VII which has two pair well developed lateral keels bearing confluent granules. Stigmata large, elongate slit-like. Genital operculum undivided with anterior margin protruding somewhat more than posterior margin. Pectines (fig 1D) lightly hirsute, no distinct median lamellae in region of second marginal lamella on right pecten; left with two indistinct lamellae in this region. Fulcra small but distinct. Basal piece very short (ratio of length to width about 0.26) and bearing a deep, broad anterior median notch. Teeth 16/15, small and narrow.

Metasoma. Dark brown with subtle variegated fuscous pattern. Intercarinal spaces granular. Lightly hirsute. Dorsal furrow shallow on all segments. Keels: Dorsal moderately developed and bearing mostly confluent granules. Superior laterals well developed on I-IV. I with serrated granules; other segments with confluent granules. Median laterals well developed and coarsely granular on I and II; on others represented by slight vestiges and variegated dark pigmentation. Inferior laterals well developed on all segments; agranular on I-III; confluent granules on IV and large serrate granules on V; anterior posterior convergence on I from 23mm between keels to 17 mm; convergence on II from 22mm to 17mm. Inferior medians well developed and agranular on I and II; vestigial on III and bearing confluent granules; slight vestiges and agranular on IV; on V well developed and with very large, somewhat serrate granules. Crescentic area (fig. 1E) well developed but with somewhat angular corners on proximal end; bounded both anteriorly and laterally by very large, blunt granules; lateral granules weakly continuous with terminal granules of anterior crest of the well developed anal arch. Anterior crest bearing nine flat, worn chisel-shaped granules plus two very large granules on each lateral terminus. Posterior crest bearing large cone-shaped granules on medial portion and smaller blunt granules laterally. Telson (fig. 1F) lightly hirsute. Subaculear protruberance large and triangular in lateral silhouette; superior edge not subparallel with superior surface of vesicle. Surface of vesicle in general agranular but bearing coarse, scattered punctations and three clusters (3:3:3) of three large granules on ventro-proximal margin. Vesicle about 1.7 times as long as wide; 1.3 times as wide as deep and about 4.4 times as long as aculeus.

DISCUSSION

Diplocentrus scorpions within the adult size range of this taxon have fewer pectinal teeth. The spine-formula of tarsomere II is different from other taxa in the genus. Table 2 gives a list of twenty-eight ratios that distinguish *D. whitei* from other known diplocentrid species. The main differences are found in the appendages. Since one cannot predict the structures which will undergo variation during speciation Table 1 has many more precise measurements than the so-called "standard" measurements. This is especially important when only one specimen of the taxon described is available.

ACKNOWLEDGEMENTS

The author wishes to thank the British Museum (Natural History) for the privilege of studying the type specimen of *D. whitei.*

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Stahnke, H.L. 1974. Revision and keys to the higher categories of Vejovidae (Scorpionida). J. Arachnol. 1: 107-141.

Stahnke, H.L. 1975. The Determination of the Type Species of *Diplocentrus* (Scorpionida). J. Arizona Academy Sciences (In Press).

TABLE 1

CODE NO.	STRUCTURES MEASURED	MEASUREMENT
1.00	Total length (L.)	62.8
2.00	Trunk L.	29.1
3.00	Metasoma L.	33.7
4.0	Carapace L.	8.9
4.1	Anterior width (W.)	6.1
4.2	Median W.	8.0
4.3	Posterior W.	9.7
4.4	1st lat. eye to median eye	3.35
4.5	Ant. marg. to med. eyes	3.35
4.6	Median notch depth (D.)	0.70
4.7	Dist. betwn. median eyes	0.40
4.8	Diam. 1st pr. lat. eyes	0.23
4.10	Diam. med. eyes	0.35
4.11	Med. eyes to post. margin	5.55
5.0	Sternum L.	2.7
5.1	W.	2.5
6.1	Pedipalp L.	31.94
6.2	Tibia L.	17.14
6.3	Manus L.	6.9
6.4	W.	7.5
6.5	D.	5.0
6.51	Exterior surface L.	7.30
6.6	Tarsus L.	9.6
6.7	Patella L.	7.5
6.8	W.	3.2
6.9	Femur L.	7.3
6.10	W.	3.2
6.11	Leg IV L.	28.8
6.12	Coxa L.	6.3
6.13	Trochanter L.	4.2
6.14	Femur L.	6.9
6.15	W.	2.1
6.16	Patella L.	6.0
6.17	W.	2.4
6.18	Tibia and Tarsomere I L.	5.4
6.19	Tibia W.	1.2
7.0	Mesosoma L.	20.2
7.22	Pecten dentate area L.	3.8
7.3	Terminal tooth L.	0.8
7.4	2nd marg. lamella L.	0.9
7.5	3rd marg. lamella L.	1.3
7.6	Basal piece L.	0.65
7.7	W.	2.5
7.8	Genital operculum L.	1.6
7.9	W.	3.5

CODE NO.	STRUCTURES MEASURED	MEASUREMENT
8.0	Metasoma L.	33.7
8.1	Segment I L.	4.2
8.2	W.	4.4
8.3	D.	3.6
8.4	Segment II L.	4.6
8.5	W.	3.95
8.6	D.	3.3
8.7	Segment III L.	4.9
8.8	W.	3.8
8.9	D.	3.3
8.10	Segment IV L.	5.7
8.11	W.	3.5
8.12	D.	3.2
8.13	Segment V L.	7.4
8.14	W.	2.9
8.15	D.	2.9
8.16	Telson L.	6.9
8.17	Vesicle L.	5.7
8.18	W.	3.4
8.19	D.	2.7
8.20	Aculeus L.	1.3
	(Distances between trichobothria)	
9.1	D1 - D6	4.1
9.2	D1 - M1	5.85
9.3	D1 - M2	7.15
9.4	D1 - D2	1.05
9.5	D1 - D3	1.0
9.6	D2 - D3	0.73
9.7	D2 - D4	1.8
9.75	D3 - D4	1.95
9.8	D3 - D5	2.25
9.9	D4 - D5	1.1
9.10	D4 - D6	1.55
9.105	D4 - M1	3.05
9.11	D5 - D6	1.0
9.115	D5 - M1	2.85
9.12	D6 - M1	1.9
9.125	D6 - M2	3.1
9.13	M1 - M5	4.1
9.135	M1 - M2	2.1
9.14	M1 - B1	8.8
9.15	M2 - B1	7.9
9.16	E1 - E2	1.55
9.17	E1 - E3	0.65
9.18	E1 - E4	3.65
9.19	E1 - E5	6.35
9.20	E2 - E3	1.6
9.21	E2 - E4	3.4
9.22	E2 - E5	5.05

TABLE 2

CODES	RATIOS	CODES	RATIOS
3.00/2.00	1.16	6.2/6.3	2.48
3.00/4.00	3.79	6.2/6.6	1.79
3.00/6.1	1.06	6.2/6.9	2.35
3.00/6.4	4.49	6.3/6.6	0.72
4.0/4.2	1.11	6.4/6.3	1.09
4.0/6.6	0.93	6.4/6.5	1.50
4.0/6.12	1.41	6.51/6.6	0.76
4.0 8.1 + 8.4	1.01	6.6/6.4	1.28
		6.9/6.14	1.00
4.0 8.7 + 8.10	0.84		
		6.11/3.00	1.15
4.0 8.10 + 8.13	0.68	6.16/6.18	1.11
		7.6/7.7	0.26
4.0/8.13	1.20		
		7.6/7.8	0.41
4.3/4.1	1.59		
		8.16/8.1	1.47
4.3 - 4.1 4.0	0.40		
		9.12/9.13	0.46

NEW ALABAMA RECORDS FOR *ZOROTYPUS HUBBARDI* CAUDELL (ZORAPTERA)[1]

C.M. Cooper[2]

ABSTRACT: New Alabama records for *Zorotypus hubbardi* Caudell are Colbert, Franklin, Jackson, Lauderdale, Madison, Saint Clair, and Winston Counties. All specimens were obtained from pieces of wood in sawdust piles.

DESCRIPTORS: Zoraptera, *Zorotypus hubbardi,* Alabama

New county records for the relatively rare insectan order Zoraptera were collected during a 3 week period (3 July 1975 to 21 July 1975) in Alabama. The collections constitute 7 new county records for *Zorotypus hubbardi* Caudell. Seven county records previously existed: Lamar Co., Pickens Co., Tuscaloosa Co., Greene Co., Mobile Co., Baldwin Co., and Houston Co. (Valentine and Wilson 1949). The county records reported here extend the recorded distribution to the Tennessee state line and show the presence of colonies in the previously unrecorded northern half of the state.

All collections were made at sawmill sites, with 4 of the sites associated with functioning sawmills. Seven other active sawmill operations in the northern half of Alabama yielded no Zoraptera upon examination. Records of *Zorotypus hubbardi* collections are mainly associated with sawdust or wood residue in sawdust piles. All specimens collected were found on moist pieces of wood buried in sawdust. Only 2 of the 7 collection sites handled hardwoods exclusively, and all mills were over 3 years old. Of the 95 Zoraptera collected, 25 apterous males, 40 apterous females, 1 dealate female, and 29 nymphs were obtained.

New county records for Alabama are as follows: Winston Co., 3 July 1975, from pine bark fragments in sawdust pile; Pell City, Saint Clair Co., 3 July 1975, from wood in old hardwood shavings and sawdust pile; Vina, Franklin Co., 18 July 1975, from pieces of wood in pine bark fragments; Lauderdale Co., 19 July 1975, from pieces of pine bark in old sawdust residue; Colbert Co., 19 July 1975, from pieces of wood in old sawdust pile; Gurley, Madison Co., 20 July 1975, from pieces of wood in sawdust burner residue; Scottsboro, Jackson Co., 21 July 1975, from pieces of wood in sawdust burner residue.

REFERENCES CITED

Valentine, B.D. and E.O. Wilson, 1949. Records of the Order Zoraptera from Alabama. Entomol. News 60: 180-181.

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[1] Accepted for publication: November 21, 1975

[2] Research Fellow, Department of Biology, University of Mississippi, University, Mississippi 38677

NEW MISSISSIPPI RECORDS OF *ZOROTYPUS HUBBARDI* CAUDELL (ZORAPTERA)[1]

Russell F. Mizell, T.Evan Nebeker[2]

ABSTRACT: New Mississippi records for *Zorotypus hubbardi* Caudell are Oktibbeha and Forrest counties. Five adults and one nymph were collected under the bark of a dead oak tree in Oktibbeha County. Two adults and three nymphs were collected under the bark of a dead pine tree in Forrest County.

DESCRIPTORS: Zoraptera, *Zorotypus hubbardi,* Mississippi

Zorotypus hubbardi Caudell has been previously reported from eleven counties. Copeland (1954) listed Lamar and Pearl River counties while Riegel (1963) reports collections in Holmes and Rankin counties. The most recent collections by Darst et al. (1974) were reported from Stone, Lafayette, Calhoun, Tishomingo, Panola, Pontotoc, and Marshall counties.

Previous collection sites have included under pine bark and from a colony of termites *"Reticulitermes virginicus"* (Riegel, 1963) beneath the bark of decaying logs (Copeland, 1954); and predominantly from wood or bark fragments in sawdust piles (Darst et al., 1974). Six specimens, five apterous adult females and one nymph were collected by the author (R.F.M.) from beneath the bark at the base of a standing dead oak tree in Oktibbeha County on 5 July 1975. Two adults and three nymphs were collected under the bark of a dead pine tree in Forrest County 21 September 1975.

REFERENCES CITED

Copeland, T.P. 1954. New southeastern records for *Zorotypus hubbardi* (Zoraptera). Entomol. News 65: 95-99.

Darst, P.H., C.M. Cooper, R.N. Paul and J.P. Steen. 1974. Mississippi records for *Zorotypus hubbardi* (Zoraptera). Entomol. News 85: 224.

Riegel, G.T. 1963. The distribution of *Zorotypus hubbardi* (Zoraptera). Ann. Entomol. Soc. America 56: 744-747.

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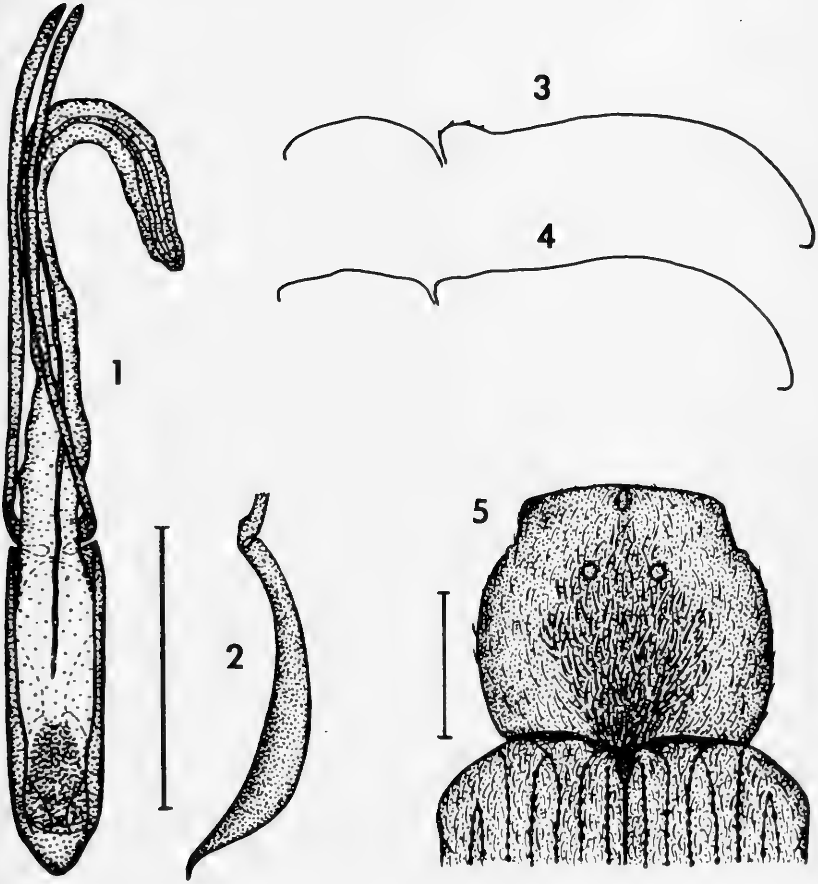
[1] Accepted for publication: November 17, 1975

[2] Department of Entomology, Mississippi Agricultural and Forestry Experiment Station, Mississippi State University, Drawer EM Mississippi State, Mississippi 39762.

Assigned No. 3176, Mississippi Agricultural and Forestry Experiment Station.

ERRATUM



Figs. 1-5 (line accompnaying Figs. 1 and 2, and Fig. 5 equals 0.5 mm): 1. *S. piercei*, male genitalia, dorsal view; 2. lateral view of median lobe of same; 3. lateral view of dorsal outline of prothorax and elytra of *S. tuberculatus;* 4. same of *S. piercei;* 5. dorsal view of prothorax and base of elytra of *S. piercei.*

The above is a reprint of page 169, Vol. 86, nos. 7 & 8, September & October 1975 issue of ENTOMOLOGICAL NEWS. This is reprinted because of a printing fault in the original issue.

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE ANNOUNCEMENT A.N.(S.)97

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 3, 22nd September, 1975).

1003. *Chaitophorus* Koch, 1854 (Insecta, Hemiptera): designation of type species.

1780. TETHYIDAE Fischer, 1886 and APLYSIIDAE Pilsbry, 1895-6 (Gastropoda): designation of type-genus.

1993. *Paraonis* Grube, 1873 (Polychaeta, Paraonidae): designation of type-species.

2045. *Petromyzon* Linnaeus, 1758 (Pisces): ruling on gender and stem of generic name for purposes of Article 29.

2060. *Xiphidium glaberrimum* Burmeister, 1838 and *Orchelimum cuticulare* Audinet-Serville, 1838 (Orthoptera); suppression; designation of *Orchelimum vulgare* Harris, 1841 as type-species of *Orchelimum* Audinet-Serville, 1838.

2083. *Simrothiella* Pilsbry, 1898 (Mollusca, Solenogastres): designation of type-species.

2088. *Polycarpa* Heller, 1877 (Tunicata, Ascidiacea): designation of type-species; *Cynthia pomaria* Savigny, 1816 to be given precedence over *Ascidia singularis* Gunnerus, 1770 and *Distomus mamillaris* Pallas, 1774.

2089. *Hiltermannicythere* Bassiouni, 1970 (Crustacea, Ostracoda): designation of type-species.

2090. *Rhiniodon* Smith, 1828 (Pisces): proposed suppression in favour of *Rhincodon* Smith, 1829.

2096. *Gecarcinus hirtipes* Lamarck, 1818 (Crustacea: Decapoda): proposed suppression.

2098. *Monstrilla intermedia* Kriczagin, 1877 (Copepoda, Monstrilloida): proposed suppression.

2106. *Cossmannella* Mayer-Eymar, 1896 (Mollusca, Bivalvia): designation of type-species.

2107. *Polydrusus* Germar, 1817 (Insecta, Coleoptera): designation of type-species.

2108. *Thamnophilus ruficollis* Spix, 1825 (Aves, Formicariidae): proposed suppression.

2109. *Notozus* Forster, 1853 (Insecta, Hymenoptera, Chrysididae): designation of type-species; *Elampus* Spinola, 1806: proposed suppression.

2121. *Microdryas* Laseron, 1950 (Mollusca: Gastropoda): designation of type-species.

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, S.W.7 5BD, England. Those received early enough will be published in the Bulletin of Zoological Nomenclature.

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ERRATA

In the paper on Seasonal Distribution of Protura in Three Delaware Forests by Walker and Rust, ENT NEWS 86: 9 & 10, page 197, Table 2, three lines of figures should be corrected as follows: Site One: Newark: C.D. should read 11.66, 8.88, 1.21, 3.08, 3.56, 1.84 and 4.92; Site Two: Woodside: C.D. should read 4.01, 9.30, 27.24, 37.00, 6.33, 1.58 and 31.47; Site Three: Georgetown: C.D. should read 2.35, 0.76, 12.49, 6.03, 1.19, – and 16.53.

The mailing date for the Nov.-Dec. issue of ENT NEWS, Vol. 86, Nos. 9 & 10, was Jan. 15, 1976, not 1975 as erroneously printed in that issue.

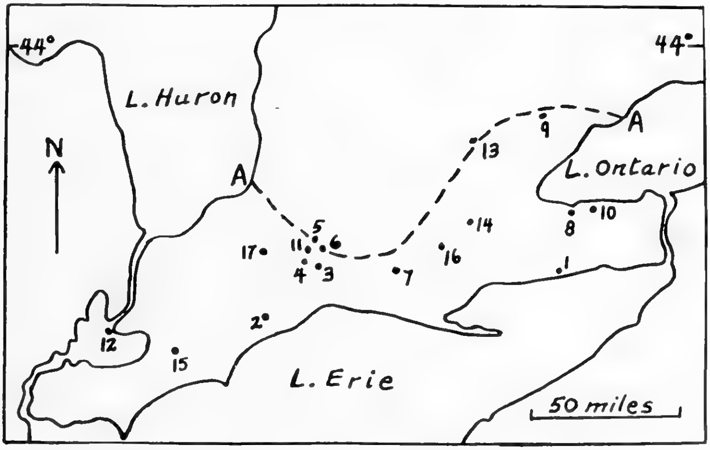

Fig. 1. Distribution of *Dermacentor variabilis* (Say) in southern Ontario. A – A: northern limit of Carolinian Zone (Soper, 1955).

The above is a reprint of the map on page 159, Vol. 86, nos. 7 & 8, September & October 1975 issue of ENTOMOLOGICAL NEWS. This is reprinted because of a printing fault in the original issue.

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.

Wanted: A CATALOGUE OF THE DIPTERA OF AMERICA NORTH OF MEXICO. USDA agric. Handbook No. 276, by Alan Stone *et. al.* William Downing, 173 Ireland Ave. Cincinnati, Ohio. 45218.

Wanted: DRAGONFLIES OF NORTH AMERICA by Needham and Westfall. Please contact James H. Kennedy, 24 Walnut Lane, Camp Hill, Pa. 17011.

For Sale: Entomological literature (new and secondhand books) on Lepidoptera, Coleoptera, etc. Jacques Rigout - Sciences Nat. 45, rue des Alouettes - Paris 75019.

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.

For Sale: East African Lepidoptera. Contact J. Kielland, 4916, Boroy, Norway.

For Sale: Lepidoptera, Coleoptera and other groups, expecially Carabidae, from France and neighboring countries. Write Remi Aulnette, 16 rue Jousselin, 28.100 Dreux, France.

Wanted: Water striders of the genus *Trepobates* (Hemiptera: Gerridae) for monograph of the genus. Send loan material to: Mr. Paul Kittle, Dep't. of Zoology, Univ. of Arkansas, Fayetteville, Ark., 72701.

Wanted: Gerridae (water striders) with complete collection data (locality and date) in alcohol or pinned; all loan specimens identified to species and almost all returned. Diane M. Calabrese, Bio Sci Group, U-43, Univ. of Conn., Storrs, Conn., 06268.

Exchange: Coleoptera of all families from Arizona. Ask for list and send yours. Dr. Rudolph Lenczy, 126 Los Robles, Green Valley, Arizona, 85614.

Wanted: Living females of large Dynastidae. They must be sent by air mail, rolled in a sheet of newspaper, put in a wooden box. I shall pay a very good price for all specimens received. Jacques Rigout, Sciences Nat., 45 rue des Alouettes, 75019, Paris, France.

Wanted: Rhysodidae for world-wide revision. Willing to identify and return or exchange for U.S. Carabidae. Ross T. Bell, Zoology Dep't., University of Vermont, Burlington, Vt., 05401, U.S.A.

MARCH & APRIL 1976 NOS. 3 & 4

ENTOMOLOGICAL NEWS

THE AMERICAN ENTOMOLOGICAL SOCIETY

ENTOMOLOGICAL NEWS is published bi-monthly except July and August by The American Entomological Society at the Academy of Natural Sciences, 1900 Race St., Philadelphia, Pa., 19103, U.S.A.

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Editorial Policy: Manuscripts on insect life and related terrestrial arthropods are appropriate for submission to ENTOMOLOGICAL NEWS. Titles should be carefully composed to reflect the true contents of the article, and be kept as brief as possible. Classification as to order and family should be included in the title, except where not pertinent. Following the title there should be both a short informative abstract (not a descriptive abstract) of not over 150 words and a list of 3-10 key words or descriptors. The author's complete mailing address, including zip code number, should be given as a footnote to the article. All papers describing new taxa should include enough information to make them useful to the non-specialist. Generally this requires a key and a short review or discussion of the group, plus references to existing revisions or monographs. Illustrations are nearly always needed.

Illustrations: For maximum size and definition, *full page* figures, *including legends,* should be submitted as nearly as possible in a proportion of 4/6. Maximum size of printed illustration, including all legends, is 4½ x 6½ inches. Authors will be charged for all text figures and half-tones at the rate of $5.00 each, regardless of size.

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(Continued on inside of back cover)

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REVIEW OF *REUTERIA* PUTON 1875, WITH DESCRIPTIONS OF TWO NEW SPECIES (HEMIPTERA: MIRIDAE)[1]

Thomas J. Henry[2]

ABSTRACT: Redescriptions and figures of the male genitalia and tergal processes are given for six of the seven species of *Reuteria: bifurcata* Knight, *fuscicornis* Knight, *irrorata* (Say), *marqueti* Puton, *platani* Knight and *querci* Knight. The new species, *dobsoni* from Pennsylvania and *wheeleri* from Georgia and North Carolina, are described and illustrated, and a neotype is designated for *irrorata.* A key to the species and complete synonymies are provided for *irrorata* and *marqueti*. Information on host plants and distributions are given for each species.

DESCRIPTORS: Hemiptera, Miridae, *Reuteria,* review, key, new species, *dobsoni, wheeleri.*

The genus *Reuteria* belongs to the subfamily Orthotylinae and the tribe Orthotylini (Carvalho 1958). Puton (1875) erected the monobasic genus *Reuteria* using the Palearctic *marqueti* as the type-species. Reuter (1883) transferred *Capsus irroratus* Say, 1832 to *Reuteria* and placed *marqueti* as a junior synonym of *irrorata.* Most subsequent authors followed this interpretation until Knight (1922) noted that the genital claspers of *irrorata* and *marqueti* are not identical. In 1939 Knight described *bifurcata, fuscicornis, querci,* and *pollicaris* and again noted that *marqueti* is different from Nearctic *Reuteria.* Knight (1941) described *platani* and provided a key to the North American species and Froeschner (1949) gave a key to the 5 Nearctic species known from Missouri and neighboring states. Wagner (1957) still considered *marqueti* a synonym of *irrorata,* and Carvalho (1958) listed only 6 species in his "Catalog of the Miridae of the World." Later, Wagner (1961, 1967) gave *marqueti* specific rank, raising the number of *Reuteria* to seven.

In this paper six of the seven previously known species of *Reuteria* are redescribed, a neotype is designated for *irrorata,* and two new species are described. A key to the species, modified from Knight (1941), is presented. The host plants and distribution are given for each species; the 1st and 2nd antennal segments of 4 species and the male genitalia and tergal processes for 8 of the 9 species are illustrated. The original citations have been listed for each species. Other citations are referred to the Carvalho catalog (1960), except those not included in the catalog or where there has been confusion in synonymy.

The following abbreviations are for institutions cited in this paper:

AMNH American Museum of Natural History, New York, New York

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[1] Accepted for publication: January 31, 1976

[2] Bureau of Plant Industry, Pennsylvania Department of Agriculture, Harrisburg, Pennsylvania 17120

BM	British Museum (Natural History), London, England
CU	Cornell University, Ithaca, New York
LSU	Louisiana State University, Baton Rouge, Louisiana
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts
NMNH	National Museum of Natural History, Washington, D.C.
PDA	Bureau of Plant Industry, Pennsylvania Department of Agriculture, Harrisburg, Pennsylvania
PSU	Pennsylvania State University, University Park, Pennsylvania
PU	Purdue University, West Lafayette, Indiana
TJH	T.J. Henry collection
UW	University of Wisconsin, Madison, Wisconsin
ZMHU	Zoologisches Museum der Humboldt-Universität, Berlin, DDR-East Germany

Morphological Notes

Knight (1939) was the first to utilize male genitalia to delimit species of *Reuteria.* The male genital claspers of known species have been figured (Knight 1939, 1941; Seidenstücker 1954; Kelton 1959; Wagner 1973) except *platani* Knight, which was described from 2 females. Both right and left claspers are distinctive for each species.

The spiculi of the aedeagus are also quite characteristic. Kelton (1959) figured those of *fuscicornis* and noted that the genus belonged to a taxon having 2 or more spiculi. I have found that they range in number from 2 in *irrorata* to 4 in *marqueti.* The spiculi of *Reuteria* may be straight, spatulate and margined with fine serrations, or slender, curved, or forked. The forked spiculi may be twisted around other spiculi or may be slender and clothed with fine setae that give a feathered appearance.

Another distinguishing character not previously associated with *Reuteria* is the uniquely formed tergal process. Knight mentioned tergal processes in the Orthotylinae when he described species of *Lopidea* (1962), *Ilnacora* (1963), and *Melanotrichus* (1968). He also used them in erecting the genus *Hesperocapsus* (1968), and Knight and Schaffner (1968, 1972) used them in describing additional species of *Lopidea.* In *Reuteria* these structures are formed on the posterior margin of the last abdominal tergite, just left of the median line.

Genus *Reuteria* Puton, 1875:519

Type-species: *Reuteria marqueti* Puton 1875:519.

Diagnosis: Mirids with narrow black lines on each side of the 1st antennal segment which connect ventrally at the apex; small (3.7 – 4.7 mm), fragile, white and tinged with green, often marked with blotches of green on the dorsum and femora, but the blotches may vary from none to many within a species; dorsum clothed with simple white or silvery pubescence; claws characterized by convergent parempodia.

Key to the Species of *Reuteria*

1. First antennal segment with inner black line indistinct on basal half; transverse apical portion and outer black line combined to form a letter J (Fig. 3) . . . . *platani* Knight

First antennal segment with inner black line complete to base 2

2. Second antennal segment with a broad fuscous to black area occupying basal half to three-fourths of segment . . . . *fuscicornis* Knight

Second antennal segment pale, a black annulus at base; at most the black color not occupying more than basal one-fourth of segment 3

3. Second antennal segment with a rather broad fuscous area at base, length greater than diameter of first segment (Fig. 4) . . . . *querci* Knight

Second antennal segment with a narrow black annulus at base, length subequal to diameter of first segment (Fig. 2) 4

4. Corium and clavus conspicuously marked with green blotches 5

Corium and clavus with a few or no green blotches 7

5. Larger species, 4.49 – 4.60 mm; dorsal aspect of hind femora mostly without large green blotches, usually replaced with a brown or fuscous line at apex; rostrum reaching middle of metacoxae; Palearctic . . . . *marqueti* Puton

Smaller species, 4.00–4.40 mm; dorsal aspect of hind femora with 3 or 4 large green blotches; rostrum reaching middle of mesocoxae; Nearctic 6

6. Left arm of right clasper long, slender, curved upward; tergal process slender with lateral branch spine-like (Fig. 12) . . . . *wheeleri* n. sp.

Left arm of right clasper short and stout; tergal process short, stout, without spine-like lateral branch . . . . *irrorata* (Say)

7. Membrane without fuscous mark bordering large areole; veins pale; tergal process slender and curved (Fig. 5) . . . . *bifurcata* Knight

Membrane with a sharply defined fuscous mark bordering large areole; veins green; tergal process stout and straight 8

8. Larger species, 4.40–4.60 mm; membrane opaque white; hind femora with large green blotches on dorsal aspect; tergal process pointed at apex (Fig. 6) *dobsoni* n. sp.

Smaller species, 3.9 mm; membrane clear; hind femora without large green blotches on dorsal aspect; tergal process truncate at apex . . . . *pollicaris* Knight

Reuteria bifurcata Knight

Reuteria bifurcata Knight 1939:130; Carvalho 1958:129; Akingbohungbe et al. 1972:12.

Malacocoris irroratus, Wirtner 1904:201[3]

Male: length 4.80 mm, width 1.60 mm. **Dorsum:** pale to white; clothed with simple white or silvery pubescence. **Head:** width 0.75 mm, vertex 0.36 mm. **Rostrum:** length

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[3] I have examined Wirtner's specimens of *Reuteria,* including several taken July 31, at Greensburg, as listed in his 1904 paper, and all are *bifurcata.*

1.30 mm, reaching middle of intermediate coxae. **Antennae:** I, length 0.44 mm; II, 1.69 mm, a narrow black annulus at base; III, 1.21 mm; IV, 0.69 mm. **Pronotum:** length 0.62 mm, width at base 1.25 mm. **Hemelytra:** translucent white, with a green spot at apex of embolium and cuneus. **Membrane:** translucent white; veins pale. **Legs:** pale; knees black; hind femora sometimes with a few small green blotches on dorsal aspect. **Genitalia:** fig. 5.

Female: length 4.56 mm, width 1.65 mm. **Head:** width 0.74 mm, vertex 0.40 mm. **Rostrum:** 1.34 mm. **Antennae:** I, 0.44 mm; II, 1.62 mm; III, 1.10 mm; IV, 0.68 mm. **Pronotum:** length 0.58 mm, width at base 1.20 mm. Similar to male in color, markings and pubescence.

Distribution: Ill., Md., N.Y., Okla. (Knight 1941); Mo. (Froeschner 1949).

Specimens Examined – ILLINOIS: 1♂, Rockford, July 5, 1932, Dozier and Mohr (AMNH). NEW YORK: 1♂, Hempstead, Long Island, VII-21-09, C.E. Olsen (AMNH). NORTH CAROLINA: 1♂, Mecklenburg Co., Rt. 51, 1 mi. W. of Rt. 16, nr. Matthews, June 14, 1974, A.G. Wheeler, Jr., on *Carya ovata* (PDA). PENNSYLVANIA: 2♀♀, Greensburg, July 5, 1903 (?) O. Heidemann (Allotype) (CU); Greensburg, 1♀, July 31, 1903, Wirtner (Det. H.H. Knight) (CU); 1♂, Cumberland Co., Camp Hill, Wood St., July 16, 1973, T.J. Henry and A.G. Wheeler, Jr., on *Platanus occidentalis;* 3♂♂, 6♀♀, Butler Co., 7 mi. W. of Butler, Rt. 422, July 24, 1973, A.G. Wheeler, Jr., on *Carya laciniosa;* 1♂, Lehigh Co., Allentown, Lehigh Park, July 24, 1973, K.R. Valley, on *Salix babylonica;* 1♂, Northampton Co., Hwy. 191, 1.5 mi. S. of Nazareth nr. Jackson Sch. Bldg., July 26, 1973, K.R. Valley, on *Carya ovata;* 1♂, Chester Co., nr. Seven Stars, Doyle Nurs., T.J. Henry and A.G. Wheeler, Jr., on *Juglans* sp. (PDA).

Remarks: *R. bifurcata* superficially resembles several other *Reuteria,* but may be distinguished by the lack of large green blotches on the dorsum, the pale veins on the membrane, the tergal process, and the bifurcate right genital clasper. This species was taken most often on *Carya* spp.

Reuteria dobsoni n. sp.

Male: Holotype, length 4.64 mm, width 1.56 mm. **Dorsum:** pale to white, marked with green; thinly clothed with simple, silvery-white semierect pubescence. **Head:** width 0.74 mm, vertex 0.36 mm, tylus tinged with green. **Rostrum:** length 1.28 mm, apex fuscous, reaching posterior margin of middle coxae. **Antennae:** I, 0.40 mm, white, outer black line stout, uniformly thick, inner line tapering to a point at base; II, 1.60 mm, yellowish or testaceous with narrow black annulus at base; III, 1.10 mm, yellowish; IV, 0.70 mm, yellowish. **Pronotum:** length 0.60 mm, width at base 1.16 mm; white, lightly tinged with green along margins; area of calli dingy white. **Hemelytra:** translucent white, tinged with green on mesoscutum, apex of scutellum, inner angle of clavus and cuneus; a greenish spot present at apex of embolium and cuneus. **Membrane:** opaque white; veins green, darker posteriorly, a fuscous or brownish spot present at posterior margin of large areole. **Venter:** whitish, propleura and sides of abdomen tinged with green. **Legs:** whitish, very lightly tinged with green; front and middle femora with small, greenish apical markings, hind femora with 3 large green blotches on dorsal aspect, the distal one being larger and more slender; anterior half of knees black; tibiae white to testaceous; tarsi and claws pale. **Genitalia:** fig. 6.

Female: Allotype, length 4.40 mm, width 1.60 mm. **Head:** width 0.70 mm, vertex 0.42 mm. **Rostrum:** length 1.28 mm. **Antennae:** I, 0.46 mm; II, 1.62 mm; III, 1.16 mm; IV, 0.72 mm. **Pronotum:** length 0.80 mm, width 1.18 mm. Similar to male in color, markings and pubescence.

HOLOTYPE: ♂, Pennsylvania, York Co., 2 mi. south of Dillsburg, Aug. 5, 1974, B. Stinner, on *Quercus bicolor* (NMNH TYPE NO. 73661); ALLOTYPE: ♀, same data as holotype (NMNH); PARATYPES: 1♂, Pennsylvania, Dauphin Co., Conewago Twp., Brandt Farm, Aug. 3, 1972, T.J. Henry, at black light trap (TJH); 1♂, Pennsylvania, Butler Co., 7 mi. W. of Butler, Rt. 422, July 24, 1973, A.G. Wheeler, Jr.,.on *Carya laciniosa* (PDA); 1♂, Pennsylvania, Centre Co., Boalsburg, Twin View Nurs. July 30, 1974, A.G. Wheeler, Jr., on *Quercus palustris* (PDA).

Remarks: *R. dobsoni* closely resembles *bifurcata,* but is easily separated by the larger size, green blotches on the hind femora and distinctive male genitalia which most closely resemble those of *platani.*

This species is named after Professor R.C. Dobson, Department of Entomology, Purdue University, who is an inspiration to all students having the privilege to work with him and who has done much to stimulate my interests in entomology.

Reuteria fuscicornis Knight

Reuteria fuscicornis Knight 1939:129; Hoffmann et al. 1949:19; Carvalho 1958:130; Kelton 1959:28,64; Akingbohungbe et al. 1972:12.

Male: length 4.30 mm, width 1.30 mm. **Dorsum:** pale to white; clothed with recumbent white or silvery pubescence. **Head:** width 0.65 mm, vertex 0.55 mm, buccula, lorum and tylus tinged with green. **Rostrum:** length 1.21 mm, reaching middle of intermediate coxae. **Antennae:** I, 0.43 mm, black lines in some specimens very heavy; II, 1.53 mm, black, apex testaceous (Fig. 1); III, 1.17 mm, testaceous; IV, 0.88 mm, testaceous. **Pronotum:** length 0.52 mm, width at base 1.12 mm. **Hemelytra:** white, apex of clavus, cuneus, embolium and base of cuneus and middle area of corium marked with green. **Membrane:** translucent white; veins greenish, with a fuscous spot on posterior margin of large areole. **Legs:** pale; knees black; hind femora with dark green blotches on dorsal aspect. **Genitalia:** fig. 7.

Female: length 4.28 mm, width 1.56 mm. **Head:** width 0.64 mm, vertex 0.40 mm. **Rostrum:** 1.36 mm. **Antennae:** I, 0.44 mm; II, 1.44 mm; III, 1.08 mm, IV, 0.84 mm. **Pronotum:** length 0.50 mm, width at base 1.02 mm. Similar to male in color, markings and pubescence.

Distribution: Ia., Ill., Minn., N.Y., Ont. (Knight 1941).

Host: hornbeam, *Ostrya virginiana;* American hornbeam, *Carpinus caroliniana* (Knight 1941).

Specimens Examined – DISTRICT OF COLUMBIA: 2♀♀, Washington, July 20, 1907 O. Heidemann (CU). MARYLAND: 2♂♂, Odenton, July 12, 1914, July 21, 1918, W.L. McAtee, on chestnut; 1♀, Great Falls, July 21, 1919, W.L. McAtee; 1♀, Glen Echo, July 1, 1923, J.R. Malloch (NMNH). MASSACHUSETTS: 8♂♂, 10♀♀, Holliston, 5, 7, 29, 30-VII, N. Banks (AMNH). NEW JERSEY: 1♂ Berkley Hgts., VII-7, E.L. Dickerson (AMNH). PENNSYLVANIA: 5♂♂, 2♀♀, Spring Br., DDT Expt., Aug. 25, 1945 (NMNH); 1♀ Butler Co., 7 mi. W. of Butler, Rt. 422, July 24, 1973, A.G. Wheeler, Jr., on *Cornus racemosa* (PDA); 2♀♀, Cambria Co., Johnstown, July 24, 1975, A.G. Wheeler, Jr., reared from *Carpinus caroliniana* (PDA).

Remarks: This species is easily distinguished by the fuscous second antennal segment and by the tergal process. The *Reuteria* n. sp. referred to by Hoffmann et al. (1949) is *fuscicornis.*

Reuteria irrorata (Say)

Capsus irroratus Say 1832:346.

Malacocoris irroratus, Uhler 1878:507; Atkinson 1889:144; Osborn 1892:123; Heidemann 1892:226; Uhler 1894:267; Osborn 1900:201; Crevecoeur 1905:233; Tucker 1907:59.

Reuteria irrorata Horvath 1908:10; Reuter 1909:70 (in part); Hüeber 1908:228; Smith 1910:160; Reuter 1912:59 (in part); Knight 1918:129, 1922:281, 1923:523; Hussey 1922:33; Blatchley 1926:851; Knight and McAtee 1929:12; Knight 1939:129, 1941:93, 94, 95; Froeschner 1949:169; Carvalho 1952:78 (in part), 1958:130 (in part); Akingbohungbe et al. 1972:12; Slater 1974:156, 191, 192 (in part); Wheeler and Henry 1975:366.

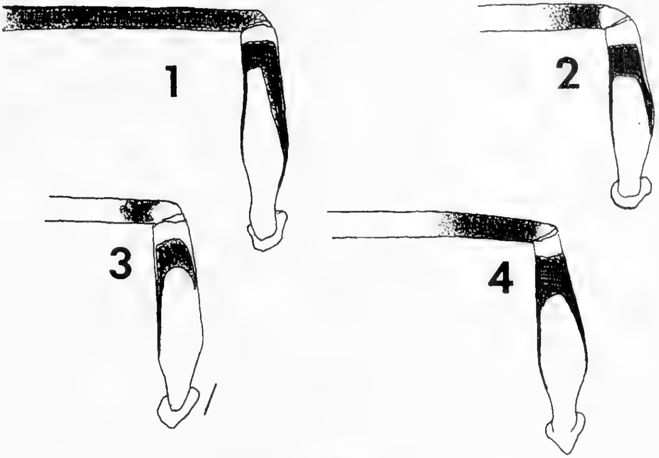
Male: length 4.20 mm, width 1.30 mm. **Dorsum:** pale to white; clothed with suberect white or silvery pubescence. **Head:** width 0.69 mm, vertex 0.35 mm, tinged with green on buccula, lorum, tylus and behind eyes. **Rostrum:** length 1.18 mm, reaching middle of intermediate coxae. **Antennae:** I, 0.38 mm; II, 1.41 mm, testaceous, a narrow black annulus at base (Fig. 2); III, 1.41 mm, testaceous; IV, 0.56 mm, testaceous. **Pronotum:** length 0.62 mm, width at base 1.25 mm. **Hemelytra:** translucent white, strongly marked with green blotches on clavus, corium and cuneus; base and apex of cuneus and apex of embolium with dark green spots. **Membrane:** clear or transparent white, with a small fuscous mark near posterior margin of large areole; veins green. **Venter:** conspicuously tinged with green, especially on propleura. **Legs:** pale to testaceous; knees black; hind femora marked with 3 or 4 green blotches on dorsal aspect. **Genitalia:** fig. 8.

Female: length 4.20 mm, width 1.48 mm. **Head:** width 0.68 mm, vertex 0.40 mm. **Rostrum:** 1.18 mm. **Antennae:** I, 0.42 mm; II, 1.44 mm; III, 0.92 mm; IV, 0.56 mm. **Pronotum:** length 0.50 mm, width at base 1.04 mm. Similar to male in color, markings and pubescence.

Distribution: Kans. (Tucker 1907); Ia., Ill., Ind., Minn., N.Y. (Knight 1941); Mo. (Froeschner 1949); Wisc. (Akingbohungbe et al. 1972).

Host: river birch, *Betula nigra* (Heidemann 1892); bur oak, *Quercus macrocarpa* (Crevecoeur 1905); chestnut, *Castanea dentata;* hickory, Carya sp. (Knight and McAtee 1929); American elm, *Ulmus americana;* common baldcypress, *Taxodium distichum* (Knight 1941).

Specimens Examined – INDIANA: 3♂♂, Tippecanoe Co., June 26, 1934, G.E. Gould; 1♂, Fountain Co., July 7, 1935, G.E. Gould; 1♀, Clark Co., State Forest, June 24, 1937, B.E.M.; 1♀, Tippecanoe Co., Aug. 16, '32 (1948) H.O. Deay, on elm (PU). NORTH CAROLINA: 1♂, Mecklenburg Co., Rt. 51, 1 mi. W. of Rt. 16, nr. Matthews, June 16, 1974, A.G. Wheeler, Jr., on *Quercus stellata* (PDA). PENNSYLVANIA: 7♂♂, 2♀♀, State College, July 20, 1949, S.W. Frost (PSU); 1♂, Philadelphia Co., Chestnut Hills, Morris Arboretum, July 11, 1974, A.G. Wheeler, Jr., on *Acer palmatum* (PDA); 1♂, Dauphin Co., Harrisburg, 2301 No. Cameron St., Agri. Building, July 10, 1974, T.J. Henry, on *Ulmus americana* (PDA); 1♀ Montgomery Co., Fort Washington, Aug. 1, 1974, A.G. Wheeler, Jr., on *Ulmus* sp. (PDA). WISCONSIN: 4♂♂, 11♀♀, Dane Co., July 12, 14, 1971, A.E. Akingbohungbe, on elm and bur oak (UW).



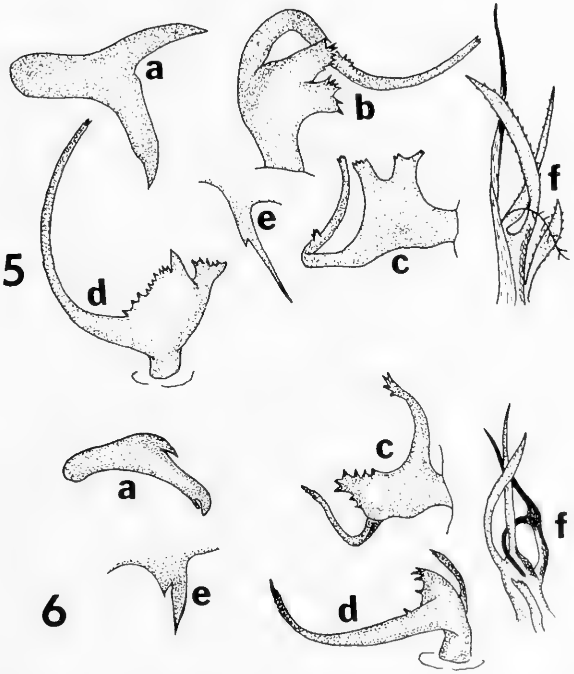


Fig. 1-4, 1st and 2nd antennal segments of *Reuteria* spp, 1, *fuscicornis* Knight. 2, *irrorata* (Say). 3, *platani* Knight, 4, *querci* Knight.

Fig. 5-6, male genitalia of *Reuteria* spp.; a, left clasper; b-d, right clasper (b, anterior view, c, lateral view; d, posterior view); e, tergal process; f, spiculi of aedeagus. 5, *bifurcata* Knight. 6, *dobsoni* n. sp.

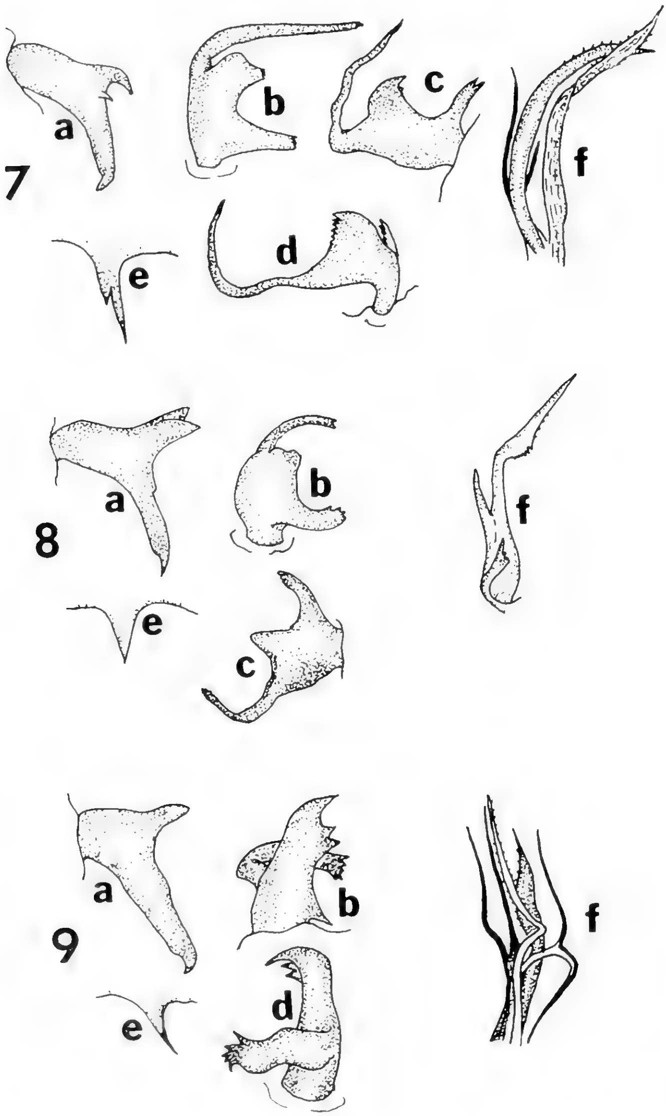


Fig. 7-9, male genitalia of *Reuteria* spp.; a, left clasper; b-d, right clasper (b, anterior view, c, lateral view, d, posterior view); e, tergal process; f, spiculi of aedeagus. 7, *fuscicornis* Knight. 8, *irrorata* (Say). 9, *marqueti* Puton.

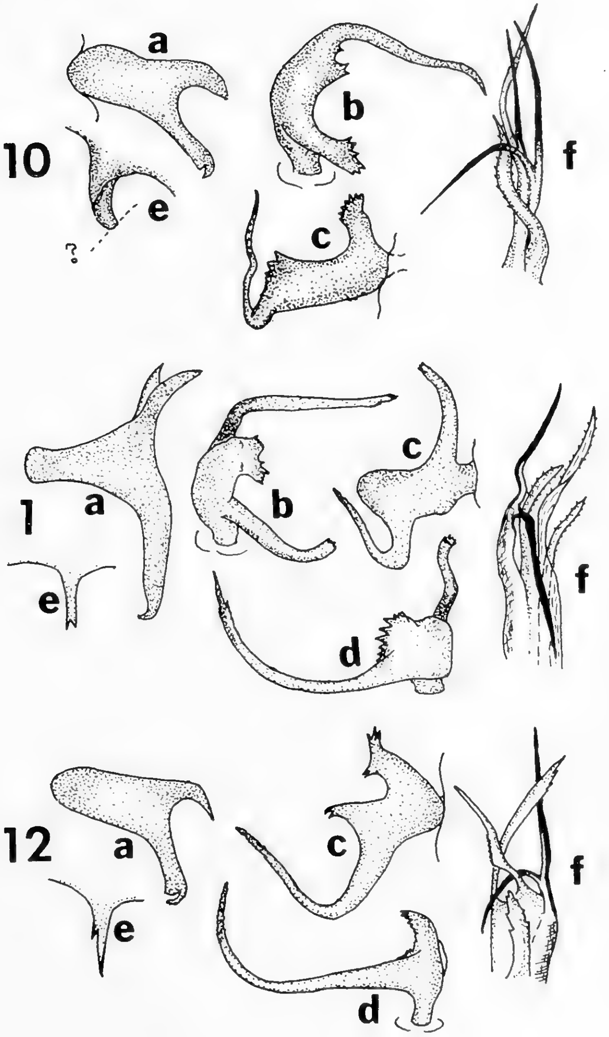


Fig. 10-12, male genitalia of *Reuteria* spp.; a, left clasper; b-d, right clasper (b, anterior view, c, lateral view, d, posterior view); e, tergal process; f, spiculi of aedeagus. 10, *platani* Knight. 11, *querci* Knight, 12, *wheeleri* n. sp.

Remarks: *R. irrorata* may be separated from the other species by the conspicuous green blotches on the clavus, corium and dorsal aspect of the hind femora, the shorter rostrum and by the male genitalia. Superficially, *irrorata* resembles *marqueti.* This fact alone probably led early workers to confuse the two species. All references to *irrorata* (Say) in Europe are erroneous and actually represent *marqueti* Puton. Since these species were considered one for many years, European workers incorrectly cited both North America and Europe in their records. Stichel's (1957) distribution record for Mexico probably refers to the genus *Saileria* Hsiao.

My attempts have failed to locate Say's mirid material. It appears to have been either lost or destroyed. Upon Say's death, his collection was housed at the Academy of Natural Sciences of Philadelphia. Later his collection, already largely "vermin-eaten," was shipped to T.W. Harris at Harvard (Dow 1913). Further destruction occurred during transportation by stagecoach to Massachusetts (Mallis 1971). Uhler (1876) noted that a few of Say's Hemiptera "types" were present in the Harris collection, but badly damaged by dermestids. Harvard's Hemiptera (except the Harris collection) were traded to the American Museum of Natural History in N.Y. in 1970. Through the kind efforts of Dr. R.T. Schuh (AMNH) and Ms. M.K. Thayer (MCZ), these collections were searched without success for any possible Say specimens. Dr. H.H. Knight, Iowa State University, also indicated that Say's mirid material no longer exists (personal communication). Thus, it is concluded that the type of *irrorata* no longer exists.

Say's original description of *Capsus irroratus* clearly places this plant bug in the genus *Reuteria,* but is not sufficient to separate it from all other species. Since Say's specimen(s) cannot be located, I find it necessary to follow Knight's (1939, 1941) interpretation of *irrorata* (Say). To preserve this concept, a neotype is designated for this species.

NEOTYPE: ♂, Indiana, White Co., Monticello, Tall Timbers Marina, Lake Shafer, July 9, 1975, T.J. Henry, on *Ulmus fulva* (NMNH Type No. 73730).

Reuteria marqueti Puton
(Type of genus)

Reuteria marqueti Puton 1875:519; Reuter 1883:325; Löw 1883:60; Hüeber 1909:238; Knight 1922:281, 1939:129; Wagner 1961:52, 1967:157, 1973:162.

Reuteria marquetii, Atkinson 1890:144.

Reuteria irrorata, Horvath 1908:10 (in part); Reuter 1909:70 (in part); Oshanin 1910:854 (in part); Reuter 1912:59 (in part); Hedicke 1935:54 (in part); Cerutti 1937:32; Wagner 1952:111, 1956:419 (in part); Carvalho 1952:78 (in part), 1958:130 (in part); Seidenstücker 1954:82; Stichel 1956:503 (in part).

Male: length 4.68 mm, width 1.54 mm. **Dorsum:** pale to white; clothed with white or silvery pubescence. **Head:** width 0.74 mm, vertex 0.36 mm. **Rostrum:** length 1.20 mm, reaching middle of hind coxae. **Antennae:** I, 0.50 mm; II, 1.64 mm; III, broken; IV, broken. **Pronotum:** length 0.56 mm, width at base 1.10 mm, white, calli somewhat yellowish. **Hemelytra:** white with large green blotches on corium and clavus, green marking along inner and outer margin of clavus and apex of embolium. **Membrane:** transparent with two vague brownish patches on apical half; veins green; large areole bordered by fuscous mark on posterior margin. **Legs:** pale; knees black; middle femora sometimes with green blotch near apex, hind femora with a short brown line at apex of dorsal aspect, and often mixed with green blotches. **Genitalia:** fig. 9.

Female: length 4.49 mm, width 1.52 mm. **Head:** width 0.72 mm, vertex 0.40 mm. **Rostrum:** length 1.37 mm. **Antennae:** I, 0.45 mm; II, 1.54 mm; III, 0.92 mm; IV, 0.63 mm. **Pronotum:** length 0.53 mm, width at base 1.11 mm. Similar to male in color, markings and pubescence.

Distribution: Czechoslovakia (Stichel 1957); Austria, France, Germany, Greece, Hungary, Italy, Switzerland (Carvalho 1958).

Host: *Carpinus* (Löw 1883); *Alnus, Quercus, Rubus, Tilia,* and *Ulmus* (Göllner-Scheiding 1973).

Specimens Examined – FRANCE: 2♂♂, Toulouse, Marquet (BM). GERMANY: 7♀♀, Saxonia sept. Leipzig, Albert-Park, 1-9-1951, Dorn.; 1♀, 28-7-38, Mainz Stadpark, E. Wagner; 1♂, Naumburg, Burgergarten, 21-8-27, coll. K. Dorn (ZMHU). HUNGARY: 1♀, Simontornya, Leg. 1929, 24-VIII, F. Pillich (ZMHU).

Remarks: This species superficially resembles *irrorata* with the presence of large green blotches on the dorsum, but may easily be distinguished by the male genitalia. All specimens examined from Europe are distinct from the Nearctic species. The specimens from "Toulouse" are smaller (3.90-4.00mm). All other structures appear identical except for slight normal variation noted in the left genital clasper of the "Toulouse" specimens, those from Germany, and those figured by Seidenstücker (1954). Wagner's (1973) drawing of the vesica is incomplete. *R. marqueti* is undoubtedly a good species and so far is restricted to the Palearctic region.

Reuteria platani Knight

Reuteria platani Knight 1941:95; Carvalho 1958:130.

Male: length 4.20 mm, width 1.60 mm. **Dorsum:** pale to white; clothed with white or silvery pubescence. **Head:** width 0.72 mm, vertex 0.34 mm. **Rostrum:** length 1.32 mm, reaching hind margin of middle coxae. **Antennae:** I, 0.40 mm, inner black line abbreviated, forming a J-shaped mark (Fig. 3); II, 1.50 mm, a narrow black annulus at base; III, 1.02 mm; IV, broken. **Pronotum:** length 0.54 mm, width at base 1.16 mm. **Hemelytra:** white, apex of embolium and cuneus with a green spot, cuneus tinged with green, a few dark setae present. **Membrane:** clear translucent, veins pale. **Legs:** pale; knees black; hind femora with or without light green blotches on dorsal aspect. **Genitalia:** fig. 10.

Female: length 4.90 mm, width 1.64 mm. **Head:** width 0.73 mm; vertex 0.41 mm. **Rostrum:** 1.42 mm. **Antennae:** I, 0.43 mm; II, 1.77 mm; III, 1.12 mm; IV, 0.65 mm. **Pronotum:** length 0.60 mm, width at base 1.16 mm. Similar to male in color, markings and pubescence.

Distribution: Ill. (Knight 1941).

Host: sycamore, *Platanus occidentalis* (Knight 1941).

Specimens Examined – DISTRICT OF COLUMBIA: 2♀♀, Washington, July 25, 1908, O. Heidemann (CU). PENNSYLVANIA: 1♂, Northampton Co., Rt. 191, Hecktown, July 26, 1973, K.R. Valley, on *Platanus occidentalis;* 1♀, Northampton Co., Bethlehem, Holy Cross Cem., July 31, 1973, J. Spirk, on *Platanus* sp.; 1♀, Chester Co., Turnpike, E. of Exit 23, Aug. 6, 1973, J.F. Stimmel and A. G. Wheeler, Jr., on *P. occidentalis;* 4♀♀, Northampton Co., Farmerville, St. Johns Cem., Aug. 9, 1973, J. Spirk, on *P. occidentalis;* 2♀♀, Northampton Co., Easton, Hay's Cem., Aug. 14, 1973, J. Spirk, on *P. occidentalis;* 1♀, Dauphin Co., Harrisburg, Wm. Penn H.S., Aug. 9, 1974, T.J. Henry and J.F. Stimmel, on London plane, *P. acerifolia* (PDA).

Remarks: Previously known only from the original description, *platani* was described from 2♀♀ collected in Ill. I now have examined a single ♂ and 9♀♀ from Pennsylvania collected on two species of *Platanus.* The J-shaped marking on the first antennal segment is quite distinct and may be used to separate *platani* from other species.

Reuteria pollicaris Knight

Reuteria pollicaris Knight 1939:131; Carvalho 1958:130.

Remarks: This species is known only from the type-locality, Aberdeen, Mississippi. Knight (1939, 1941) illustrated the male claspers which show a close relationship to *irrorata* and *querci.* The tergal process is quite similar to that of *querci* but has the apex truncate. It also possesses a lateral branch which is not spine-like but more or less bifid and rounded apically.

Reuteria querci Knight

Reuteria querci Knight 1939:131; Carvalho 1958:130; Akingbohungbe et al. 1972:12.

Male: length 4.30 mm, width 1.40 mm. **Dorsum:** pale to white, tinged with green; densely clothed with white or silvery pubescence. **Head:** width 0.71 mm, vertex 0.35 mm. **Rostrum:** 1.17 mm, reaching anterior margin of hind coxae. **Antennae:** I, 0.43 mm; II, 1.51 mm, testaceous, black on basal third (Fig. 4); III, 0.95 mm; IV, 0.56 mm. **Pronotum:** length 0.56 mm, width at base 1.14 mm. **Hemelytra:** white, tinged with green, clavus and corium with scattered light green blotches, cuneus marked with green, especially at base and apex. **Membrane:** translucent; veins green, a fuscous mark at posterior angle of large areole. **Legs:** pale, tinged with green; knees black; front and middle femora occasionally with green blotches, hind femora with green blotches on dorsal aspect. **Genitalia:** fig. 11.

Female: length 4.40 mm, width 1.50 mm. **Head:** width 0.70 mm, vertex 0.35 mm. **Rostrum:** 1.24 mm. **Antennae:** I, 0.44 mm; II, 1.50 mm; III, 1.02 mm; IV, 0.62 mm. **Pronotum:** length 0.52 mm, width 1.12 mm. Similar to male in color, markings and pubescence.

Distribution: Ia., Ill., Md., Minn., N.Y., Va. (Knight 1941); Mo. (Froeschner 1949).

Specimens Examined – DISTRICT OF COLUMBIA: 4♂♂, 1♀, Washington, July 14, 16, 1897, O. Heidemann (CU, AMNH). IOWA: 1♂, 1♀, Ames, July 12, 1929, H.M. Harris (LSU). NEW YORK: 1♂, New Rochelle, VII-21-1949, L. Lacey, at light (AMNH).

NORTH CAROLINA: 5♂♂, 13♀♀ and nymphs, Mecklenburg Co., Rt. 51, 1 mi. W. of Rt. 16, nr. Matthews, July 6, 7, 1974, A.G. Wheeler, Jr., on *Quercus stellata* (PDA); 7♂♂, 12♀♀ and nymphs, July 4, 5, 1975, same locality as 1974 (PDA). VIRGINIA: 1♂, 7♀♀, Falls Church, 16 July, N. Banks (AMNH).

Remarks: This species may be separated by the broad fuscous area at the base of the second antennal segment and by the male genitalia.

Reuteria wheeleri n. sp.

Male: Holotype, length 4.40 mm, width 1.60 mm. **Dorsum:** whitish with greenish tinge; clothed with simple white or silvery pubescence. **Head:** width 0.74 mm, vertex 0.34 mm; lightly marked with green behind eyes and on buccula and tip of tylus. **Rostrum:** length 1.20 mm, reaching middle of mesocoxae. **Antennae:** I, 0.42 mm, whitish with inner black line tapering to a fine point; II, 1.36 mm, testaceous, black at base; III, 0.94 mm; IV, 0.52 mm. **Pronotum:** length 0.56 mm, width at base 1.10 mm, calli lightly tinged with green. **Hemelytra:** marked with many large greenish blotches, similar to the typical *irrorata;* scutellum green at middle of base; mesoscutum lightly marked with greenish; apex of cuneus and embolium with strong greenish-blue point. **Membrane:** transparent; veins green; a fuscous spot at posterior angle of large areole. **Venter:** whitish, area across coxal cleft greenish, sides of abdomen tinged with green. **Legs:** testaceous; front femora greenish below, middle femora with greenish spot at dorsal apex, hind femora with two blue-green spots at middle and a green line at apex of dorsal aspect; tibiae testaceous, knees black on outer half; last tarsal segment and claws brownish. **Genitalia:** fig. 12.

Female: Allotype, length 4.36 mm, width 1.64 mm. **Head:** width 0.70 mm, vertex 0.40 mm. **Rostrum:** length 1.22 mm, reaching anterior margin of middle coxae. **Antennae:** I, 0.42 mm; II, 1.24 mm; III, 0.94 mm; IV, 0.62 mm. **Pronotum:** length 0.54 mm, width 1.16 mm. Similar to male in color, markings and pubescence.

HOLOTYPE: ♂, North Carolina, Mecklenburg Co., Rt. 51, 1 mi. W. of Rt. 16, nr. Matthews, June 13, 1975, A.G. Wheeler, Jr., on *Quercus stellata* (NMNH Type No. 73662). ALLOTYPE: ♀, same data as for holotype (NMNH). PARATYPES: 4♂♂, 4♀♀, same data as for holotype (NMNH, PDA). 1♂, Georgia, Atlanta, June 11, 1943, P.W. Fattig, det. R.I. Sailer, *Reuteria* n. sp. (NMNH).

Remarks: This species closely resembles *irrorata* in general aspects but may be separated by the larger size, longer rostrum, tergal process, and male genitalia. The male genital claspers most closely resemble those of *dobsoni* and *platani*. This species appeared about one month earlier than *querci* which was collected in abundance on the same host at the same locality in 1974 and 1975.

This species is named after my good friend, Dr. A.G. Wheeler, Jr., who has done much to increase our knowledge of insect biology and who also collected many of the specimens used in this study.

ACKNOWLEDGEMENTS

I wish to thank Drs. K.C. Kim (PSU), K.R. Valley (PDA), and A.G. Wheeler, Jr. (PDA) for reading the manuscript and making useful suggestions. Also I thank Mr. W.R.

Dolling (BM) and Mr. A. Provonsha (PU), and Drs. J.B. Chapin (LSU), U. Göllner-Scheiding (ZMHU), J.L. Herring (NMNH), K.C. Kim (PSU), L.L. Pechuman (CU), and R.T. Schuh (AMNH) for loaning specimens and Dr. H.H. Knight, Iowa State University, for allowing me to examine his type collection.

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REDESCRIPTION OF *PARASCORPIOPS MONTANA* BANKS (SCORPIONIDA, VAEJOVIDAE)[1]

Oscar F. Francke[2]

ABSTRACT: *Parascorpiops montana* Banks is redescribed, and a lectotype is designated. This monotypic genus is endemic to Borneo, and its relationships with the two other genera of the subfamily Scorpiopsinae are analyzed from morphological and zoogeographical viewpoints.

DESCRIPTORS: Scorpionida, Vaejovidae, Scorpiopsinae, *Parascorpiops*; redescription, lectotype, monotypic genus, Southeast Asia, Borneo, subfamilial zoogeography.

The higher categories of Vaejovid scorpions have been recently treated by Stahnke (1974). This author however, failed to examine two supposedly monotypic genera which because of their geographical distribution are very important to our understanding of the systematics and evolution of Vaejovidae. The Brazilian taxon, *Physoctonus physurus* Mello-Leitão, retained by Stahnke in the subfamily Vaejovinae, and whose holotype I have recently examined, belongs to the family Buthidae (redescription in preparation), eliminating the zoogeographic puzzle formerly created by this genus in an otherwise exclusively North American subfamily. The Bornean species *Parascorpiops montana* Banks belongs in the subfamily Scorpiopsinae, and taxonomically is known only from the brief original description which appeared in 1928.

I have recently examined the 11 syntypes of *P. montana,* and since knowledge of this species is important in understanding the phylogeny of the subfamily Scorpiopsinae, a redescription is made here, followed by some taxonomic observations on the subfamily.

Parascorpiops montana Banks

Parascorpiops montana Banks 1928, pp. 505-506; Takashima 1945, p. 71; Stahnke 1974, p. 124. *Parascorpiops montanus* Werner 1934, p. 283.

Lectotype – Adult male (measurements in Table 1). New designation.

Prosoma. Carapace fusco-ferrugineous with distinct variegated fuscous pattern; median and lateral eyes piceous; posterior one-half of lateral margins, and posterior margin moderately, uniformly infuscate. Anterior margin strongly, abruptly emarginate

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[1] Accepted for publication: January 20, 1975

[2] Department of Zoology, Arizona State University, Tempe, AZ 85281

ENT. NEWS, 87: 3 & 4: 75 - 85, March & April 1976

medially; median notch approximately two times wider than deep, extending to posterior margin of second pair of lateral eyes (Fig. 1). Two pairs of lateral eyes, subequal in size, and slightly smaller than median eyes. Anterior median furrow moderately deep, wide. Ocular prominence moderately raised above carapacial surface, with vestigial longitudinal furrow medially. Median eyes separated by slightly more than their own diameter, located at anterior two-fifths of carapace length. Posterior median and posterior marginal furrows vestigial. Posterior lateral furrows arcuate, moderately deep and wide. Texture: submedially with moderately dense, small granules; medially and laterally sparsely granulose. Venter ochreous-fuscescent, maxillary lobes vestigially infuscate. Sternum pentagonal, posterior one-third with deep median longitudinal furrow bifurcating submarginally.

Mesosoma. Tergites fusco-ferrugineous with distinct fuscous pattern: I-II with coarsely reticulated fuscosity; III-IV antero-laterally with sparse and fine reticulations, uniformly infuscate on other regions; V-VI uniformly infuscate throughout; VII with distinct reticulated fuscosity. Tergite width tapering distally: I approximately as wide as carapace; VII about two-thirds as wide as carapace, and approximately as long as wide. Tergites shagreened to vestigially granulose, keel-less. Genital operculi ochreous, median longitudinal membranous connection absent (Fig. 2). Genital papillae present. Pectinal basal piece ochreous, anterior margin shallowly notched medially. Pectines flavous: two marginal lamellae, one middle lamellae, fulcra absent; pectinal tooth count 6-6, each tooth approximately three times longer than wide (Fig. 4). Sternites ochreous fuscescent: III-VI vestigially infuscate laterally; VII with margins moderately infuscate, disc diffusely infuscate. Stigmata about three times longer than wide. Sternite VII acarinate, smooth.

Metasoma. Preanal segments fusco-ferrugineous with moderately dense, reticular fuscosity; telson ochreous fuscescent. Dorsal lateral carinae: on I weak to vestigial, smooth to sparsely granose, ending abruptly in small subconical granule; on II moderately strong, subgranose tending to serrate, ending abruptly in small granule; on III-IV moderate to strong, serrate, ending abruptly in medium sized granule. Lateral supramedian carinae: on I moderately strong, coarsely granulose; on II-IV weak to vestigial, subgranose. Lateral inframedian carinae: on I weak to moderate, subgranose, complete; on II-IV obsolete. Ventral lateral carinae: on I weak to moderate, subgranose, moderately convergent distally; on II-IV weak, subgranose, subparallel. Ventral submedian carinae: on I vestigial, smooth, feebly convergent distally; on II vestigial, smooth, parallel; on III vestigial to obsolete, smooth; on IV weak to vestigial, subgranose. Segments I-IV dorsally flat, without median longitudinal depression; intercarinae smooth to vestigially rugose and shagreened.

Segment V over one and one-half times longer than segment IV. Dorsal lateral carinae vestigial, subgranose. Lateral median keels present on basal one-third, vestigial, with scattered small granules. Ventral lateral and ventral median carinae moderate, distinctly granulose. Telson slightly deeper than wide; vesicle with weak postero-lateral bilobations ventrally, aculeus short and strongly curved.

Chelicera. Ochreous: chela with fine fuscous variegations dorsally; fingers with moderately dense, uniform fuscosity. Ventral surfaces of chela and fingers densely covered with long, whitish hairs. Dentition shown in Fig. 5.

Pedipalp. Fusco-ferrugineous with moderately dense, uniform or sparsely variegated fuscosity. Femur wider than deep. Dorsal internal carina strong, granulose. Dorsal external keel moderately strong, granulose. External carina moderate, complete, granulose. Ventral external keel present on basal one-half, weak to vestigial, subgranose. Ventral internal keel strong, granulose. Ventral face vestigially shagreened. Internal face shagreened, with sparse to moderately dense small granules. Dorsal and external faces shagreened. Three femoral trichobothria: internal, dorsal, and external.

Tibia wider than deep. Dorsal internal keel obsolete; basal tubercle strong, subconical. Dorsal median carina moderately strong, granulose. Dorsal external keel strong, coarsely granose. External keel moderately strong, granulose. Ventral external keel strong, granulose tending to serrate. Ventral median keel obsolete. Ventral internal keel moderate, granulose; basal tubercle weak. Tibial faces shagreened, with sparse to moderately dense small granules. Neobothriotaxic: one internal, two dorsal, 17 external, and 10 ventral trichobothria arranged as shown in Figs. 7-9.

Chela hexagonal in cross-section, with conspicuous dorso-ventral compression. Dorsal face flat: basal one-half with vestigial reticular patterning of small granules; distally with dense, small granulation. External face moderately granulose, distinctly reticulated. Ventral face shagreened to densely, minutely granose. Internal face shagreened to moderately granulose. Dentate margins of fingers with strong, matching lobations basally (Fig. 11); when fingers are closed a distinct gap appears at basal region of lobes. Orthobothriotaxic, with 26 trichobothria arranged as shown in Figs. 10-12.

Legs. Ochreous fuscescent to brunneous. Basal segments shagreened, distal segments smooth. Tibial spur absent. Internal and external pedal spurs present. Tarsomere II truncate distally, armed ventrally with median longitudinal row of small spines flanked by three pairs of submedian setae. Ungues equal in size, subunguicular spine well developed.

Allolectotype – Adult female (measurements in Table 1). New designation. Differs from lectotype as indicated below.

Prosoma. Carapace with posterior median and posterior marginal furrows weak to moderately deep.

Mesosoma. Tergites distal taper not as pronounced; VII about seven-ninths as wide as carapace, distinctly wider than long. Tergites lustrous, vestigially granulose posteriorly. Genital operculi elongate-ellipsoidal, with complete median longitudinal membranous connection. Genital papillae absent. Pectinal tooth count 6-6, each tooth about three times longer than wide, but smaller than on male (Fig. 3). Sternite VII with submedian and lateral carinae vestigial, smooth.

Metasoma. Proportionately slightly shorter, but otherwise very similar in morphology and sculpturing.

Pedipalp. Chelal fingers curvature not as strong, thus chela appearing slightly more elongate. Dentate margins on fingers straight or nearly so, leaving no gap between them when closed. Dentate margin of fingers granulose, with all granules subequal in size except for terminal ones. Dentate margin of movable finger divisible into three regions according to granular placement, as follows: basal one-fifth with single median longitudinal row of granules; distal one-fifth with oblique, imbricated rows of granules;

intervening three-fifths without recognizable pattern, granules randomly placed three to four abreast (Fig. 6). Trichobothrial pattern as on male; especially on external face of fixed finger, where trichobothrial relative positions are not affected by presence or absence of lobation on dentate margin.

Type locality. Mt. Poi (5,400 ft), Sarawak (Island of Borneo), Federation of Malaysia; no date (Dr. E. Mjoberg). Primary types permanently deposited in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

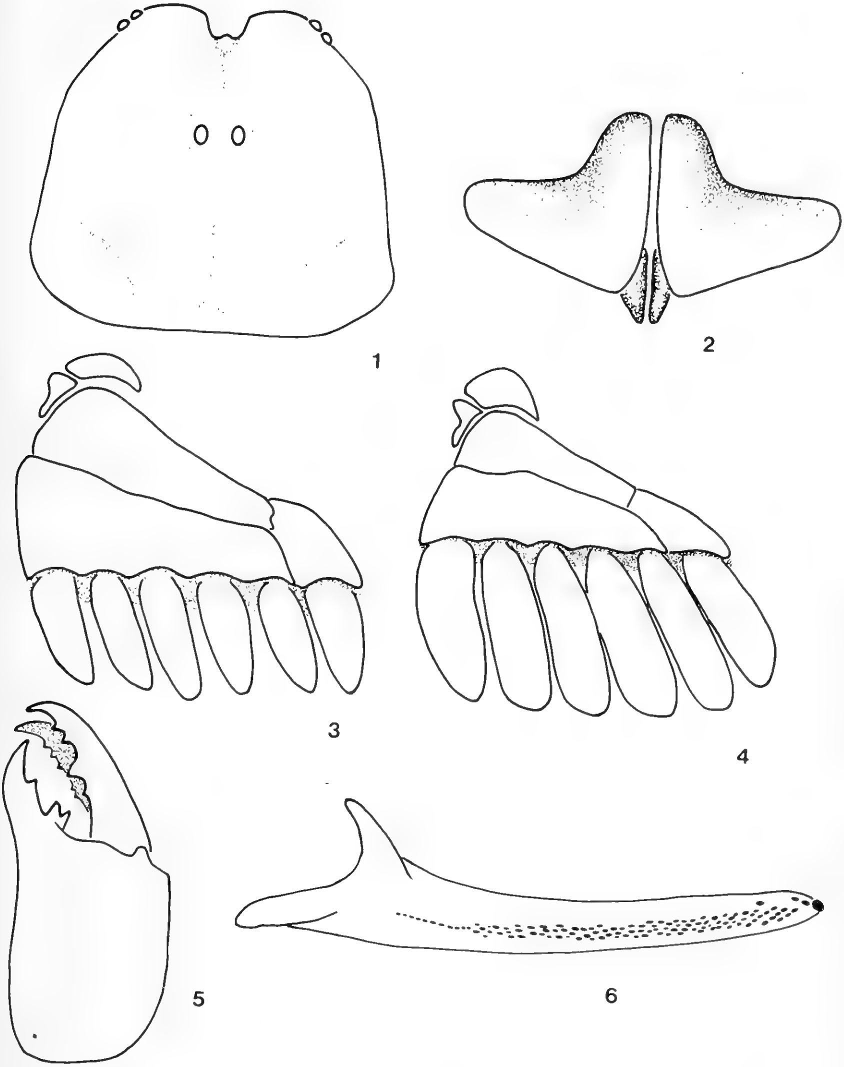
Distribution. Presently this species appears to be endemic to the Island of Borneo. In the original description Banks (1928) also reported specimens from Mt. Dulit (4,000 ft), Sarawak.

Intraspecific variability. In addition to the primary types, the following paralectotypes have been examined:
– One adult male, differing from the lectotype in being slightly darker, and the pedipalp chelae appearing slightly more robust. This specimen is missing the third leg on the left side.
– Five adult females, one of which appears to have molted a short time before capture as indicated by its softer exoskeleton and lighter coloration. The four other paralectotypes differ little from the allolectotype, except for one having a pectinal tooth count of 5-6.
– Three juvenile males with carapace lengths of 5.5mm, 5.3mm, and 4.6mm respectively. In these specimens the base color is ochreous and the fuscous patterning on all structures is very conspicuous. The pedipalp chelae are morphologically similar to that of adult females, with the fingers shallowly curved and straight edged. Tergite VII however, shows the proportions of adult males, i.e., as long as wide.

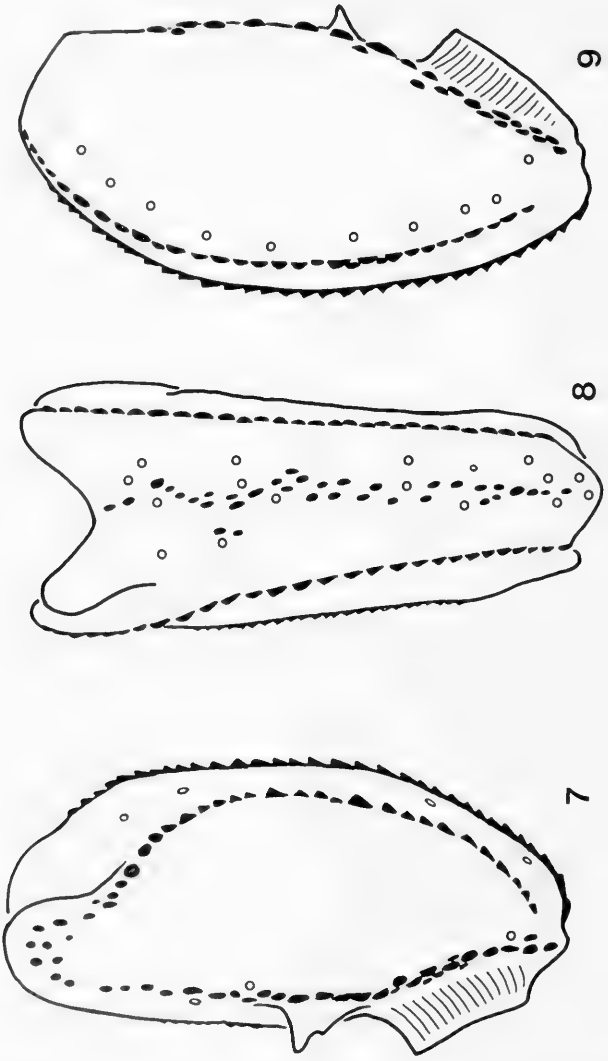
Taxonomic and Zoogeographic Notes

The subfamily Scorpiopsinae is confined to southeast Asia, where three genera have been recognized. The genus *Scorpiops* Peters contains approximately 13 described species and subspecies found in India, Nepal, Bangladesh, and Burma. The monotypic genus *Dasyscorpiops* Vachon is known only from the holotype, which was collected at Malacca, Malaysia. Finally, *Parascorpiops* Banks which is also monotypic and endemic to the island of Borneo (Fig. 13). These three genera are very closely related, and on the basis of morphologic and zoogeographic data it is possible that they should be lowered to subgeneric rank under *Scorpiops.*

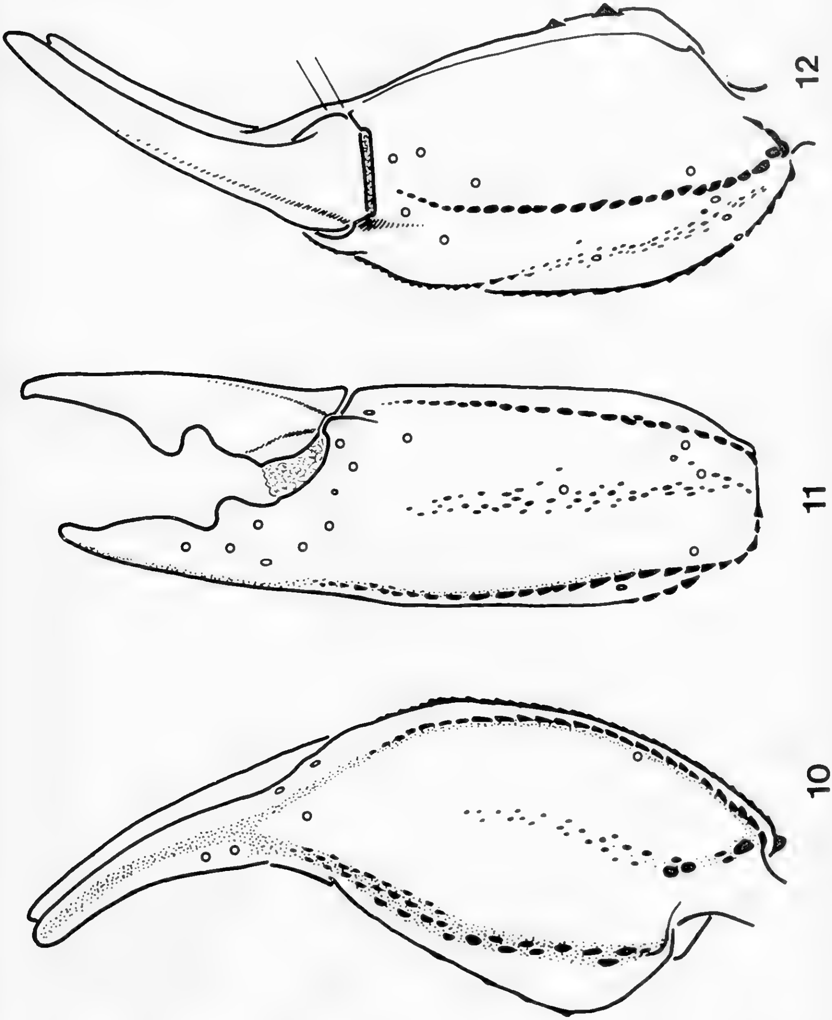
Scorpiops and *Parascorpiops* are separable only by the number of lateral eyes, *Scorpiops* with three pairs and *Parascorpiops* with two pairs. Although this character has been formerly used extensively in scorpion taxonomy, I find it to be quite variable on many taxa and consequently rank it very low on the weighted hierarchy of taxonomic characters. The majority of Vaejovid scorpions have three pairs of lateral eyes, and this character has been used, quite erroneously in my opinion, as a familial character. However, *Anuroc-*



Figures 1-6. *Parascorpiops montana* Banks, type specimens from Mt. Poi, Sarawak, Federation of Malaysia. Lectotype male figs. 1, 2, 4, 5; allolectotype figs. 3, 6. 1- Carapace, dorsal aspect. 2- Genital region, showing operculi and papillae. 3 and 4- Pectines, showing one extensive middle lamella and absence of fulcra. 5- Right chelicera, dorsal aspect. 6- Dentate margin of movable finger of right pedipalp chela.



Figures 7-9. *Parascorpiops montana* Banks, lectotype male. Tibia of right pedipalp showing carinal development and trichobothrial pattern (open circles). 7- Dorsal aspect. 8- External aspect. 9- Ventral aspect.



Figures 10-12. *Parascorpiops montana* Banks, lectotype male. Chela of right pedipalp showing carinal development and trichobothrial pattern (open circles). 10- Dorsal aspect. 11- External aspect. 12- Ventral aspect.

tonus Pocock has four pairs of lateral eyes, and in some *Uroctonus* spp. the third pair of lateral eyes is often vestigial or completely missing (Gertsch and Soleglad 1972). Strictly speaking then, *Parascorpiops* which has only two pairs of lateral eyes should not be included in the family Vaejovidae (as presently defined); but because it is closely related to *Scorpiops* which does have three pairs of lateral eyes, both genera have been referred to the family Vaejovidae. Although I do not agree with the placement of the subfamily Scorpiopsinae in the family Vaejovidae, a discussion of this problem would carry me beyond the intended scope of this contribution and I must apologize for deferring on this topic until a future contribution. However, returning our attention to the relationships within the Scorpiopsinae, I find that the distinction between *Scorpiops* and *Parascorpiops* is rather superficial and is founded on a taxonomically unreliable character.

Similarly, if we dismiss the number of lateral eyes as a valid generic character, the separation of *Dasyscorpiops* from both *Scorpiops* and *Parascorpiops* is based on a single character, whose usefulness at the generic level in this case is also questionable. *Dasyscorpiops* is recognizable by the presence of 85-86 trichobothria on the pedipalp tibia, whereas in *Scorpiops* and *Parascorpiops* these do not exceed 44. Among scorpions in general it is known that the highest variability in trichobothrial numbers occurs on the tibia (Vachon 1974); and I specifically mention the genus *Euscorpius* Thorell (Chactidae), which has some interesting morphological affinities to the Scorpiopsinae. In *Euscorpius* the tibial trichobothria vary from a low of 27 in *E. germanus* (Koch), to a high of 49-50 in *E. italicus* (Herbst). This intrageneric variability represents an increase of 85% in the number of tibial trichobothria, while the intergeneric variability within the Scorpiopsinae shows an increase of 91%. In both instances approximately the same extent of variation occurs, and thus it is justifiable to raise some questions about the validity of this particular taxonomic character at the generic level in the subfamily Scorpiopsinae.

Zoogeographically it is not surprising that the currently recognized Scorpiopsine genera are perhaps more closely related that their present taxonomic status indicates. It is known that the entire Malayan Peninsula has been emergent (above sea level) since the early Cenozoic some 62 million years ago (Umbgrove 1938, Gobbett and Hutchinson 1973); thus, no apparent marine isolating barriers have existed between *Scorpiops* and *Dasyscorpiops* since that time. This does not imply that these two taxa originated before that time, but it does suggest that the apparent discontinuous distribution might be the result of insufficient sampling in the intervening area rather than representing a discrete gap between them.

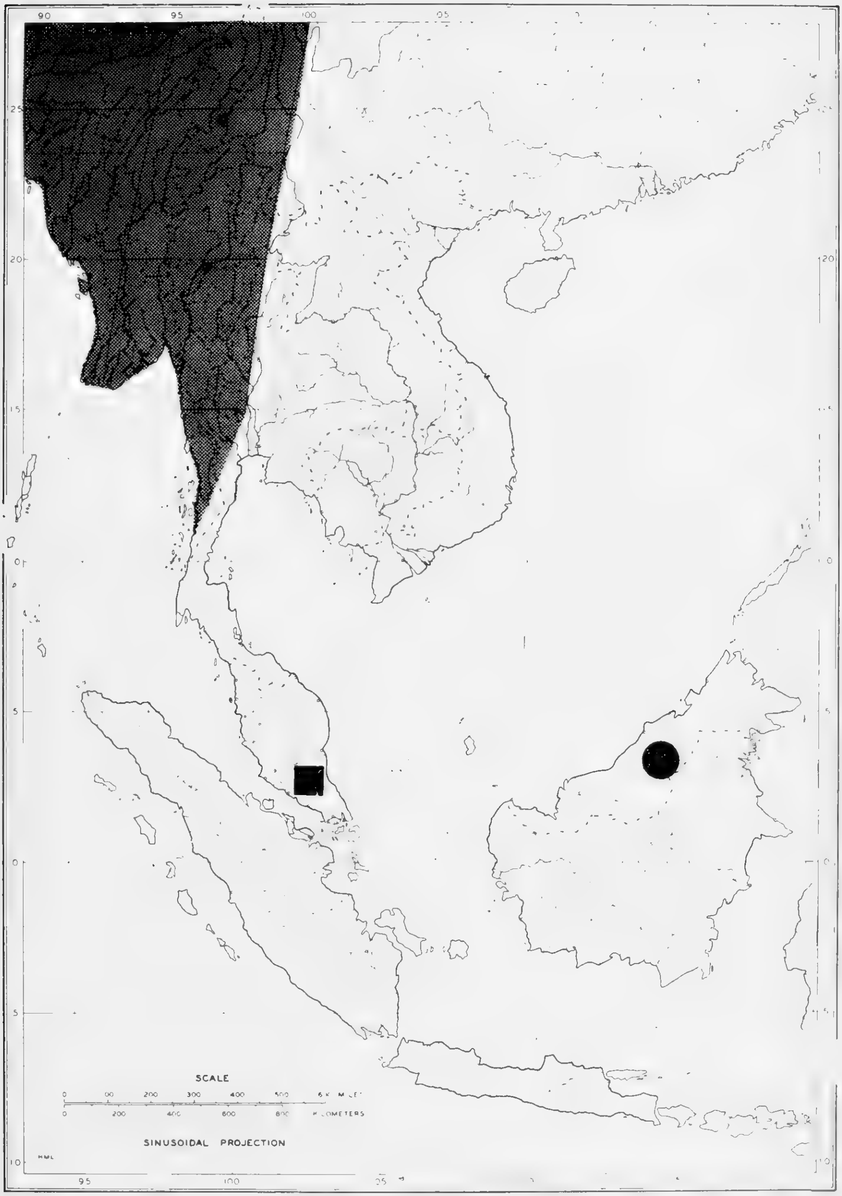


Figure 13. Map of Southeast Asia showing the known distribution of the three genera currently recognized in the subfamily Scorpiopsinae: *Scorpiops* Peters (stippled area), *Dasyscorpiops* Vachon (square), and *Parascorpiops* Banks (circle).

Similarly, extensive land connections between the Malayan Peninsula and Borneo have been dated back to the Pleistocene, spanning the period from two million to 10 thousand years ago (Umbgrove 1938, Gobbett and Hutchinson 1973). Therefore, *Parascorpiops* does not appear to have been geographically isolated from its mainland relatives for more than a few thousands of years. I find it unlikely, although not entirely impossible, that differentiation has proceeded at the rather fast rate required to attain the extent of divergence conductive to generic recognition.

Recapitulating the views expressed in this contribution, both morphological and zoogeographical data tend to support my contention that the Scorpiopsine taxa are very closely related, and that the recognition of three distinct genera might no be valid. However, the genus *Scorpiops* with its 13 described species and subspecies must be revised before any taxonomic changes are made. At that time it should also be possible to investigate into greater depth the relationships among the Eurasian "Vaejovidae" and "Chactidae", and between these and their New World counterparts.

ACKNOWLEDGEMENTS

I am extremely grateful to Dr. Herbert W. Levi, Curator in Arachnology at the Museum of Comparative Zoology, Harvard University, for enabling me to study the type specimens deposited at that institution. My special thanks go to Dr. Mont A. Cazier, Arizona State University, for discussing at length this and other zoogeographical problems, and for reviewing the manuscript. I was supported by an Arizona State University Graduate College Fellowship during the course of these investigations.

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Table 1. Measurements (in Millimeters) of *Parascorpiops montana* Banks

		Lectotype	Allolectotype
Total length		49.15	55.10
Carapace length		6.75	7.80
	Anterior width	3.95	4.40
	Width at median eyes	6.50	7.90
	Posterior width	7.45	9.10
Mesosoma length		15.90	20.10
Metasoma length		26.50	27.20
I	length/width/depth	2.70/2.50/1.90	2.80/2.70/2.20
II	length/width/depth	3.20/2.10/2.00	3.30/2.40/2.20
III	length/width/depth	3.50/2.00/2.00	3.60/2.20/2.20
IV	length/width/depth	4.00/2.00/2.00	4.10/2.10/2.20
V	length/width/depth	6.50/1.90/2.00	6.50/1.95/2.10
Telson length		6.60	6.90
	Vesicle length/width/depth	5.00/2.40/2.50	5.50/2.40/2.60
	Aculeus length	1.60	1.40
Pedipalp length		26.60	29.70
	Femur length/width/depth	6.50/2.80/1.80	7.10/3.10/2.20
	Tibia length/width/depth	5.70/2.80/1.90	6.50/3.30/2.35
	Chela length/width/depth	14.40/5.10/3.80	16.10/5.60/3.90
	Movable finger length	7.00	8.50
	Fixed finger length	5.20	6.90
Chelicera: chela length/width		2.05/1.50	2.50/1.90
	Movable finger length	1.65	2.20
	Fixed finger length	0.80	1.30

NOTE ON AN EXTRAORDINARILY HIGH MATING SWARM IN THE ANT *MYRMICA LAEVINODIS* (HYMENOPTERA: FORMICIDAE, MYRMICINAE)[1] [2]

Michael D. Hubbard[3], Björn Nagell[4]

ABSTRACT: A mating swarm of *Myrmica laevinodis* Nylander was observed in Schlitz, Germany, using a medieval stone tower as an extraordinarily high swarm marker.

DESCRIPTORS: Ants, behavior, reproduction, sociobiology.

On 30 August 1975, we observed a mating flight of the ant *Myrmica laevinodis* Nylander in the town of Schlitz, Hessen, Federal Republic of Germany. Large numbers of this ant were swarming above a high medieval stone tower in the town's central market square. This tower, serving as a swarm marker, was approximately 36 m in height, and was by far the tallest object in the vicinity. The swarm was observed near midday, during mild, fair weather.

There are many European records of species of *Myrmica* forming dense mating swarms, some thick enough to resemble clouds of smoke above trees or low buildings (Donisthorpe, 1915; White, 1883). In the United States various species of *Myrmica* often use other low objects as swarm markers, such as car tops in the prairies or horses in open fields (Neal A. Weber, pers. comm.). Interspecific swarms of other species of *Myrmica* have been reported and are apparently not uncommon (Stitz, 1939). In this mating swarm, however, all specimens collected were of the single species *M. laevinodis* and all observed, many *in copula,* appeared to be the same species. The swarm consisted of several thousand individuals flying above and landing on the top and upper sides of the high tower. Males appeared to greatly outnumber females. Mating pairs were observed both in the air and on the surface of the tower. The caretaker of the tower reported that these mating swarms are quite common throughout the warm summer months, but there was no way of knowing whether species other than *Myrmica laevinodis* use this tower as an extraordinarily high swarm marker.

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[1] Accepted for publication: December 22, 1975

[2] This study was partially supported by a grant from the Cooperative State Research Service, U.S.D.A., Grant #616-15-20.

[3] Laboratory of Aquatic Entomology, Florida A&M University, Tallahassee, Florida 32307.

[illegible] lish Water and Air Pollution Research Laboratory, S-10031 Stockholm, Sweden.

ENT. NEWS, 87: 3 & 4: 86 March & April 1976

THE GENUS *PTERELLA* ROBINEAU-DESVOIDY (DIPTERA: SARCOPHAGIDAE, MILTOGRAMMINAE) OF THE ETHIOPIAN & MADAGASCAN ZOOGEOGRAPHICAL REGIONS[1]

Elizabeth A. Nesbitt[2]

ABSTRACT: The genus *Pterella* Robineau-Desvoidy from the Ethiopian and Madagascan zoogeographical regions is reviewed with a new key. Two new species are described from these regions.

DESCRIPTORS: Diptera: Sarcophagidae, Miltogramminae: *P. lucida* n.sp., *P. eos* n.sp.

Since Zumpt's review of the *Pterella* species of the Ethiopian zoogeographical region (1961), two more species have been described from that area (Zumpt & Stimie, 1965; and Nesbitt, 1975) and two from Madagascar (Zumpt, 1964). Further two species are described below. A key is included for all known species from both regions. Because 9 of the species are characterized by the structure of the male terminalia only, and because of the great similarity in external features, especially in the "*obscurior*-complex", most of the females cannot be identified.

Key to the Species

1 (2) Abdomen entirely red, with silver pollinose transverse bands on tergites III to V. Frons at tip of ocellar triangle measuring half of eye-length. Female only. 8mm. – Kenya. 1. *P. rubriventris* (Villeneuve)

2 (1) Abdomen predominantly black, sometimes laterally more or less ill-defined reddish 3

3 (4) Parafrontalia with 5-6 pairs of proclinate *fo* bristles. Male terminalia see fig. 1. 4-5mm. – Liberia, Zaire, Angola. . . . . 2. *P. liberiensis* Zumpt

4 (3) Parafrontalia with 2 pairs of proclinate *fo* bristles 5

5 (10) Thorax and abdomen covered with a thick pollinosity, with or without a definite pattern on the abdomen 6

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[1] Accepted for publication: December 22, 1975

[2] Department of Entomology, South African Institute for Medical Research.

6 (7) Abdomen with a thick yellow pollinosity, without pattern. Last tergite of male glossy black, that of the female pollinose as the preceding tergites. Male terminalia see Zumpt (1964, p. 52). 5-7 mm. – Madagascar.3. *P. vadoni* (Séguy)

7 (6) Abdomen with a thick olive pollinosity and a pattern of round glossy spots on each tergite 8

8 (9) Glossy spots on abdomen smaller than half the width of each tergite. Paralobi with a bunch of long thick hairs (see Zumpt & Stimie, 1965 p. 16). 5-7 mm. – Lesotho. . . . . 4. *P. stuckenbergi* Zumpt

9 (8) Glossy spots on abdomen longer than half the width of each tergite. Paralobi without long thick hairs (see Zumpt & Stimie, 1965 p. 15). 6mm. – Lesotho, South Africa, South West Africa. . . . . 5. *P. triseriata* Curran

10 (5) Thorax and abdomen with thin olive or grey pollinosity, indefinite pattern changing with incidence of light 11

11 (12) Third antennal segment dark brown. Sternopleural bristles 1:1 Male terminalia see fig. 2. 5-8 mm. – Nigeria, Uganda. Angola, Rhodesia, South Africa, South West Africa. . . . . .6. *P. africana* Curran

12 (11) Third antennal segment yellow or orange. Sternopleural bristles 2:1 (second posterior bristle may be reduced to a long hair): "*obscurior*-complex", not separable on external features 13

13 (18) Paralobi with long thick hairs 14

14 (15) Paralobi with a row of long thick hairs, cerci with a few setae (see Nesbitt, 1975 p. 132). 6-8 mm. – Kenya, Tanzania, Nigeria. . . . . 7. *P. kenyae* Nesbitt

15 (14) Paralobi with a bunch of long thick hairs on a protuberance 16

16 (17) Cerci densely covered with setae, paralobi bifurcate terminally (fig. 3). 6-8 mm. – Mozambique, South West Africa, Kenya. . . . 8. *P.santosdiasi* Zumpt

17 (16) Cerci with a few setae, paralobi merely indented terminally (fig. 4). 5-8 mm. – Angola, Tanzania, South West Africa. . . . . 9. *P. lucida* n.sp.

18 (13) Paralobi without long thick hairs 19

19 (22) Paralobi incised to a greater or lesser degree terminally 20

20 (21) Cerci slender, paralobi curved dorso-ventrally in the distal half (fig. 5). 6-11 mm. – Entire Ethiopian zoogeographical region. 10. *P. obscurior* (Villeneuve)

21 (20) Cerci broader, paralobi not curved thus, narrow distally (see Zumpt, 1961 p. 105). 6-10mm. – South Africa, West and Central Africa.
. . . . 11. *P. angustifrons* (Villeneuve)

22 (19) Paralobi not incised, rounded or pointed terminally 23

23 (24) Paralobi rounded terminally, densely covered with setae on the inner surface, cerci with long hairs (fig. 6). 8mm. – Madagascar. . . . . 12. *P. eos* n.sp.

24 (23) Paralobi pointed terminally, fewer setae, cerci with short slender hairs (see Zumpt, 1964 p. 54). 5-10 mm. – Madagascar. . . . . 13. *P. pan* Zumpt

1. *Pterella rubriventris* (Villeneuve)

Setulia rubriventris Villeneuve, Revue Zool. afr. 3, 1913, p. 41; Curran, Amer. Mus. Novit. 836, p. 3; Zumpt, Proc. R. ent. Soc. Lond. (B) 21, 1952, p. 8.

Pterella rubriventris, Zumpt, Explor. Parc natn. Albert Miss. G.F. de Witte 98, 1961, p. 95.

Mr. A.C. Pont of the British Museum (Natural History) kindly sent the holotype, a female and the only specimen so far recorded. It is in poor condition but appears to be distinct from any of the specimens that we have seen. However, as started above, we have not found features on the females that serve to identify them, and *P. rubriventris* may be the female of a described male species.

Villeneuve's description was brief and a redescription is given:

Female – Eyes bare, facets small. Frons at vertex measuring about ½ of eye-length, widening considerably towards the lunula. Frontal stripe yellow, subparallel, twice as wide as the neighbouring parafrontalium at the tip of the ocellar triangle. Parafrontalia and – facialia yellow with dense yellow pollinosity and microscopic white setae. Ocellar triangle small, *oc* barely distinguishable amongst bristly hairs; *iv, ev* and *f* well developed, 2 *fo* and 13 *paf,* a few bristly hairs on the posterior parafrontalium. Anterior bucca and antennal groove yellow with yellow pollinosity, antennae orange. Third antennal segment twice as long as second (not 3 times, as stated by Villeneuve), arista orange in basal thickened half, becoming dark brown terminally. Posterior bucca and occiput black with dense white pollinosity and fine black setae. Palpi slender, yellow, proboscis dark brown.

Thorax black, tip of scutellum reddish, grey pruinosity leaving undusted three very indistinct longitudinal stripes. Scutum damaged and only the following chaetotaxy discernible: 1 prescutellar *dc* anterior *ph,* 3 *h* (inner one reduced), 2 *n,* 2 *sa, prs,* 2 *pp* and 2 *pst* with a few bristly hairs. Sternopleura with 1 antero-dorsal and 1 postero-dorsal bristles, the latter accompanied by 2 bristly hairs. Only the left wing remaining, hyaline, epaulet yellow-brown, costal spine broken, r_{4+5} with three setae. Thoracic squama white, broad. Only the right mid- and hind-legs remaining, both incomplete. Femora and tarsi black, tibia dark brown.

Abdomen red with white pollinose bands on the anterior half of tergites III-V, rubbed off in places. Tergites III and IV with black vittae on ventral surface.

Length 8 mm.

Collection – British Museum (N.H.), holotype from Muille, Kenya, 14. IX. 1911, leg. R.J. Storoly.

2. *Pterella liberiensis* Zumpt

Pterella liberiensis Zumpt, Explor. Parc natn. Albert Miss. C.F. de Witte 98, 1961, p. 95 fig. 39.

This species was described from 2 males from Liberia showing slightly different shapes of the paralobi. To my knowledge five more males have been collected at Luabo, former Belgian Congo, and at Chianga, Angola.

The hypopygium has been redrawn (fig. 1).

3. *Pterella vadoni* (Séguy)

Setulia vadoni Séguy, Bull. Mus. natn. Hist. nat. (2), 34, 1962, p. 344 fig. 1.
Pterella vadoni, Zumpt, Verh. naturf. Ges. Basel 75, 1964, p. 52 fig. 2.

Widespread over Madagascar.

No further specimens have been recorded since Zumpt's publication.

4. *Pterella stuckenbergi* Zumpt & Stimie

Pterella stuckenbergi Zumpt & Stimie, Ann. Natal Mus. 18, 1965, p. 16 fig. 9.

Based on 3♂♂ and 1♀ from the Maseru district, Lesotho.

No further specimens have been recorded.

5. *Pterella triseriata* Curran

Pterella triseriata Curran, Amer. Mus. Novit. 836, 1936, p. 4; Zumpt, Explor. Parc natn. Albert Miss. G.F. de Witte 98, 1961, p. 97; Zumpt & Stimie, Ann. Natal Mus. 18, 1965, p. 15 fig. 8.

Setulia triseriata, Zumpt, Proc. R. ent. Soc. Lond., (B) 21, 1952, p. 9.

This species has been based on a single female from Bloemfontein, Orange Free State. Zumpt & Stimie described the male sex from Maseru, Lesotho. Since then, further specimens have been seen from Jamestown and the Sandflats, Cape Province; the Drakenberg Mts., Natal; and the Waterberg Reserve and Grootfontein, South West Africa.

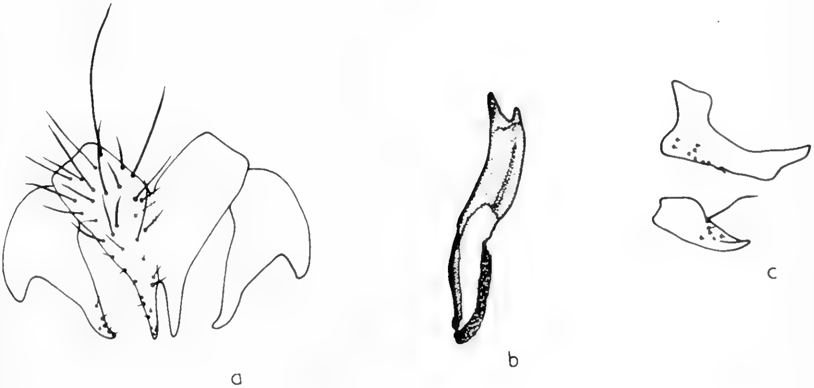

Fig. 1. *Pterella liberiensis* Zumpt a) cerci and paralobi, b) phallosome laterally, c) parameres. Male from Luabo, former Belgian Congo.

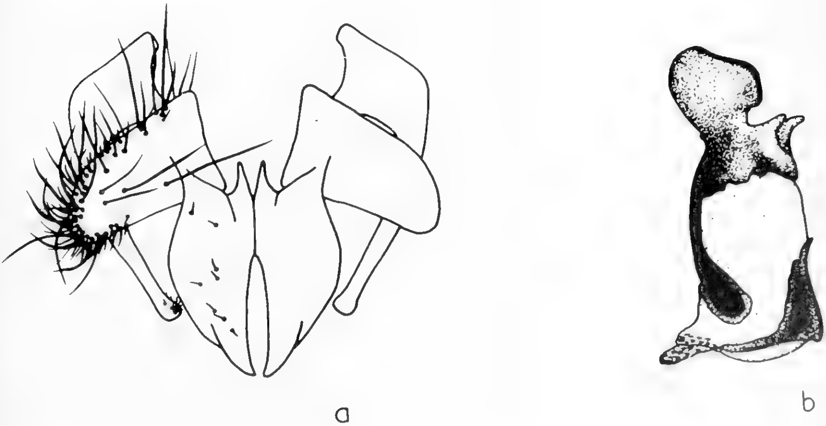

Fig. 2. *Pterella africana* Curran a) cerci with paralobi, b) phallosome laterally. Allotype from Johannesburg, Transvaal.

6. *Pterella africana* Curran

Pterella africana Curran, Amer. Mus. Novit. 836, 1936, p. 4; Zumpt. Explor. Parc natn. Albert Miss. G.F. de Witte 98, 1961, p. 98 fig. 40.

Setulia africana, Zumpt, Proc. R. ent. Soc. Lond. (B) 21, 1952, p. 9.

Zumpt (1961) in his revision of the *Pterella* species had listed one male (allotype) and two females, including the holotype, from the Transvaal. Further 4♀♀ were recorded from the Cape Province and from Rhodesia. Since then, more male and female specimens have been seen from Grahamstown, Cape Province; Warmbad, Transvaal; Rocadas, Angola; Ankole, Uganda; and Usakos and Gobabis, South West Africa.

7. *Pterella kenyae* Nesbitt

Pterella kenyae Nesbitt, Pan. – Pacif. Entomologist 51, 1975, p. 131 fig. 2.

This species was only recently described and based on 4♂♂ from Diani Beach, Kenya, and 3♂♂ from the Kilifi district, Kenya. Further males have now been received from Archer's Post, Kenya; Singida, Tanzania; and Ile-Ife, Nigeria.

8. *Pterella santosdiasi* Zumpt

Pterella santosdiasi Zumpt, Explor. Parc natn. Albert Miss. G.F. de Witte 98, 1961, p. 101 fig. 41.

Described from the island of Inhaca, Mozambique, further male specimens have been received from the Nduma Nature Reserve, Natal: Tsumeb, South West Africa; and Archer's Post as well as Diani Beach, Kenya. The hypopygium has been drawn (fig. 3).

9. *Pterella lucida* n.sp.

Amongst the material sent to me by Mr. A.C. Pont, there are 15 males belonging to this new species collected by the British Museum Expedition 1972, in Angola and South West Africa. There is another male from Tanzania in the collection of the California Academy of Sciences. They fall within the "*obscurior*-complex" and are only distinguishable by the terminalia. It is remarkable that so many specimens of a new species have been collected from different localities.

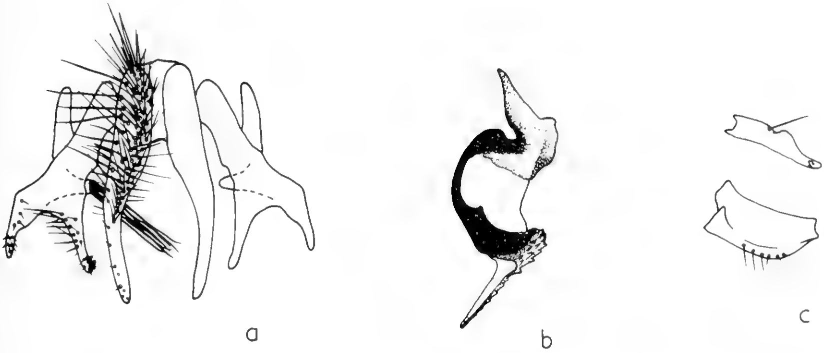

Fig. 3. *Pterella santosdiasi* Zumpt a) cerci with paralobi, b) phallosome laterally, c) parameres. Holotype from Inhaca Island, Mozambique.

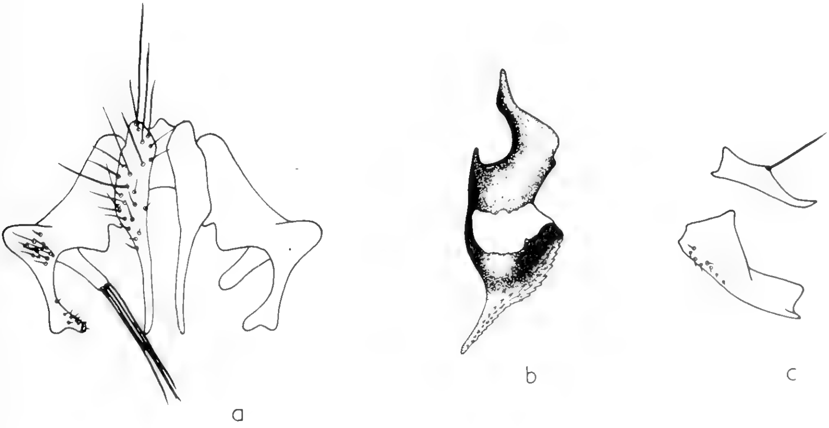

Fig. 4. *Pterella lucida* n. sp. a) cerci and paralobi, b) phallosome laterllay, c) parameres. Holotype from Rocadas, Angola.

Male – Eyes bare, facets small. Frons at the narrowest part measuring about 1/3 of eye-length. Frontal stripe orange, subparallel but widening at the vertex, in the middle about as wide as the neighbouring parafrontalium. Parafrontalia and – facialia orange, blackened posteriorly, white pollinosity and microscopic white setae. Chaetotaxy: *oc* with several bristly hairs, *iv, ev,* 2 proclinate *fo,* 12 *paf.* Antennal groove orange with dense white pollinosity, antennae orange, third segment 3 to 3-1/2 times as long as second. Arista brown, thickened in basal two-thirds. Anterior bucca orange as the parafacialia, posterior bucca black with white pollinosity and black setae. Palpi yellow, slender, proboscis black.

Thorax black with thin grey pruinosity leaving 3 or 5 narrow undusted stripes which are not distinct. Only 1 prescutal *ac* and 2 prescutal *dc* distinct from the long hairs, *ia* = 0+1, *prs,* 3 *h,* 2 *sa,* 2 *n* and *sc* = 3+1. Pleura black with white pruinosity and long black hairs. 1 *pst* and 2 or 3 *pp* both accompanied by well developed hairs, *st* = 1:2. Wings hyaline, epaulet black, basicosta yellow, veins yellow to brown, costal spine short vein r_{4+5} with a few dorsal setae. Thoracic squama broad, halter yellow. Legs black, fore-tibia with 1 dorsal and 1 posterior bristle and a short row of ventral bristles lying close to the leg, mid-tibia with 1 submedial *ad* and *av,* and 1 or 2 short *pd,* hind-tibia with a row of short *ad* terminating in a longer submedial *ad,* 3-6 *av.*

Abdomen black, only a very narrow transverse band of silver pollinosity on the anterior of tergites III-V. Phallosome typical of the "*obscurior*-complex", cerci narrow, paralobi with slightly indented terminal end and 4 long well developed hairs on a slender protuberance from the middle (fig. 4).

Length: 5-8 mm.

Female – There are a number of females from the typical localities before me. So far, however, it is not possible to assign them with certainty to this species.

Collection – British Museum (Natural History). Holotype and 3 paratypes from Rocadas, Angola, 19-22. II. 1972; 3 paratypes from Rio Longa 4 miles south of Lussusso, Angola, 8. III. 1972, and 1 paratype from Tsumeb, South West Africa, 17. II. 1972. All collected by the British Museum Southern African Expedition 1972.

Collection – California Academy of Sciences, San Francisco. 1 paratype from Singida, Tanzania, 26. I. 1970, leg. M.E. Irwin and E.S. Ross.

Collection – South African Institute for Medical Research, Johannesburg. 4 paratypes from Rocadas, Angola, 19-22. II. 1972 and 2 paratypes from Rio Longa 4 miles south of Lussusso, 8. III. 1972 all collected by the British Museum Expedition 1972.

10. *Pterella obscurior* (Villeneuve)

Setulia fasciata var. obscurior Villeneuve, Ann. S. Afr. Mus. 15, 1916, p. 509.

Theromyia obscurior, Rohdendorf, Bull Soc. ent. Egypte 18, 1934, p. 14; Rohdendorf, Lindner Fliegen pal. Reg. 64 h, 1935, p. 78.

Setulia obscurior, Zumpt, Proc. R. ent. Soc. Lond. (B) 21, 1952, p. 9 fig. 3.

Pterella obscurior, Zumpt, Explor. Parc natn. Albert Miss. G.F. de Witte 98, 1961, p. 101 fig. 42.

Zumpt (1961) redescribed the species. There are a number of specimens in the collections and the range of the species is Africa south of the Sahara. Fig. 5 is a redrawing of the hypopygium of the lectotype from Pretoria, South Africa.

11. *Pterella angustifrons* (Villeneuve)

Setulia fasciata var. angustifrons Villeneuve, Ann. S. Afr. Mus. 15, 1916, p. 509.
Setulia angustifrons, Zumpt, Proc. R. ent. Soc. Lond. (B) 21, 1952, p. 9.
Pterella angustifrons, Zumpt, Explor. Parc natn. Albert Miss. G.F. de Witte 98, 1961, p. 104 fig. 42.

Further specimens have been recorded from South Africa, Zaire, Nigeria and East Africa. The range overlaps with that of *P. obscurior.*

12. *Pterella eos* n.sp.

There are three males of this new species collected by Dr. F. Kaiser from Madagascar in the collection of the S.A.I.M.R. They fall within the range of variability shown in the "*obscurior*-complex", but they are easily identified on their hypopygial structure.

Male – Eyes bare, facets small, inner ones slightly larger. Frons at vertex measuring 1/3 (in holotype) to 2/5 of eye-length, narrowing slightly towards the lunula. Frontal stripe orange in holotype, and reddish-brown darkened in the middle in paratypes. At the tip of the ocellar triangle the frontal stripe is 2½ - 3 times as wide as the neighbouring parafrontalium. Parafronalia and – facialia yellow with dense white pollinosity depending on the incidence of light, sparsely scattered with fine white setae. Chaetotaxy: *oc* barely distinguishable from several bristly hairs, *iv, ev* and *f* well developed. Two pairs of stout *fo* accompanied by several smaller bristles, 13-14 *paf* irregularly arranged. Antennal groove yellow with dense white pollinosity, antennae orange, third segment 3 times as long as second. Arista dark brown, thickened in basal two-thirds. Vibrissae distinctly separated from peristomal bristles. Bucca black with white pruinosity and short black setae. Palpi slender, yellow, proboscis black.

Thorax black, reddish-grey pruinosity leaving narrow longitudinal undusted stripes visible under certain incidences of light. Chaetotaxy reduced, only prescutal *ac,* 2 prescutal *dc* and 1 *ia* visible amongst the long hairs. *Prs,* 3 *h,* 2 *n,* 3 *sa* well developed, *sc* = 3+1, 1 *pst* and 3 *pp.* Meso- and sternopleura densely beset with long hairs and bristles, *st* = 1:2. Wings hyaline, epaulet black, veins brown, costal spine short, base of r_{4+5} with a few short setae on the dorsal surface. Thoracis squama pale yellow, broad, halter yellow. Legs black, femora with thin grey pruinosity. Fore-tibia with 1 dorsal bristle distally, 1 *pd* and 4 ventral bristles, mid-tibia with a well developed *ad* and *av* each accompanied by smaller bristles, 1 medial *pd* and 2 short *pv,* hind-tibia with a row of *ad,* a row of *pd,* 2 thick and 3 or 4 thinner *av.*

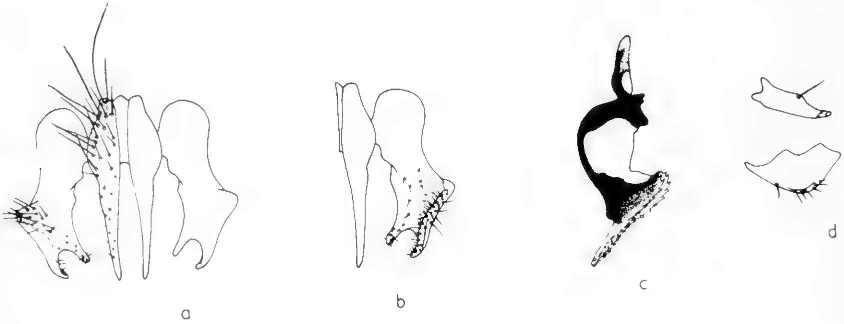

Fig. 5. *Pterella obscurior* (Villeneuve) a) cerci and paralobi, dorsal view, b) cercus and paralobus, ventral view, c) phallosome laterally, d) parameres. Lectotype from Pretoria, Transvaal.

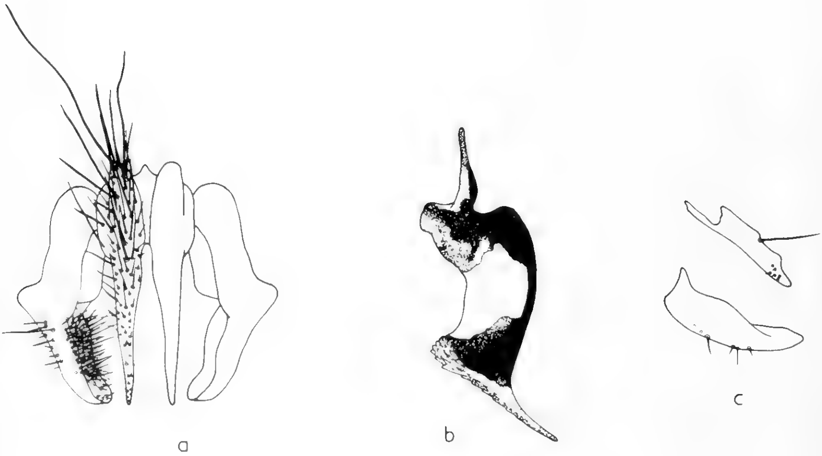

Fig. 6. *Pterella eos* n. sp. a) cerci with paralobi, b) phallosome laterally, c) parameres. Paratype from Perinet, Madagascar.

Abdomen longer than broad, reddish-brown, tergites I+II darkened, indistinct narrow dark brown vittae on tergites III and IV. Dense pale yellow pollinosity forming uneven transverse bands on the anterior margins of tergites III-V. Cerci slender, paralobi rounded terminally and densely covered with setae; phallosome typical of the "*obscurior*-complex" (fig. 6).

Length: 8 mm.

Female – unknown

Collection – South African Institute for Medical Research, Johannesburg. Holotype from Ankarafantsika, Majunga Province, Madagascar, 18. VI. 1958, and 2 paratypes from Périnet, Tamatave Province, Madagascar, 2. X. 1958 and 5. X. 1958, all collected by F. Kaiser.

13. *Pterella pan* Zumpt

Pterella pan Zumpt, Verh. naturf. Ges. Basel 75, 1964, p. 53 fig. 3.

Described from Madagascar, where this species has a wide distribution. No further species have been reported since Zumpt's description.

ACKNOWLEDGEMENTS

I wish to thank Dr. P.H. Arnaud, Jr., California Academy of Sciences and Mr. A.C. Pont, British Museum (Natural History) for entrusting me with the study of Miltogramminae from their collections, and for presenting specimens to the South African Institute for Medical Research, Professor F. Zumpt, Head of the Department of Entomology, for assisting me in the preparation of this paper, and Prof. J.F. Murray, Director of the South African Institute for Medical Research, for providing the necessary research facilities.

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ARISTAPEDIA IN A HYMENOPTERAN PARASITOID[1]

G.P. Waldbauer, P.W. Price, J.G. Sternburg[2]

ABSTRACT: Aristapedia in a wild female *Enicospilus americanus* (Christ) (Hymenoptera: Ichneumonidae) is described, and figured. The head is generally deformed. The terminal three segments of the flagellum of the left antenna are apparently identical to a normal pretarsus and two tarsomeres.

DESCRIPTORS: aristapedia, homoeosis, antenna, Ichneumonidae, *Enicospilus americanus* (Christ)

The interpretation of aristapedia and other forms of homoeosis (Villee 1942) is still being debated (Wigglesworth 1972). Nevertheless, these phenomena raise significant questions about the evolution of insects and the control of development. Homoeotic laboratory strains and experimentally induced homoeosis have been reported several times, but its occurrence in nature—as in this instance—has apparently been seldom noted. (Hadorn 1966, Villee 1943, Wigglesworth 1972).

In the winter of 1972-73 we collected in Champaign, Illinois, a cocoon of *Hyalophora cecropia* (L.) (Lepidoptera: Saturniidae) which, unknown to us, contained a cocoon of the parasitoid *Enicospilus americanus* (Christ) (Hymenoptera: Ichneumonidae). It was held unopened in an outdoor insectary until March 25, 1973, when it was transferred to an incubator at 25°C, with a 17L-7D photo-period. The abnormal female ichneumonid described below emerged on May 18, 1973.

The illustration shows dorsal (Fig. 1) and frontal (Fig. 2) views of the abnormal head and corresponding views (Figs. 3 and 4) of the head of a normal female. The abnormal head capsule is generally deformed; the compound eyes are small and misshapen; and the ocelli are widely spaced and on separate conical projections rather than on a common base. The mouthparts appear to be normal. The antennal sockets are slightly asymmetrical, with the left misplaced dorsolaterally.

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[1] Accepted for publication: January 17, 1976

[2] Department of Entomology, University of Illinois, Urbana, 61801

ENT. NEWS, 87: 3 & 4: 98 - 100, March & April 1976

Figs. 1-4: Heads of aristapedic (1 and 2) and normal (3 and 4) *Enicospilus amercanus;* dorsal views (1 and 3) and frontal views (2 and 4). The aristapedic antenna (1A and 2A), a normal tarsus and pretarus (1B and 2B), and enlarged views of the aristapedic (2C) and normal (2D) pretarsi are compared.

The left antenna exhibits a remarkably perfect aristapedia. The antennal socket, antennal sclerite, and the scape are slightly deformed; the pedicel appears normal. The flagellum is short, with only ten apparent subsegments. The proximal seven resemble normal flagellar subsegments, but the eighth and ninth appear almost identical to the two distal tarsomeres of a normal leg, and are articulated like tarsomeres rather than like flagellar subsegments (Fig. 1, A and B; Fig. 2, A and B). The tenth is apparently identical to a normal pretarsus (Fig. 2, C and D). It has an apparently normal arolium and the claws seem normal in position, size, shape, and pectination. The claws articulate with an unguitractor plate whose base extends into the preceding subsegments in the form of a tendon resembling the pretarsal retractor tendon of a normal leg.

The right antenna is of approximately normal length. The basal third of the flagellum is indistinctly segmented and somewhat deformed, but the distal two-thirds and the scape and pedicel appear normal. The flagellum is grossly deformed about a third of its length from the base, where there is an indication of two additional shafts—one with one subsegment and the other with two (Figs. 1 and 2).

The abnormal specimen described here and the normal one used for comparison have been deposited in the collection of the Illinois Natural History Survey, Urbana.

ACKNOWLEDGEMENTS

We are grateful for financial support from U.S. Public Health Service training grant PH GM 1076, and thank Mrs. Alice Prickett for making the drawings.

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SEXUAL BEHAVIOR IN *HYPOSOTER FUGITIVUS* (HYMENOPTERA: ICHNEUMONIDAE)[1]

Edward M. Barrows[2]

ABSTRACT: Sexual behavior in males of *Hyposoter fugitivus* is similar to that of other ichneumonid wasps. Sexually aroused males vibrate wings and antennae while pursuing females and antennate females when near them. During copulation lasting about 17 min, a male lay to the right of the female in a position unusual for Hymenoptera *in copula.*

DESCRIPTORS: Ichneumonidae, *Hyposoter fugitivus, Quercus coccinea, Anisota senatoria,* sexual behavior.

Knowledge of mating behavior in Ichneumonidae, a family of parasitic wasps which may contain as many as 60,000 species (Townes, 1969), is extremely limited. Gordh and DeBach (in press), who surveyed the literature on this subject, found reference to mating behavior in only eight species and Gordh and Hendrickson (in press) noted mating in *Bathyplectes.* Details of a mating of *Hyposoter fugitivus* (Say) are reported here.

H. fugitivus parasitized 30% of 148 small larvae of *Anisota senatoria* (J.E. Smith) (Lepidoptera: Saturniidae) found feeding on the same branch of an oak tree, *Quercus coccinea* Muenchh. 1.3 m above the ground in Reston, Fairfax County, Virginia on August 26. Parasitized *Anisota* larvae were recognized by their immobility and abnormal body form.

Twenty-eight parasitized larvae were individually placed in 9 cm^3 glass vials plugged with cheesecloth. Vials were maintained near a north-facing window in indirect sunlight at room temperature, 21 to 27°C. One wasp emerged from each moth larva.

Interactions between males and females of four pairs of 3- to 4-day-old virgin, adult wasps were observed. One pair was placed in a 9 cm^3, clear glass vial with a cheesecloth plug and the other pairs were placed in 80 cm^3 petri dishes in late morning under indirect sunlight at 24°C. I continuously observed the wasps for 90 min.

Initially males approached females, briefly antennated females' antennae, and then quickly moved away from females; males

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[1] Accepted for publication: December 23, 1975

[2] Department of Biology, Georgetown University, 37th & O Streets, Washington, D.C. 20057

moved their antennae alternately. Males began rapid antennal quivering, persistently approaching females (which seemed to ignore males), and vigorous wing fluttering in 14 min. The pair in a vial commenced copulation within 15 min from the beginning of the observational period and copulation lasted for 16 min and 57 sec. No courtship was seen after the male mounted the female. The male lay to the right of the female in a position unusual for copulating Hymenoptera. The fore- and middle legs of the female were on the substrate. Her left hind tarsi touched the dorsum of the male's thorax and her right hind tarsi touched the male's metasoma. The male's left leg touched the female's metasoma and his other legs were on the substrate. The male did not move. Near the end of copulation the female moved her head slightly from side to side 45 times in 1 min. At the end of copulation the male quickly detached from the female and moved away from her for a few seconds. Then both sexes crawled in the vial touching one another intermittantly. During the 30 min after copulation, the male approached the female several times and fluttered his wings, but no second copulation occurred. Finally the male was placed in a vial with a novel, virgin female for 20 min. He occasionally approached her and rapidly fluttered his wings but did not mate.

After 60 min the pairs of wasps which were in petri dishes and did not copulate were transferred to separate vials and observed for 30 additional minutes. Males frequently antennated females and occasionally approached them while fluttering wings; however, no copulation ensued. Sexually aroused males of *H. fugitivus* behave similarly to other ichneumonids in that they vibrate their wings and antennate females.

ACKNOWLEDGEMENTS

G. Gordh made important suggestions regarding this note; R.W. Carlson and D.M. Weismann (Syst. Entomol. Lab., Agr. Res. Serv., USDA) identified *Hyposoter fugitivus* and *Anisota senatoria,* respectively.

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IMMATURE STAGES AND BIOLOGY OF *ORIUS TANTILLUS* (MOTSCHULSKY), (HEMIPTERA: ANTHOCORIDAE), INHABITING RICE FIELDS IN WEST MALAYSIA[1]

Gary V. Manley[2]

ABSTRACT: Results of a study of the predatory anthocorid bug, *Orius tantillus* (Motschulsky), collected from the rice fields in West Malaysia are presented. The egg and five nymphal instars are described and illustrated.

Egg development in the laboratory took approximately 3.0 days. The average time spent in each of the five nymphal stages was 2.8, 2.1, 1.4, 2.2, and 3.8 respectively.

DESCRIPTORS: Hemiptera, Anthocoridae, *Orius,* Malaysia, rice predator, predator, rice, immature, biology

During studies of entomophagous arthropods of rice fields in West Malaysia *Orius tantillus* was found to prey upon a variety of rice field insects. Ghauri (1972) found *O. tantillus* to be widely distributed having observed specimens from Ceylon, India, Queensland, and the Solomon Islands as well as other Pacific islands. During this study the species was collected throughout West Malaysia. Life history, behavior and ecology was investigated with the hope that such information would help in an evaluation of its potential as a biological control agent of rice pests. Studies were conducted from 1971 to 1973 at the Malaysian Agricultural Research and Development Institute, Rice Research Station at Bumbong Lima, West Malaysia.

Materials and Methods

Field collected adults were brought into the laboratory for studies of life history and biology. Specimens were reared at room temperature and humidity in glass cylinders approximately 50 mm long and 7 mm in diameter. Both ends of the tubes were plugged with cotton. The cotton on one end of the tube was wet with tap water twice daily. To obtain nymphs of a known instar they were examined daily to check molting.

Adults and nymphs were fed daily on first and second instar nymphs of *Nephotettix virescens* (Homoptera: Cicadellidae). Four

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[1] Accepted for publication: January 19, 1976

[2] U.S. Peace Corps Volunteer, Malaysian Agricultural Research and Development Institute. Permanent address: 7907 Rustic Forest, San Antonio, Texas, 78239, U.S.A.

ENT. NEWS, 87: 3 & 4: 103 - 109, March & April 1976

to six leafhopper nymphs were placed in each container every morning.

Descriptions were based on living and freshly killed, as well as field collected and laboratory reared materials. Specimens were killed in 70% ethanol and mounted on microscope slides in glycerol. Averages and ranges given in the descriptions were based on 4 - 6 measurements. Length was measured from the tip of the tylus to the tip of the abdomen. The widest measurement represents the widest point which is approximately at the middle of the abdomen for instars 1 through 3 and across the mesothoracic wing pads for instars 4 and 5. The width of the head was measured between the outer ocular margins of the compound eye.

Biology

Orius tantillus appears to be widely distributed throughout West Malaysia, having been collected in various localities in Kedah, Province Wellesley, and Selangor. Under many field conditions the species appears to be present in low numbers but on occasion becomes very abundant. The low density of specimens observed in many rice field samples is perhaps due to its small size and its apparent preference for main stem portions of the rice plant, thereby making it difficult to collect with a sweep net. Specimens appear to be most readily collected on warm sunny days after the vegetation has dried. On one occasion 20 minutes collecting at 9:30 a.m. yielded only 2 specimens, but by 11:15 a.m., when the vegetation had dried, 30 specimens were collected in the same place in 10 minutes with a sweep net.

Under suitable conditions the species becomes very common and may represent one of the most abundant predators in a sample of rice field insects. In Selangor during 1971 *O. tantillus* were estimated to be present on the batas of a rice field at a density of approximately 16 adults per square meter. Highest densities were frequently observed in nurseries. In rice fields highest densities have been encountered during the early part of the growing season.

In the laboratory eggs were laid singly in rearing containers, usually with the posterior portion inserted in the cotton at one end of the container and the operculum about level with the surface of the cotton. On occasion the eggs were laid on their sides or placed between the cotton and glass of the rearing container. In all observed cases the eggs laid on a given day were placed at the same end of the container, usually near each other but never touching.

Number of eggs laid per day ranged from 1 to 7 with an average of 1.56 eggs per day (Table I). The average was figured from 10 females over 104 laying days. The lowest number of eggs laid per day for an individual female was 0.6 over a period of 27 days; the highest was 2.5 eggs per day over a period of 13 days. Frequency of egg laying did not appear to follow any particular pattern. Some females laid 1 or 2 eggs every day for several days very regularly and then might miss a day or more or might lay 4 or 5 eggs in 1 day. Other specimens would lay more irregularly but tended to lay larger numbers of eggs on laying days. The longest recorded lapse in egg laying was 10 days and the longest continued laying period was 12 days. Field collected females laid eggs for a varying number of days before dying; the maximum being 27 days.

Eggs hatched in 3 days and no eggs were observed not to hatch. Nymphal development averaged 12.3 days. The entire development period averaged 15.3 days (Table II).

All stages are non-specific predators. In the laboratory specimens were observed to feed on various species of leafhoppers, lepidoptera eggs, thrips, aphids and early instar lepidoptera larvae including first instar stem borer larvae *(Tryporysa incertulas).* Observations indicated that thrips may be the preferred food of this species and make up a significant part of the natural diet.

Orius tantillus nymphs and adults approached potential prey with beak extended. Once contact was made the prey was killed rapidly, suggesting that a poison may be involved in the capture of prey. Leafhopper nymphs 2 to 3 times the size of the anthocorid put up very little fight after being bitten.

Nymphs and adults showed no particular shyness in attacking prey larger than themselves, particularly when they were starved.

In glass rearing containers adults would eat 2-5 leafhoppers of second instar *Nephotettix* per feeding, which usually lasted from 1 to 2 hours. The feeding time per leafhopper varied greatly, but 10

Table I. Egg Laying Histories

Female number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average**
Number of laying days	4	22	18	5	4	2	5	10	4	27	
Number of eggs laid	6	15	27	8	5	4	12	15	10	17	11.9
Average number of eggs laid per day	1.5	0.7	1.5	1.6	1.3	2.0	2.4	1.5	2.5	0.6	1.5
Range of eggs laid per day	1-3	1-3	1-4	1-3	1-2	2-0	1-5	1-7	1-6	1-5	

Table II. Development of Immature Stages of *Orius tantillus* in Days

Stage	**Number of individuals**	**Range**	**Mean**	**Cumulative mean age**
Egg	35	3.0	3.0	3.0
Nymphal				
First	16	2-3	2.8	5.8
Second	16	1-3	2.1	7.9
Third	15	1-2	1.4	9.3
Fourth	14	2-3	2.2	11.5
Fifth	14	3-4	3.8	15.3

to 20 minutes was normal. During that time the arthocorid often removed the beak and inserted it in a new place.

Interestingly it was observed that the absence or presence of leafhoppers in the area of the feeding bug appeared to determine the length of time the prey was fed upon as well as the number of leafhoppers killed in a given length of time. The larger the number of leafhoppers in the container the larger the number killed even though the total feeding time may have been about the same. This took place because *O. tantillus* appeared to be attracted by movement of prey near it. Not uncommonly *O. tantillus* would kill a leafhopper, feed on it for a short time, and then if another leafhopper moved nearby, the anthocorid would leave the insect it was feeding on and attack the living prey. This feeding behavior might be repeated several times, thereby obtaining a greater mortality of prey than necessary to support the predator. It appeared to be necessary for the leafhoppers to move to the predator since the anthocorid usually did not go searching for prey until it had finished feeding.

The habit of leaving a dead prey to attack another living prey may be considered a beneficial predator characteristic since it causes a higher mortality of the prey population. The role played by this factor on prey morality would depend on the mobility and density of the prey species. This type of behavior pattern may cause higher mortality in clumped populations than in evenly dispersed ones.

In cages the behavior usually resulted in several dead leafhoppers in the immediate area of the predator. The anthocorid would often move from one dead leafhopper to another during its feeding. In the field, however, this would not happen. Once the prey had been released it would fall to the ground and the predator would not be able to return. The predator would therefore be required to obtain a new prey.

Description

Egg (Fig. A)

Length 0.438 mm, width 0.186 mm, width at anterior end 0.106 mm.

Form ellipsoidal. Anterior end capped by a circular operculum surrounded by an expanded rim of chorion 0.106 mm in diameter. The basal one-half of the chorion marked by a pattern of rectangles. The anterior portion of the chorion smooth. The operculum appears to be flat without any medial projection. When laid the egg is entirely white in color. The day following the eye spots appear red and entire egg becomes straw colored. On proceeding days the eye spots become deeper red and the egg a darker straw color until hatching takes place.

First Instar (Fig. B)

Length 0.50 – 0.57 mm ($\bar{x}$ = 0.55 mm), width 0.15 – 0.20 mm ($\bar{x}$ = 0.17 mm), width of head 0.14 – 0.15 mm ($\bar{x}$ = 0.15 mm), humeral width 0.15 – 0.16 mm ($\bar{x}$ = 0.15).

Form elongate, convex above and below. The body is uniformly straw colored slightly suffused with pale orange-red. The head is triangular, widest at eyes and concolorous with rest of body above and below. Eyes are deep brick red. Dorsal surface sparsely covered with short setae being most numerous on the tylus. Antenna 0.26 mm long, 4 segmented, ratio of length of segments approximately 1 : 2 : 2 : 4; pale smoky-gray in color, all segments concolorous, whitish annuli at joints; segment 4 diameter 2 times that of the 3 interior segments. Segment 1 glabrous, other segments about equally clothed with setae. Labrum 0.21 mm long, 3 segmented, ratio of length of segments approximately 1 : 3 : 3, concolorous with head except segment 3 which is smoky-gray in color, concolorous with antenna. All segments with a few scattered setae.

Thorax concolorous with head above and below. Thoracic nota are all transverse and wing pads are lacking. Femur and coxa concolorous with thorax. Tibia and tarsus pale smoky-gray with numerous setae. Spines at distal of tibia. Protibia with largest concentration of spines. All coxa widely and about equally separated, tarsi are 2-segmented, the first segment much shorter than the second.

The abdomen concolorous with thorax. Abdominal tergites 3, 4 and 5 with a median orangish-red spot. Tergites 8 and 9 each with 2 long setae, one on either side of middle near the lateral margins. Abdomen with 4 pairs of dorsal scent glands opening as follows: a pair between the third and fourth, fourth and fifth, and fifth and sixth segments with the openings of each pair jointed by a groove; a separated pair located between the sixth and seventh segments.

Second Instar (Fig. C)

Length 0.75 – 0.77 mm ($\bar{x}$ = 0.76 mm), width 0.24 – 0.30 mm ($\bar{x}$ = 0.27 mm), width of head 0.17 mm, humeral width 0.22 – 0.25 mm ($\bar{x}$ = 0.23 mm).

With the exception of size this instar appears to be essentially the same as the first instar. Antenna is 0.30 mm long, ratio of length of segments are approximately 1 : 2 : 2 : 4. Labrum 0.23 mm long, ratio of length of segments approximately 1 : 3 : 3.

Third Instar (Fig. D)

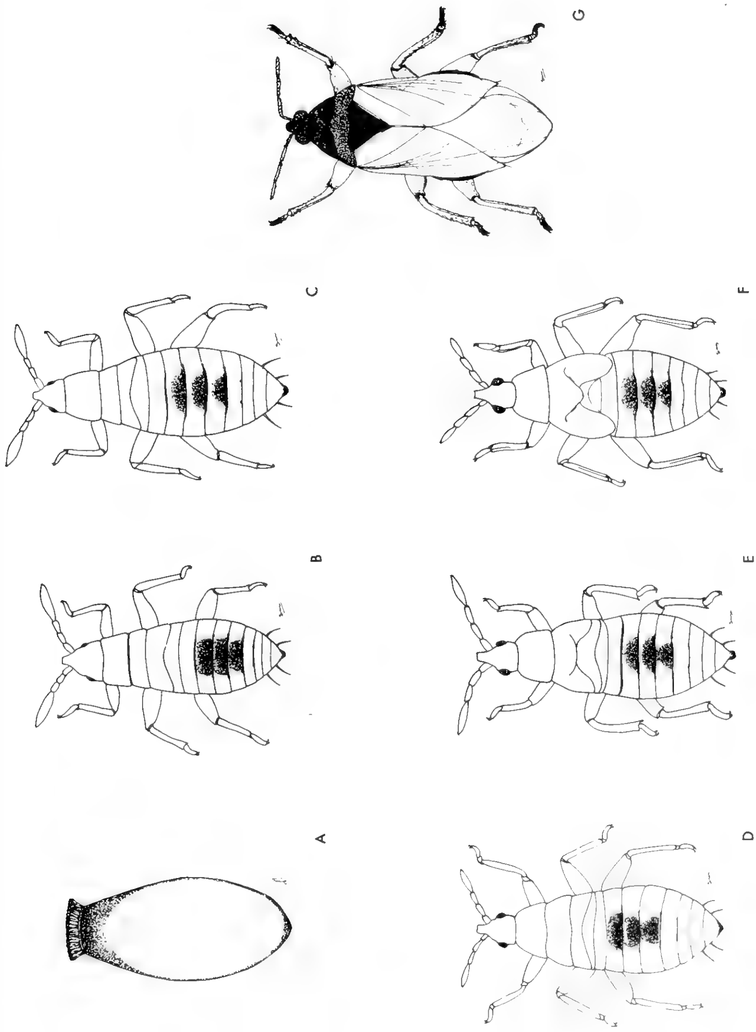
Length 0.87 – 1.0 mm ($\bar{x}$ = 0.96 mm), width 0.37 – 0.40 mm ($\bar{x}$ = 0.38 mm), width of head 0.23 mm, humeral width 0.27 mm.

Form and coloration of the body differs little from the first and second instars.

Meso and meta-thoracic wing pads are slightly visible, extending only slightly beyond median posterior margin. Meta-thoracic wing pads slightly more developed than meso-thoracic wing pads.

Antenna is 0.36 mm long, ratio of length of segments are approximately 2 : 3 : 3 : 4. Antenna different from earlier instars by having all segments of about equal diameter.

Labrum 0.25 mm long, ratio of length of segments approximately 1 : 4 : 3. Third segment more blackish in color.



Figs. A – G. *Orius tantillus*. A, lateral view of egg; B, first instar; C, second instar; D, third instar; E, fourth instar; F, fifth instar; G, adult.

Fourth Instar (Fig. E)

Length 1.15 – 1.40 mm ($\bar{x}$ = 1.22 mm), width 0.45 – 0.52 mm ($\bar{x}$ = 0.50 mm), width of head 0.26 – 0.27 mm ($\bar{x}$ = 0.26 mm), humeral width 0.35 – 0.37 mm ($\bar{x}$ = 0.37 mm).

Form essentially unchanged from earlier instars. Head, thorax and abdomen concolorous with third instar. Antenna smoky-gray, all segments same color and of about equal diameter; segments 2, 3, and 4 about equally clothed with hairs, segment 1 with only a few hairs. Antenna length 0.45 mm, ratio of length of segments approximately 2 : 4 : 3 : 5. Labrum concolorous with head, except last segment is tinged with black, distal half darkest, length is 0.30 mm, ratio of length of segments is approximately 2 : 4 : 3.

Legs slightly paler than thorax. Meso-coxa slightly wider separated than pro and meta-coxa. Meso-thoracic wind pads are strongly evident, reaching well beyond median posterior margin of the meso-notun. Meta-thoracic wing pads reaching to posterior margins of first abdominal segment.

Fifth Instar (Fig. F)

Length 1.55 – 1.62 mm ($\bar{x}$ = 1.59 mm), width 0.50 – 0.55 mm ($\bar{x}$ = 0.53 mm), width of head 0.30 mm, humeral width 0.42 – 0.43 mm ($\bar{x}$ = 0.43 mm).

Form essentially the same as other instars but color tends towards a deeper yellow-orange. Body widest at wing pads. Head with two reddish crescent shaped spots near eyes indicating the position of developing ocelli. Labrum smoky-gray in color, concolorous with antenna. Setae nearly lacking in segments two and three, segment one clothed with scattered setae. Antenna length 0.52 mm, ratio of length of segments approximately 3 : 4 : 4 : 5. Length of labrum 0.39 mm, ratio of length of segments approximately 2 : 6 : 4.

Thorax concolorous with head except wing pads are tinged with black, black color most concentrated near lateral margins. Legs slightly paler in color than thorax, tarsus tinged with black. Pro-coxa and meta-coxa separated by less than one diameter, meso-coxa separated by more than one diameter.

Meso-thoracic and meta-thoracic wing pads of about equal length, extending to anterior margin of third abdominal segment. Lateral margins of pronotum, wing pads, and abdomen with stout setae.

ACKNOWLEDGEMENT

The author wishes to express thanks to Shamsulmajidi bin Abdul Majid for the drawings and to M.S.K. Ghauri (Commonwealth Institute of Entomology) for identifying *O. tantillus.*

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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

INSECT ECOLOGY Peter W. Price. 1975. Wiley-Interscience. 514 pp.

The need for a readable, comprehensive, single-volume introductory text on insect ecology has been clear for a long time. That is what Peter Price has produced, but it is not without its problems. The recent history of general ecology texts demonstrates that a variety of approaches can work, but none is likely to please everybody in a field as amorphous as ecology. Cornell University has long led the field in emphasizing the role of co-evolution in insect ecology, so it is no surprise that Price, who got his Ph.D. far above Cayuga's waters in 1970, has written his text from an evolutionist's slant. This is especially evident in the titles of the first group of chapters: "Trophic structure of community", "Coevolution of plants and herbivores", "Coevolution of prey and predator", etc. It is also evident in the extensive coverage Price gives to the ideas of the MacArthur-Levins-Wilson school, whose models proceed from an evolutionary perspective. (The author has, to his credit, left out the whole "fitness set" muddle.) Price is a Canadian, and the Canadian school of modeling, identified with such names as K.E.F. Watt, Hardwick, Morris, and Pielou also receives considerable attention. Price is to be commented for giving broad and balanced coverage to divergent, and often conflicting, approaches to ecological problems; if the result leaves one unsatisfied with the intellectual state of ecological theory it is the discipline's fault, not Price's. The only way to be smug in ecology today is to wear blinders that focus one's attention narrowly on one approach.

In his Preface Price explains why he has deemphasized methodology as well as the whole field of biological control, referring the reader to recent large-scale treatments of these areas. Except for them, though, Price says he has "aimed at a comprehensive treatment of the subject". Nonetheless, the book really ought to be called "Animal Synecology With Special Reference to Insects". Many of the "classic" papers in contemporary ecology deal with organisms very different from insects, and Price is obliged to review them in some detail, *faute de mieux.* Despite the fact that most species of organisms are insects, only about half of the entries in the taxonomic index are entomological. This, however, is perhaps to the good, since it represents a major departure from the parochialism of traditional, agricultural insect ecology. I am troubled by the virtual omission of a large and significant aspect of insect ecology – physiological autecology/ environmental physiology. The terms "photoperiod", "photoperiodism", and "diapause" do not appear in the subject index: There is not one reference to S.D. Beck, E. Bünning, A.S. Danilevskii, A.D. Lees, H.J. Muller, or W.B. Watt. (Price dresses down physiologists for giving inadequate attention to the ultimate, i.e., evolutionary factors in adaptation, but couples that with a *bird* example to illustrate the concept of proximate and ultimate factors!) Although M.S. Mani is referenced (as a tangent from island biogeography theory), there is no mention of Downes' excellent papers on Arctic insects. The bias against physiology persists into discussions of behavior. The Harvard sociobiological school is emphasized, but coverage of the ecological significance of behavior in non-social insects is weak; thermoregulatory behavior – even Hamilton's classic studies of desert Tenebrionids – is neglected; but the Cornellian subject of defensive chemistry is presented well.

Needless to say seasonal polyphenism, complex life cycles, and even locust phases are not treated at all. Nor is subsociality in earwigs, wood roaches, and the beetle *Popilius;* one can go on enumerating pet topics which are given short shrift, and in this field each reader's list will be different. I am dissatisfied with the treatment of insect territoriality and associated phenomena; there is a two-page table of references, which hardly skims the surface and is often inadequate – despite the huge literature of butterfly territoriality, three of the four examples are from one paper (which is not a review) and the fourth is from a field guide! Epigamic behavior, including topographic rendezvous sites, is dealt with in the same desultory fashion.

Aside from the normal contemporary ration of typographical errors (which is too high), the book shows occasional, annoying lapses. On page 273 sexual dimorphism is illustrated by the Brentid beetle *Arrhenodes minutus,* in which the males have large mandibles but the females do not. The text complains about lack of data on sexual differences in insects; the caption says the adaptive significance of the dimorphism is not understood. Long before Price was born, none other than L.O. Howard described in precise detail how the male of *A.* (then *Eupsalis) minutus* stands guard over the female as she uses her beak to bore oviposition holes in a tree trunk, helps her to free herself after each operation, and uses his mandibles to pick up intruding males and throw them off the tree.

Most of the illustrations are clear, but there is a horrible exception: on pp. 415-416 two National Geographic maps have been reproduced in half-tone to illustrate sea-floor spreading, and by some demon's intervention their features appear to match so that without careful examination the mid-Atlantic seems to flow into the mid-Indian Ocean. The usefulness of these particular cuts is questionable even if they were set off from each other unambiguously.

Insect Ecology is extraordinarily up-to-date. There are many references to 1974 and 1975 publications. Both the author and the publisher are to be congratulated on this; one can only hope it signals a new trend in these days of instantaneous obsolescence.

If one must be a masochist to write a review paper in ecology today, what must one be to write a 1031-reference, 500-page textbook? It seems to me that the state of affairs in ecology today is nearing the chaos which precipitates one of T.S. Kuhn's scientific revolutions. As a Cornell product myself I share Price's conviction that ecology and evolution are inseparable, and I do not know which will provide the revolutionary impulse. However, I have a feeling that both ecologists and evolutionists neglect physiology at their own peril. I expect *Insect Ecology* to be widely adopted (and rightly so – in many ways it is superior to most of the general ecology texts around), so I will just warn my students that they had better pick up Q_{10}'s somewhere, too.

Arthur M. Shapiro, Dep't. of Zoology,
University of California, Davis, CA.

TABULAR KEYS & BIOLOGICAL NOTES TO COMMON PARASITOIDS OF SYNANTHROPIC DIPTERA BREEDING IN ACCUMULATED ANIMAL WASTES[1]

E.F. Legner, I. Moore[2], G.S. Olton[3]

ABSTRACT: A tabular key and short discussion of salient biological characteristics are given for 9 genera and 14 species of parasitic insects commonly found attacking larvae and pupae of synanthropic Diptera in accumulations of animal wastes. Species included are, *Aleochara* sp., *Trichopria* sp., *Tachinaephagus zealandicus* Ashmead, *Phygadeuon* sp., *Stilpnus* spp., *Muscidifurax raptor* Girault & Sanders, *M. raptorellus* Kogan & Legner, *M.* sp., nr. *raptorellus, M. raptoroides* K. & L., *M. uniraptor* K. & L., *M. zaraptor* K. & L., *Pachycrepoideus vindemiae* Rondani, *Spalangia cameroni* Perkins, *S. endius* Walker, *S. longepetiolata* Bouček, *S. nigra* Latreille, *S. nigripes* Curtis, *S. nigroaenea* Curtis, and *Sphegigaster* sp. Electron photomicrographs clarify the shape of certain diagnostic characters. References to other less common parasitoids, *Alysia manducator* (Panzer), *Figites* sp., are made; and pertinent literature references are given.

DESCRIPTORS: Medical Entomology; Diptera; Hymenoptera; Synanthropic Flies; Parasitoids; Tabular Keys.

Records of the activity of parasitoids from synanthropic muscoid Diptera developing in accumulated animal wastes such as are found in dairys and poultry ranches, are repetitious enough from diverse world collection sites that most major species are probably known (Ables and Shepard, 1974; Anonymous, 1972; Azab et al., 1963; Bouček, 1963; Bridwell, 1919; Feng, 1933; Girault, 1910; Girault and Sanders, 1910; Graham-Smith, 1916, 1919; Greenberg, 1971; Johnston and Bancroft, 1920; Johnston and Tiegs, 1921; Kogan and Legner, 1970; Legner, 1965, 1966, 1967, 1969; Legner and Greathead, 1969; Legner and McCoy, 1966; Legner and Olton, 1968, 1971; Legner and Poorbaugh, 1972; Legner et al., 1967, 1974; Lindquist, 1936; Moore and Legner, 1971; Mourier, 1971; Mourier and ben Hannine, 1969; Muesebeck et al., 1951; Nikolskaya, 1952; Peck, 1963; Peck at el., 1964; Roy and Siddons, 1939; Steve, 1959; Sytshevskaya, 1963, 1964; Thompson, 1943; West, 1951.) The role of parasitoids in reducing the average density of their fly hosts can be significant, sometimes producing over 90% mortality of the later host developmental stages, with parasitoids attacking the pupal stage being predominant (Legner, 1971; Legner and Brydon, 1966; Legner and Dietrick, 1972, 1974; Legner and Greathead, 1969; Legner and Olton, 1971; Mourier and ben Hannine, 1969.) However, the degree of parasitization of muscoid Diptera that breed in isolated field pads of animal manure is comparably low with few of the parasitic species involved being common to those found in accumulated wastes (Legner et al., 1974; Olton and

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[1] Accepted for publication: January 25, 1976

[2] Professor of Biological Control and Staff Research Associate, respectively, Department of Entomology, University of California, Riverside 92502

[3] Assistant Entomologist, Department of Entomology, University of Arizona, Tucson 85721

ENT. NEWS, 87: 3 & 4: 113 - 144, March & April 1976

Legner, 1973). The characteristics of accumulated wastes cause an attraction for a distinct muscoid as well as parasitic fauna which is apparently related to a higher humidity and reduced rate of decomposition. Consequently, accumulated wastes are also a primary producer of flies of medical and veterinary importance such as the common house fly and several species of *Fannia*, and much attention has been placed on parasitoids to combat these flies.

The following keys and illustrations are presented in order to fill the need for a simple means of identification of the common parasitoids of synanthropic flies, principally the species *Musca domestica* L., *Stomoxys calcitrans* (L.), *Muscina stabulans* (Fallen), *Ophyra leucostoma* (Wiedemann), *Fannia canicularis* (L.), *F. femoralis* (Stein), and *F. scalaris* (Fab.). The parasitoids of these flies are currently being exchanged around the world in biological control attempts. The following species are included:

COLEOPTERA

Staphylinidae

1. *Aleochara* sp.

HYMENOPTERA

Diapriidae

2. *Trichopria* sp.

Encyrtidae

3. *Tachinaephagus zealandicus* Ashmead

Ichneumonidae

4. *Phygadeuon* sp.
5. *Stilpnus* sp.

Pteromalidae

6. *Muscidifurax raptor* Girault & Sanders
7. *M. raptorellus* Kogan & Legner
8. *M.* sp. nr. *raptorellus*
9. *M. raptoroides* Kogan & Legner
10. *M. uniraptor* Kogan & Legner
11. *M. zaraptor* Kogan & Legner
12. *Pachycrepoideus vindemiae* Rondani
13. *Spalangia cameroni* Perkins
14. *S. endius* Walker

15. *S. longepetiolata Bouček*
16. *S. nigra* Latreille
17. *S. nigripes* Curtis
18. *S. nigroaenea* Curtis
19. *Sphegigaster* sp.

Parasitic species not frequently encountered or very restricted in their original distribution are *Alysia manducator* (Panzer) (Braconidae) from northern Europe and Uruguay and *Figites* sp. (Figitidae) (Hewitt, 1914; James, 1928; Legner and Olton, 1968) with one species infrequently found in several areas. Other even rarer species are reported (Dresner, 1954; Ho et al., 1974; Howard, 1911; Roy et al., 1940).

The construction and use of tabular keys employed here are given by Newell (1970, 1972). Scanning electron micrographs are included for some species where the general shape of a character may be useful in its identification.

TABULAR KEY TO THE COMMON PARASITOIDS OF SYNANTHROPIC FLIES

KG1.

STATEMENT OF CHARACTERS

1. Venation of forewing = VEN. FORE.
   RED. = membranous; venation reduced, no complete cells present.
   COMP. = membranous; venation not reduced, at least one complete cell present.
   CORN. = corneous, no venation.

2. Number of antennal segments = NO. ANT. SEGS.
   LESS 14 = less than fourteen.
   16 = sixteen.
   22 = twenty-two.

3. Location of antennae = LOC. ANT.
   MID. NO PLAT. = inserted in the middle of the face, not on a small platform.
   MID. PLAT. = inserted in the middle of the face on a small platform.
   ANT. NO PLAT. = inserted at the anterior margin of the face, not on a platform.

4. Ratio of length of marginal vein to length of stigmal vein of forewing = RAT. MARG. STIG.
   10.1 = ten to one.
   NONE = no venation.
   NO STIG. = stigmal vein absent or greatly reduced.

5. Pubescence between eye facets = PUB. EYE.
   PUB. = pubescence present.
   GLAB. = glabrous.

6. Length of first antennal segment = LENG. ANT. ONE.
   LONG = longer than next two segments combined.
   SHORT = shorter than next two segments combined.

TABULAR KEY TO THE COMMON PARASITOIDS
OF SYNANTHROPIC FLIES
KG1.

VEN. FORE	NO. ANT. SEGS.	LOC. ANT.	RAT. MARG. STIG.	PUB. EYE	LENG. ANT. SEG. ONE		
CORN.	LESS 14	MID. NO PLAT.	NONE	GLAB.	SHORT	$\overline{\mathrm{KG1}}$	*Aleochara* spp.
COMP.	22	MID. NO PLAT.	NO. STIG.	GLAB.	SHORT	$\overline{\mathrm{KG1}}$	*Phygadeuon* sp.
COMP.	16	MID. NO PLAT.	NO STIG.	GLAB.	SHORT	$\overline{\mathrm{KG1}}$	*Stilpnus* sp.
RED.	LESS 14	MID. NO PLAT.	2.1	GLAB.	LONG	$\overline{\mathrm{KG100}}$	*Muscidifurax* spp.
RED.	LESS 14	MID. NO PLAT.	1.1	GLAB.	LONG	$\overline{\mathrm{KG1}}$	*Pachycrepoideus vindemiae* Rondani
RED.	LESS 14	ANT. NO PLAT.	10.1	PUB.	LONG	$\overline{\mathrm{KG200}}$	*Spalangia* spp.
RED.	LESS 14	MID. NO PLAT.	6.1	PUB.	LONG	$\overline{\mathrm{KG1}}$	*Sphegigaster* sp.
RED.	LESS 14	MID. NO PLAT.	1.1	PUB.	LONG	$\overline{\mathrm{KG1}}$	*Tachinaephagus zealandicus* Ashmead
RED.	LESS 14	MID. PLAT.	NO. STIG.	PUB.	LONG	$\overline{\mathrm{KG1}}$	*Trichopria* sp.

TABULAR KEY TO THE SPECIES OF *Muscidifurax*.
STATEMENT OF CHARACTERS
KG100.

1. Marginal fringe = MARG. FRIN.
   PRES. = fringe of setae present on posterio-apical margin of forewing.
   ABS. = fringe of setae absent from posterio-apical margin of forewing.

2. Length of stigma = LENG. STIG.
   ELONG. = stigma longer than wide.
   SHORT = stigma about as long as wide.

3. Frontal grooves = FRONT. GROOV.
   PARAL. = parallel.
   US. PAR. = usually parallel.
   CONV. = convergent.
   US. CONV. = usually convergent.

4. Spiracular ridge = SPIR. RIDGE
   SHORT = spiracular ridge shorter than diameter of spiracle.
   LONG = spiracular ridge as long as diameter of spiracle.

5. Mating behavior = MAT. BEH.
   BIP. = biparental.
   UNIP. = uniparental.

6. Progeny per host = PROG. HOST.
   SOL. = solitary.
   PAR. GREG. = partially gregarious.
   GREG. = gregarious.

7. Possible Origin = ORIG.
   W.U.S.A. = Western United States.
   UR. & ARG. = Uruguay and Argentina.
   P.R. = Puerto Rico.
   C.A. = Mexico and Central America.
   COSM. = Unknown, now cosmopolitan.

TABULAR KEY TO THE SPECIES OF *Muscidifurax* KG100.

MARG. FRIN.	LEN. STIG.	FRONT GROOV.	SPIR. RIDGE	MAT. BEH.	PROG. HOST	ORIG.	
ABS.	ELONG.	US. PAR.	SHORT	BIP.	SOL.	W.U.S.A.	*zaraptor*
ABS.	SHORT	US. CONV.	SHORT	BIP.	GREG.	CHILE	*raptorellus*
ABS.	ELONG.	US. PAR.	SHORT	BIP.	PAR. GREG.	UR. & ARG.	sp. near *raptorellus*
PRES.	ELONG.	PARAL.	SHORT	BIP.	SOL.	COSM.	*raptor*
PRES.	ELONG.	CONV.	LONG	UNIP.	SOL.	P.R.	*uniraptor*
PRES.	ELONG.	CONV.	SHORT	BIP.	SOL.	C.A.	*raptoroides*

TABULAR KEY TO THE COMMON SPECIES OF *Spalangia* ASSOCIATED WITH SYNANTHROPIC FLIES.
STATEMENT OF CHARACTERS
KG200.

1. Condition of posterior disc of pronotum = COND. PRON. DISC
   LINE = pronotum with an isolated crenulate line parallel to and near posterior margin.
   NO LINE = pronotum without an isolated crenulate line parallel to and near posterior margin.

2. Pronotal Border = PRON. BORD.
   BORD. = Pronotal collar bordered anteriorly by a narrow groove setting off the ridge-like margin.
   ROUND = pronotal collar rounded anteriorly.

3. Texture of pronotum = TEXT. PRON.
   RUG. = anterio-lateral surface of pronotum rugose or crowdedly rugulosely punctured.
   PUNC. = anterio-lateral surface of pronotum umbilicately punctured with interspaces smooth.

4. Puncturation of head = PUNC. HEAD
   DENS. = disc of head between the eyes very densely crowdedly punctured, the punctures separated by less than their diameters.
   SPARS. = disc of head between the eyes sparsely punctured, the punctures separated by about their diameters.

5. Length of gena = LEN. GEN.
   LONG = longer than length of eye.
   EQUAL = equal to length of eye.
   SHORT = shorter than length of eye.

6. Dorsal carinae on abdominal petiole = PET. DORS. CAR.
   7-10 = number of carinae, longitudinally arranged.
   5-8 = number of carinae, longitudinally arranged.
   IRR. = irregularly arranged carinae.

7. Lateral hairs on abdominal petiole = LAT. PET. HAIR.
   PRES. = present, at least 10 on each side.
   RARE = not more than 2 on each side, usually absent.
   ABS. = absent.

8. Possible Origin = ORIG.
   COSM. = Unknown, now cosmopolitan
   HOLA. = Holarctic.
   EA. AFR. = East Africa.

TABULAR KEY TO THE COMMON SPECIES OF
Spalangia ASSOCIATED WITH SYNANTHROPIC FLIES
KG200.

COND. PRON. DISC.	PRON. BORD.	TEXT. PRON.	PUNC. HEAD	LENG. GENA	PET. DORS. CAR.	LAT. PET. HAIR	DISTR.	
LINE	BORD.	RUG.	SPARS.	SHORT	7-10	PRES.	COSM.	*nigroaenea*
LINE	ROUND	RUG.	SPARS.	LONG	7-10	ABS.	COSM.	*cameroni*
LINE	ROUND	RUG.	SPARS.	SHORT	5-8	ABS.	EA.AFR.	*longepetiolata*
LINE	ROUND	PUNC.	SPARS.	EQUAL	7-10	RARE	COSM.	*endius*
NO LINE	ROUND	RUG.	DENS.	LONG	5-8	PRES.	HOLA.	*nigra*
NO LINE	ROUND	PUNC.	SPARS.	SHORT	IRR.	ABS.	HOLA.	*nigripes*

1. *Aleochara* spp. (Coleoptera: Staphylinidae).

Members of this group are characterized by the forewings being developed into corneous shields (elytra) under which the hind wings (the actual organs of flight) are folded in repose. In this family the elytra are short, leaving much of the abdomen exposed. The abdomen is highly flexible. The genus *Aleochara* differs from other staphylinids in that the antennae are inserted on the face between the anterior margins of the eyes, the tarsi are all five-segmented, the maxillary palpi are five-segmented and the labial palpi four-segmented. The two terminal segments of the palpus are considerably narrower than the preceding with the last segment minute. All members of this genus in which the life histories are known are solitary ectophagous parasitoids on the pupae of flies within the puparium (Kemner, 1926; Lesne and Mercier, 1922; Moore and Legner, 1971, 1973; White and Legner, 1966).

2. *Phygadeuon* sp. (Hymenoptera: Ichneumonidae)

Members of this genus, along with those of *Stilpnus* can be distinguished from other species listed here by their complete wing venation. Both the forewings and hind wings have the venation closed to form several cells. This genus is unique here in having the antennae of 22 segments with the first two segments short and the third segment longer than the first two combined. The antennae are inserted in the middle of the face between the eyes. The species are solitary internal larval parasitoids most commonly found in humid higher Holarctic latitudes (Legner, 1966; Legner and Olton, 1968). Their size varies with the size of the host.

3. *Stilpnus* sp. (Hymenoptera: Ichneumonidae)

As in *Phygadeuon* the wing venation is complete, there being complete cells in both the forewings and hind wings. The antennae are of 16 segments with the first two segments short, the first being shorter than the next two together. The color is a shining metallic black. These are solitary endophagous larval parasitoids, apparently restricted to the genus *Fannia* in accumulated animal wastes (Legner and Olton, 1971; Loomis et al., 1968). They vary greatly in size with males being about half that of females.

Genus *Muscidifurax* (Hymenoptera: Pteromalidae)

In this genus the wing venation is incomplete and the marginal vein is about twice as long as the stigmal vein. The antennal insertions are in the middle of the face between the eyes. The first antennal segment is longer than the next two together. There are less than 14 antennal segments. Females have one ring segment and seven funicular segments, males have two and six, respectively. The disc of the pronotum and the head are finely reticulate, without coarse punctures (Fig. 1). The few species are very similar in appearance but have good behavioral characters distinguishing them (Legner, 1969; Kogan and Legner, 1970). Females are black; males black with translucent testaceous spots on the first, second and third ventral abdominal segments. The eggs are hymenopteriform, covered with small tubercles which distinguishes them from those of *Spalangia* (Gerling, 1967) and with size differences for some species. The species may be either solitary or gregarious. The average mass of solitary species of this genus is relatively fixed as host size does not appreciably affect them (Legner, 1969). They are ectophagous pupal parasitoids. The key reference is Kogan and Legner (1970). Van den Assem and Povel (1973) discuss courtship behavior patterns that are species specific. Markwick (1974) gives biological characteristics that distinguish *M. raptor* and *M. zaraptor* and these species from *Spalangia endius.* Other references refer to distribution, identity and biology of species of this genus (Ables and Shepard, 1974; Anonymous, 1938; Broadbent, 1972; Frison, 1927; Kotschetova and Tjutjunkova, 1972; Legner, 1967, 1969a, 1972; Legner and Dietrick, 1974; Legner and Gerling, 1967; Legner et al., 1965; McCoy, 1967; Nikolskaya, 1952; Wylie, 1967, 1971a, b, 1972).

4. *Muscidifurax zaraptor* Kogan & Legner

A fringe of setae (or their sockets) is absent from the posterio–apical margin of the forewing. The stigma is small, elongate, suboval, frequently acuminate at the internal angle where a hair is implanted. The uncus is usually directed toward the anterior margin of the wing. The pedicel of the antenna of the female is conspicuously slender proximally. The frontal grooves are usually parallel. The median area of the propodeum in the female is closed behind by the fusion of the lateral and median plicae. The digitus of the male genitalia is subrectangular with four or five apical processes. Length of female 2.84 mm, male 2.18 mm. This species is biparental and solitary. It was originally found in the western United States, but is now known to extend into southwestern Canada.

5. *Muscidifurax raptorellus* Kogan & Legner

A fringe of setae (or their sockets) is absent from the posterio-apical margin of the forewing. The stigma is not elongate; sometimes it is roundly clubbed. The uncus is directed towards the apex of the wing. The pedicel of the antenna of the female is not slender proximally. The frontal grooves are usually convergent. The median area of the propodeum of the female is usually open behind with the lateral and median plicae not fused in the middle (Fig. 1). The digitus of the male genitalia is subtrapezoidal, broader distally and usually with only three distal processes. Length of female is 2.11 mm, male 1.82 mm. This species is biparental and gregarious. It was originally known from Chile.

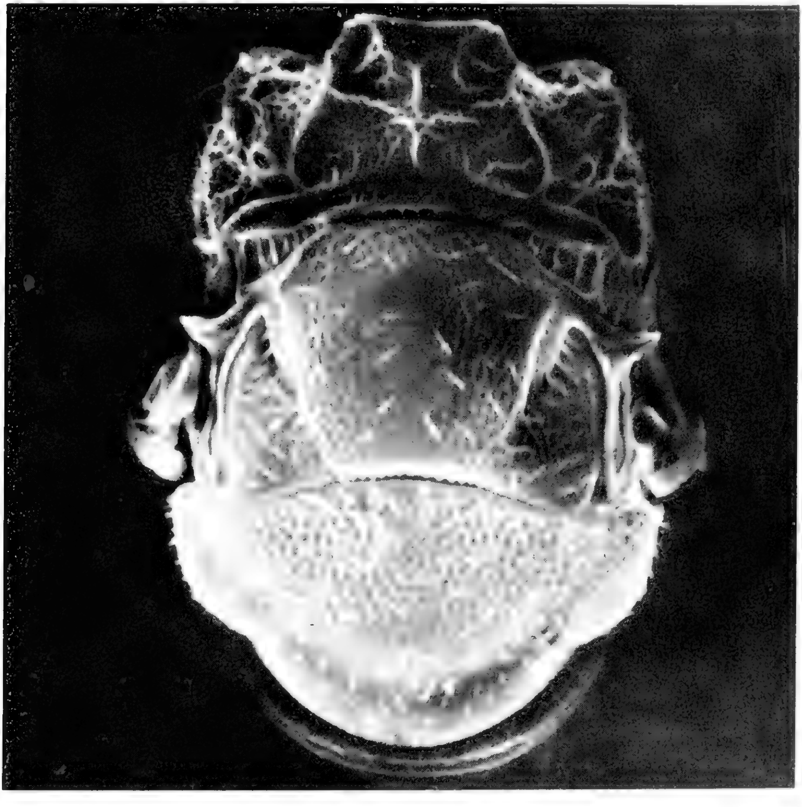

Fig. 1. Thorax of *Muscidifurax raptorellus* Kogan & Legner, showing shape and relative dimensions of pronotum (100 X).

6. *Muscidifurax* sp. near *raptorellus*

The fringe of setae (or their sockets) is absent from the posterio-apical margin of the forewing. The stigma is elongate. The uncus is directed apically. The pedicel of the antenna of the female is not slender proximally. The frontal grooves are usually convergent. The median area of the propodeum of the female is usually open behind with the lateral and median plicae not fused in the middle. The digitus of the male genitalia is subtrapezoidal, broader distally and usually with only three distal processes. Length of female is 2.11 mm, male 1.82 mm. It is biparental and partially gregarious (not more than 10% of the time). This species is known from Uruguay.

7. *Muscidifurax raptor* Girault & Sanders

The fringe of setae (or their sockets) is well developed on the posterio-apical margin of the forewing. The stigma forms a rather abrupt enlargement at the end of the stigmal vein, usually subquadrangular and distally acuminate where a hair is frequently implanted. The uncus is directed distally. The frontal grooves are parallel. The median area of the propodeum of the female is closed behind. The digitus of the male genitalia is subtrapezoidal, broadest distally and usually with three apical processes. Length of female is 2.33 mm, male 1.73 mm. It is biparental and solitary. A nearly cosmopolitan species which has not been collected in Asia.

8. *Muscidifurax uniraptor* Kogan & Legner

The fringe of setae (or their sockets) is well developed on the posterio-apical margin of the forewing. The stigma is formed as a gradual dilation of the tip of the stigmal vein. The uncus is directed distally. The frontal grooves are convergent. The digitus of the male genitalia is subrectangular and usually with four distal processes. The spiracle of the female propodeum is remote from the lateral plica, i.e., the spiracular ridge is as long as the longest diameter of the spiracle. Length 2.15 mm in females; the occasional males are the smallest of all the *Muscidifurax* species. This species is uniparental and solitary. It was originally known only from Puerto Rico at an elevation of 3000 feet.

9. *Muscidifurax raptoroides* Kogan & Legner

The fringe of setae (or their sockets) is well developed on the posterio-apical margin of the forewing. The stigma is formed as a gradual dilation of the tip of the stigmal vein. The uncus is directed distally. The frontal grooves are convergent. The digitus of the male genitalia is subrectangular and usually with four apical processes. The spiracle of the propodeum of the female is not remote from the lateral plica, i.e., the spiracular ridge is shorter than the largest diameter of the spiracle. Length of female is 2.31 mm, of male 1.78 mm. This species is biparental and solitary. It was originally known from Costa Rica.

Another population, originally known from Mexico, is morphologically very similar to this species. The two populations apparently do not cross freely, but tests conducted so far are not conclusive.

(To be concluded in May-June issue)

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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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Wanted: Live eggs, cocoons and adults of exotic Lepidoptera, together with necessary host plant foods. Write, if possible in German, to Willi Mappes, Am Bäumelfeld 100, D 8501 Kleinschwarzenlohe, West Germany.

VOL. 87 MAY & JUNE 1976 NOS. 5 & 6

ENTOMOLOGICAL NEWS

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(Continued on inside of back cover)

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TABULAR KEYS & BIOLOGICAL NOTES TO COMMON PARASITOIDS OF SYNANTHROPIC DIPTERA BREEDING IN ACCUMULATED ANIMAL WASTES

(Concluded from March-April issue)

E.F. Legner, I. Moore, G.S. Olton

10. *Pachycrepoideus vindemiae* Rondani (Hymenoptera: Pteromalidae)

This species is similar in appearance to species of *Muscidifurax* but can readily be distinguished by the short marginal vein which is not longer than the stigmal vein. The wing venation is incomplete. The antennae arise from the middle of the face between the eyes with the first segment longer than the next two together. There are less than 14 antennomeres. The head and the disc of the pronotum are finely reticulate without noticeable punctures. This species is an ectophagous, usually solitary, pupal parasitoid; its distribution is cosmopolitan. Some references are Crandall (1939), Legner and Olton (1968), Legner et al. (1967), Nostvik (1954), Steve (1959), and van den Assem (1974).

Genus *Spalangia* (Hymenoptera: Pteromalidae)

Species of this genus have incomplete wing venation. The marginal vein is about ten times as long as the stigmal vein. The antennae are located at the front margin of the head. The first antennal segment is longer than the next two combined. There are less than 14 antennomeres. The pronotal disc is coarsely punctured with polished interspaces (Fig. 2). The eggs are hymenopteriform and smooth with the size being variable according to the species (Gerling, 1967). Host size does not appreciably affect the size of solitary species of this genus (Legner, 1969). These species are usually solitary ectophagous pupal parasitoids. The five species treated here are easily distinguished among themselves. The key reference is Bouček (1963). Markwick (1974) gives biological characteristics of *S. endius* and distinguishes this species from *Muscidifurax*. Other references include Azizov (1972), Brethes (1915), Cameron (1881), Gerling and Legner (1968), Handschin (1934), Kotschetova and Azizov (1972), Legner (1967), McCoy (1963), Mourier (1971), Pinkus (1913), Richardson (1913), Simmonds (1929a, b), Vandenburg (1928, 1931), Wylie (1972).

11. *Spalangia nigroaenea* Curtis

The disc of the head between the eyes is sparsely punctured with the punctures separated mostly by about their diameters. The disc of the pronotum has an isolated crenulate crossline consisting of closely spaced large punctures in front of and parallel to the posterior margin. The pronotal collar is bordered anteriorly by a narrow groove setting off the ridge-like margin

(Fig. 3 & 4). The anterio-lateral surface of the pronotum is rugose or crowdedly rugulosely punctured. The length of the gena is less than that of the eye. The ratio of abdominal petiole length to the narrowest width is 1.7 in females and 2.2 in males (Fig. 5 & 6). The length of the stretched body is 2.9-3.8 mm in females and 2.5-3.5 mm in males. This species is cosmopolitan.

12. *Spalangia cameroni* Perkins

The disc of the head between the eyes is sparsely punctured with the punctures mostly separated by more than their diameters. The disc of the pronotum has an isolated crenulate crossline consisting of large closely spaced punctures near to and parallel to the posterior margin. The pronotal collar is rounded anteriorly, without a distinct ridge (Fig. 7 & 8). The anterio-lateral surface of the pronotum is rugose or crowdedly rugulosely punctured. The length of the gena is less than that of the eye. The ratio of abdominal petiole length to the narrowest width is 1.8 in females and 2.5 in males (Fig. 9 & 10). The length of the stretched body is 2.5-3.3 mm in females and 2.4-3 mm in males. A cosmopolitan species.

13. *Spalangia longepetiolata* Bouček

The disc of the head between the eyes is sparsely punctured, the punctures being separated mostly by more than their diameters. The disc of the pronotum has a distinct crenulate cross line of large crowded punctures parallel to and just anterior to the posterior margin (Fig. 11 & 12). The pronotal collar is rounded at the anterior margin. The anterio-lateral surface of the pronotum is rugose or crowdedly rugulosely punctured. The length of the gena is greater than that of the eye. The ratio of abdominal petiole length to the narrowest width is 1.7 in females and 3-5 in males (Fig. 13 & 14). Therefore, females do not possess the long petiole characteristic that generated the name of this species from Bouček, 1963. The length of the stretched body is ca. 2.2-3.1 mm in females and 2-2.8 mm in males. This species was originally known from East Africa.

14. *Spalangia endius* Walker

The disc of the head between the eyes is sparsely punctured with the punctures mostly separated by more than their diameters. The disc of the pronotum has an isolated crenulate crossline consisting of large closely placed punctures in front of and parallel with the posterior margin (Fig. 15 & 16). The pronotal collar is rounded anteriorly, without a distinct ridge. The anterio-lateral surface of the pronotum is umbilicately punctured with the interspaces smooth, not rugose. The length of the gena is about equal to that

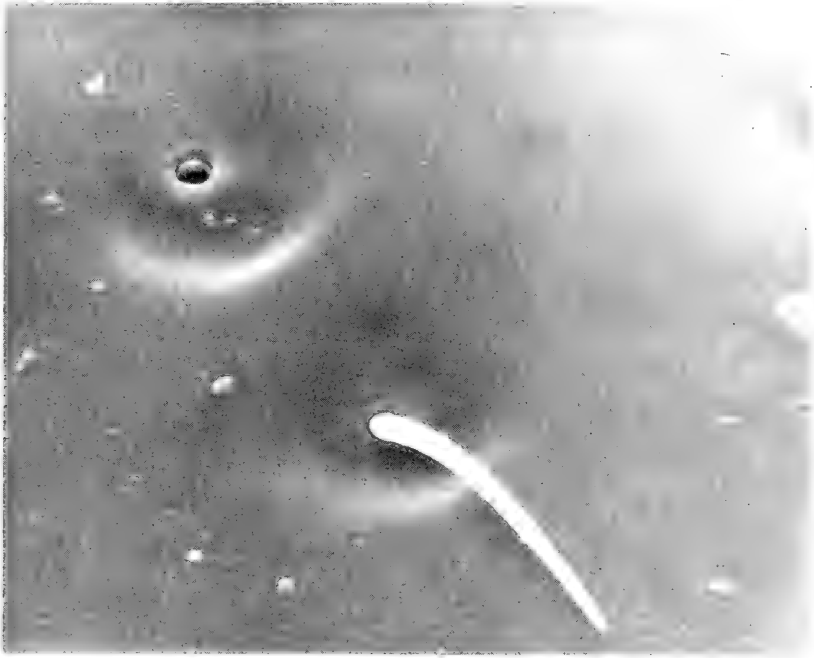


Fig. 2. Punctures on pronotum in female *Spalangia endius* Walker, showing seta in one of them (1500 X).

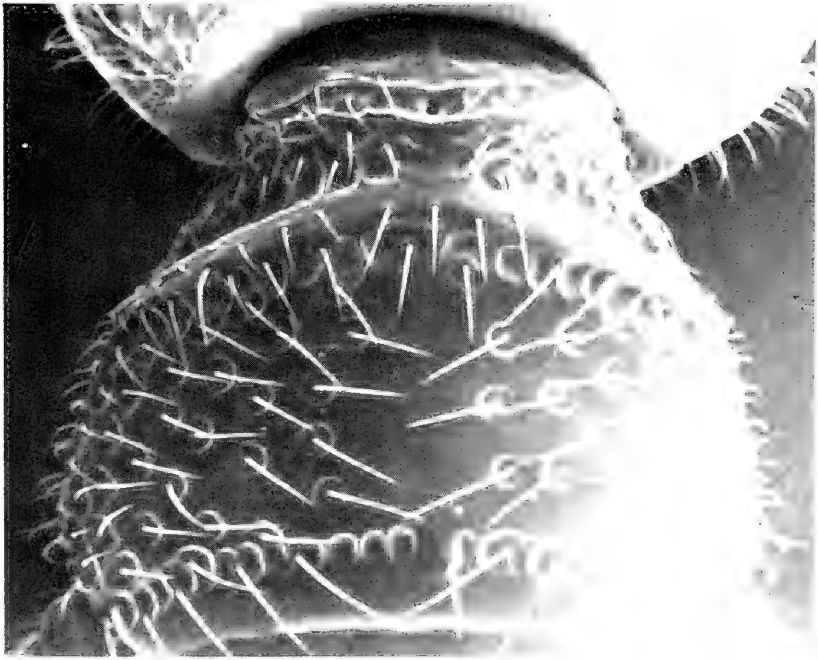


Fig. 3. Pronotum in female *Spalangia nigroaenea* Curtis (170 X).

of the eye. The ratio of abdominal petiole length to the narrowest width is 1.7 in females and 2.0 in males (Fig. 17 & 18). The length of the stretched body is 2-3 mm in females and 1.9-2.6 mm in males. A cosmopolitan species.

15. *Spalangia nigra* Latreille

The disc of the head between the eyes is very densely crowdedly punctured, the punctures being separated by less than their diameters. The pronotum is without a distinct crenulate line of large punctures parallel to the posterior margin (Fig. 19). The pronotal collar is rounded anteriorly without a distinct ridge. The anterio-lateral surface of the pronotum is rugose or crowdedly rugulosely punctured. The length of the gena is greater than that of the eye. The ratio of abdominal petiole length to the narrowest width is 2 in females and 2.2 in males (Fig. 20). The length of the stretched body is 3-4.5 mm in females and 2.5-3.7 mm in males. This was originally a Holarctic species.

16. *Spalangia nigripes* Curtis

The disc of the head between the eyes is sparsely punctured, the punctures being separated mostly by more than their own diameters. The disc of the pronotum is without a distinct crenulate cross-line of large crowded punctures parallel to and just anterior to the posterior margin. The pronotal collar is rounded at the anterior margin. The anterio-lateral surface of the pronotum is umbilicately punctured with the interspaces smooth. The length of the gena is less than that of the eye. The ratio of abdominal petiole length to the narrowest width is 1.6 in females. The length of the stretched body is 2.5-3.7 mm in females and 2-3.1 mm in males. This species was originally Holarctic in distribution.

17. *Sphegigaster* sp. (Hymenoptera: Pteromalidae)

The wing venation is greatly reduced with a single vein along the anterior margin and a spur, the stigmal vein near its apex. The antennae are located on the middle of the face between the anterior margins of the eyes, not on a platform. They are of less than 14 segments with first segment elongate, longer than the next two combined. The pronotal disc is finely densely punctured. The color is shining black with the legs testaceous. The abdomen is noticeably smaller than the thorax in contrast to other genera treated here.

Sphegigaster sp. was originally found active on *Musca domestica* and *Stomoxys calcitrans* only in East and South Africa (Legner & Greathead, 1969; Legner & Olton, 1968); however, the genus is well represented by a number of species in the Palearctic (Graham, 1969).

Fig. 4. Pronotum in male *Spalangia nigroaenea* Curtis (175 X).

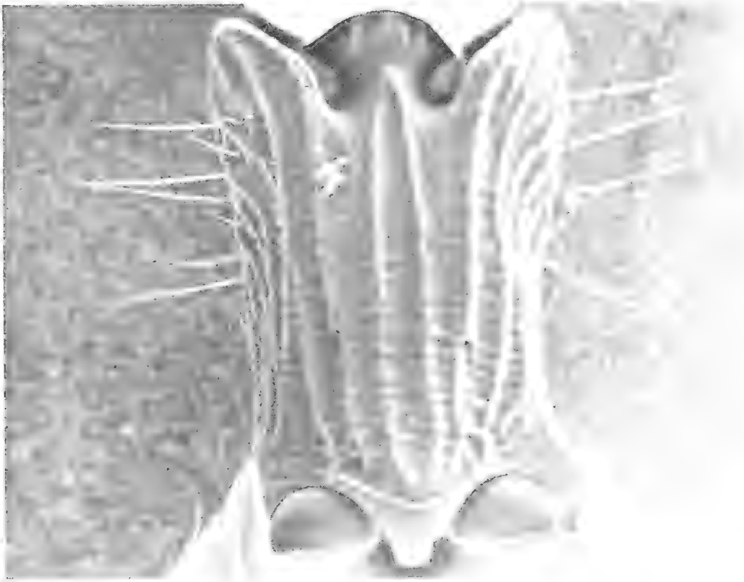


Fig. 5. Abdominal petiole in female *Spalangia nigroaenea* Curtis (215 X).

18. *Tachinaephagus zealandicus* Ashmead (Hymenoptera: Encyrtidae)

The wing venation is greatly reduced with a single vein along the margin and a very short spur, the stigmal vein, near its center. The antennae are located in the middle of the face between the eyes. They are of less than 14 segments with the first segment elongate, longer than the next two combined. As in *Muscidifurax,* the pronotal disc is finely reticulate and almost imperceptibly punctured. The color is shining black with the underside of the thorax and the legs testaceous. The size varies with host size and number of individuals developing on one host. The eggs are encyrtiform (dumbell shaped). It is an endophagous gregarious larval parasitoid which was originally known from Australasia. The key reference is Olton & Legner (1975). Other references are Ashmead (1904), Gahan (1938), Gourlay (1930), Ferriere (1933), Johnston and Tiegs (1922), Legner and Olton (1968), Olton and Legner (1974), Risbec (1956).

19. *Trichopria* sp. (Hymenoptera: Diapriidae)

The wings are without veins except for a short marginal vein and with a stigma so near the margin that the stigmal vein is almost absent. The antennae in this family usually arise from a small platform in the middle of the face between the eyes. The femora and apical half of the tibiae are swollen. The body is highly polished black without ground sculpture and with scattered long setae. The size varies with that of the host. The species of this genus are usually solitary endophagous larval parasitoids. Key references are Legner and Olton (1968), Legner et al. (1967), and Muesebeck (1961).

GLOSSARY

Digitus of the male genitalia. Paired finger-like structures at base of the aedeagus.

Frontal Grooves. A pair of impressed grooves in the center of the head between the eyes running from the antennal insertions in the direction of the median ocellus.

Funicular Segments of antenna. The median segments following the small ring segment or segments but not including the terminal club.

Gena. The sides of the head below the eyes.

Hymeopteriform Egg. Ovoid or spindle shaped in outline, both ends smoothly rounded.

Lateral and Median Plica. A fold or wrinkle on the propodeum.

Marginal Vein. That vein which runs along the anterior basal portion of the wing beyond the sub marginal.

Petiole of abdomen. The narrow basal segment or segments of the abdomen.

Pronotal Collar. The posterior region of the pronotum.

Propodeum. The posterior lateral sclerite of the metathorax.

Ring Segments of the antenna. One or two small or minute segments between the second segment and the funicle.

Spiracular Ridge. A short ridge extending from the mesothoracic spiracle to the lateral plica.

Stigma. A thickened enlargement of the distal end of the stigmal vein.

Stigmal Vein. A short vein extending from the distal end of the marginal vein into the surface of the anterior wing.

Synanthropic Flies. Flies coexisting with man over an extended period and whose density is partially or wholly governed by him.

[illegible] A finger-like distal process of the stigma.

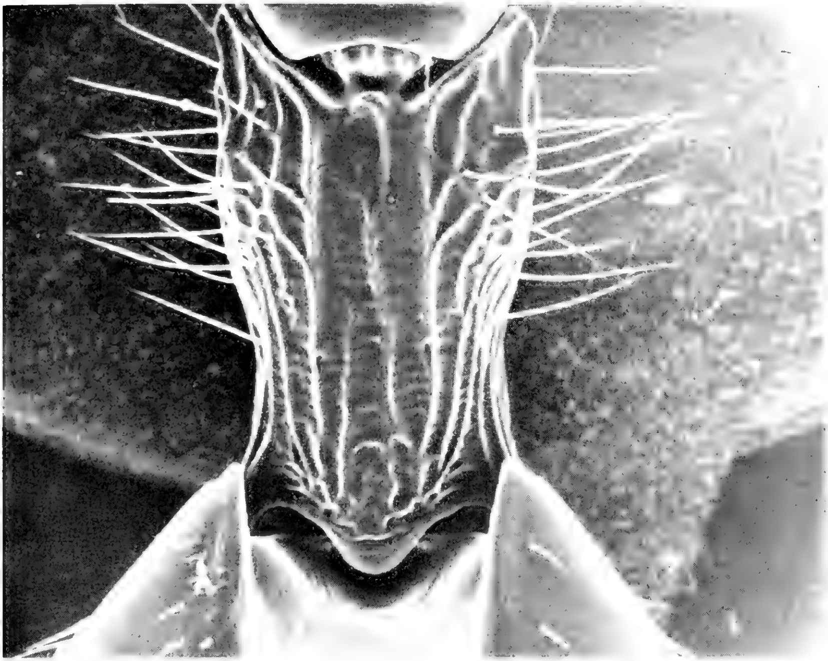


Fig. 6. Abdominal petiole in male *Spalangia nigroaenea* Curtis (190 X).

Fig. 7. Pronotum in female *Spalangia cameroni* Perkins (170 X).

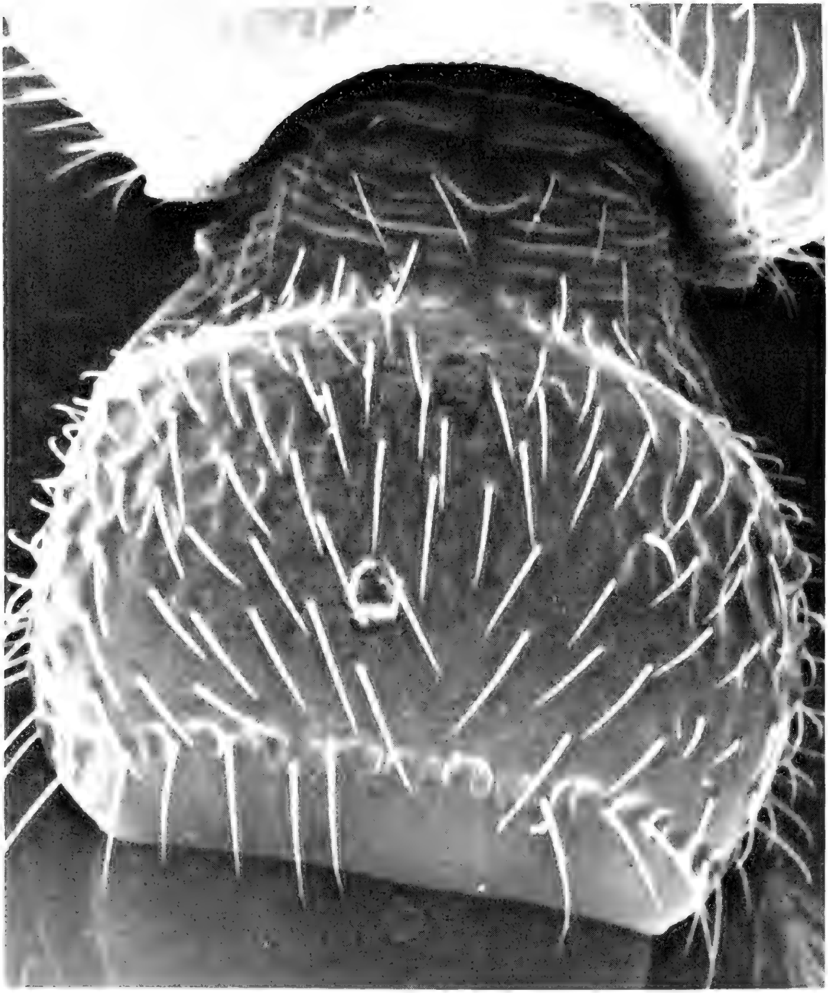


Fig. 8. Pronotum in male *Spalangia cameroni* Perkins (170 X).

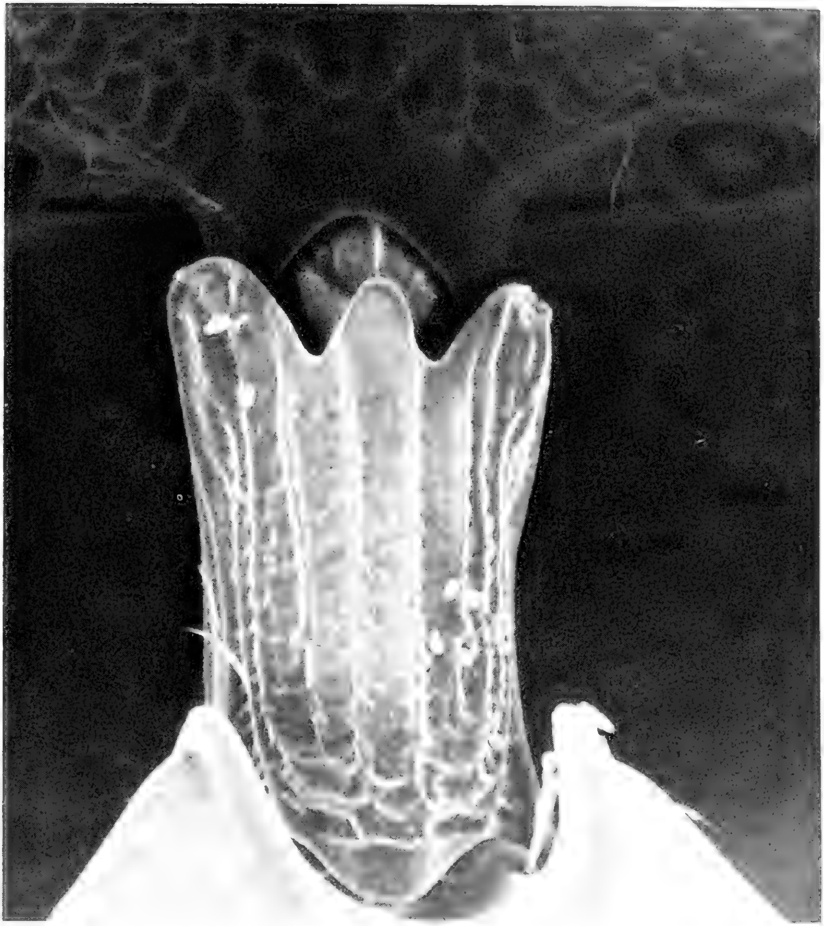


Fig. 9. Abdominal petiole in female *Spalangia cameroni* Perkins (215 X).

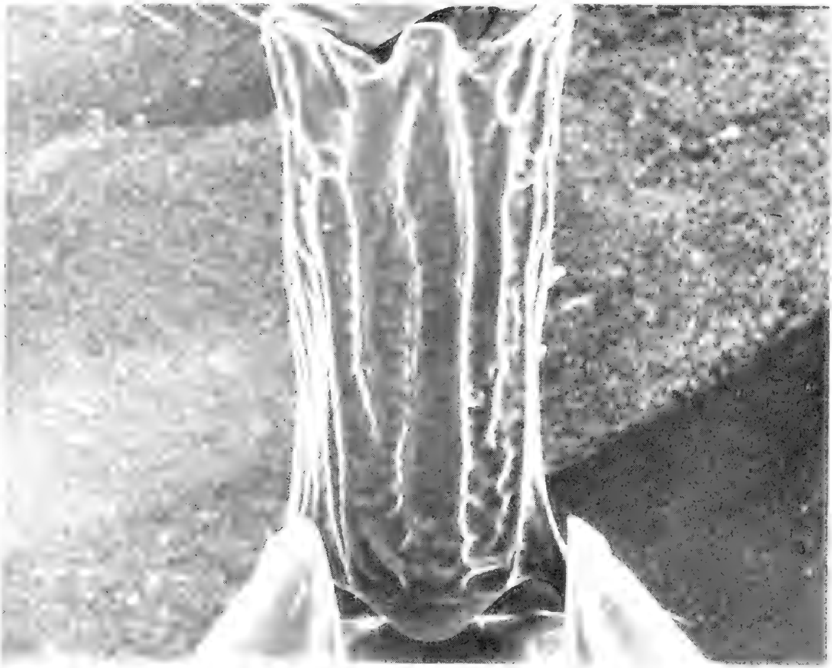
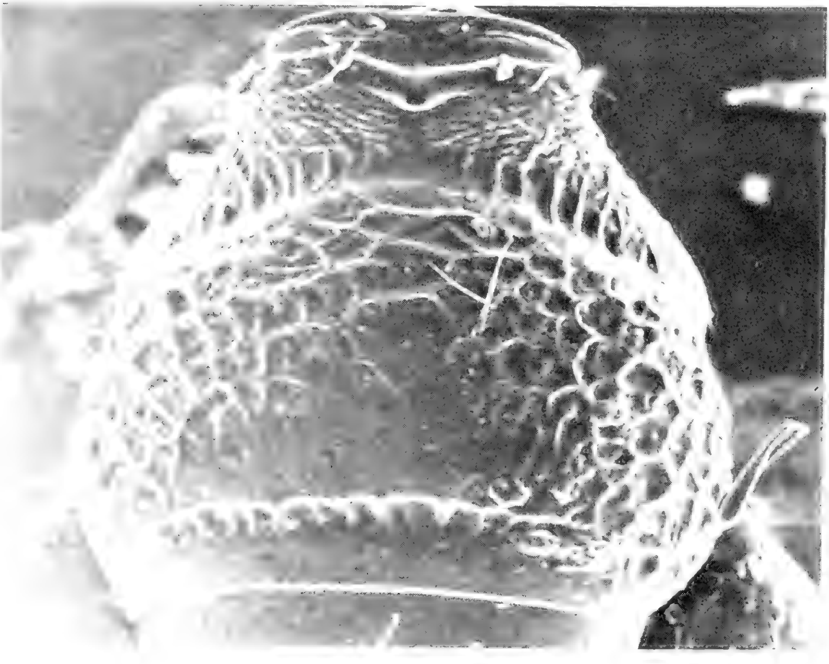


Fig. 10. Abdominal petiole in male *Spalangia cameroni* Perkins (215 X).



11. Pronotum in female *Spalangia longepetiolata* Bouček (150 X).

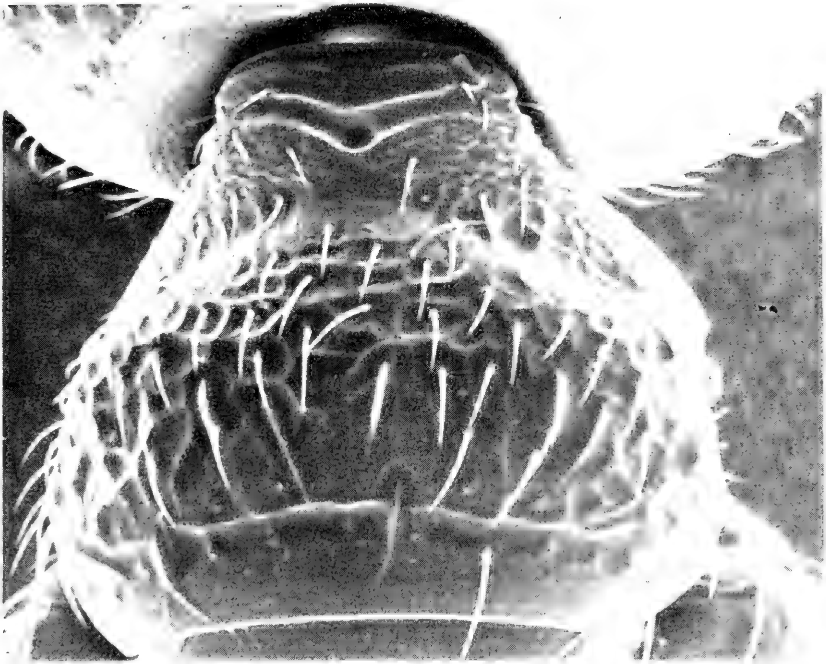


Fig. 12. Pronotum in male *Spalangia longepetiolata* Bouček (170 X).

Fig. 13. Abdominal petiole in female *Spalangia longepetiolata* Bouček (170 X).

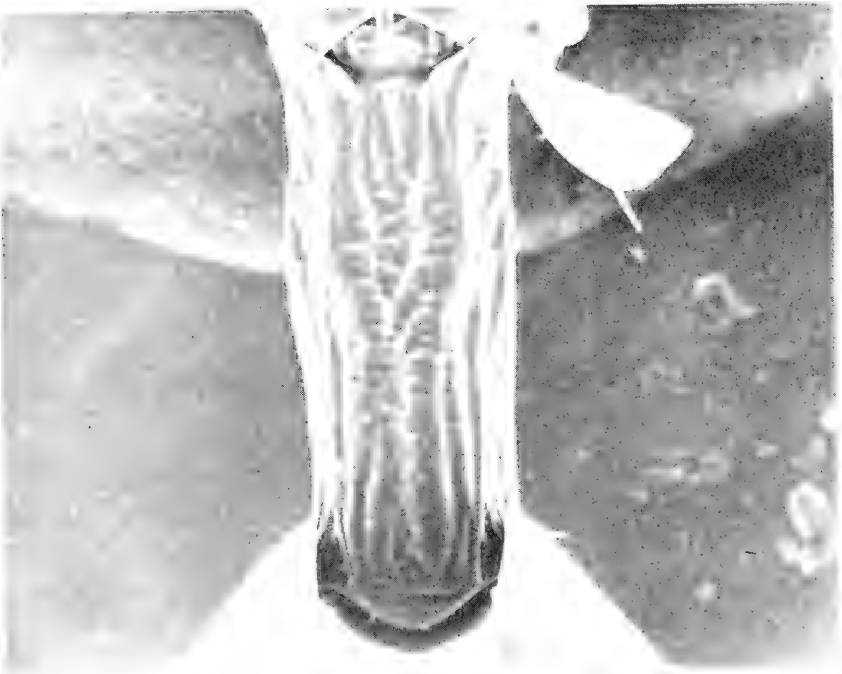
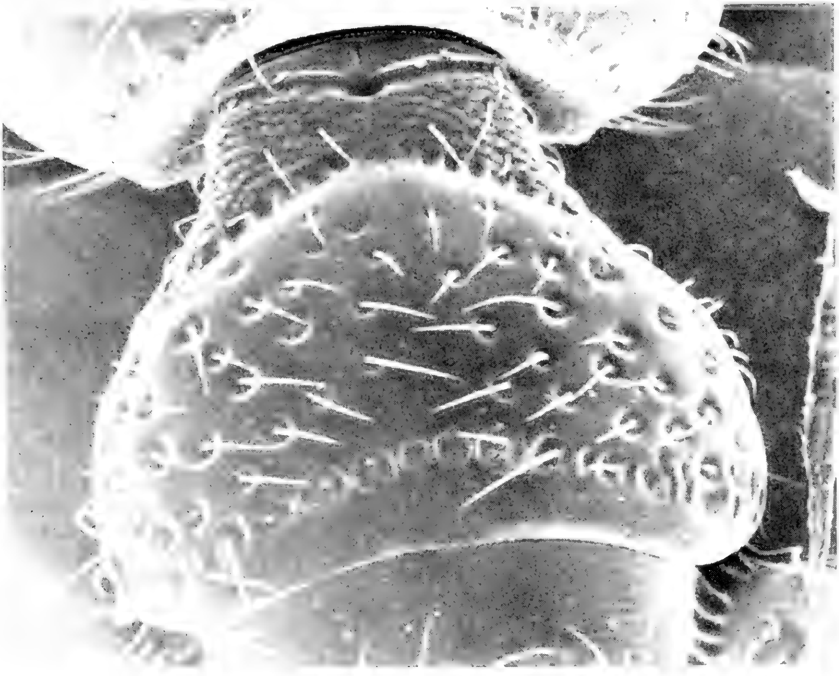


Fig. 14. Abdominal petiole in male *Spalangia longepetiolata* Bouček (170 X).



5. Pronotum in female *Spalangia endius* Walker (190 X).

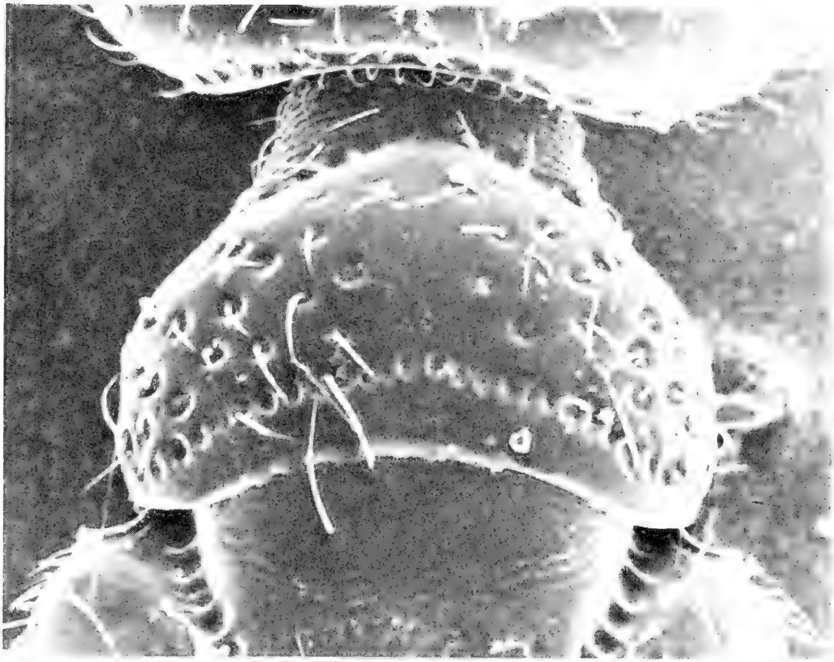


Fig. 16. Pronotum in male *Spalangia endius* Walker (190 X).

Fig. 17. Abdominal petiole in female *Spalangia endius* Walker (215 X).

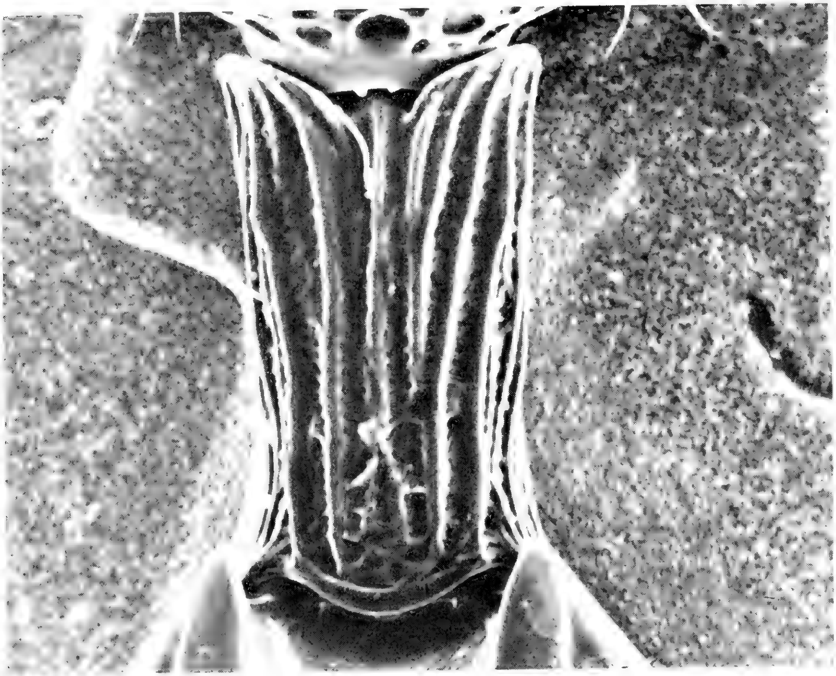
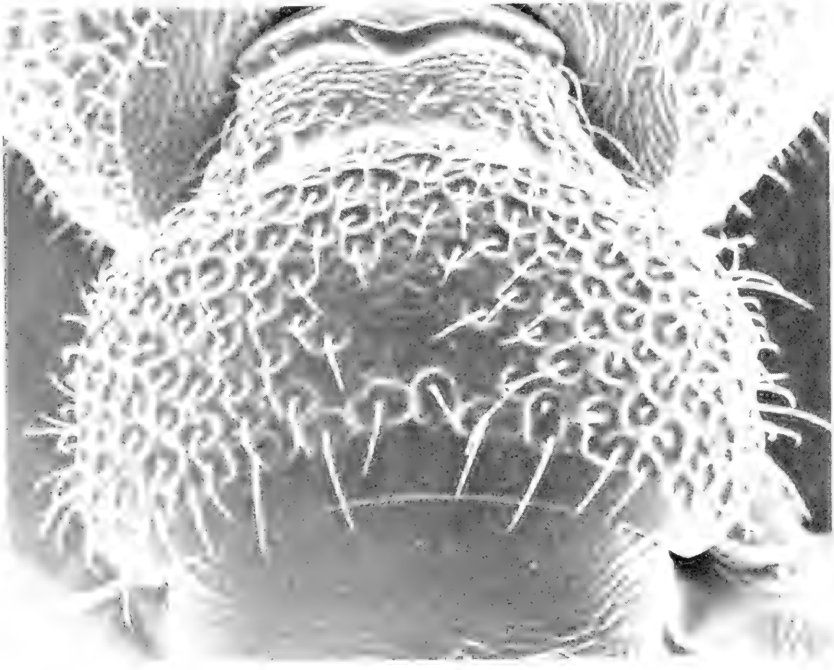


Fig. 18. Abdominal petiole in male *Spalangia endius* Walker (215 X).



19. Pronotum in female *Spalangia nigra* Latreille (170 X).

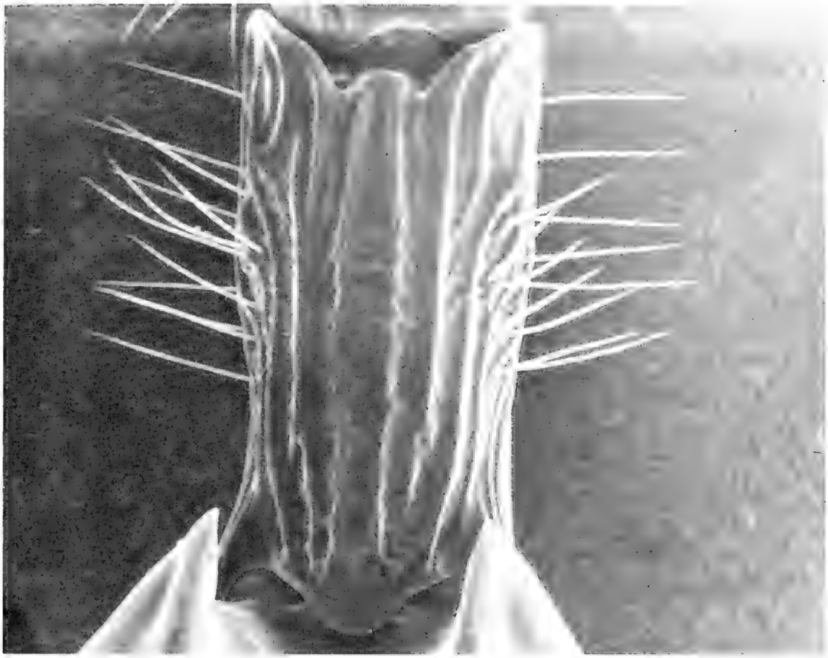


Fig. 20. Abdominal petiole in male *Spalangia nigra* Latreille (190 X).

ACKNOWLEDGEMENTS

We express our appreciation to the following who have furnished us with information, identifications or have helped in various ways: Drs. I.M. Newell and T.W. Fisher and Messrs. J.C. Hall and R.E. Orth of the Division of Biological Control, University of California, Riverside; and Dr. Z. Bouček of the British Natural History Museum, London, and Dr. B.D. Burks of the U.S. National Museum, Washington.

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NOTES ON THE DISTRIBUTION OF OREGON SHIELD-BACKED KATYDIDS WITH THE DESCRIPTION OF A NEW SPECIES OF *IDIOSTATUS* (ORTHOPTERA: TETTIGONIIDAE: DECTICINAE)[1]

David C. Rentz[2], David C. Lightfoot[3]

ABSTRACT: A new species of *Idiostatus* in the Hermani Group is described from the Greasewood-saltbush plant association of southeastern Oregon in the Abert Lake vicinity. New records of *Idiostatus inermoides* Rentz extend the range of that species north into southern Oregon. *Capnobotes occidentalis* is recorded from Oregon for the first time and a population of *Apote notabilis* is listed as the southern distributional record of the species.

DESCRIPTORS: *Idiostatus:* new species; bionomics; distribution. New records: *Capnobotes occidentalis; Apote novabilis.*

Recent field collections in southeast Oregon by the second author have yielded a number of range extensions and a new species of *Idiostatus.* New range extensions include *Capnobotes occidentalis* Thomas, Great Basin species recorded from Oregon for the first time and *Apote notabilis* Scudder for which the included record is the southernmost known distribution of the species. The known geographic range of *Idiostatus inermoides* Rentz is extended from northwestern Nevada into southeastern Oregon. The new species of *Idiostatus* is closely related to *I. inermoides* and may actually come into contact with that species as represented by the population's Alvord Desert-Juniper Lake area.

Idiostatus chewaucan **Rentz and Lightfoot**, new species

(Figures 1 – 6)

Diagnosis. – Readily recognized as a member of the Hermani Group (see

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[1] Accepted for publication: January 19, 1976

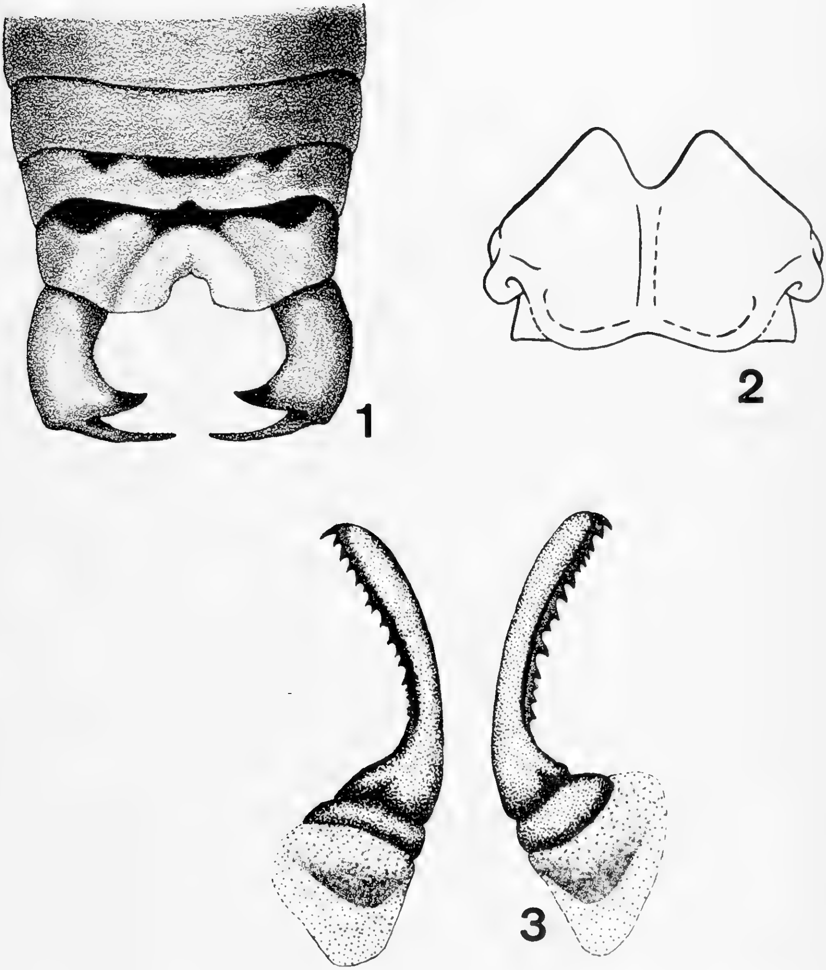
[2] Department of Entomology, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118

[3] Department of Entomology, Oregon State University, Corvallis, OR 97330

ENT. NEWS, 87: 5 & 6: 145 - 158, May & June 1976

Rentz, 1972; 62) by its distinctive coloration which is basically green with the central portion of the abdominal tergites and pronotum contrastingly colored forming a broad longitudinal stripe. Males have the lower tooth of the cercus less elongate (fig. 1) than in *I. hermani* and the titillators have fewer teeth (fig. 3) and are flanged basally. The tenth tergite is unspecialized and marked with black as is typical of the species group. Females have a short ovipositor and subgenital plate with a well defined notch (fig. 2). As with most of the other members of the Hermani Group, *I. chewaucan* is an occupant of the Greasewood-saltbush plant community.

Description. – HOLOTYPE MALE. Oregon, Lake County, Abert Lake, 12 July 1974. David C. Lightfoot collector. The holotype and allotype are deposited in the California Academy of Sciences, Number 12519. Size medium for genus, form robust. HEAD with fastigium of vertex well produced, broad, 1 1/2 times as broad as interocular distance. Eyes prominent, bulging, distinctly longer dorso-ventrally, 2 1/2 times as broad as first antennal segment. PRONOTUM smooth dorsally, not polished, transverse sulcus present in anterior portion extending for short distance onto lateral lobes; median portion of disk with a pair of minute indentations, median carina indicated only by color; posterior portion of lateral lobe declivent, posterior margin of disk concave, raised. TEGMINA protruding for a distance equal to slightly less than half the length of pronotum. APPENDAGES. Fore femur bearing 1 and 3 teeth on anterior margin of ventral surface, genicular lobe of same bearing a pair of minute teeth; fore tibia armed dorsally with 3 evenly spaced spines on posterior margin, anterior margin unarmed; ventral surface bearing 6 teeth on both margins. Middle femur armed on anterior margin of ventral surface only, with 2 and 3 minute teeth; anterior genicular lobe with 2 minute teeth, posterior genicular lobe with a single tooth; middle tibia armed dorsally with 2 spines, placed medially on anterior margin and 4 spines on posterior margin; ventral surface bearing 6 spines on both margins. Hind femur armed ventrally with 3 and 5 teeth on outer margin, inner margin with 4 and 5 teeth; genicular lobe armed only internally. Hind tibia armed dorsally with 21 spines on internal margin, 24 on outer margin, dorsal surface bearing a pair of apical spurs, the internal of which is slightly longer; ventral surface bearing 6 and 7 spines on internal margin, external margin with 7 and 12 spines; apex with 4 very elongate spurs, internal pair less than half the length of outer spur. Plantula of hind tarsus short, quadrate, 1/3 length of metatarsus. ABDOMEN dorsally smooth, without any trace of median carina, pilosity absent except where noted below; dorsum of tenth tergite with soft median integumental area well indicated, sparsely pilose; cercus rather stout, shaft evenly cylindrical, apex divided forming 2 teeth, the ventral of which is slightly the longer, apex of dorsal tooth distinctly curved mesad and ventrad. Subgenital plate rather prominent, apex with shallow V-shaped incision; styles short 1 1/2 times longer than broad, 1/3 length of one side of incision. Titillator very similar to that of *I. inermoides* Rentz, base flat, flanged at ventro-external margin, arm elongate, flat, toothed on outer margin with 7 teeth, apical quarter of titillator concave dorsally. COLORATION basically light green. Dorsum of head, pronotum, and abdomen dark pinkish brown; abdominal tergites 5-10 marked laterally with black, 10th tergite more extensively marked. All femora unmarked with black. Teeth and spines all black-tipped, teeth of femora entirely black. Tegmina with veins straw brown, cells smoky.



Figures 1-3. Diagnostic structures in *Idiostatus chewaucan* Rentz and Lightfoot, new species. Figure 1, apex of Abomen, male paratype. Figure 2, subgenital plate, female paratype. Figure 3, titillator, male paratype.

ALLOTYPE FEMALE. Same data as holotype. Similar to male but with following exceptions: size somewhat larger, form more robust. Tegmina slightly protruding beneath pronotum, with 5 longitudinal veins extending from base to apex. Tenth tergite deeply excavate, V-shaped. Cercus stout, conical, apex blunt, faintly directed ventrad. Subgenital plate with median notch broadly U-shaped, somewhat resembling *I. hermani* Thomas. Ovipositor about equal in length to hind femur, straight, apex with many scattered minute tubercles. Color similar to male except dorsal longitudinal stripe much lighter.

Derivation of name. – This species is named after pluvial Lake Chewaucan which covered the area where the species is found. Abert Lake and Summer Lake are remnants of Lake Chewaucan.

Type Locality, – The exact type locality of *Idiostatus chewaucan* (fig. 5) is a State Highway Commission gravel stockpile area along U.S. H.W. 395, approximately 4 miles north of Lake Abert and 2 1/2 miles south of Hogback Summit, Lake County, Oregon.

Seasonal Occurence. – *I. chewaucan* has only been collected in the middle of July at which time adults were prevalent though a few last instar nymphs were also present. In captivity, males stopped singing in September and females declined ovipositing in October. Towards the end of September, specimens becaue sluggish and colors began to darken and fade. In captivity, two females collected on July 17, 1975, lived until November 22 of that year. At the time of death one still contained 13 eggs, the other 6.

Distribution. – *I. chewaucan* is known only from the Chewaucan basin in south-central Oregon (fig. 6). This large "U" shaped basin contains two large saline lakes, Lake Abert and Summer Lake. The species is found in localized populations and appears to inhabit only the northern ends and central perimeter of the basin. Specimens were found at the north end of Lake Abert (type locality), the north end of Summer Lake, and in an area 6 miles northwest of Valley Falls. Searches were made along the east side of Lake Abert and the west side of Summer Lake without finding a trace of the species. The southern edge of the basin does not seem to have a favorable habitat (see habitats below). The Alkali Lake basin and the Silver Lake-Christmas Valley area north of the Chewaucan basin both offer a suitable habitat. However during the two consecutive years *I. chewaucan* was collected, these other areas were collected without a sign of any *Idiostatus* species. Warner Valley to the east also has a suitable habitat though the 2,000 foot escarpment of Abert Rim which borders the east side of the Chewaucan basin may act as a barrier to movement in that direction, since the species seems to be limited to lower elevations.

Habitats. – *I. chewaucan* seems to be very particular in habitat preference. This species occupies the greasewood-saltbush plant community, although

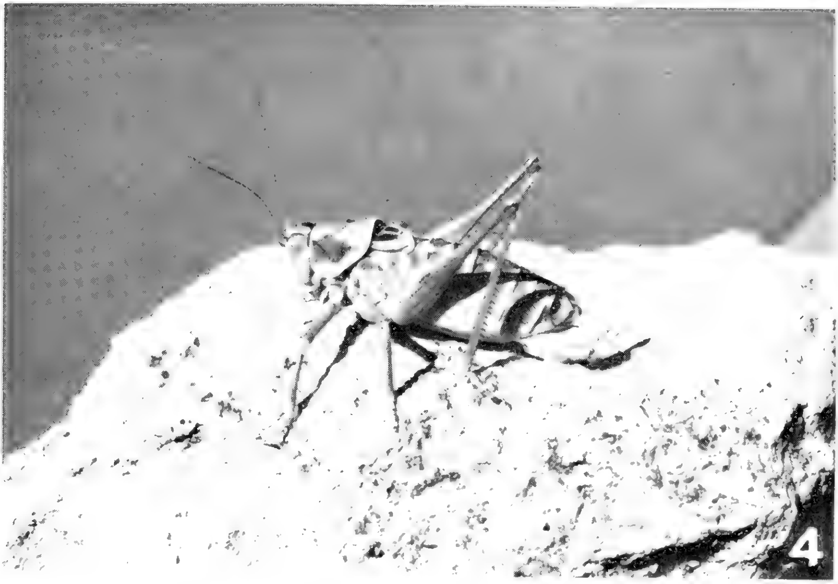


Figure 4. *Idiostatus chewaucan* Rentz and Lightfoot, new species, male paratype. Figure 5. Type locality, *Idiostatus chewaucan* looking south. Note Abert Rim and Abert Lake in distance. Plants in foreground include greasewood, saltbush, and rabbit bush.

only in areas where soil and plant conditions are suitable. It appears that *I. chewaucan* is limited to areas where the plants *Sarcobatus vermiculatus, Atriplex confertifolia*, and *Grayia spinosa* are found growing together on soil that is sandy or very loose. Both the vegetation and soil appear to be important factors. Many areas were searched where just one of the above elements was missing, with no sign of the species.

Of the three plants, *Sarcobatus vermiculatus, Atriplex confertifolia*, and *Grayia spinosa, I. chewaucan* seems to prefer *Atriplex confertifolia*. Although specimens were found on all three of these shrubs, they were found most often on *Atriplex*, although *Sarcobatus* was usually the most abundant. In captivity, specimens fed readily on all three plants, but no feeding was observed in the field. The only other plants *I. chewaucan* was found on were Russian thistle *(Salsola kali*), filaree *(Erodium cicutatium*), both growing on gravel surrounding the gravel piles at the type locality, and *Atriplex canescens* which was noted at some locations. In all areas *I. chewaucan* was collected, there were small amounts of rabbit brush *(Chrysothamnus nauseosus)* although no specimens were found on it. Ana Reservoir was the only location where big sagebrush *(Artemisia tridentata*) was present but no specimens were found on this plant either.

A number of areas were searched without success where the proper vegetation was present but the ground consisted of heavy alkaline or clay soils. All locations where *I. chewaucan* was collected were areas of loose, sandy soil where alkali flats met elevated land, and always at the north end of the flat. This may be attributed to the fact that in the northern Great Basin, prevailing southerly winds have deposited sand and light soils on the northern flanks of most of the smaller basins. Sandy soil may be preferred by *I. chewaucan* for oviposition or may only be significant for the proper vegetation.

Typical orthopteran associates of *I. chewaucan* include: *Aeoloplides* sp., *Trimerotropis arenacea, Trimerotropis bilobata, Trimerotropis gracilis,* and *Trimerotropis latifasciata.*

Behavior. – As with other members of the Hermani Group, *I. chewaucan* is a diurnal species. Through observations at the type locality, it was found that the species became active soon after sunrise in the morning when the temperature reached about 65°F. At this time males began to sing. Singing increased as the day got warmer. The peak period of singing was from about 10:00 A.M. to 3:00 P.M. (PDST) when the temperature ranged from 80° to 95°F. During the mid-day hours, specimens were always found on the upper parts of bushes. In the late afternoon singing diminished and ceased completely by 6:00 P.M. At 7:00 P.M. both males and females were noted

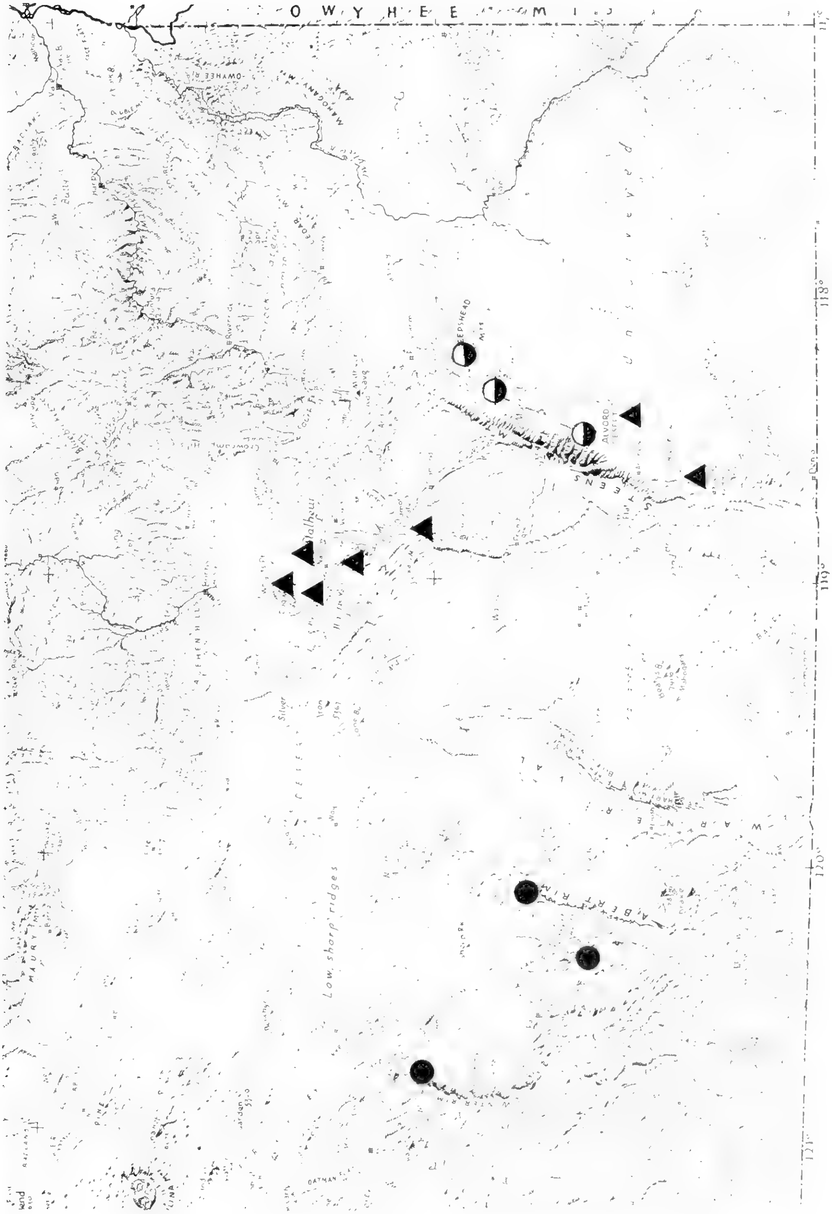


Figure 6. Known distribution of *Idiostatus* species in southern Oregon. Filled circles, *I. chewaucan*; triangles, *I. inermoides*; half-filled circles, *I.* species.

wandering about on the ground though none were heard singing. Males resumed singing shortly after sunset (8:45 P.M.). At night singing males were always found in bushes while females and other males would wander around on the ground. Driving along highway 395 near the type locality from 9:30 P.M. to 11:00 P.M. both females and males were found to be very numerous on the surface of the road and males could be heard singing from surrounding vegetation. Males continued singing until about 1:00 A.M. when the temperature dropped to 60°F.

No mating or oviposition was observed in the field though observations were made in captivity. Oviposition was observed often from mid August to the end of September, always occurring in the evening. All eggs were laid in sand. The oviposition procedure is exactly as described of *I. hermanii* (Rentz, 1973) though the number of eggs laid at a single site is not known. Mating was observed on August 25 at approximately 1:00 P.M., when the temperature was 85°. The mating procedure was similar to that illustrated of *I. hermani* (Rentz, 1972). Copulation took place on a sand surface, the female upright and the male on his back with his abdomen arched under the female, Copulation lasted 12 minutes after which the two separated and the female tried unsuccessfully to remove the spermatophore. Though no other matings were witnessed, throughout the month of August females were often seen in the afternoon with spermatophores attached. As mentioned, *I. chewaucan* is found in localized populations. These populations appear to be stationary. At all locations *I. chewaucan* was collected it was found to be quite numerous.

Song. – The song of *I. chewaucan* is very much like that of *I. inermoides* through somewhat louder. During both the daytime and night the song takes the form of a continuous buzz, broken intermittently by a few zicks. The day and night songs sound identical though the night song is at a somewhat slower pace, probably due to the cooler temperature. The song begins with a series of raspy zicks which gradually increase to a very rapid, continuous, zick-zick-zick - - -. At close range the rapid individual zicks can be made out but at a distance it sounds like a high-pitched, undulating, buzz. In the morning and early evening when singing begins the periods of buzzing are short and broken by long series of zicks. Both warning zicks and the Distress Call are used by *I. chewaucan.*

Additional Remarks. – In collecting specimens it was found that collecting on the road surface at night was by far the best method (Rentz, 1968, 1973). During the day specimens were always found in bushes where they were extremely difficult to capture. Once located in a bush the specimen usually dives into the middle to the dense, thorny plant where it is nearly impossible

Measurements (in mm) of *I. chewaucan*

	Length body	Length pronotum	Width pronotum	Length hind femur	Length ovipositor
Males:					
holotype	27.0	7.1	4.5	18.6	
paratopotype	23.0	6.3	4.5	18.0	
NE end Abert Lk	28.0	6.2	4.5	18.0	
NE end Abert Lk	30.0	6.0	4.5	18.5	
NE end Abert Lk	29.0	6.8	4.6	18.3	
NE end Abert Lk	28.0	6.0	4.0	18.5	
NE end Abert Lk	26.0	7.6	4.6	19.0	
NE end Abert Lk	26.5	6.0	4.5	19.0	
NE end Abert Lk	28.5	7.0	4.5	18.5	
Females:					
allotype	30.0	6.6	4.1	19.6	19.2
paratopotype	28.0	6.7	4.0	20.0	21.4
NE end Abert Lk	26.0	6.9	4.2	20.0	21.3
NE end Abert Lk	26.0	6.8	4.3	20.0	19.0
NE end Abert Lk	27.0	6.5	4.1	20.2	18.0
NE end Abert Lk	27.0	6.8	4.0	19.8	20.0
NE end Abert Lk	25.0	6.2	4.0	18.5	20.4
NE end Abert Lk	26.0	6.2	4.1	20.0	21.2
NE end Abert Lk	25.0	6.1	4.0	20.0	20.5
NE end Abert Lk	24.0	6.0	4.3	18.0	20.0

to see. Road collecting was also useful in determining the extent of populations as described by Rentz (1973).

I. chewaucan is most closely related to *I. inermoides* and the two could possibly come into contact at the southeastern limit of the range of *I. chewaucan* or the western limit of *I. inermoides*. Warner Valley would be one of the most likely areas where the two might come into contact. This area has not been collected for either species and future collecting here would be most desirable.

Males of *I. chewaucan* key to *I. inermoides* Rentz (Rentz: 1973:35). Females key to *I. hermani* Thomas. Both sexes can be readily separated at those points by inserting, at couplet 13 that males of *I. chewaucan* have the lower tooth of the cercus less elongate and more stout and the titillators have fewer teeth and are flanged basally. Females may be separated at couplet 8 (Rentz: 1973:39) by noting the difference in distribution between *I. hermanii* and *I. chewaucan.*

Records. – OREGON: LAKE COUNTY: Lake Abert, 4 mi. N.E., 15 July 1974 (D.C. Lightfoot & W.N. Mathis, 3♂♂, 2♀♀, holotype, allotype, paratypes); Lake Abert, 1-6 mi. NE., 17, 18 July 1975 (D.C. Lightfoot, 24♂♂, 27♀♀, 1 last instar ♂, 1 last instar ♀, paratypes); Lake Abert, X-L Ranch, 1 mi. E., 18 July 1975 (D.C. Lightfoot, 2♂♂, 1♀); Valley Falls, 6-7 mi. NW., 19 July 1975 (D.C. Lightfoot, 2♂♂, 1♀, 1 last instar ♂); Summer Lake, Ana Res., 1/2 mi. NE., 19 July 1975 (D.C. Lightfoot, 3♂♂).

The topotypic series was collected at mid-day around noon when singing males revealed their presence. Most of the specimens were collected on Russian thistle *(Salsola kali)* which was growing on the gravelly area adjacent to the gravel piles. Individuals also were heard and seen on the surrounding greasewood and saltbushes but were very difficult to capture. Both males and females were taken from vegetation. The species was fairly common at the type locality but seen nowhere else. On this same day, stops were made all along the east side of Lake Abert and at Alkali Lake, but *I. chewaucan* was not heard or seen at any of these locations. All specimens of the type series were green except one male which was gray-brown in color.

As with other members of the Hermani Group, the coloration of *I. chewaucan* is highly variable. The general color patterns are very similar to *I. inermoides* though usually there is not as much color variation per individual. The two basic color forms, green and gray-brown, were at about an equal proportion in all specimens seen. In green specimens, all retained two parallel pink-red stripes running the length of the body on the dorsum. Green specimens varied from having black markings only on the last two abdominal tergites to those with black markings on each tergite. In specmens lacking the black marks, the pink-red coloration was usually much more reddish than those with the black markings which retained a more pinkish color in the two parallel stripes. In the gray-brown specimens, there are two general color patterns. In one the entire body is basically a mixture of gray and brown with the black variegated pattern on the dorsum of the abdomen. The other has a generally gray body except for a broad yellow stripe which runs dorsally the entire length of the body from the fastigium to the last abdominal tergite. The pattern of black markings on the dorsum of the abdomen is usually much less pronounced in specimens with the yellow band. There are color variations within the green color form and the gray-brown color form, but unlike *I. inermoides,* there was found to be no mixture of green and brown in any one specimen, with the rare exception of a slight greenish tinge in the legs of some gray-brown individuals.

Idiostatus inermoides **Rentz.**

Idiostatus inermoides was found to be fairly common throughout the southern end of the Sunset Valley between Harney and Malheur lakes. This is an area of extensive alkali flatland, vegetated mostly by greasewood with some sagebrush and *Atriplex* spp. *I. inermoides* was found only on the flats and unlike *I. chewaucan*, on heavy alkaline soils, where it showed a preference for *Sarcobatus vermiculatus*. Specimens were rarely taken on saltbushes *(Atriplex* spp). and occasionally on Russian thistle *(Salsola kali)* growing along the road sides. *I. inermoides* was also collected in the Alvord basin, just north of the type locality (near Denio, Nevada; Rentz 1973). Here too, specimens were found only on alkaline flatland and showed a preference for *Sarcobatus vermiculatus*. In both the Sunset Valley and Alvord basin, the species was found over a wise area but in scattered, localized populations.

In most respects, *I. inermoides* was very similar to *I. chewaucan*. The species appeared to be most active during the early afternoon and late evening. The song of *I. inermoides* sounded very much like *I. chewaucan* though not quite as loud. At night *I. inermoides* did not sing to the degree of *I. chewaucan*, though the song did take the form of a buzz.

One interesting observation was that specimens were not found on the road surface at night. On five or six occasions, the second author drove for some time in the evenings on smooth, paved, roads but was able to find only one specimen (♀), crushed on the road surface, even though numerous males could be heard singing from roadside vegetation. In the Alvord basin, road collecting was impractical because the only road through the area had a very rough, gravel surface.

Records. – OREGON: HARNEY COUNTY: Narrows, 5 mi. N., 17 August 1974 (D.C. Lightfoot, 1♂); Malheur Environmental Field Station, 7-15 August 1975 (D.C.

Lightfoot, 13♂♂); Narrows, 5 mi. N., crushed on surface H.W. 205, 12 August 1975 (D.C. Lightfoot, 1♀); Narrows 20 mi. S., 13 August 1975 (D.C. Lightfoot, 2♂♂); Harney Lake, N.E. end, sand-dunes, 13 August 1975 (D.C. Lightfoot, 1♂); Alvord Desert, Borax Lake, 10 August 1975 (D.C. Lightfoot, 1♂); Fields, 1 mi. N., 10 August 1975 (D.C. Lightfoot, 1♂).

Idiostatus **sp. ?**

Traveling to the Alvord Desert a stop was made just north of Juniper Lake to collect Orthoptera and a species of *Idiostatus* was discovered that looked identical to *I. chewaucan*. The habitat at this location was very different from that typical of *I. chewaucan* or *I. inermoides*, being a sagebrush plant community rather than a greasewood-saltbush plant community. Specimens were collected on sagebrush and rabbit brush where males were found singing. Continuing south along the gravel road, a number of stops were made and the species was encountered each time. After many observations, it became apparent that the species had no host preference. Specimens were found on all plants from sagebrush to giant wild rye grass *(Elymus glauca)*. Specimens were especially numerous in a dense growth of Russian thistle which bordered the road much of the way. The species was noted as far south as Mann Lake with the exception of one female that came to a black-light at Pike Creek, three miles south of Alvord Ranch. This location was also in the sagebrush plant community, well above the alkali flat below. No males were heard singing during the day at Pike Creek nor were any other *Idiostatus* seen. At both Mann Lake and Juniper Lake, specimens of *I. inermoides* were seen on greasewood which was found growing only near the lakes. Though attempts were made, unfortunately none of these specimens could be caught.

This species is very closely related to *I. chewaucan* and *I. inermoides* if not one of the two. It has characteristics similar to both species yet cannot be placed with either one. The size is nearly the same as *I. chewaucan* thus larger than *I. inermoides*. The cerci are very similar to both species though the internal tooth seems to be stouter than either *I. chewaucan* or *I. inermoides*. The subgenital plate of the female does not compare with *I. chewaucan*, though is similar to *I. inermoides*. The coloration is highly variable as in both species, but tends to follow the pattern of *I. chewaucan*. To the unaided ear the song could be taken for either species. The main reason we believe this species to be something other than *I. chewaucan* or *I. inermoides* is the very different habitat in which it was found. In collecting *I. chewaucan* and *I. inermoides* we have always found them to be quite particular as to the plant life they are associated with, which is not characteristic of this species. A strong possibility is that this population is just a variation of *I. inermoides*.

Typical orthopteran associates of *Idiostatus* sp: *Aulocara elliotti, Oedale-*

onotus enigma, Melanoplus spp., *Conozoa wallula, Trimerotropis pallidipennis, Cratypedes neglectus,* and *Steiroxys* sp.

Records. – OREGON: HARNEY COUNTY: Juniper Lake to Mann Lake, 9, 11 August 1975 (D.C. Lightfoot, 7♂♂, 2♀♀); Alvord Desert, Pike Creek, 9 August 1975 (D.C. Lightfoot, 1♀).

Capnobotes occidentalis (Thomas)

During the second author's stay at the Alvord Desert he camped at Pike Creek, a small stream which runs down the east face of Steens Mountain and discharges into the great playa of the Alvord Desert.
C. occidentalis was found to be quite common at this location. The two nights spent there were warm and still and males were very common at night singing from surrounding vegetation. The species was especially abundant in the vicinity of a cluster of cottonwood and willow trees growing along the portion of the creek where he camped. The surrounding vegetation consisted mostly of sagebrush and rabbit brush with many open areas of short grass. Most of the specimens were found on sagebrush growing near the creek though a few were on the cottonwood and willow trees. The species became very scarce and was seldom encountered away from this small grove of trees. All specimens seen on sagebrush were gray in color. Only two green individuals were found, one on willow and the other on cottonwood. Males situated themselves near the tops of sagebrush plants to sing. Those in the trees were usually on the lower branches. Singing began only after dark, about 9:00 P.M., and continued through the entire night. The temperature both nights ranged from 85°F at sunset to a low of 72°–74°F shortly after midnight. The song consisted of a continuous series of loud, rapid, tsh-ts-ts-ts-ts-ts-ts-ts--tsh-ts-ts-ts-ts-ts-ts-ts---tsh-ts-ts-ts-ts-ts-ts-ts- - - - -, each set lasting about 3 seconds at 1 second intervals. The species was also collected about 8 miles south of Pike Creek near Andrews in the early summer of 1972, when a male was swept from sagebrush and rabbit brush.

Records. – OREGON: HARNEY COUNTY: Andrews, 3 mi. N.E., 15 June 1972 (D.C. Lightfoot, 1♂); Alvord Desert, Pike Creek, 9-10 August 1975 (D.C. Lightfoot, 7♂).

Apote notabilis Scudder

While at Pike Creek, the second author collected a male of *Apote notabilis*, which appears to be the southermost record for the species.

While collecting in the evening, a call similar to *Capnobotes* was heard. Though much time was spent trying to locate the source, the attempt was unsuccessful. The following afternoon the song was heard again and after stalking it for nearly a half hour, a large, gray, decticid was spotted near the top of a five foot sagebrush plant. Attempts to catch it were unsuccessful as it dove for the center of the bush. Much of that evening and night was spent trying to locate the extremely wary insect as it sang. The next morning the song was again heard and after a great deal of time, finally the katydid was captured which to my surprise was an adult male Apote *notabilis*. This specimen sang at any and all times of the day and night, the form of the song never changing. The song itself consisted of a short series of very loud, rapid, tsit-tsit=tsit-tsit-tsit-tsit- - - -, lasting for about 4 seconds. Only one series was elicited at a time and usually 2 to 3 minutes apart. This long pause in the song made locating the specimen a very difficult and time consuming task, especially since it would usually stop singing when approached within 75 feet. No other specimens of this species were heard or seen on the trip.

Records. – OREGON: HARNEY COUNTY: Alvord Desert, Pike Creek, 11 August 1975 (D.C. Lightfoot 1♂).

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REDISCOVERY OF *BEMBIDION RUFOTINCTUM* CHAUDOIR, WITH EXTREME RANGE AND DISTRIBUTIONAL RECORDS OF *BEMBIDION* AND OTHER CARABIDAE (COLEOPTERA)[1]

Kenneth W. Cooper[2]

ABSTRACT: The history, rediscovery in Vermont, and ecology of *Bembidion rufotinctum* Chaud. are briefly described; ranges of *B. obscurellum* Motsch. and *B. rapidum* Lec. are shown to have reached the Atlantic coast (in N.H. and Mass., respectively), and that of *B. oberthueri* Hayw. to include California. The European *B. obtusum* Serv. occurs in upper New York State. Distributional records and comments on an additional 10 species of *Bembidion*, chiefly from New Hampshire, are provided, as well as notes on the adventitious *Trechus discus* Fabr., on *Platypatrobus lacustris* Darl., and *Helluomorphoides praeustus bicolor* (Harris). *Bembidion* is represented in New Hampshire by not less than 56 species, and probably not more than 70.

DESCRIPTORS: Carabidae: history, habitat, biological notes, extreme ranges, distribution.

Darlington (1931) has made a very large contribution to our knowledge of New England Carabidae in his unpublished manuscript "The cicindelid and carabid beetles of New Hampshire, with special reference to their geographical relationships", available in the Archives of Harvard University. For a number of years during my residence in New Hampshire this manuscript served as a stimulus and guide to my field studies which, at that time, were viewed by me as preparatory to an examination of the cytology of *Bembidion* species and their natural history, with the hope of unravelling some biological puzzles that could be related to the well known glacial history of the region. Regrettably that pleasant occupation necessarily ended when I relocated in California. The present account adds to Darlington's records of *Bembidion,* as well as to those for a few other notable carabids, describes the interesting history and rediscovery of *B. rufotinctum* Chaud., and establishes the fact that *B. obscurellum* Motsch., which Lindroth (1971) has shown to be increasing its range, has now reached and colonized at least one point on the Atlantic coast.

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[1] Accepted for publication: January 19, 1976

[2] Department of Biology, University of California, Riverside, 92502

ENT. NEWS, 87: 5 & 6: 159 - 166, May & June 1976

1. *Bembidion (Pseudoperyphus) rufotinctum* Chaud.

Bembidion puritanum Hayw. and *B. rufotinctum* are among the least known of our New England *Bembidion*, though each is easily recognized. They have an interesting history which stands apart from that of other northeastern species in three notable ways: each has been known only from small series of specimens from Massachusetts, the precise localities of capture and habitats are unknown for the specimens on which their descriptions are based, and each has eluded rediscovery for 80 years or more. Quite possibly *B.puritanum*, known from only 4-5 specimens, when found again will prove to be a coastal form living intertidally within airbells between narrow rifts of fractured rocks submerged at high tide, as does the superficially similar *B. laticeps* Lec. along rocky areas of the southern coast of California from San Diego to at least Carmel.

So far as I can ascertain, *B. rufotinctum* is known only from Chaudoir's specimen or specimens, a total of a dozen or so specimens in the Blanchard, Fall, Hayward and Leconte collections at Harvard University, a single specimen in the Casey collection at the U.S. National Museum, and another (as *B. blanchardi* Hayw.) in the residue of the Horn collection remaining at the Academy of Natural Sciences, Philadelphia. All but Chaudoir's material was collected by Frederick Blanchard in April, May and September, chiefly or entirely in 1888, at Lowell, Middlesex County, Massachusetts. Blanchard's correspondence, in the Archives of the Museum of Comparative Zoology at Harvard, does not mention *B. rufotinctum* (= *B.blanchardi* Hayw.), so it sheds no light on its specific habitat or on the manner of its collection. As Chaudoir (1868) described *B. rufotinctum* without mention of locality, Lindroth (1963) therefore has designated Lowell, Mass. as the type locality. However, for reasons that will become clear, Lowell is very likely a place at which *B. rufotinctum* can at best only occasionally or rarely be found, for it is an unsuitable environment for the species.

It has not been possible for me to narrow down the locality of Chaudoir's material. It was received from John A. Guex (deceased 1857), possibly along with specimens of *B. planum* Hald., to judge from Chaudoir's comments, and very likely before 1854 or 1855 for in those years Guex donated his collection of Coleoptera to the Academy of Natural Sciences (Phillips and Phillips 1963). Through the kind searches of Dr. Michael G. Emsley and Mrs. Venia Phillips, both of the Academy, it can be stated that no specimens of *B. rufotinctum* are now to be found in the Guex collection under either Chaudoir's specific name or that of *B. planum*, nor does the Academy's file of Guex's correspondence contain any interchanges with Baron Chaudoir that might throw light upon Guex's source. The specimens of *B. planum* now in the Academy collections are labelled "Mass.", "N.J.", "N.Y.", and "Penn.", the majority of which were from the collections of Charles Wilt; among these there is included a specimen of the related *B. fugax* Lec. from "Mass.", also from Wilt's material. Possibly then, Chaudoir's material came from Massachusetts. But New York may have been his source, for Csiki (1928), on grounds I have not uncovered, lists *B. rufotinctum* as from New York as well as Massachusetts. Csiki may possibly have seen or known of specimens now in Europe originating from material received from Wilt, for Horn (1886) states that Wilt engaged in "constant exchanges". New Jersey and Pennsylvania seem more remote possibilities.

In June of 1964 I found *B. rufotinctum* in abundance in the wooded Queechee Gorge of the Ottauquechee River, Windsor County, Vermont, a little less than a mile south of the crossing of U.S. Highway 4, elevation about 128 m. Here the small, rapidly running river flares out at a roughly level open area of slightly to strongly uptilted, cracked and waterworn rocks (see Doll 1961). In nearly every spring, and following heavy rains during the summer and fall, that rocky table is wholly inundated. Following subsidence of the waters, the dissected rocks retain pools of stagnant water, but along their western margin the river forms a turbulent race through a deep, narrow main channel, 5 to 10 m wide. Along the spray zone on the rocks, amid algal mats, on the otherwise bare rock itself, in shingled cracks of the rocks, and back to little more than a couple of meters of the rushing water, *B. rufotinctum* abounds. It runs rapidly on the sprayed rock faces, rarely flying. In spring and summer months, during brief periods of inundation, it is found at the new margins of the water, far back from the channel, in damp shingle and gravel. Several teneral specimens were found in mid September amid rhizoids of the low, tightly grown moss that is shallowly embedded in rock fissures along the margins of the race of the main channel. *B. rufotinctum* therefore overwinters in the imaginal state. I now have remaining some 70 specimens collected in V, VI, VII, VIII and IX, 1964-1967: 34 males and 36 females. In all of my collecting, males and females have occurred in nearly equal numbers.

The fact that *B.rufotinctum* is a dweller, and presumably a forager, on nearly bare rock ledges along turbulent waters no doubt accounts for its apparent rarity, as that particular and seemingly barren and harsh environment is rarely occupied by other *Bembidion,* and is hardly likely to be closely attended by collectors. Prof. Darlington, who visited the Queechee Gorge locality with me, says that the river at Lowell, Mass., with its mud and sand, is not at all like that at the rocky gorge, and that he suspects that the specimens collected by Blanchard in early spring may have been taken in flood debris, for he believes Blanchard collected in floods. If so, the specimens taken later in the year at Lowell may also have arrived flood-borne.

Elsewhere in the immediate area adjacent to that inhabited by *B. rufotinctum* are to be found *B. honestum* Say and *B. planum* Hald. (along a gravel bar), *B. nigrum* Say, *B. semistriatum* Hald., *B. versicolor* Lec., and *B. oberthüeri* (where there are stretches of fine or sandy muds far back from the race), *B. castor* Lindr., *B. patruele* Dej., *B. rapidum* Lec. and, on a sandy rise that remains above water during inundation, thicketted with small willows, *B. postremum* Say.

Mr. Robert Davidson, of the Department of Zoology, University of Vermont, and Mr. Paul Choate, of the Department of Entomology, University of New Hampshire, have since collected *B. rufotinctum* not only at Queechee Gorge, but abundantly elsewhere. Publication of their notes and observations will greatly extend our knowledge of this very pretty and hitherto obscure *Bembidion.*

2. *Bembidion (Phyla) obtusum* Serv.

Lindroth (1963) first called attention to the occurrence of this "truly European species, quite recently discovered in North America and perhaps not established", citing 3 examples from Ontario (Bondhead, 7.IX.56) Canada, as well as one taken on shipboard in New York City. In Berlese samples of leaf litter from Bergen Swamp, Genesee Co., N.Y., 29.VIII.64, Prof. W.B. Muchmore recovered a mature female and 3 mature males of this species, the identity of which I have checked against European specimens, including preparations of the aedeagus. Like the 3 Canadian specimens, all 4 have atrophied wings. The species is therefore very likely firmly established. As this locality is only some 15 miles southwest of Rochester, N.Y., *B. obtusum* quite possibly was introduced in upper New York State prior to the First World War (see Cooper 1961). Netolitzky (1931) summarizes its distribution in Europe.

3. *Bembidion (Peryphus) obscurellum* Motsch.

Lindroth (1971) has pointed to this species as a clear example of one that has expanded its range eastward in recent times, an expansion presumably made possible and encouraged by the extensive deforestation of recent years. According to Lindroth it was unknown from east of Manitoba until discovered in western Ontario in 1947. Lindroth points out that since then it has been reported from near Lake Superior (1956), from Quebec (Ville de Louraine, 1964) and Vermont (1965). On 10.VI and 26.VI.66, in a large tract of sandy fields at Rye, Rockingham Co., New Hampshire, dominated by clumps of *Spartina pectinata* Link, *S. patens* (A.T.) Muhl. and mats of *Spergularia marina* (L.) Ginseb., *B. obscurellum* was abundant amid the roots of the grass clumps and under litter, along with the earwig *Forficula auricularia* L. Evidently the *Bembidion* were members of a well-established population, for some 14 (6 males, 8 females) of the 53 specimens taken were teneral. The sex ratio in my sample is 1.8 : 1, 34 males and 19 females. As *B. obscurellum* is common in California, it now ranges from coast to coast in North America, and is a circumpolar species.

4. *Bembidion (Eupetedromus) immaturum* Lindr.

Described from Newfoundland by Lindroth (1955) and recorded by him from Quebec and New Hampshire, I can add that it has also been found at Whittier, Carroll Co., V and VI.65, Concord, Merrimack Co., 22.V.65, and running on soft, very fetid mud in a small *Typha* marsh at Lancaster, Coos Co., 15.V.63. A single specimen received from Mr. Loren Russell was taken by him at Davenport, Scott Co., Iowa in IX.66, considerably extending the known range to the west and south.

5. *Bembidion (Notaphus) rapidum* Lec.

B. rapidum was not known to reach the Atlantic coast, nor had it been recorded from northeastern states (Lindroth 1963). It has been found by me sparingly at Hanover, Grafton Co., 26.VII.63 and Lake Chocorua, Carroll Co., 26.VI.65, and in a light trap by Prof. R.L. Blickle, University of New Hampshire at Rochester, Strafford Co., 2.VII.65, all New Hampshire localities. It reaches the Atlantic coast at Woods Hole, Plymouth Co., Mass., where Mr. Geoffrey Pollitt (of Harvard University) took a small series of specimens on 31.VII.66. It is also frequent in June and July at Mendon Ponds, Monroe Co., N.Y. (Dr. Jakov Krivshenko), Galeton, Potter Co., Pa., and in black light collections made by Prof. S. Hughes-Schrader at Durham, Durham Co., N.C.

6. *Bembidion (Notaphus) oberthueri* Hayward

Ranging from the Rockies to the east, and not uncommon in my experience in Pennsylvania, Vermont and New Hampshire, Darlington (1931) regards it as "probably a recent immigrant from the west". It is known from as far west as Alberta; the sole record from British Columbia (Kamloops) is regarded by Lindroth (1963) as doubtful. On 14.VI.70 I collected a single male from a sunned, muddy, grassy, openly wooded streamside near Poopout Hill (ca. 2290 m elevation), south of Barton Flats), San Sernardino Co., Calif.

7. Other records of *Bembidion*

To Darlington's extensive list (some 35+ species) of New Hampshire *Bembidion* may be added the following:

B. (Ochthedromus) americanum **Lec.** from Grafton Co., Hanover, 19.VII.65, Carroll Co., Lake Chocorua, 26.VI.65, and from black light collections by Prof. Blickle at Merrimack Co., Hooksett, 8.VII.63, and at Strafford Co., Rochester, 2.VII.63, Durham, 13.VII.63 and 8.VIII.65, and Lee., 17.VII.65.

B. (Notaphus) cordatum **Lec.**, a single female, on alga-overgrown mud at the inlet of Girl Brook to the Connecticut River during a prolonged spell of low water, Hanover, Grafton Co., 19.VII.65.

B. (Notaphus) constrictum **Lec.**, salt marsh at Hampton, Rockingham Co., 25.VIII.64, 15.VIII.65 (evidently close to or at the same locality at which Darlington collected *B. (Notaphus) contractum* Say. The aedeagus and fully developed wings leave little doubt as to the identify of my specimens.

B. (Semicampa) praticola **Lindr.**, Hanover, Grafton Co., 2 specimens, 18.VII.64.

B. (Trepanedoris) fortestriatum **Motsch.**, wooded, swampy margins of sphagnum bogs at Grantham and North Grantham, Sullivan Co., 19.VI.66 and 7.VIII.66.

The following are difficult but not uncommon forms now at last recognizable with confidence from Lindroth's great work (1963); very probably all were taken by Darlington:

B. (Notaphus) castor **Lindr.**, counties: Carroll, Cheshire, Coos, Grafton Merrimack and Sullivan, V-VIII.

B. (Furcacampa) mimus **Hayw.**, counties: Cheshire, Grafton and Sullivan, V-VIII.

B. (Trepanedoris) concretum **Csy.**, counties: Grafton, Sullivan and Strafford, VI-X.

8. Trechus (Lasiotrechus) discus **Fabr.**

The first record for North America of this Eurasian species is that of Chagnon (1934), at light, Lanoraic, Quebec, 29.VI.33. Lindroth (1963) has given additional records for Canada, as well as 2 from upper New York State (Lyons 1950, *ca.* 27 miles west of Rochester, and Ithaca, 1955). I have taken individual specimens under rocks along the White River at White River Junction, and along the Connecticut River at Hartland, Windsor Co., Vermont. It is frequent at black lights in Hanover, Grafton Co., and has been taken at black light by Blickle at Durham and Lee, Strafford County, New Hampshire; all records are for July and August; collectively they show the species to be established in New England. As for *B. obtusum*, an original introduction may have occurred at Rochester, N.Y. According to Lindroth (1945, 1963), it is most frequent in Europe during August, overwinters as a larva, and is frequently found in burrows of small rodents and moles.

9. *Platypatrobus lacustris* Darlington

Described from a unique specimen by Darlington (1938), this remarkable carabid remained a great rarity, only 9 or so specimens being known to 1965, including one from Maine (Robert, 1963). On Darlington's suggestion that the mite commonly carried by *Platypatrobus* might offer a clue to its habitat, Goulet (1965) submitted the mite to Dr. E. Lindquist, who identified it as a form occuring commonly in beaver lodges. Thereafter Goulet took some 51 *P. lacustirs* near Ottawa in association with an abandoned beaver lodge standing on very wet soil. Thus an insightful hint, and an admirable bit of detection led to a most notable discovery. Since then, Choate and Dyrkacz (1975) reported capture of a large series of *Platypatrobus* from the walls, mud foundation and chamber of a beaver lodge at Ossipee Co., N.H. Bell and Bell (1964) reported 2 teneral specimens taken at black light near Stowe, Lamville Co., Vt., 28.VIII.63. Prof. Blickle took a teneral female (21.VI.65) and a mature male, with mites (28.VI.65), at black light, Jefferson, Coos Co., N.H.

10. *Helluomorphoides praeustus bicolor* (Harris)

A single female, taken at black light by Blickle, Durham, Strafford County, 11.VI.65; a noteworthy record and no doubt not an accidental occurrence for Darlington records it from Swanzey Pond, Cheshire Co., 19.V.

Considering now Darlington's records of *Bembidion* from New Hampshire, plus the new records and determinations given here, and Lindroth's (1963) record of *B. (Trepanedoris) pseudocautum* Lindr. from New Hampshire, 47 species are now definitely known from New Hampshire. In addition, there are 9 species, not mentioned here, which I have taken close by in Vermont in the company of Prof. Ross T. Bell, of the University of Vermont, which without doubt are to be found in New Hampshire as well. So the *Bembidion* fauna of New Hampshire is not less than 56 species nor, to judge from Lindroth's (1963) extensive records of North American *Bembidion*, is it likely to exceed 70. New Hampshire, therefore has a representation of about 22 to 28% of the total likely number of species to be found in North America north of Mexico (*cf.* Lindroth, 1967).

ACKNOWLEDGEMENT

It is a pleasure to express my gratitude to all those whose names are mentioned in the text for their help and for specimens with which they provided me, to Prof. James P. Poole of Dartmouth College who identified the plants dominating the habitat of *B. obscurellum*, to Prof. P.J. Darlington and Dr. John F. Lawrence of Harvard, to Mr. Robert Davidson of the University of Vermont, and to Dr. Gerald Noonan of the Milwaukee Public Museum, all of whom cordially provided information otherwise inaccessible to me.

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THE STATUS OF BELOSTOMATID NAMES PUBLISHED BY J. N. F. X. GISTEL (HEMIPTERA: BELOSTOMATIDAE)[1]

A.S. Menke[2]

ABSTRACT: *Belostoma pallidum* Gistel is regarded as an emendation or lapsus for *Belostoma testaceopallidum* Latreille; *Belostoma fakir* Gistel is a senior synonym of *Lethocerus cordofanus* Mayr; *Iliastus* Gistel is a senior synonym of *Lethocerus* Mayr. A petition will be submitted to the International Commission on Zoological Nomenclature to conserve the name *Lethocerus*.

DESCRIPTORS: Hemiptera; Belostomatidae: *Iliastus* Gistel, *Lethocerus* Mayr, *Lethocerus cordofanus, Lethocerus fakir, Belostoma pallidum, Belostoma testaceopallidum,* synonymy, nomenclature, petition.

The numerous but rare works of Johannes Gistel (or Gistl) have been largely ignored by insect taxonomists; although they are recorded in bibliographies such as Index Litteraturae Entomologicae by Horn & Schenkling. Strand (1919) has given probably the most complete bibliography of Gistel's papers, and Horn (1924, and in Horn and Kahle, 1937) gave us some insight into Gistel's life and work.

The belostomatid names dealt with here were published in two different books with identical content as far as entomology is concerned. One work is folio size and bears the title "Naturgeschichte des Thierreichs ..." etc. It was first published in 1848, and was apparently reprinted in 1851. The second work is more comprehensive because it includes the plant and mineral kingdoms. It was coauthored with F. Bromme who was responsible for the plant and mineral section of the book. The title of this octavo size work is "Handbuch der Naturgeschichte aller drei Reiche ..." etc. Its title page bears the date 1850, but apparently at least the zoological portion was published in 1847 because the names discussed below are cited with that date by Neave (Nomenclator Zoologicus) and Sherborn (Index Animalium). However, in the bibliographic section of Index Animalium, the Gistel and Bromme book is dated "[1847 – 1849]" which does not help to clarify the situation. The zoological portion of the "Handbuch" is identical with the "Naturgeschichte" except for the pagination

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[1] Accepted for publication: January 19, 1976

[2] Systematic Entomology Laboratory, IIBIII, Agr. Res. Serv., USDA, mail address: c/o U.S. National Museum, Washington, D.C. 20560.

due to the different page sizes. The plates in the two books are different; many more insects are displayed in the "Naturgeschichte." A copy of the "Naturgeschichte" is in the National Agriculture Library, and a copy of the "Handbuch" is in the Smithsonian Institution. The location of Gistel's types, if they still exist, is unknown; but possibly they are in Munich, Germany (Horn and Kahle, 1935). For the most part, Gistel's descriptions are very brief, making identification of his taxa difficult.

Throughout the 1847 and 1848 works, Gistel cites many well-known generic and specific names usually without giving their authors, a practice common in those days. Other names are followed by "mihi", "N.", or "Nobis", indicating clearly that they are new Gistelian taxa. In the "Naturgeschichte" index these names are preceded by an asterisk. Unfamiliar names that are not followed by mihi etc., pose a problem. In some cases it is difficult to determine whether or not these names should be attributed to Gistel or to some prior author. Certain of these names appear to be emendations or misspelling of older names. Of some help in identifying Gistel names is the second section of a paper published in 1857 by Gistel entitled "Achthundert and zwanzig neue oder unbeschriebene wirbellose Thiere". Pages 54-57 of this paper contain "Neue Genera und Species von Insecten beschrieben von J. Gistel in dessen und Bromme's Naturgeschichte, Stuttg. 1848 und 1850. 8°". This is simply a list of his new taxa accompanied by a notation of the page of the "Handbuch" (1847) on which each name was published, plus the origin of the species (he described taxa from all parts of the world). As Gistel indicates at the middle of page 57, "Ueber die übrigen neuen Thiere vergleiche man das Werk selbst", the 1857 list of his new taxa is incomplete.

Kirkaldy (1906) discussed some "Naturgeschichte" Hemiptera names, but none of the belostomatid taxa were mentioned.

The belostomatid section in Gistel (1847 and 1848) consists of a few short paragraphs which are quoted below. The material is on pages 489-490 and 626 of the "Handbuch" (1847) and on pages 149 and 191 of the "Naturgeschichte". Pages 626 and 191 are found in an addendum section titled "Schluss".

Page 489-90 & 149: "I. Flusswanze *(Belostoma).*"

"Fühler 3-gliedig, etwas gekämmt. Vorderfüsse (beide) mit starken Nägeln, hintern 2-klauig, compress, breit. Rüssel reicht bis zu den Vorderfüssen. Bauch platt, scharf gerandet. Rückenschild gross, 3-eckig."

"Anm. Leben im Aequatorial-Amerika."

"Weissliche F. (*B. pallidum*). Blassgelb, einfarbig; Augen grau.- Hieher *Iliastus* (mihi) *grandis*, eine *Nepa*, unbekannt woher (in meiner Sammlung). 3" lang und 1 1/2" breit (eigens zu beschreiben). Die grösste Wanze, die ich je gesehen."

Pages 626 and 191: "In Aegypten erscheint in den Gewässern um Cairo ein *Belostoma* (*B. Fakir,* N.), das pechbraun ist, mit dunkler pechbraunen, vorstehenden Augen begabt. Grösse von *B. grandis*."

The first specific name, *pallidum*, appears to me to be an emendation or lapsus for *Belostoma testaceopallidum* Latreille, 1807, the type-species of the genus. It is not in Gistel's 1857 list, and it does not have an asterisk in the "Naturgeschichte" index.

The generic name *Iliastus* is a problem. It is not in the 1857 list. Gistel indicates that this name is to be described sometime in the future (it never was), and he gives only dimensional data. Although *Iliastus* is not accompanied by a description (unless size is sufficient), the name is associated with the Linnaean species *Nepa grandis*. Thus its identity and availability are assured under Article 16(a) (v). This has important consequences because *grandis* belongs in the Giant Water Bug genus *Lethocerus* Mayr, and thus *Iliastus* is a senior synonym. This is unfortunate because *Lethocerus* has enjoyed widespread popular usage for over 60 years. The conservation of *Lethocerus* would seem to require a petition to the Commission using the provisions of Article 79(b). This would be a simple case because *Iliastus* has not been mentioned since it was published except for inclusion in nomenclators such as Neave, Schulze et al, and Sherborn, while *Lethocerus* has been used many times. It might be argued that a petition is unnecessary for the following reason: throughout his text on the belostomatids Gistel uses the generic name *Belostoma* when referring to these bugs (note that he refers *grandis* to *Belostoma* on p. 626 and 191). Consequently, one could argue that *Iliastus* is a manuscript name ("eigens zu beschreiben") published in synonymy of *Belostoma*. According to Article 11(d) names published in synonymy are not available unless they have been adopted as the name of a taxon. The listing of *Iliastus* in nomenclators does not constitute such usage. Furthermore, the absence of *Iliastus* from the 1857 list may be an indication that Gistel did not consider the name as anything more than a manuscript name. However in the index of the "Naturgeschichte", names of new taxa are preceeded by an asterisk, and *Iliastus* has one. A secondary argument might also be made that because Gistel did not give an author for *Nepa grandis*, there is no proof that he is referring to Linnaeus' well-known bug.

Thus *Iliastus* could be thrown out simply because it does not fulfill the provisions of Article 16. However, *grandis* is listed under *Iliastus* in the "Naturgeschichte" index without an asterisk, an indication that Gistel was referring to the Linnaean species. Because continued usage of *Lethocerus* appears threatened, I intend to submit a petition to the Commission asking for its conservation.

Belostoma fakir is definitely a new taxon, and it is listed as such in Gistel's 1857 paper. The only clues to the identity of *fakir* are that it occurs in Egypt and that it compares in size with *grandis* Linnaeus ("3" lang and 1 1/2" breit"). Only two Egyptian belostomatids approach 3 inches in length: *Lethocerus cordofanus* Mayr, 1853, and *Hydrocyrius colombiae* Spinola, 1850. The largest specimens of these species that I have seen are about 2 and 3/4 inches long and slightly over an inch in breadth. Assuming that Gistel's comparison of the relative sizes of *fakir* and his *grandis* specimen was somewhat inexact, then *fakir* could be conspecific with either *L. cordofanus* or *H. colombiae.* In his generic description of *Belostoma*, Gistel mentions the broad, flat hindlegs, characteristic of species now placed in *Lethocerus*. The hindlegs of *Hydrocyrius* are flattened but they are not as broad as in *Lethocerus.* This evidence and the fact that *Lethocerus* is more common in Egypt than *Hydrocyrius* (at least based on material I have seen in collections), leads me to the conclusion that *Belostoma fakir* Gistel [1847] is a senior synonym of *Lethocerus cordofanus* Mayr, 1853 (new synonym).

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A NEW SPECIES OF *SCAPHOIDEUS* FROM FORMOSA (HOMOPTERA: CICADELLIDAE)[1,2]

Paul H. Freytag[3]

ABSTRACT: A new species of *Scaphoideus, S. matsumurai* n. sp. is described from Formosa. This species is compared with *S. festivus* Matsumura which it is closely related to and the name it was previously placed under. The known distribution of *S. matsumurai* n. sp. is Formosa, and that of *S. festivus* Matsumura is Japan, China, and the U.S.S.R.

DESCRIPTORS: Homoptera: Cicadellidae; *Scaphoideus festivus, Matsumurai* Japan, Formosa.

While checking the *Scaphoideus* type material from the Matsumura Collection it was found that the specimens from Formosa which Matsumura had placed with *S. festivus* Matsumura were not *festivus* but represented a new species. This species is described at this time and compared with *festivus* which appears to be its closest relative.

Scaphoideus matsumurai n. sp.

(Figures 1-7, 14-16)

Resembling *festivus* in general color pattern and size, differing in male genital features.

Length of male 5.0 mm. female 5.6-5.8 mm.

Color: Generally yellow to yellowish-brown. Crown with an orange band between eyes near middle, and a black line along anterior margin. Pronotum with a transverse orange band across both anterior and posterior margins. Scutellum with a transverse orange band across middle.

Male genitalia: Plates long, triangular, nearly pointed at apex. Pygofer long, narrow, rounded at apex. Styles hook-shaped, with apical end straight and sharply pointed. Connective Y-shaped with parameres fused to lateral margins of apex. Parameres long, narrowing to pointed apeces; in lateral view, curving dorsally from base. Aedeagus with a broad base, a long narrow shaft with a pair of dorsally bent, flaring apical processes.

Holotype male: Formosa, Heirombi, XI-20-1906, Matsumura, in the Matsumura

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[1] Accepted for publication: January 29, 1976

[2] This paper (No. 76-7-11) is published with the approval of the Director of the Kentucky Agricultural Experiment Station, Lexington. Manuscript received.

[3] Department of Entomology, University of Kentucky, Lexington, Kentucky 40506

Collection, Hokkaido University, Sapporo, Japan. Allotype and paratype females: Formosa, Kanshirei, IV-15-1907, Matsumura, both in the Matsumura Collection.

Note: One other female in the British Museum, which is probably this species, is labeled "Formoso, M. Kato". This species is named in honor of Dr. S. Matsumura who in his life time published much on the leafhoppers of Japan and Formosa.

Scaphoideus festivus Matsumura

(Figures 8-13, 17-19)

Scaphoideus festivus Matsumura 1902, p. 384.

A long, narrow, brightly colored species.

Length of male 4.8-5.1 mm., female 5.4-6.0 mm.

Color: Generally yellow to yellowish-brown. Crown with a broad orange transverse band between eyes near middle, and a black line around anterior margin of crown between eyes which is expanded into a spot like area at median line. Face with three to four transverse parallel black bands below anterior margin. Pronotum with two transverse orange bands one along anterior margin, other along posterior margin. Scutellum with a transverse orange band across middle.

Male genitalia: Plates long, triangular, nearly pointed at apex. Pygofer long, narrow, truncate at apex. Styles hook-shaped, apex curved laterally, blunt. Connective short, broad with parameres fused to lateral margins at distal end. Parameres long, narrow near base, flaring greatly near middle, then narrowing sharply to a pointed apex. Aedeagus short, without processes, but with lateral extensions on each side for connection with internal pygofer processes.

Lectotype female: The single female specimen from Japan in Matsumara's collection (as indicated in his description of this species) is here designated the lectotype. The location of the remaining specimen or specimens, probably females, of this type series is unknown.

Figures 1-7. *Scaphoideus matsumurai* n. sp. Fig. 1. Lateral view of aedeagus, and terminal view of apex. Fig. 2. Ventral view of aedeagus. Fig. 3. Lateroventral view of style. Fig. 4. Ventral view of connective and parameres. Fig. 5. Lateral view of connective and parameres. Fig. 6. Ventral view of plate. Fig. 7. Lateral view of pygofer, plate and valve.

Figures 8-13. *Scaphoideus festivus* Matsumura. Fig. 8. Lateral view of aedeagus showing connection to pygofer processes. Fig. 9. Ventral view of aedeagus showing connection to pygofer processes. Fig. 10. Lateroventral view of style. Fig. 11. Ventral View of connective and parameres. Fig. 12. Ventral view of plate. Fig. 13. Lateral view of pygofer, plate, valve and anal tube.

All drawn to the same scale.

MATSUMURAI

0.5 mm

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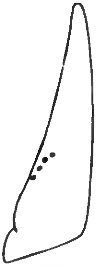

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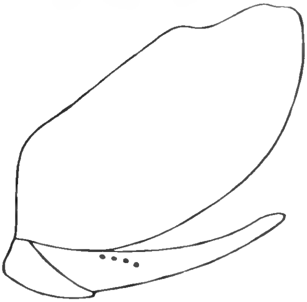

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FESTIVUS

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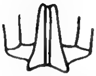

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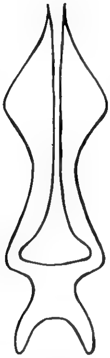

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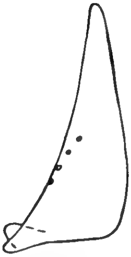

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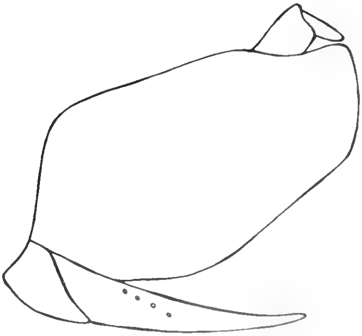

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Note: Additional males and females from various parts of Japan, are in the Hokkaido University Collection, the U.S. National Museum, and the North Carolina University Collection. All these specimens were collected after this species was described, but some with the lectotype do have type labels attached. Also from RUSSIA: 1 male, 2 females, labeled "Vladivostok, 28, 8, 1965, Anufriev," in the Canadian National Collection; and from CHINA: 1 male, Suisapa, 1000 m., Lichuan Distr., W. Hupoh, VII-25-1948, Gressitt and Djou; 12 females, Mokausan, Che Kiang Pr., IX-16-28-1927, Mrs. Dora E. Wright, in the California Academy of Science; 1 male, Foochow, VII-10-14-1936, M.S. Yang, in the British Museum. All other records of this species in the literature from other countries south of the northern part of China are probably in error, and most such records should be referred to the closely related species *ornatus* Melichar (1903) which occurs throughout the Oriental Region. Evans (1966) synonymized *pristidens* Kirkaldy (1906) from Australia under *festivus* but this is undoubtedly in error.

ACKNOWLEDGEMENTS

I wish to thank Dr. S. Takagi for the loan of the *Scaphoideus* material in the Hokkaido University Collection, including the type material. Also Dr. J. P. Kramer, United States National Museum; Dr. D. A. Young, North Carolina University; Dr. W. J. Knight, British Museum Natural History; Dr. K. G. A. Hamilton, Canadian National Collection; and Dr. P. H. Arnaud, California Academy of Science, for the loan of material from their respective collections.

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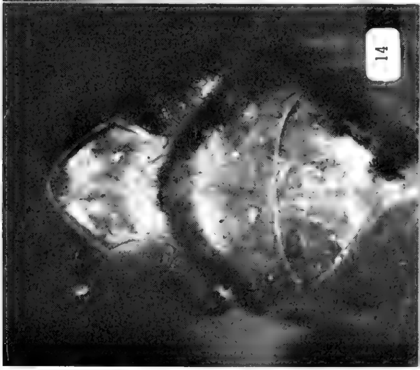
Figures 14-16. *Scaphoideus matsumurai* n. sp. Fig. 14. Dorsal view of head, pronotum, and scutellum of holotype. Fig. 15. Face view of holotype. Fig. 16. Face view of allotype.

Figures 17-19. *Scaphoideus festivus* Matsumura Fig. 17. Dorsal view of head, pronotum, and scutellum of lectotype. Fig. 18. Face view of male from Japan. Fig. 19. Face view of lectotype.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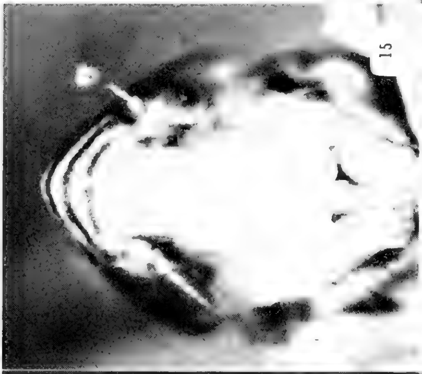
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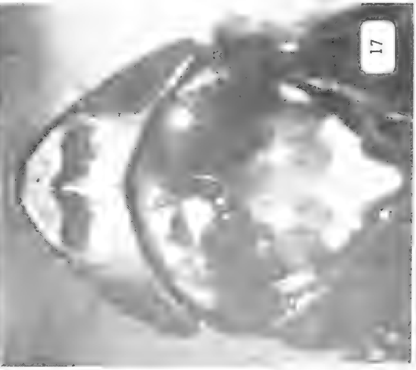
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AN ALTERNATIVE TO PITFALL TRAPS IN CARRION BEETLE STUDIES (COLEOPTERA)[1]

Paul P. Shubeck[2]

ABSTRACT: A new design of a ground surface box-trap for carrion beetles is described. Eight months of continous usage indicated that it is a useful and trouble-free trap for collecting carrion beetles.

DESCRIPTORS: Carrion beetle trap; Silphidae, Staphylinidae, Histeridae, Leiodidae, Scarabaeidae, Nitidulidae; Hutcheson Memorial Forest, N.J.

Several studies on carrion beetles have been published which utilized carrion bait that was simply left on the ground or suspended in the air. More recently, however, carrion-baited pitfall traps have become more popular and, in fact, Newton and Peck (1975) have published a paper describing such a trap in detail. Their discussion also includes much helpful related information, i.e. liquid preservatives for beetles collected, jars for storage, shipping, etc.

For my early studies on carrion beetles (1968; 1969) I found pitfall traps to be reasonably adequate yet occasionally troublesome. They can be vulnerable to carrion-feeding vertebrates unless screened carefully and anchored firmly. If anchored firmly, the container then cannot easily be removed from the ground when beetles are being collected. Some workers have successfully secured pitfall traps by piling stones (small boulders) over the covered opening (Newton and Peck, 1975; Pirone, 1974) but one is at a loss if boulders are not found in the collecting area. Furthermore, I have found pitfall traps to be subject to flooding in spite of holes that are drilled in the bottoms of the cans for drainage.

During the past seven years I have devised a variety of carrion beetle traps that have been placed on the ground or suspended above the ground (1971; 1975a; 1975b). Four traps of a ground surface box-type design (Fig. 1) were in continuous operation during an eight month long seasonal study (unpublished data). At no time was there the slightest evidence that any one of the traps was disturbed or that carrion had been removed (or cans flooded). Expensive locks, fixtures, or hardware are not required for their construction.

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[1] Accepted for publication: January 29, 1976

[2] Biology Department, Montclair State College, Upper Montclair, N.J. 07043

The security of the trap depends on two pre-drilled holes through the lower portion of the box (one hole on each side). These two holes match up with two pre-drilled holes in wood blocks inside the box which are actually firmly attached to the trap platform. After placing carrion into a one-gallon can which is inserted up into the box assembly (which has 1/2" mesh screen on top), the entire unit is inserted under the rain cover and between the side supports of the cover and finally down, around and adjacent to the blocks upon which the can rests. At this time two large galvanized nails are manually inserted through the matching holes at the bottom of the box and in the blocks on the platform. This arrangement gives the appearance of a solidly nailed assembly having no detachable or movable parts. Since wood absorbs moisture and expands it may be advisable to have a pair of pliers handy when removing the nails and opening the trap for specimens.

Detailed diagrams, with measurements, for the above design have been

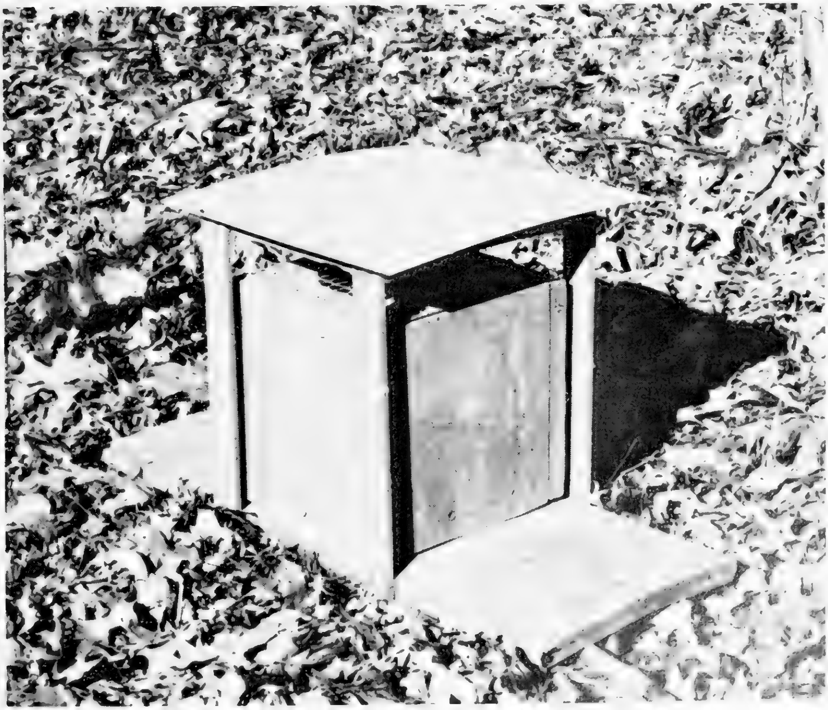

Figure 1. Carrion Beetle trap after 8 months of continuous use in Hutcheson Memorial Forest. Photograph by Thomas P. Shubeck.

duplicated by ditto machine and photocopier and copies are available to the reader upon request. This trap is relatively inexpensive to construct and it was found to be durable and trouble-free during eight months of continuous use in Hutcheson Memorial Forest (near East Millstone, N.J.). The four traps used in the project accounted for the collection of over 6700 beetles, or an average of 1675 beetles per trap. The overwhelming majority of beetles taken were Silphidae, Staphylinidae, Histeridae, Leiodidae (Catopinae = Leptodiridae), Scarabaeidae, and Nitidulidae. An ecological or systematic study of carrion beetles, that involves collecting, is by its very nature a foul-smelling experience. The satisfaction of using a clean, dry, efficient trap makes the job just a little less trying for the entomologist.

ACKNOWLEDGEMENTS

I would like to thank the Hutcheson Memorial Forest Committee of Rutgers University for giving me permission to work in the forest, and the Montclair State College Development Fund Board for financial assistance when this trap was designed.

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A LOW COST BATTERY POWERED BLACKLIGHT TRAP[1] ,[2]

Eli Levine[3], Leland Chandler

ABSTRACT: The construction of a low cost battery powered blacklight trap is described.

DESCRIPTORS: BL Trap, Insect Trap, Trap

In conjunction with studies on the biology of *Bellura gortynoides* Walker (Lepidoptera: Noctuidae), a low cost battery powered BL trap was needed to monitor emergence of these moths. A battery powered unit was necessary since the research area was located 3/4 mile from the nearest source of line current. A 6-W omnidirectional trap developed jointly by the USDA and Purdue University (Hollingsworth et al. 1963) to run on household current was modified to accept a 15-W BL tube (Type F15T8/BL) and to run on 12 VDC from a car battery. A transistorized 15-W recreational vehicle fluorescent fixture[4] with its plastic shield, lamp, and lampholders removed was inverted and mounted on the baffle (Fig. 1). The lampholders were also remounted on the baffle to accommodate the lamp. The wiring of the trap is the same as that of the original fixture. For convenience, a long power cord with color coded battery clips may be connected to the circuit board in the fixture.

The trap draws only 1 ampere/hour and can be expected to run continuously for at least 2 days in the field between battery rechargings.

The fluorescent fixture may be obtained for less than $16 and the trap itself can be made from several dollars worth of sheet metal and furnace pipe.

[4] Available from J.C. Whitney and Co., P.O. Box 8410, Chicago, Illinois 60680, as stock number 12-1776P. Mention of a proprietary product does not constitute recommendation or endorsement by Purdue University.

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[1] Accepted for publication: January 29, 1976

[2] Purdue University Agricultural Experiment Station Journal Paper No. 6129.

[3] Department of Entomology, Purdue University, West Lafayette, Indiana 47907. Present address: Department of Entomology, Ohio Agricultural Research and Development Center, Wooster, Ohio 44691.

ENT. NEWS, 87: 5 & 6: 179 - 180, May & June 1976

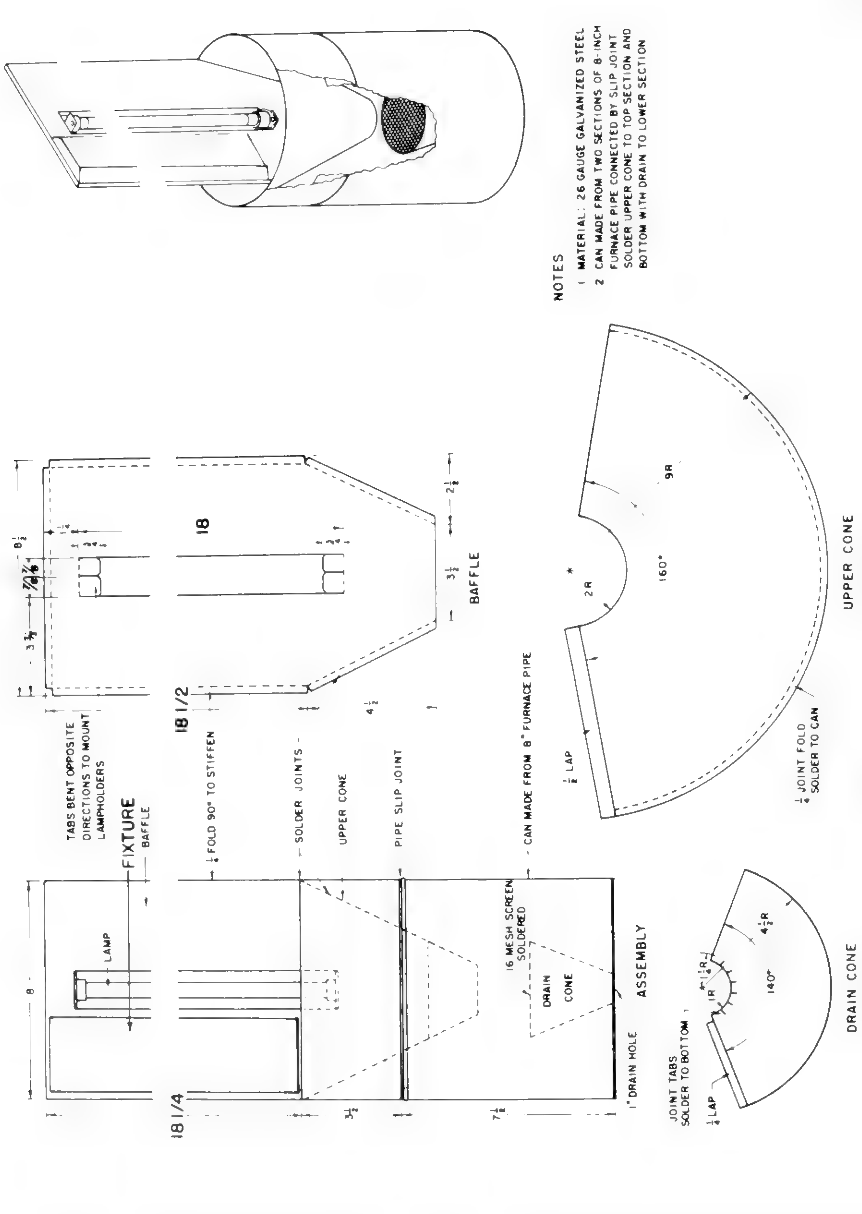

Figure 1. Modified USDA-Purdue blacklight construction plans. (After Hollinsworth).

ABERRANT REPRODUCTIVE BEHAVIOR PATTERNS OF DRAGONFLIES IN HUMAN-IMPACTED HABITATS[1] (ODONATA: LIBELLULIDAE)

Raymond W. Neck[2]

ABSTRACT: Aberrant male territorial and female ovipositional behavior is described for the dragonfly, *Libellula croceipennis* Selys, in human-impacted habitats.

DESCRIPTORS: Dragonfly, behavior, territoriality, oviposition, *Libellula croceipennis*, artificial habitats.

Many animals possess behavior patterns shaped by generations of natural selection that result in aberrant behavior in habitats modified by human activity. This note chronicles two such behavior patterns concerning a brilliant red dragonfly, *Libellula croceipennis* Selys, as observed in a highly urbanized section of Austin, Travis County, Texas.

Territorial Defense of a Wading Pool

During a six-week period from 2 August-15 September 1970 an adult male specimen was observed numerous times perched on a clothes line located about 1.6 m above a wading pool (2 m in diameter, 0.4 m in depth). All observations concerned a single individual, identifiable by a missing left prothoracic leg. Perching (with drooped wings) occurred at various times of the day in contrast to the "quite constant" arrival times of *Perithemis tenera* (Say) at various perch sites (Jacobs 1955). Patrolling of the intermediate area around the pool was also observed. No other *L. croceipennis* individuals were observed at the pool. On one occasion the dragonfly was observed to leave immediately upon arrival at a time when the pool contained no water. Such behavior may indicate that the pool was sought for actively by means of visual landmarks; however, if water was not detected (visually or hygrically), flight continued to the next stop on the daily patrol route. Contrary to previous reports that territorial agression was not used inter-specifically (Moore 1964), this individual was observed to chase away much smaller damselflies. However, possible territorial behavior by a "large dragonfly" against a butterfly has been reported (Manley 1971).

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[1] Accepted for publication: January 29, 1976

[2] Texas Parks and Wildlife Department, John H. Reagan Building, Austin, Texas 78701.

No detailed data are available for typical habitat of this dragonfly. Needham and Westfall (1955) report "ponds and streamside pools" as typical nymphal habitat for species of the genus *Libellula*. Personal observations of this species indicate that shaded slow-moving creek waters (and periodically isolated pools) are frequented by adult *L. croceipennis*. Needham and Westfall (1955) record this species from Oklahoma, Texas and Baja California south to Costa Rica. The nearest typical habitat was only 350 m from the wading pool.

The behavior of this individual may have resulted from several factors. Preference by adults for waters similar to that experienced during nymphal period is known for some odonates (Johnson 1966). Moore (1962) reported abnormal habitat selection (salt marsh pools shown to be unsuitable) during times of high population levels. Relative population levels of *L. croceipennis* at the time of these observations are unknown, but overcrowding as a result of drought (resulting in decreased water surface area) may have been a factor.

Territoriality in dragonflies aids dispersal which reduces overcrowding in restricted breeding areas (Kormondy 1961; Moore 1957). If this individual were driven out of normal habitat, it may well have been an "inferior" male. The varied times of arrival of this individual is a further indication that these observations may have involved an "inferior" male.

Attempted Oviposition on Glass Surface

On 15 September 1970 I observed a female *L. croceipennis* performing typical ovipositional thrusts with its abdomen toward and touching windshield glass of parked automobiles. At times several dips in succession by an individual were observed. These observations were made in a sizable parking lot located adjacent to a creek (a four-lane street separated creek and parking lot). The particular cars involved were 40-60 m from the wooded edge of the creek at which adults are commonly observed. Quite apparently these females had mistaken the reflective surface of the glass for a water surface.

Previous records of similar mistakes concerning other surfaces by female dragon flies have been reported. Kennedy (1938) reported that pool-breeders were attracted to shining surfaces such as an automobile roof and a petroleum pool. Many *Anax junius* (Drury) are killed in California oil pools (Kennedy 1917). Muller (1937) reported female *Orthetrum* laying eggs on shiny cement floors in Java. Neville (1960) reported *Pantala flavescens* (a tropical small pool breeder) showing sexual behavior and ovipositional movements over an automobile roof and tents.

Dragonflies respond visually to highly reflective surfaces, but antennal sense organs may determine the suitability of water type for oviposition (Corbet 1962). Observations reported herein indicate that visual stimuli may overcome lack of stimulus of antennal receptors in *L. croceipennis.*

Conclusion

Human impact upon natural populations of animals is usually considered in terms of severe reduction or extirpation of local populations. However, many species are able to exist in small microhabitats and/or adapt to artificial habitats. As seen in these observations, aberrant results occur as finely-tuned adaptations which evolved under natural conditions but are utilized in unnatural conditons.

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A RECORD OF *PALAEODIPTERON WALKERI* IDE (DIPTERA: NYMPHOMYIIDAE) FROM MAINE: A SPECIES AND FAMILY NEW TO THE UNITED STATES[1]

Terry M. Mingo, K. Elizabeth Gibbs[2]

ABSTRACT: A pair of *Paleodipteron walkeri* Ide (Nymphomyiidae: Diptera) *in copula* were collected from the Narraguagus River, Hancock County, Maine on August 8, 1974. This species has been reported from eastern Canada but this collection represents a new record for the species and family from the United States.

DESCRIPTORS: *Paleopdipteron walkeri* Ide, Nymphomyiidae Diptera, Maine.

The Nymphomyiidae constitute a small family of rare, minute flies which currently includes four species, one reported from Japan, one from India, and two from Canada. Cutten and Kevan (1970) and Kevan and Cutten-Ali-Khan (1975) have reviewed present knowledge of the family.

Palaeodipteron walkeri Ide has been reported from New Brunswick (Ide 1965; Kevan and Cutten-Ali-Khan 1975) and Quebec (Cutten and Kevan 1970). It is described as being aquatic in the larval stage and associated with aquatic mosses. The adult stage is both aquatic and aerial.

On August 8, 1974, a pair of adult *P. walkeri* were collected from the Narraguagus River, Hancock Co., Maine. The pair were wingless, **in copula** and with an attached rosette of 14 eggs. Similar pairs of specimens have been described by Ide (1965) and Cutten and Kevan (1970). Our identification was made from their figures and descriptions.

The specimens were collected in the course of a general survey with a conventional aquatic sampling device known as a Hess sampler. The water was about 45 cm deep with a substrate of small rocks, gravel and sand. The collection site was located at 44°, 52', 21"N; 68°, 5', 29"W (U.S. Geological Survey Map, Lead Mountain Quadrangle, Maine) at an elevation of about 95 m. This is about 30 m north of the confluence of the Narraguagus with Humpback Brook. At the time of collection the river was 9 m wide with a current velocity of 50 cm/sec.

The collection date suggests that these specimens were adults of the second generation as described from New Brunswick by Kevan and Cutten-Ali-Khan (1975).

ACKNOWLEDGEMENTS

We acknowledge financial support of the Office of Water Research and Technology through the Land and Water Resources Center, University of Maine at Orono.

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[1] Accepted for publication: January 28, 1976

[2] Department of Entomology, University of Maine at Orono, Orono, Maine 04473

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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 ORTHOPTERA OF EUROPE. Volume II, by K. Harz, Series Entomologica, Volume II, 1975. 939 pages, 3519 figures. Publishers: W. Junk, The Hague, Netherlands. Price: Dutch Guilders 300. ($115.00 U.S.)

Volume II is the successor to the first volume which included the Ensifera, ie. the families Tettigoniidae, Gryllidae, Gryllotalpidae, and Rhaphidophoridae. Volume II covers Caelifera, ie. Tetrigidae, Tridactylidae, Acrididae, Pamphagidae, Pyrgomorphidae, Catantopidae. As with the first volume, the author has made the book available to a broader audience by having the major portions (keys, superfamily, family, and generic diagnoses) in German and English. The species diagnoses and legends are only in German.

This series covers a very broad geographic area. The southeastern and eastern limits are the Ural Mountains to the northern reaches of the Caspian and Black Seas to the Aegean.

Details for each species include synonomies, description, distribution, references to biology and bionomics, type locality, sex and location of type. There are over 3,500 line drawings with each species being figured by at least one drawing.

Volume II is a technical improvement over Volume I. It is printed on a better quality, glossy paper and the line drawings, which in the first volume were coarse and poorly reproduced, are done with a finer pen line and, as such, improve the appearance of the book greatly. This series will serve as a landmark for students for several generations. The time and effort the author has devoted to making this a useful manual for identification is reflected in its over 900 pages. Its only drawback is its excessive price which is probably directly correlated with today's high costs of production.

D. C. Rentz

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 BUTTERFLIES OF NORTH AMERICA. William H. Howe, coordinating editor and illustrator, with 20 contributors. Doubleday and Company, New York, 1975. 633 pp., 97 color plates. $39.95.

The road to Hell is paved with good intentions. Surely it was a good idea to bring Holland's "Butterfly Book" (now 45 years out of print) up to date. Surely it was a good idea to bring in specialists, who know their groups better than anyone else, to do the text. Surely no one in the United States, except Marjorie Statham, could paint butterflies the way W. H. Howe (who is a professional artist) could. Yet "The Butterflies of North America" is gravely flawed. Where did this $40 book go wrong?

It wasn't in the plates, which are superb. Colors, textures, and shapes are accurately rendered, in many cases better than they could be in photographs. One need only look at most other recent published pictures of butterflies to appreciate how masterful Howe's work is. Even the subtle characters of *Erynnis* species are accurately conveyed (plate 93). The only artistic lapses I could find in 97 plates were the too-lurid (and in my copy, slightly off-register) pinks of the fringes and hindwing discal spots of some *Colias,* and a too-greenish hue in some blue Lycaenids, especially *Plebeius saepiolus* (plate 60) and the female *Atlides halesus* (plate 49). The only major problem with the plates is that the captions do not refer the reader to the species accounts in the text, obliging a trip to the index. But clearly the plates alone are worth the price of the book.

Unfortunately, some of the text isn't; and where it fails, the blame falls squarely on Howe's shoulders. The problems in the text all reflect the primary problem with Howe the editor; his work was seemingly capricious and in some cases gravely injudicious. The specialists who submitted copy some six years ago were apparently somewhat surprised at how and when it came out. Howe as an author was worse than Howe as an editor. As his own reviewer, is it possible that he made his own text worse?

Howe says: "With the exception of a new subspecies of *Speyeria egleis,* no new names are introduced in this book." One wishes! It was Howe's job as editor to see that no new names were unintentionally validated, and that any deliberate validations carried complete descriptions. As I write this, it is unclear just how many complications "The Butterflies of North America" has added to taxonomy, but surely there are enough to keep the ICZN from dying of boredom. As for Howe's new subspecies of *egleis, toiyabe,* it is a minor disaster. More responsible people who knew about it refrained from naming it; and Howe's description, in this Protean group, is apparently based on the holotype only! Single-specimen taxa are still appropriate for Bolivian bat fleas, but in North American butterflies they have been *outrê* for some while. Howe, it is evident from the text generally, is a relict typologist. This is nowhere clearer than in his treatment of

Speyeria, which seems to be a sincere (and occasionally successful) attempt to bring chaos out of order.

Howe believes in geographic subspecies, and the book attempts to bring them all in, both in the text and the plates. This is valuable to those who label collections, and occasionally it even has some value in evolutionary biology. But Howe seems blissfully unaware of the great "subspecies controversy" of the sixties, triggered by Brown and Wilson and fought mostly by Lepidopterists in the pages of *Systematic Zoology.* The casual reader will come away from "The Butterflies of North America" with a subspecies concept less sophisticated than that in, say, Klots. Nor is consistency one of Howe's virtues: he gives two of the feeble "subspecies" of *Papilio brevicauda* space on a plate but fails to figure the very distinctive-looking (and widely distributed) *Phyciodes campestris montana.*

To catalogue the individual errors, lapses, and taxonomic headaches in this book would require more space than is available in a review. Recently, J.W. Tilden published a corrigenda for W. G. Wright's "Butterflies of the West Coast," making that book useful for the first time since it was published 70 years ago. Perhaps someone will do the same for Howe, only sooner. I hope whoever does will look at the life-history information with an especially critical eye. In recent years, Noel MacFarland, Oakley Shields, and others have been crusading for respectability in host plant records. Nonetheless, Howe and some of his collaborators have succeeded in dredging up all the old garbage and slinging it on yet again. Example: "Fleabane *(Erigeron)*" is listed by Howe as a food of *Pieris protodice* (p. 378). I happen to be intimately acquainted with that record, having used the plant referred to as an inedible-unattractive control in oviposition preference tests by the hundreds. It dates from William Beutenmuller (1893) and must have come into being like this: in vacant lots in New Jersey and New York City two of the commonest weeds are *Lepidium virginicum,* a Crucifer, which *Pieris protodice* eats, and *Conyza* (formerly *Erigeron*) *canadensis,* a Composite, which it does not eat. The two plants look a lot alike. Probably Beutenmuller collected the wrong one for determination after finding *protodice* on the other. Is there any excuse for perpetuating such an obviously impossible record for over 80 years? More recent errors (e.g., Emmel and Emmel's record of *Plebeius glandon podarce* associated with *Vaccinium;* the host is *Dodecatheon*) are also being validated by frequency of citation. On page 381 Howe invents a new plant taxon, *Nasturtium cleome! (Nasturtium* and *Cleome* are Crucifer and Caper genera, respectively. One assumes he was thinking of *Tropaeolum.)*

Despite the unintentional validations (at least five), the sections by specialists are much better than those by Howe (one rare biological lapse I noted was Downey's treatment of *cottlei* as a potential subspecies of *Plebeius acmon*). Howe does bold, imaginative things in his sections, consistently failing to rationalize them (Apaturini or -inae raised to family rank; *Pieris nelsoni* a subspecies of *P. protodice,* from which it is isolated by 2000 miles and 3 life zones; etc.). The perfect counterpoint is to be found in C.D. MacNeill's treatment of the family Hesperiidae. It is a model of what the whole book could (should) have been. The species entries are compact, but pack in a tremendous amount of information on distribution, biology, and taxonomy. The overview includes a great deal of synthesis and much new information, but is never arbitrary or capricious. MacNeill's text and the accompanying plates provide the first reference for visual identification of North American skippers in the long history of literature! Between Howe's art work and MacNeill's chapter, "The Butterflies of North America" becomes a must for every Lepidopterist who can afford it – but oh, what it MIGHT have been!

Arthur M. Shapiro, Department of Zoology,
University of California, Davis, California 95616

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ANNOUNCEMENT A.N.(S) 98

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 4, 30th January, 1976).

260. *Dermacentor andersoni* Stiles, 1908 (Acarina: IXODIDAE): proposed conservation.
1772. *Ophiura* Lamark, 1801 and *Ophioderma* Müller & Trosenel, 1840: revised proposals for stabilisation.
2097. *Ophiolepis* Müller & Troschel, 1840: proposed designation of type-species.
2112. CIRCINAE in Aves and Mollusca: proposals to end the homonymy.
2113. *Pterois zebra* Quoy & Gaimard, 1825 (Pisces: SCORPAENIDAE): proposed suppression.
2116. *Halecium* Oken, 1815 (Coelenterata: Hydroida): Proposed validation: *Thoa* Lamouroux, 1816, proposed suppression.
2119. *Lecanium acuminatum* Signoret, 1873 (Hemiptera: COCCIDAE) proposed designation of neotype.
2120. *Cystioceras* Börner, 1912 (Insecta: Collembola): proposed suppression.

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Book wanted: Essig, E.O., Insects of Western North America. Write editor, ENT. NEWS, address inside front cover.

VOL. 87 SEPTEMBER & OCTOBER 1976 NOS. 7 & 8

ENTOMOLOGICAL NEWS

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SYSTEMATICS, BEHAVIOR & BIONOMICS OF COSTA RICAN KATYDIDS OF THE GENUS *SPHYROMETOPA* (ORTHOPTERA: TETTIGONIIDAE: AGROECIINAE)

David C. Rentz

ABSTRACT: Katydids of the genus *Sphyrometopa* are aberrant members of the Agroeciinae. They are found in primary growth forests in low population numbers which increase when windfalls or man's activity create openings in the forest providing herbaceous secondary growth. Nymphs are green and live in low, green herbaceous growth and move to the dry leaves of primary forests at maturity. Two species are known: one from the mountains of central Costa Rica, the other from the Atlantic lowlands of that same country.

DESCRIPTORS: behavior; distribution; karyotype Agroeciinae

Katydids of the genus *Sphyrometopa* Carl occur in primary and secondary forest habitats in central and eastern Costa Rica. The systematic position of the genus has been unclear and the bionomics of the species unreported in the literature. The author's numerous visits to Costa Rica have provided the opportunity to study the species of *Sphyrometopa* and provide observations on their life history strategies. In this paper I present a clarification of the genus, redescription of species and observations on the biology and bionomics of species.

TAXONOMIC HISTORY

Sphyrometopa was proposed by Carl in his 1908 revision of the conocephalids in the Geneva Museum. He included a single species, *S. femorata* Carl, and was unaware that Rehn (1905) had described the same species but had placed it in the genus *Conocephalus*. Both species were described from single females. Later Karny (1912) in his Genera Insectorum section on the Copiphorinae listed both names separately and included Carl's original figures. He too was unaware of the synonymic nature of the two names.

The subfamilial placement of *Sphyrometopa* is not entirely clearcut. *Sphyrometopa* species bear characters making them difficult to place in any

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[1] Accepted for publication: March 9, 1976

[2] Department of Entomology, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118

ENT. NEWS, 87: 7 & 8: 189 - 202, September & October 1976

subfamily with confidence. They show relationships with both the Copiphorinae and Agroeciinae. Rehn (1905) placed his species in the Conocephalinae. Hebard (1927) noted that *Sphyrometopa* as well as several other tropical American genera were aberrant members of the Agroeciinae. Walker and Gurney (1972) presented a table listing characters which can be used to distinguish agroeciines from copiphorines. On the basis of these characters, *Sphyrometopa* shows more relationship with the agroeciines than with the copiphorines. The characters placing them in the Agroeciinae include: vertex separated from frons by a thin sulcus; no trace of tooth on vertex; ovipositor curved, not straight. The usual character distinctive of the subfamily is the narrow fastigium. This is not found in *Sphyrometopa.* Instead, the fastigium is very broad which is similar to the usual state found in the Copiphorinae. Related tropical American genera here considered as aberrant Agroeciinae and possessing broader than average fastigia are: *Uchuca* Giglio-Tos, *Eppia* Stal, and *Dectinomima* Caudell.

BIONOMICS

Sphyrometopa species live in primary growth forests. They secondarily move to clearings and forest openings of early secondary growth as the opportunity arises. One of the species herein described occurs in the Atlantic Lowland Tropical Forest, the other from the Lower Montane altitudinal belt of the Cordillera de Tilaran and south of the western edge of the Cordillera Central. Both species are more abundant in the early herbaceous secondary growth adjacent to primary forests. These katydids, like many acridomorphid grasshoppers found in new secondary growth, move out of the forest and into such situations as a result of natural catastrophe such as tree falls. Certain human-associated instrusions into the forests such as paths or roads also provide suitable habitats for these insects. However, they are restricted to small clearings or marginal areas and are absent from larger clearings such as open fields because of the need of the flightless adults to return to primary forest upon maturity. *Sphyrometopa* populations reach their highest levels in small clearings or along paths where suitable amounts of sunlight can penetrate to permit growth of herbaceous flora. Upon the return of such areas to climax-type vegetation with a predominance of shade, the *Sphyrometopa* populations dwindle.

BIOLOGY

Sphyrometopa species undergo at least five nymphal instars. The nymphs of the first three stages are lime green, occasionally with a few black speckles

Figure 1. *Sphyrometopa femorata* Carl. Adult male, Monte Verde, Costa Rica.

Figure 2. *S. atlantica* Rentz. Second or third instar nymph, Finca La Selva, Costa Rica.

(see fig. 2). The fourth instar bears a trace of green and is yellowish brown. Fifth instars are much darker and have lost all green coloration. The faces of young nymphs are green, the brown appearing in fourth instar.

The difference in nymphal coloration reflects a different life style between nymphs and adults. The young nymphs occur in green vegetation, usually dense grasses and herbs. They are frequently found in the vegetation a foot or so from the ground. Although never found far from the forest, the nymphs seem to venture farther into secondary growth areas than do adults. Last instar nymphs are more associated with leaf litter and tend to live closer to the primary forest. Adults occur on the ground at the margin of the primary forest usually in leaf litter or associated vegetative debris where they remain secluded and quiet during the day. At night they climb onto vegetation where they sing and feed. Some adults remain deep within primary forests and live within the sheltered buttresses of large trees.

Sphyrometopa Carl

1908. *Sphyrometopa* Carl, Revue Suisse de Zoologie, Annales, 16 (2): 134-135.

Generic description. – HEAD with fastigium of vertex broad, 3-4 times as broad as first antennal segment; surface of fastigium minutely rugulose. Eye round, situated high on head. Frons smooth, flat. First antennal segment produced on dorso-internal margin, flagellum annulate. PRONOTUM dorsally finely rugulose, with a thin median carina; lateral lobes moderately deep, humeral sinus well indicated, thin but persistent transverse sulcus present in anterior portion of disk of aciculate spines. TEGMINA and WINGS well developed, never extending to apex of abdomen, incapable of flight. LEGS: Fore and middle femora wholly unarmed, hind femur with a number of teeth on both margins of ventral surface; genicular lobe of hind femur with a prominent tooth on internal margin. Fore and middle tibiae unarmed dorsally. Hind tibia armed dorsally with a single pair of apical spurs, ventrally with 2 pairs of spurs. ABDOMEN without distinctive median carina, apical portion of each tergite raised, pinched; cercus complex, apical tooth prolonged, thin; basal portion with a prominent internal knob. Titillators paired, flat, with a pair of accessory sclerites. FEMALE with tenth tergite excised medially. Ovipositor short, sickle-shaped, distinctly upturned usually dark brown in color. Subgenital plate simple, medially excised. COLORATION: Face with a large circular dark brown, almost black, polished patch encompassing two-thirds of face; adult dark brown and grey, frequently with a broad, dorsal yellow-brown longitudinal stripe (fig. 1). Legs mottled brown, outer pagina of hind femur dark brown on entire ventral half, this area bounded dorsally by a lighter creamish stripe. Nymphs: first four instars light lime green, fifth instar straw brown, rarely an overcast of green; legs, pronotum, sides of abdomen darker (see fig. 2).

Sphyrometopa femorata Carl

(figures 1, 3-7, 15, 17, 18, map 1)

1908. *Sphyrometopa femorata* Carl. Revue Suisse de Zoologie, 16 (2): 135, plate 4,

Map. 1. Known distribution of *Sphyrometopa* species in Costa Rica.

figs. 6,7. Type locality: "Costa Rica." Holotype female in the Museum d'Histoire Naturelle, Geneva, Switzerland.

1912. *Homorocoryphus rehni* Karny, 1912, Genera Insectorum, 139:37, New name for *Conocephalus diversus* Rehn, 1905, Proceedings of the Academy of Natural Sciences of Philadelphia, p. 825-826, figs. 14, 15. Holotype female: "Guatel, Costa Rica. C.F. Underwood collector." Holotype in Academy of Natural Sciences of Philadelphia. New synonymy.

This species was described twice, first by Rehn (1905), then three years later by Carl. Rehn's name was found to be a primary homonym and was replaced by Karny (1912). Coincidentally both Rehn's and Carl's species are synonyms although Karny did not detect this even though the generic names were both within the scope of his work and both species were illustrated by their respective authors.

This author has examined the types of both species. There is no question concerning the synonymy of the two. Unfortunately, the precise type

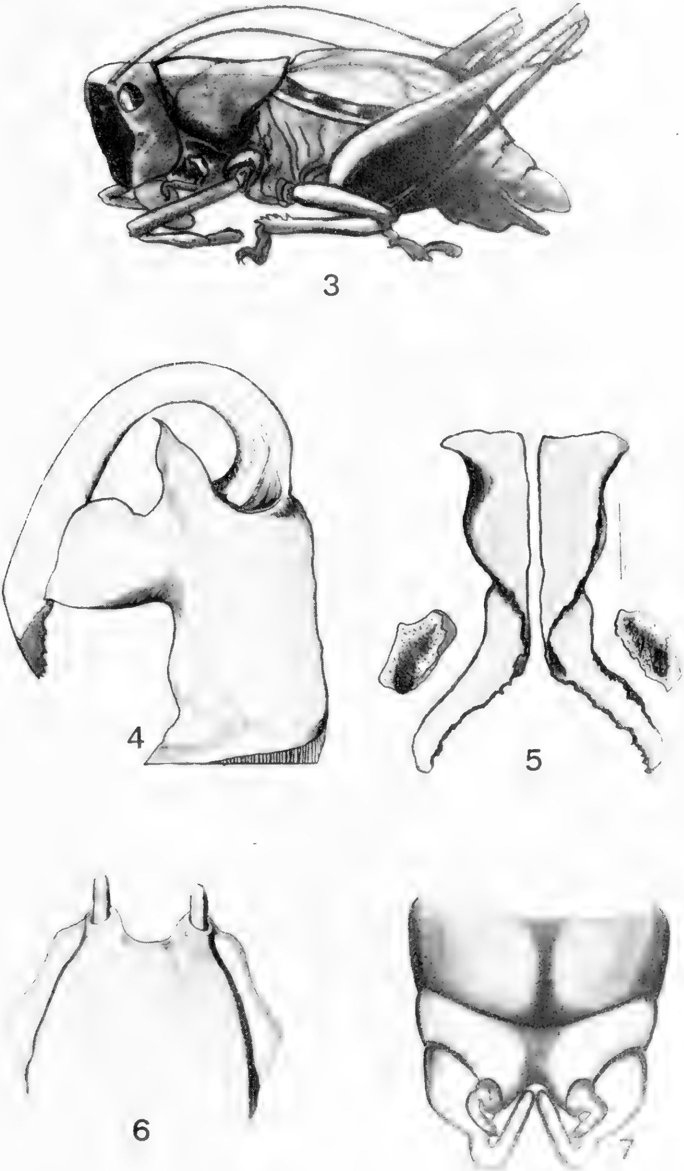
Figure 3A. Holotype, *Conocephalus diversus* Rehn (=*Sphyrometopa femorata* Carl). Original from Rehn (1905).

localities for either have not been located but they must have been collected in central Costa Rica, probably south of San José. The type of *S. femorata* is considerably larger than that of *C. diversus.* It approaches *S. atlantica* in this respect (tables 1, 2). But the reduction of rugulosity of the pronotum and shape of the subgenital plate and the truncate tegmina serve to separate it from *S. atlantica.* The type of *C. diversus* is much smaller, similar in size to the populations from Monte Verde.

Mention of *Sphyrometopa* species in the literature was made by Hebard (1927) in his studies on the Panamanian Tettigoniidae. Although he did not record the genus from that country, he discussed its relationships with *Eppia* Stal, *Uchuca* Giglio-Tos, and *Dectinomima* Caudell. Males of *S. femorata* have never been described and the habits of the species are unreported until now.

Diagnosis. – Size small for genus (fig. 1). Pronotum relatively smooth, faintly granulate; fastigium of vertex (fig. 1) relatively narrow; apex of tegmina truncate. Males with internal "toe" of cercus with proximal angle acute (fig. 4); titillator with apex truncate (fig. 5). Females with subgenital plate with lateral angles acute (figs. 17, 18), unmodified. Known from central Costa Rica.

Species description. – PLESIOTYPE MALE. COSTA RICA: PUNTARENAS PROVINCE: Monte Verde Cloud Forest Reserve, near Powell house, 23 March 1974. D.C. Rentz collector. Plesiotype deposited in Academy of Natural Sciences of Philadelphia. Size small, form slender. PRONOTUM dorsally finely rugulose; anterior margin truncate; lateral lobes shallow, broad transverse sulcus thin, but well defined on anterior 1/3 of disk. TEGMINA and wings present, the latter much less developed than in *S. atlantica, in situ* attaining 6th or 7th tergite; apex of tegmen broad, not lanceolate,



Figures 3-7. Diagnostic characters in males of *Sphyrometopa femorata.* Fig. 3, adult male, 7x; fig. 4, right cercus, dorsal view; fig. 5, titillators; fig. 6, subgenital plate, ventral view; fig. 7, apex of abdomen, dorsal view.

stridulatory area well developed. LEGS: hind femur bearing a number of stout teeth on both margins of ventral surface. Fore and middle tibiae armed on ventral surface with 6 spines on anterior margin, 4 on posterior; middle tibia armed on ventral surface with 5 spines on anterior margin, 4 on posterior; hind tibia with 15 spines on both margins of dorsal surface, ventral surface unarmed except at apex. Apex of hind tibia with a single pair of apical spurs of equal length on dorsal surface; ventral surface with two pairs of apical spurs and a pair of subapical spines preceeded by a single spine on outer margin which is in turn preceeded by a pair of spines. ABDOMEN: tenth tergite, titillator and subgenital plate as in figs. 4-7). COLORATION: overall ground color a mixture of dark browns, face very dark brown, almost black; vertex and pronotal disk mottled grey brown; legs as in *S. atlantica.*

Redescription of holotype female. – Size large for species, form robust. PRONOTUM dorsally finely rugulose, median carina indicated mostly by color; anterior margin of disk obtuse, posterior margin truncate; lateral lobes deep, concave in region of coxa; humeral sinus well indicated; transverse sulcus of disk deep, well indicated in anterior quarter. TEGMINA and wings attaining middle of sixth segment, tegmen with apex truncate. LEGS: tibiae and femora armed as in male. ABDOMEN: tenth tergite deeply incised, apices produced as in fig. 15; cercus broad in basal two-thirds, apex narrowed; subgenital plate with apex relatively broad; ovipositor relatively narrow, not as greatly upturned as in *S. atlantica* (fig. 13). COLORATION precisely as described for male.

Records. – COSTA RICA: CARTAGO PROVINCE: Cachi, Rio Reventazon, March 1902, 1100 meters elevation, (P. Biolley, 1♀, ANSP). Monte Verde, Pension, 1500 meters elevation, 22, 23 July 1973, 24 March 1974 (D.C. Rentz, K.R. Brodey, 7♂♂, 7♀♀, DCR); Powell property, 1580 meters elevation, 23 March 1974 (D.C. Rentz, 1♂, CDR). Navarro, 24 July 1929, 1160 – 1190 meters elevation, (C.H. Lankester and J. Rehn, 1♀, ANSP). Uncertain geographic placement in Costa Rica: El Muneco, 20 June 1928, 1430 meters elevation, (F.G. Wallace, 1♀, ANSP. Uncertain province: La Palma, between Volcan Irazu and Volcan Barba, 28, 30 July 1927, 1520 meters elevation (J.F. Tristan and J. Rehn, 1♀, 1 last instar ♀, ANSP).

Discussion. – S. *femorata* occurs in two different habitats at Monte Verde, Tilarán Mountains. It is present in the Monte Verde Reserve but in low population numbers. It appears to be more abundant at a slightly lower elevation in the region of the Pensión where it could be considered as abundant in the gardens and edge of the forest. This reflects the abundance-distribution pattern described for *S. atlantica.*

The Monte Verde locality lies within the Lower Montane altitudinal belt of Holdridge (1967). It is a very different climatic regime from that encountered at Finca La Selva. But apparently certain genera share species between the two localities. (See Rentz, 1975, for discussion of the two habitats with reference to climate and vegetation.

Table 1. Measurements (in mm) of *S. femorata*

	Length Body	Pronotum Length	Width	Length Exposed Tegmen	Length Hind Femur	Ovipositor
Males						
plesiotype	23.5	7.6	4.7	10.0	17.1	
Monte Verde	22.0	7.4	4.5	9.0	18.5	
Monte Verde	21.5	7.6	4.9	11.3	17.9	
Monte Verde	21.5	7.1	4.5	9.8	17.7	
Monte Verde	24.5	7.3	4.3	10.2	18.1	
Females						
Monte Verde	22.0	7.2	4.3	9.3	18.8	8.7
Monte Verde	23.0	7.3	4.3	9.0	18.8	8.9
Monte Verde	23.5	6.6	4.2	8.1	17.3	8.6
Monte Verde	22.5	7.4	4.5	8.7	20.2	9.6
Monte Verde	22.5	7.0	4.3	8.0	18.0	9.0
Monte Verde	23.5	7.2	4.5	8.5	18.8	8.5
Monte Verde	22.0	7.1	4.3	8.0	17.8	8.6
holotype *C. diversus*	21.0	7.3	4.7	8.6	19.2	9.0
El Muneco	18.5	7.6	4.6	9.0	20.0	8.3
La Palma	23.0	8.1	4.7	8.8	20.0	9.0
Cachi	21.0	7.5	4.5	8.7	19.1	8.8
Navarro	23.5	7.8	4.7	8.9	19.5	8.8
holotype *S. femorata*	26.0	8.7	4.8	9.5	22.0	8.2

Sphyrometopa atlantica Rentz, new species

(Figures 2, 8-12, 13, 14, 16 Map 1)

Diagnosis. – Size large for genus. Pronotum distinctly punctate, rugulose; fastigium of vertex broad (fig. 8); apex of tegmina lanceolate. Males with internal "toe" of cercus with proximal angle rounded (fig. 10), ventral surface with tooth (fig. 10A); titillator with apex rounded (fig. 11). Females with subgenital plate with lateral angles hooked (fig. 16). Known from the Atlantic drainage of Costa Rica.

Description. – HOLOTYPE MALE. COSTA RICA: HEREDIA PROVINCE.

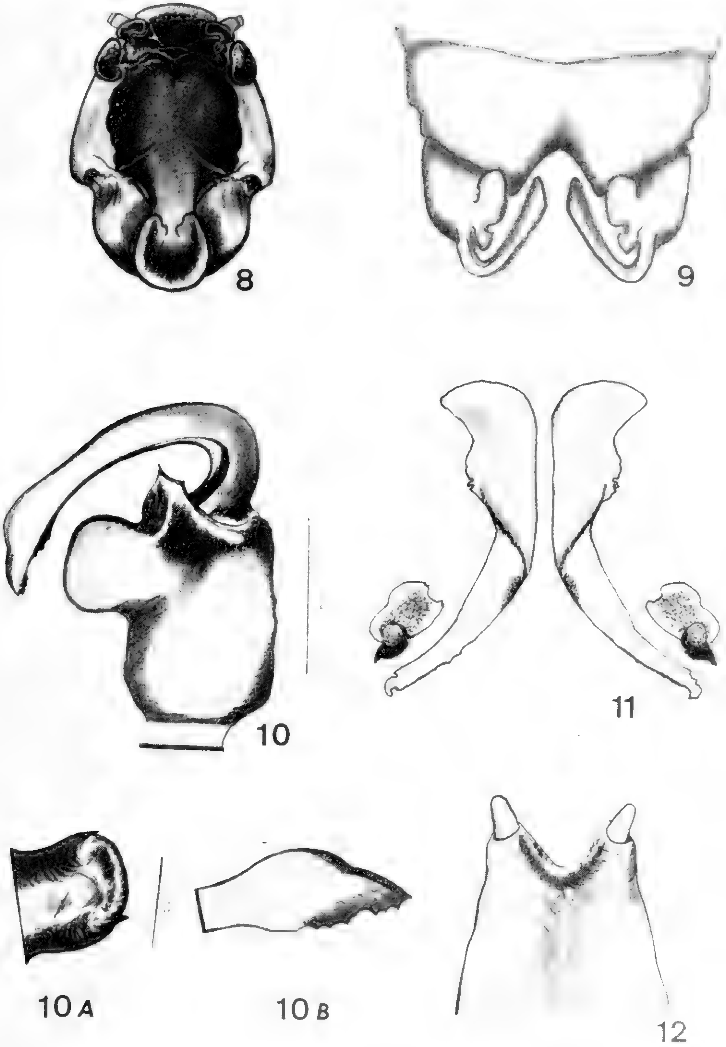
Puerto Viejo, Finca La Selva, 13-16-VIII-1973. D.C. Rentz, K.R. Brodey collectors. In arboretum II. Holotype and allotype are deposited in the Academy of Natural Sciences of Philadelphia. Size large for genus, form stout, robust. HEAD with fastigium of vertex very broad, four times as broad as first antennal segment; frons rather smooth, flat; first antennal segment produced on dorso-internal margin. PRONOTUM dorsally finely rugulose, with fine median carina; anterior margin weakly concave, distal margin truncate; lateral lobes deep, concave in region of coxa; humeral sinus well indicated, thin but persistent transverse sulcus present in anterior portion of disk. TEGMINA and wings extending to base of ninth or tenth tergite in life; tegmen lanceolate, apex acute, stridulatory area well developed. LEGS: fore and middle tibiae armed ventrally with 6 spines on anterior margin, 4 on posterior; hind tibia armed with 17 spines on internal margin and external margins of ventral surface wholly unarmed except apically. Apex of hind tibia armed dorsally with a pair of apical spurs of equal lengths; ventral surface bearing 2 pairs of apical spurs of equal lengths; a pair of subapical spines and a single presubapical spine on outer margin. ABDOMEN: tenth tergite, cercus, titillator, and subgenital plate as in figs. 9-12. COLORATION: overall ground color a mixture of dark browns; face, in region bounded by eyes (fig. 8) dark brown or blackish, bounded externally by a light creamish area, dark area extending onto clypeus a labrum; vertex and disk of pronotum mottled grey brown; fore and middle tibiae light brown with a trace of a subapical and subbasal darker annulus; fore and middle femora dark brown externally, internal (anterior) face mottled grey; hind tibia dark brown, not black, femur dark brown or blackish in ventral half, especially basally, apical half and dorsal half of femur lighter brown; tarsi dark brown with apical pad black. Abdomen darker brown laterally, dorsum light brown, ventral surface dark black; cercus and subgenital plate light brown.

ALLOTYPE FEMALE. Same data as holotype. Similar to male but with following exceptions: size larger, form more robust. Tenth tergite, cercus, and subgenital plate (figs. 13, 14, 16). Ovipositor short, sickle-shaped, distinctly upturned (figs. 13, 14). Coloration similar, ovipositor uniformly dark brown.

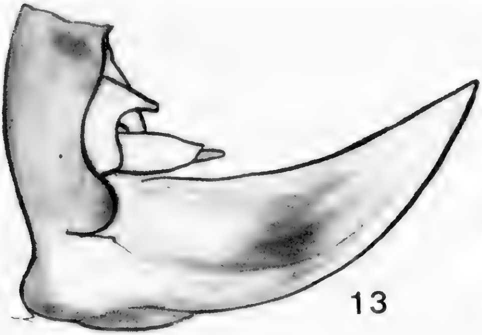
Derivation of name. – This species is named with reference to its geographical distribution in the Atlantic Lowlands of Costa Rica.

Karyotype. – 2N ♂ = 31. The largest autosome is submetacentric in configuration and some two to three times larger than the second largest autosome. The second through sixth largest autosomes are intermediate in size while autosomes seven through fifteen are relatively small. All autosomes except the largest are telocentric. The X chromosome is metacentric and similar in size to the largest autosome.

Records. – COSTA RICA: CARTAGO PROVINCE: Juan Vinas, March 1902 (L. Bruner, 1♀, 1♀, last instar, ANSP). HEREDIA PROVINCE: Estrella Valley, Vesta Farm, 13 Sept. 1923 (J. Rehn, 1♀, antepunultimate instar). La Emilia, near Guapiles, 1000 ft. elev., 16 Ausust 1923 (J. Rehn, 2♂♂ 3♀♀; 2♂♂, 1♀ last instars, ANSP). HEREDIA PROVINCE: Finca La Selva on Rio Puerto Viejo, OTS, Arboretum II, River Road, research trail at line 600, 16 July 1973, 14-16 Jan. 1975, (D.C. Rentz, K.R. Brodey, 4♂♂, 7♀♀, including holotype and allotype, numerous nymphs, ANSP).



Figures 8-12. Diagnostic characters in males of *Sphyrometopa atlantica*. Fig. 8, face of holotype; fig. 9, apex of abdomen, dorsal view; fig. 10, right cercus, dorsal view, 10A, internal knob of cercus, ventral view, 10B, apex of hook, ventral view; fig. 11, titillators; fig. 12, subgenital plate, ventral view.



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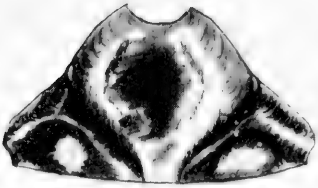

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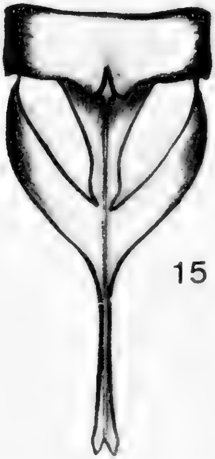

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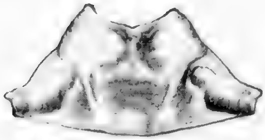

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Figures 13-15. Diagnostic characters in females of *Sphyrometopa* species. Fig. 13, 14, *S. atlantica,* lateral and dorsal views ovipositor; fig. 15, *S. femorata,* ovipositor, dorsal view; fig. 16, *S. atlantica,* allotype, subgenital plate; fig. 17, *C. diversus,* holotype, =*S. femorata,* subgenital plate; fig. 18, *S. femorata,* Monte Verde, subgenital plate.

Table 2. Measurements (in mm) of *S. atlantica*

	Length Body	Pronotum Length	Width	Length Exposed Tegmen	Length Hind Femur	Length Ovipositor
Males						
holotype	26.5	8.8	5.1	14.1	23.1	
paratopotype	28.0	9.0	5.1	13.5	22.6	
paratopotype	27.0	9.0	4.7	13.7	22.3	
La Emilia	28.3	8.6	5.1	13.6	22.0	
La Emilia	27.5	8.0	4.8	13.6	21.2	
Females						
allotype	24.0	8.6	4.7	14.0	22.6	10.1
paratopotype	31.0	9.5	5.5	14.1	24.4	10.3
paratopotype	24.0	8.6	5.1	14.2	23.8	9.6
paratopotype	27.0	8.6	4.8	14.0	22.8	10.0
paratopotype	27.0	9.2	5.0	14.1	23.7	9.7
paratopotype	28.0	9.2	5.1	13.3	24.5	9.8
La Emilia	27.0	9.0	5.3	13.0	22.0	7.5
La Emilia	24.5	8.7	5.0	13.0	21.7	9.5
La Emilia	26.5	8.8	5.2	14.1	23.4	9.8
Juan Vinas	29.0	8.9	5.0	13.3	23.2	10.2

Discussion. – *S. atlantica* is locally common along paths and clearings adjacent to primary forest at Finca La Selva. It is dependent on herbaceous vegetation to support the nymphs which apparently seek shelter and feed on such growth. The species is largely absent from grasses and is never found in cleared areas where there is an extensive grass cover. Nymphs are active during the day, their brilliant green color blending them into their environment. At night adults move onto low vegetation. Males sing after dark. The adults are most often associated with habitats vegetated by the following plants: *Selaginella eurynota, Diffenbachia seguina,* and *Costus malorticana.* Adults have been seen feeding on the flowers of ginger, *Costus malorticana.*

Frankie et al (1974) provided detailed analysis of the vegetation types found at Finca La Selva along with the climatic and rainfall regimes.

ACKNOWLEDGEMENTS

I would like to thank the Organization for Tropical Studies and the Tropical Science Center for providing the research facilities which made our stays in Costa Rica pleasant and productive. I would also like to thank Mr. Kenneth R. Brodey and Stephen T. Harty and members of the 1973-75 Academy of Natural Sciences of Philadelphia "Expeditions for Everyone" fieldtrips for assistance in the field. In addition I would like to thank Dr. David B. Weissman for karyotype information, Dr. Bernd Hauser for sending the type of *Sphyrometopa femorata,* and Michael S. Carter for illustrations.

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A PRELIMINARY LIST OF THE SPIDERS (ARANEAE) OF DELAWARE[1], [2]

George W. Uetz[3,4]

ABSTRACT: This first published list of Delaware spiders records 199 species in 26 families. Sources of records are: (1) Collections by numerous Delaware entomologists beginning about 1935 identified and recorded by T. A. Parker; (2) Museum collections of the Academy of Natural Sciences in Philadelphia; and (3) Ecological studies of spiders in the University of Delaware Experimental woodlot. Collecting data, including locality and month, are given for all species, and a map is provided showing the collecting localities.

DESCRIPTORS: spiders, Araneae, Delaware, Arachnida, Taxonomic lists.

Published records of spiders from Delaware are scarce, although Muma (1943, 1944, 1945) has recorded 384 species from the Delaware/Maryland/Virginia penninsula. T. A. Parker (1965) reported in a senior thesis on 130 species that he and others had collected in Delaware. The material is preserved in the Department of Entomology and Applied Ecology Museum, and includes specimens collected from about 1935 by several Delaware entomologists. Parker's work is the only list of Delaware spiders to date.

I have examined the spider collections of the Philadelphia Academy of Natural Sciences, but most of the additions to Parker's list are from an ecological study I made in 1970 of spiders in the University of Delaware experimental woodlot. Others are from miscellaneous collecting in New Castle County. My collecting was by sweep net, hand sorting of litter and debris, or by pitfall trapping.

In the list of species that follows, localities are indicated by numerals which correspond to points on a map of the state (Fig. 1). These are further characterized in a list of localities. Also in the list of species, the month (s) in which each species was collected is given, and the sources of records are designated by capital letters as follows:

TAP – "Spiders of Delaware"; senior thesis of T. A. Parker (1965)
ANSP – Academy of Natural Sciences of Philadelphia.
GU – the author

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[1] Accepted for publication: February 12, 1976

[2] Published as Miscellaneous Paper No. 718 with the approval of the Director of the Delaware Agricultural Experiment Station. Publication No. 437 of the Department of Entomology and Applied Ecology, University of Delaware.

[3] Department of Ecology, Ethology and Evolution, University of Illinois, Urbana, Illinois 61801.

[4] Current address: Dep't of Biol. Services, Univ. of Cincinnati, Cincinnati, OH., 45221

LIST OF LOCALITIES

New Castle County

1. White Clay Creek, north of Newark. Piedmont forest and stream valley.
2. Newark. Urban and suburban area.
3. University woodlot. Mature secondary growth forest.
4. Iron Hill, south of Newark. Undisturbed forest, mature secondary growth forest, and old field.
5. Pike Creek Valley, northeast of Newark. Piedmont forest and stream valley.
6. Thompson's Bridge, on Brandywine River north of Wilmington. Flood plain forest, marsh and mature secondary growth forest.
7. Talleyville. Mature secondary growth forest and old field.
8. Wilmington. Urban and suburban area.
9. Coochs Bridge. Stream bank and old field.
10. Glasgow. Agricultural land and old field.
11. Summit Bridge. Canal spoil bank and old field.
12. Delaware City. Oil refinery "tank farm" and marsh landfill.
13. Middletown. Agricultural land.
14. Blackbird. Pond margin.

Kent County

15. Woodland Beach. Coastal salt marsh.
16. Bombay Hook National Wildlife Refuge. Coastal salt marsh.
17. Leipsic. Coastal salt marsh.
18. Cheswold. Agricultural land.
19. Dover. Agricultural land.
20. Camden. Agricultural land.
21. Wyoming. Agricultural land.
22. Andrewsville. Agricultural land.

Sussex County

23. Greenwood. Agricultural land.
24. Bridgevill. Agricultural land.
25. Milford. Coastal salt marsh.
26. Lincoln. Agricultural land.
27. Redden State Forest. Loblolly pine forest.
28. Ellendale State Forest. Swamp forest.
29. Selbyville. Cypress swamp.
30. Cape Henlopen-Lewes. Coastal beach and sand dunes.
31. Dewey Beach. Coastal beach and sand dunes.

LIST OF SPECIES

Orthognatha

Family **Atypidae**

Atypus niger (Hentz) 27, 28. GU April and May

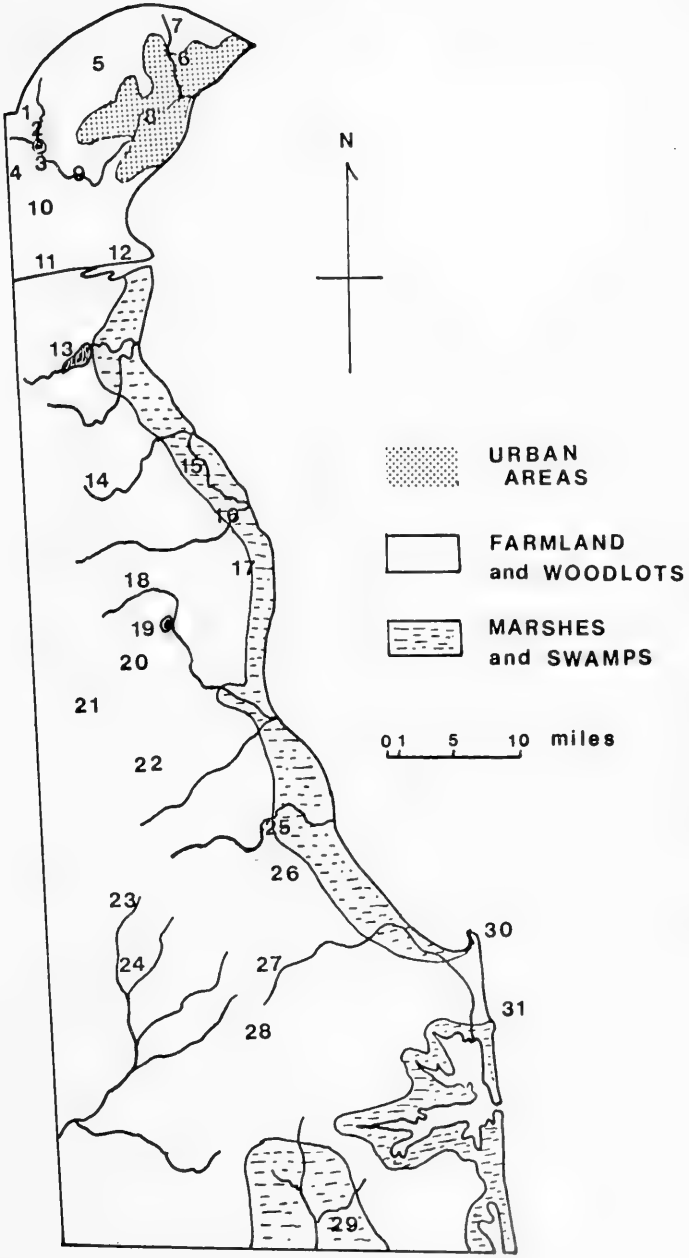

Figure 1. Map of Delaware, showing collecting localities.

Labidiognatha

- Family **Dysderidae**
  - *Dysdera crocata* C.L. Koch 2. TAP August
- Family **Segestriidae**
  - *Ariadna bicolor* (Hentz) 16. TAP September
- Family **Scytodidae**
  - *Scytodes thoracica* (Latreille) 2. GU September and October
- Family **Pholcidae**
  - *Pholcus phalangioides* (Fuesslin) 2, 11. GU, TAP August and November
  - *Physocyclus globosus* (Taczanowski) 2, 11, 25. TAP June and August
  - *Spermophora meridionalis* (Hentz) 19. TAP July
- Family **Theridiidae**
  - *Achaearanea tepidariorum* (C.L. Koch) all stations. TAP, GU. June through September.
  - *Conopistha trigona* (Hentz) 27. TAP. June.
  - *Crustulina altera* Gertsch and Archer 3. GU. June
  - *Dipoena nigra* (Emerton) 5. TAP. August.
  - *Enoplognatha marmorata* (Hentz) 15. TAP. June.
  - *Euryopis argentea* Emerton 3. GU. June and July
  - *Euryopis funebris* (Hentz) 3, 9. GU, TAP. June.
  - *Latrodectus mactans* (Fabricius) 2, 12, 18, 19. TAP, GU. June, July, August and October.
  - *Paidisca marxi* (Crosby) 3. GU. July.
  - *Pholcomma hirsutum* (Emerton) 3, 16. GU, TAP. August.
  - *Steatoda americana* (Emerton) 3. GU. June and July
  - *Steatoda albomaculatus* (DeGeer) 2. GU. July
  - *Steatoda borealis* (Hentz) 2, 16, 24, 15. TAP, GU. June, August and September.
  - *Steatoda grossa* (C.L. Koch) 2, 3, 6, 7. GU, ANSP. June, July and August.
  - *Steatoda triangulosa* (Walckenaer) 2, 6, 7. GU, ANSP, TAP. May, June and July.
  - *Theridion differens* (Emerton) 9. TAP. June.
  - *Theridion frondeum* (Hentz) 20. TAP. June.
  - *Theridion lyricum* (Walckenaer) 3. GU. June.
  - *Theridion murarium* (Emerton) 9. TAP. June.
- Family **Linyphiidae**
  - *Centromerus cornupalpis* (O.P. Cambridge). 3 GU. July and August.
  - *Drapetisca alteranda* (Chamberlin) 1. TAP. August.
  - *Frontinella communis* (Hentz) 1, 2, 3, 5, 6, 16. TAP, GU, ANSP. July through September.
  - *Lepthyphantes nebulosa* (Sundevall) 2, 3. TAP, GU. June, July and August.
  - *Lepthyphantes zebra.* (Emerton) 3. GU. July.
  - *Linyphia clathrata* (Sundevall) 1. TAP. August.
  - *Linyphia maculata* (Emerton) 3. GU. July August.
  - *Microlinphia pusilla* (Sundevall) 2, 3. TAP, GU. June.
  - *Microneta viaria* (Blackwall) 20. TAP. June.
  - *Meioneta micaria* (Emerton) 1, 20, 29. TAP. June and July.
  - *Meioneta simplex* (Emerton) 3. GU. August.
  - *Pityohyphantes costatus* (Hentz) 3. GU. September.
  - *Prolinyphia marginata* (C.L. Koch) 3. GU. August.
  - *Tennesseelum formicum* (Emerton) 3. GU. July.

Family **Micryphantidae**

Members of this family were not determined beyond the family level. Twenty-five specimens were taken in the state.

Family **Araneidae**

Acasesia hamata (Hentz) 3, 15. GU, TAP. July and August.
Acanthepeira stellata (Walekenaer) 2, 23, 24. TAP, GU. July and August.
Araneus cornutus (Clerck) 3, GU. August.
Araneus marmoreus (Clerck) 1, 2. TAP, GU. July and August.
Araniella displicata (Hentz) 3, 4. GU. August and September.
Argiope aurantia (Lucas) 2, 7, 8, 10. TAP, ANSP. August and September.
Argiope trifasciata (Forskal) 2, 9. TAP, ANSP. September.
Cyclosa conica (Pallas) 3, 4, GU. July and August.
Cyclosa turbinata (Walckenaer) 17. TAP. August.
Cyphepeira cornuta (Clerck) = (foliata Fourcroy) 1, 16. TAP. August and September.
Eustala anastera (Walckenaer) 15, 17, 23. TAP. July and August.
Eustala triflex (Walckenaer) 1, 2. TAP. August.
Mangora gibberosa (Hentz) 5, 6, 9, 15, 17. TAP. June, July and August.
Mangora maculata. (Keyserling) 1, 19. TAP. July and August.
Mangora ornata (Walckenaer) 3. GU. July and August.
Mastophora bisaccata (Emerton) 8. TAP. October.
Mecynogea lemniscata (Walckenaer) 16, 19. TAP. July and August.
Meta menardii (Latreille) 1. TAP. August.
Metepeira labyrinthea (Hentz) 2, 3. TAP, GU. June, August and September.
Micrathena gracilis (Walckenaer) 2, 3, 5, 19, 22, 26. TAP. GU. July and August.
Micrathena sagittata (Walckenaer) 3, 17, 21, 27. TAP, GU. June, July and August.
Neoscona arabesca (Walckenaer) 2, 3, 16, 17, 21. TAP, GU. August and September.
Neoscona benjamina (Walckenaer) 1, 2. GU. July and August.
Neoscona pratensis (Hentz) 16. TAP. August.
Neoscona sacra (Walckenaer) 1, 2, 5. TAP. June and August.
Neoscona frivittata (Keyserling) 12, TAP. August.
Singa pratensis (Emerton) 15. TAP. September.
Verrucosa arenata (Walckēnaer) 3, 14, 21. GU, TAP. June, July and August.

Family **Tetragnathidae**

Tetragnatha elongata (Walckenaer) 4, 9, 11, 15. GU, TAP. June, July and August.
Tetragnatha laboriosa (Hentz) 4, 9, 15, 16, 17, 19, 23. TAP, GU. June, July and August.
Tetragnatha pallescens F.O.P. Cambridge. 15. TAP. August.
Tetragnatha seneca (Seeley) 15. TAP. August.
Tetragnatha straminea (Emerton) 9, 11. TAP. June and August.
Tetragnatha versicolor (Walckenaer) 15, 16. TAP. July, August and September.
Leucauge venusta (Walckenaer) 3. GU. Guly and August.

Family **Mimetidae**

Ero leonina (Hentz) 3. GU. July.
Mimetus epeiroides (Emerton) 25. TAP. June.
Mimetus notis (Chamberlin) 2. TAP. June.

Family **Agelenidae**

Agelenopsis emertoni (Chamberlin and Ivie) 5. TAP. July.
Agelenopsis naevia (Walckenaer) 1. TAP. August.
Agelenopsis pennsylvanica (C.L. Koch) 3, 5, 6, 7, 9, 16. TAP, GU. July, August, September, and October.

Cicurina brevis (Emerton) 25. TAP. June.
Cicurina robusta (Simon) 3. GU. June.
Coras medicinalis (Hentz) 2, 3, 6, 7. GU, TAP, ANSP. May, June and August.
Tegenaria domestica (Clerck) 2. GU. September.

Family **Hahniidae**
Antistea brunnea (Emerton) 3. GU. June

Family **Pisauridae**
Dolomedes scriptus (Hentz) 2, 5. TAP. July and August.
Dolomedes tenebrosus (Hentz) 3, 5, 7. TAP, GU. August, September and February.
Pisaurina mira (Walckenaer) 3, 5, 7. TAP, GU. June, July and August.

Family **Lycosidae**
Arctosa virgo (Chamberlin) 2, 3. TAP, GU. June.
Geolycosa pikei (Marx) 30, 31. GU. May and June.
Lycosa aspersa (Hentz) 8. TAP. July.
Lycosa avara (Keyserling) 3. GU. June.
Lycosa avida (Walckenaer) 6. TAP, ANSP. May and July.
Lycosa carolinensis (Walckenaer) 3. GU. June.
Lycosa gulosa (Walckenaer) 3. GU. June.
Lycosa helluo (Walckenaer) 2, 3, 6, 15, 17. GU, TAP. June, July and August.
Lycosa modesta (Keyserlint) 16. TAP. August.
Lycosa rabida (Walckenaer) 2, 17. TAP, GU, ANSP. September and October.
Pardosa distincta (Blackwall) 15. TAP. September.
Pardosa floridana (Banks) 15, 16. TAP. June, August and September.
Pardosa lapidicina (Emerton) 3. GU. June.
Pardosa milvina (Hentz) 3. GU. June.
Pardosa saxatalis (Hentz) 3. GU. June.
Pirata arenicola (Emerton) 3. GU. July and August.
Pirata insularius (Emerton) 1, 3, 6, 10, 16. GU, TAP. June, August and February.
Pirata marxi (Stone) 3. GU. June.
Pirata minutus (Emerton) 1, 3. TAP, GU. July and August.
Schizocosa bilineata (Emerton) 6. ANSP. June.
Schizocosa crassipes (Walckenaer) 2, 3, 6, 27. TAP, GU, ANSP. June.
Schizocosa ocreata (Hentz) 3, 6. GU, ANSP. August.
Trabea aurantica (Emerton) 5. TAP. June.

Family **Oxyopidae**
Oxypes salticus (Hentz) 2, 5, 9, 15, 19, 21, 25. TAP. June through September.

Family **Gnaphosidae**
Cesonia bilineata (Hentz) 15. TAP. September.
Drassodes neglectus (Keyserling) 3. GU. August.
Drassyllus virginianus (Chamberlin) 3. GU. June.
Gnaphosa fontinalis (Keyserling) 3. GU. August.
Herpyllus ecclesiasticus (Hentz) 3, 10, 16. GU, TAP. June, September and February.
Litophyllus rupicolens (Chamberlin) 3, GU. June.
Orodrassus sp. 3. GU. June.
Sergiolus capulatus (Walckenaer) 3. GU. July.
Sergiolus famulus (Chamberlin) 15. TAP. August.
Sergiolus variegatus (Hentz) 3. GU. August.

Family **Clubionidae**
Agroeca pratensis (Emerton) 3. GU. July.

Agroeca minuta (Banks) 3. GU. July.
Castaneira cingulata (C.L. Koch) 3. GU. July and August.
Castaneira longipalpus (Hentz) 3, 27. GU, TAP. June and July.
Castaneira variata (Gertsch) 2. TAP. July.
Chiracanthium inclusum (Hentz) 2, 5. GU, TAP. June, July and September.
Chiracanthium mildei (C.L. Koch) 2, 8. GU. September.
Clubiona kastoni (Gertsch) 3. GU. July.
Clubiona tibialis (Emerton) 9. TAP. June.
Clubionoides excepta (C.L. Koch) 2. TAP. June.
Phrurolithus pugnatus (Emerton) 1. TAP. July.
Phrurotimpus alarius (Hentz) 3. GU. June and July.
Phrurotimpus borealis (Emerton) 3. GU. July and August.
Trachelas tranquillus (Hentz) 2. GU, TAP. August, October and November.

Family **Anyphaenidae**

Anyphaena celer (Hentz) 3. GU. July.
Anyphaena fraterna (Banks) 3. GU. August.
Aysha gracilis (Hentz) 3, 15, 24, 25. GU, TAP. July, August and September.
Wulfia saltabunda (Hentz) 5, 6. TAP. July and August.

Family **Thomisidae**

Formocipes aleatorius (Hentz) 4, 5, 6, 15. GU, TAP. July through September.
Mimusena vatia (Clerck) 4, 15. GU. TAP. September.
Misumenops asperatus (Hentz) 6, 15. TAP. July and September.
Misumenops celer (Hentz) 2. TAP. August.
Misumenops oblongus (Keyserling) 15. TAP. June.
Ozyptila americana (Banks) 3. GU. July.
Thanatus formicinus (Clerck) 2, 3. GU. September.
Tibellus duttoni (Hentz) 17. TAP. June.
Tibellus oblongus (Walckenaer) 9, 14. TAP. August.
Tmarus angulatus (Walckenaer) 6. TAP. June.
Xysticus elegans (Keyserling) 2. TAP. October.
Xysticus ferox (Hentz) 25. TAP. June.
Xysticus fraternus (Banks) 2, 3. TAP, GU. June.
Xysticus funestus (Keyserling) 25. TAP. October.
Xysticus gulosis (Keyserling) 17. TAP. June.
Xysticus luctans (C.L. Koch) 5. TAP. June.
Xysticus punctatus (Keyserling) 18. TAP. July.
Xysticus transversatus (Walckenaer) 3. GU. June.
Xysticus triguttatus (Keyserling) 2, 9, 31. TAP. June, July and August.

Family **Philodromidae**

Philodromus imbecillus (Keyserling) 5, 6. TAP. June.
Philodromus marxii (Keyserling) 9, 27. TAP. June.
Philodromus placidus (Banks) 23. TAP. June.
Philodromus rufus (Walckenaer) 2, 5, 9, 15. TAP. June and September.
Philodromus vulgaris (Hentz) 29. TAP. July.
Philodromus keyserlingi (Marks) 5. TAP. June.

Family **Saltcidae**

Agassa cyanea (Hentz) 9. TAP. June.
Eris marginata (Walckenaer) 2, 3, 16, 17. GU, TAP. June, July and August.
Habrocestum pulex (Hentz) 3, 15. GU, TAP. August and September.
Hentzia mitrata (Hentz) 19. TAP. July.
Hentzia palmarum (Hentz) 2, 15. TAP. January, June and September.

Icius elegans (Hentz) 5. TAP. June.
Maevia vittata (Hentz) 3. GU. August.
Marpissa lineata (C.L. Koch) 5. TAP. June.
Marpissa pikei (Peckham) 15, 17. TAP. April, August and September.
Metacyrba undata (De Geer) 9. TAP. July.
Metaphidippus exiguus (Banks) 2. TAP. July.
Metaphidippus galathea (Walckenaer) 5, 9, 23, 24. TAP.
Metaphidippus protervus (Walckenaer) 2, 4, 5, 6, TAP, GU. June, July and August.
Phiddipus audax (Hentz) 1, 2, 3, 4, 12, 13, 15, 16, 19, 21, 23, 24, 25. TAP, GU, ANSP. June through September.
Phiddipus clarus (Keyserling) 5, 21. TAP. June, July and August.
Phiddipus princeps (Peckham) 5. TAP. July.
Phiddipus whitmannii (Peckham) 2, 5, 19, 29. June, July and October.
Salticus scenicus (Linnaeus) 2, 25. GU, TAP. June and January.
Sarinda hentzi (Banks) 2. TAP. July.
Talavera minuta (Banks) 2. TAP. July.
Thiodina puerpera (Hentz) 3. GU. August.
Zygoballus bennetti (Peckham) 5. TAP. June.

Family **Oecobiidae**
Oecobius annulipes (Lucas) 2. TAP, GU. December and January

Family **Dictynidae**
Dictyna annulipes (Blackwall) 6. TAP. June.
Dictyna foliacea (Hentz) 2, 9, TAP. June.
Dictyna minuta (Emerton) 5. TAP. June.
Dictyna sublata (Hentz) 2, 5. TAP. GU. July.
Dictyna volucripes (Keyserling) 15. TAP. June.

Family **Uloboridae**
Hyptiotes cavatus (Hentz) 3. GU. September.
Uloborus octonarius (Muma) 9, 25. TAP. June.

Family **Amaurobiidae**
Callobius bennetti (Blackwall) 3, 7. TAP, GU. February and June.
Callobius ferox (Walckenaer) 2, 3. TAP, GU. March and August.

ACKNOWLEDGEMENT

I am grateful to Dr. John D. Unzicker of the Illinois Natural History Survey for his assistance with updating the nomenclature, and to the faculty of the University of Delaware Department of Enomology and Applied Ecology for their encouragement and suggestions.

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NEW CAVERNICOLOUS SPECIES OF *KLEPTOCHTHONIUS*, AND RECOGNITION OF A NEW SPECIES GROUP WITHIN THE GENUS (PSEUDOSCORPIONIDA: CHTHONIIDAE)[1]

William B. Muchmore[2]

ABSTRACT: Three new species of *Kleptochthonius (Chamberlinochthonius)* are described from caves in extreme southwestern Virginia and adjacent northeastern Tennessee. A new group of species in the subgenus is recognized on the basis of the size and location of a newly observed sensory seta.

DESCRIPTORS: Pseudoscorpionida; Chthoniidae; *Kleptochthonius; Chamberlinochthonius;* sensory seta; cavernicolous; Virginia; Tennessee.

Recently, while studying several *Kleptochthonius* collected from caves in southwestern Virginia by J.R. Holsinger and his associates, my colleague, C.H. Alteri, noticed a taxonomic character which had heretofore been unrecognized – this is a short, stout seta, apparently sensory in function, on the medial surface of the fixed finger of the palpal chela. Reexamination of all available material of the genus and restudy of the types of most *Kleptochthonius (Chamberlinochthonius)* species revealed that the presence, size and position of this seta are of systematic importance. While it will subsequently be used in the definition and diagnosis of species throughout the genus, it is here employed only to distinguish a new group among the cavernicolous *Kleptochthonius.*

Family Chthoniidae Hansen
Genus *Kleptochthonius* Chamberlin
Subgenus *Chamberlinochthonius* Vachon
proximosetus Group

Muchmore (1965) discussed a grouping of species of *Kleptochthonius (Chamberlinochthonius)* based on the form of the process for muscle attachment on the base of the movable chelal finger. This grouping still seems reasonable. As presently known, the *henroti* Group consists of *K. henroti* (Vachon), *K. proserpinae* Muchmore and *K. hetricki* Muchmore, distinguished by the possession of a long, bifurcate process; the *krekeleri* Group consists of *K. kreleleri* Muchmore, *K. orpheus* Muchmore and perhaps *K. packardi* (Hagen), which possess a long, simple process; while the other 20 species of the subgenus, which have a short, more or less bifurcate process, have not been subdivided. It now appears that further partitioning is possible, using the size and position of a newly recognized sensory seta on the medial

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[1] Accepted for publication: March 11, 1976

[2] Department of Biology, University of Rochester, Rochester, New York, 14627.

side of the fixed chelal finger. In most cavernicolous species of *Kleptochthonius* this seta is short and stout (Fig. 3) and has a hollow core; its position on the fixed finger is quite constant within a species but varies in different species from a level midway between trichobothria *est* and *ist* to just proximad of *ist* (see Figs. 2,4,5). In a few cavernicolous forms and in some epigean *Kleptochthonius,* the corresponding seta is longer and more slender (Fig. 6), but still noticeably different from typical vestitural setae; in other epigean forms it is apparently not present. The seta would appear to be a specialized sense organ important for animals of this genus which live down in the earth, either in caves or in deep, hypogean situations. No similar seta has yet been identified in any other chthoniid genus, including the closely related *Apochthonius.*

Several species of *Kleptochthonius* from extreme southwestern Virginia and adjacent northeastern Tennessee may be distinguished from others in the genus by the following combination of characters: representative of *Kleptochthonius (Chamberlinochthonius),* with a short, slightly bifurcate process for muscle attachment on the proximal end of the movable chelal finger, and with a short, stout, sensory seta on the medial side of the fixed chelal finger proximad of the level of trichobothrium *ist.* These may be called the *proximosetus* Group and include the species *K. proximosetus* Muchmore, new species, *K. affinis* Muchmore, new species, *K. similis* Muchmore, new species, *K. gertschi* Malcolm and Chamberlin (1961), *K. regulus* Muchmore (1970), and *K. binoculatus* Muchmore (1974). It seems obvious that these forms are closely related, probably derived from the same hypogean or epigean ancestor. Unfortunately no non-cavernicolous specimens of *Kleptochthonius* are available from this area of Virginia, Tennessee and adjacent Kentucky.

Key to species of the *proximosetus* Group

1. Tergites 1-6 each with 4 (or 3) setae . . . . 2.
   Tergites 1-4 each with 4 setae, and tergites 5 and 6 each with 6 setae . . . . . 4.
2. Cheliceral hand with 7 setae . . . . *proximosetus,* new species
   Cheliceral hand with 9 or more setae . . . . 3.
3. With 4 eyes, distinct though weak . . . . *affinis,* new species
   With no eyes . . . .*gertschi* Malcolm and Chamberlin
4. With 4 eyes, distinct through weak . . . . *similis,* new species
   With only 2 eyes . . . . 5.
5. Larger species with more slender appendages – palpal femur longer then 1.2 mm, 1/w ratio greater than 7.3 . . . . *regulus* Muchmore
   Smaller species with less slender appendages – palpal femur shorter than 0.95 mm, 1/w ratio less than 6.5 . . . .*binoculatus* Muchmore

Kleptochthonius (Chamberlinochthonius) proximosetus, new species

Figs. 1-3

Material: Holotype male (WM 3843.01001) and paratype female from Gallohan Cave No. 1, 7 miles SE Rose Hill, Lee County, Virginia, 28-XI-1974 (J. Holsinger, T. Kane, T. VanZant). Types are in the American Museum of Natural History, New York.

Diagnosis: A species of the *proximosetus* Group (see above), with distinguishing characters as noted in the key.

Description: Male and female similar except for sexual features and male with slightly more slender appendages. Carapace a little longer than broad; anterior margin slightly concave in middle and with small denticles laterally; no eyes present; chaetotaxy of holotype 6-4-4-2-3=19, of paratype 7-4-4-2-4=21. Coxal chaetotaxy 2-2-1:3-1-CS:2-2:2-3:2-3; with 5 or 6 spines on each coxa I. Abdominal tergal chaetotaxy of holotype 4:4:4:4:4:4:6:6:7:5:T2T:0; paratype similar. Sternal chaetotaxy of holotype male 13: [2-2] :(3) $\frac{9\text{-}10}{6}$ (3):(3)7(3):8:7:8:8:11:T1T1T1T:0:2; the figures in brackets, [2-2], in the formula refer to the long papillate openings of the lateral glands into the genital atrium – in chthoniids these were formerly referred to as "internal guard setae" (see Legg, 1974, p. 71). Sternal chaetotaxy of paratype female 9:(3)6(3):(3)8(3):9:8:8:10:11:T1T1T1T:0:2.

Chelicera as long as carapace; hand with 7 setae; fixed finger with about 12 teeth, movable finger with 1 large, isolated distally and a row of 7-8; spinneret a low elevation; flagellum of 8 pinnate setae.

Palp long and slender (Fig. 1); male with femur 1.95 and chela 2.8 times as long as carapace (female 1.7 and 2.5, respectively); male (female) with femur 7.55 (7.05), tibia 2.5(2.3), and chela 7.2(6.95) times as long as broad; hand 2.7(2.7) times as long as deep; movable finger 1.65(1.59) times as long as hand. Arrangement of trichobothria typical. A short, sensory seta on medial side of fixed finger just proximad of level of *ist* (Figs. 2,3). Fixed finger with 25-28 spaced, long, sharp macrodenticles and 13-18 pointed, microdenticles alternating distally; movable finger with about 15 spaced macrodenticles, about 12 alternating microdenticles, and about 14 contiguous, low, rounded teeth proximally. Movable finger with a small, double sensillum lateral to last macrodenticle. Proximal end of movable finger with a short, bifurcate process on dorsal side.

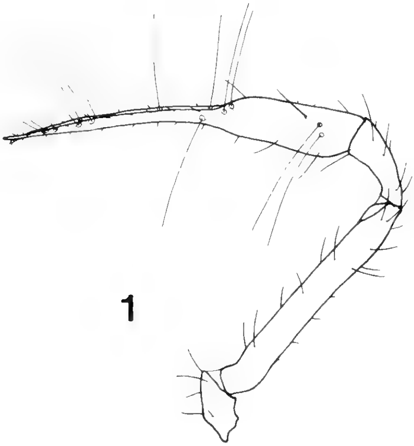
Legs slender; leg IV with entire femur 3.55-3.6 and tibia 5.9-6.0 times as long as deep.

Measurements (mm): First figures are for holotype male, with those for paratype female in parentheses. Body length 2.26(2.18). Carapace length 0.665(0.70). Chelicera 0.66(0.68) by 0.27(0.28). Palpal trochanter 0.35(0.36) by 0.18(0.18); femur 1.21(1.20) by 0.16(0.17); tibia 0.47(0.44) by 0.19(0.19); chela 1.73(1.74) by 0.24(0.25); hand 0.65(0.68) by 0.24(0.25); movable finger 1.07(1.08) long. Leg IV: entire femur 0.96(0.96) by 0.265 (0.27); tibia 0.65(0.66) by 0.11(0.11); metatarsus 0.33(0.33) by 0.10(0.10); telotarsus 0.78(0.78) by 0.07(0.07).

Etymology: The species is named *proximosetus* in recognition of the placement of the short, sensory seta on the fixed chelal finger proximad of the level of trichobothrium *ist.*

Remarks: This species and *K. similis* have been found in caves (Gallohan's and Sweet Potato) which are only about a mile apart. They are, nevertheless quite distinct as seen particularly in the development of the eyes and the number of setae on tergites 5 and 6.

The occurrence of 19 and 21 setae on the carapace of the types is



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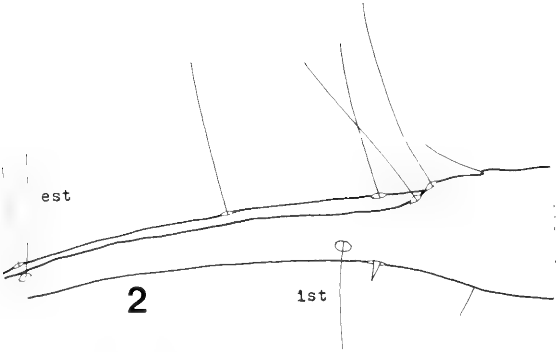

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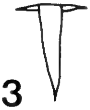

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Figs. 1-3. *Kleptochthonius (C). proximosetus,* new species: 1. Dorsal view of right palp; 2. Part of right chela showing position of sensory seta on medial side of fixed finger proximad of trichobothrium *ist;* 3. Enlarged view of sensory seta on fixed finger.

Fig. 4 *Kleptochthonius (C.) stygius* Muchmore. Medial margin of fixed finger showing position of sensory seta distad of trichobothrium *ist.*

Fig. 5 *Kleptochthonius (C.) tantalus* Muchmore. Medial margin of fixed chelal finger showing position of sensory seta far distad of trichobothrium *ist.*

Fig. 6. *Kleptochthonius (K.) crosbyi* (?). Sensory seta on fixed chelal finger, at same magnification as Fig. 3.

indicative of variation of this character in the species, the basic number undoubtedly being 20, as in other members of the group. Also, the occurrence of only 2 lateral gland openings on each side in the internal genitalia of the male is unusual; if the same situation occurs in other males of the species, then it is distinctive, as the usual number of these gland openings is 4 on each side.

Kleptochthonius (Chamberlinochthonius) affinis, new species

Fig. 7

Material: Holotype female (WM 3343.01001) from Chadwell's Cave, 3.5 miles NE Tazewell, Claiborne County, Tennessee, 10-VIII-1973 (J.R. Holsinger and D. Culver) and paratype female from English Cave, 8 miles NNE Tazewell, Claiborne County, Tennessee, 22-IV-1962 (T.C. Barr, Jr.). Types are deposited in the American Museum of Natural History, New York.

Diagnosis: A species of the *proximosetus* Group, distinguished from others by the characters noted in the key above.

Description of female: With the general features of the subgenus. Carapace a little longer than broad; anterior margin slightly concave in middle and with small denticles laterally; 4 weakly corneate eyes; chaetotaxy 6-4-4-2-4=20. Coxal chaetotaxy 2-2-1:2-1-CS;2-2:2-3:2-3; with 5-7 coxal spines on each coxa I. Abdominal tergal chaetotaxy of holotype 4:4:4:4:4:4:6:6:7:7:T2T:0; paratype 4:3:4:4:4:5:6:7:–. Sternal chaetotaxy of holotype 9:(4)6(4):(3)7(3):8:8:8:8:10:T1T2T1T:0:2; paratype similar.

Chelicera as long as carapace; with 9-13 setae on hand; fixed finger with about 10 teeth, movable finger with about 6 (some very worn); spinneret a slight elevation of the finger margin; flagellum of 8 pinnate setae.

Palp long and slender (Fig. 7); femur about 1.8 and chela about 2.55 times as long as carapace. Palpal femur 7.3-7.5, tibia 2.45-2.65, and chela 7.2-7.55 times as long as wide; hand 2.65 times as long as deep; movable finger about 1.75 times as long as hand. Arrangement of trichobothria typical. A short, sensory seta on medial side of fixed finger just proximad of level of *ist*. Fixed finger with 26-33 spaced, long, sharp macrodenticles and 19-20 pointed microdenticles alternating distally; movable finger with 17-20 spaced macrodenticles, 15 alternating microdenticles and 13-15 contiguous, low, rounded teeth proximally, Movable finger with small double sensillum near level of last macrodenticles. Proximal end of movable finger with a short, bifurcate process on dorsal side.

Legs slender; leg IV with entire femur 3.8 and tibia 6.1 times as long as deep.

Male: Unknown.

Measurements (mm): First figures are for holotype, with those for paratype in parentheses. Body length 2.13(2.10). Carapace length 0.725 (0.69). Chelicera 0.725(0.67) by 0.325(0.30). Palpal trochanter 0.37(0.355) by 0.185(0.185); femur 1.32(1.205) by 0.175(0.165); tibia 0.50(0.45) by 0.19(0.185); chela 1.88(1.75) by 0.25(0.245); hand 0.665(0.65) by 0.25 (0.245); movable finger 1.185(1.10) long. Leg IV: entire femur 1.03(0.96) by 0.27(0.25); tibia 0.73 by 0.12; metatarsus 0.37 by 0.10; telotarsus 0.85 by 0.07.

Etymology: The species is named *affinis* because of its obvious close relationship to *K. proximosetus.*

Remarks: The nearest neighbor species in the genus *Kleptochthonius* is *K. lutzi* Malcolm and Chamberlin from Cudjos Cave at Cumberland Gap, Lee County, Virginia, about 5 miles NW of English Cave and 12 miles NW of Chadwell's Cave. *K. lutzi* has a sensory seta on the fixed finger *distad* of the level of *ist*, and thus is not a member of the *proximosetus* Group.

Kleptochthonius (Chamberlinochthonius) similis, new species

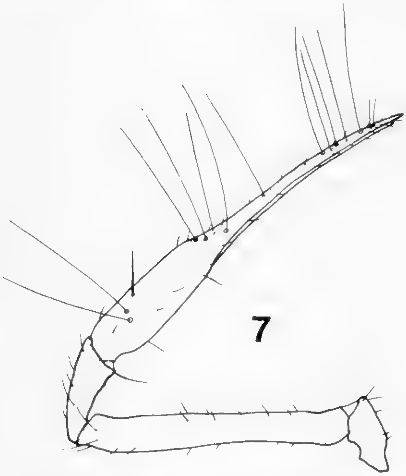
Fig. 8

Material: Holotype female (WM 3844.01001) from Sweet Potato Cave, 6.5 miles ESE Rose Hill, Lee County, Virginia, 29-XI-1974 (T. Kane and T. VanZant). Deposited in the American Museum of Natural History, New York.

Diagnosis: A species of the *proximosetus* Group, with distinguishing characters as noted in the key above.

Description of female: With the general features of the subgenus. Carapace a little longer than broad; anterior margin slightly depressed in middle and with a few small denticles laterally; 4 weakly corneate eyes; chaetotaxy 6-4-4-2-4=20. Coxal chaetotaxy 2-2-1:3-1-CS:2-2:2-4:2-3; with 5 coxal spines on each coxa I. Abdominal tergal chaetotaxy 4:4:4:4:6:6:6:7:7:7:T2T:0; sternal chaetotaxy 9:(4)6(4):(3)7(3): 8:7:8:8:9:T1T2T1T:0:2.

Chelicera slightly shorter than carapace; with 7 setae on hand; fixed finger with a row of 18 teeth, movable finger with 1 isolated distally and a row of 8; spinneret a very small elevation on the finger's edge; flagellum probably of 8 pinnate setae.



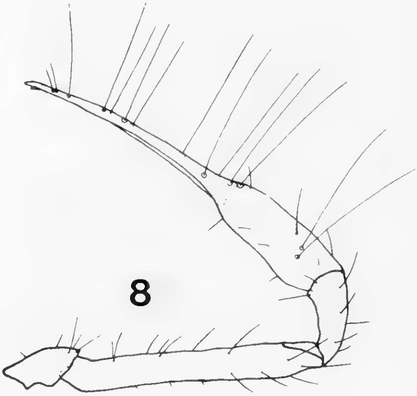


Fig. 7. *Kleptochthonius (C.) affinis,* new species. Dorsal view of left palp.

Fig. 8. *Kleptochthonius (C.) similis,* new species. Dorsal view of right palp.

Palp moderately long and slender (Fig. 8); femur 1.7 and chela 2.45 times as long as carapace. Palpal femur 7.45, tibia 2.5 and chela 6.95 times as long as wide; hand 2.6 times as long as deep; movable finger 1.64 times as long as hand. Arrangement of trichobothria typical. A short, sensory seta on medial side of fixed finger proximad of level of *ist.* Fixed finger with 29 spaced, long, sharp macrodenticles and 18 rounded microdenticles alternating distally; movable finger with 16 spaced macrodenticles, 15 alternating microdenticles and 15 contiguous low, rounded teeth proximally. Movable finger with a small double sensillum lateral to last macrodenticle. Proximal end of movable finger with a short, bifurcate process on dorsal side.

Legs rather slender; leg IV with entire femur 3.55 and tibia 5.45 times as long as deep.

Male: Unknown.

Measurements (mm): Body length 2.59. Carapace length 0.74. Chelicera 0.71 by 0.33. Palpal trochanter 0.38 by 0.19; femur 1.27 by 0.17; tibia 0.47 by 0.19; chela 1.81 by 0.26; hand 0.70 by 0.27; movable finger 1.15 long. Leg IV: entire femur 0.99 by 0.28; tibia 0.71 by 0.13; metatarsus 0.34 by 0.10; telotarsus 0.80 by 0.07.

Etymology: The species is named *similis* for its general resemblance to *K. regulus.*

Remarks: While *K. similis* is generally similar to *K. regulus,* the type locality, Sweet Potato Cave, is some 80 miles WSW of Fallen Rock Cave, the type locality of the latter. At the same time, the nearest neighbor, *K. proximosetus,* from which it differs considerably, is from Gallohan Cave, only a mile away.

ACKNOWLEDGEMENTS

I acknowledge with many thanks the cooperation of T.C. Barr, Jr., J. R. Holsinger, D. Culver, T. Kane and T. VanZant who collected the specimens treated here, and of N. Platnick, who made available type material from the American Museum of Natural History. I am indebted to C.H. Alteri for her great help in this study. The work was supported in part by a grant (GB 37570) from the National Science Foundation.

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SOME NOTES ON SOCIAL INTERACTIONS IN *POLISTES EXCLAMANS* (HYMENOPTERA: VESPIDAE)[1]

Gay D. Maher[2]

ABSTRACT: The queen's dominance may be challenged by a worker-daughter. Social grooming, apparently related to moisture or other foreign substance, is present in this species.

DESCRIPTORS: Hymenoptera, Vespidae, *Polistes exclamans,* tail-wagging, grooming.

Haplometrotic nest founding is normal in *P. exclamans* Viereck, though pleometrotic founding is not unknown. (West Eberhard, 1969, and Hermann, Barron and Dalton, 1975). However, dominance conflicts may arise in mid-season and are signaled by changes in individual or colony-wide behavior. Dominance hierarchies have been observed in many *Polistes* species which normally found pleometrotically: *P. gallicus* Linnaeus (Pardi, 1948); *P. chinensis antennalis* Perez (Morimoto, 1961a, 1961b); *P. fadwigae* Dalla Torre (Yoshikawa, 1963); and *P. fuscatus* Fabricius, *P. canadensis* Linnaeus, *P. flavus* Cresson, and *P. annularis* Linnaeus (West Eberhard, 1969). Behavior which is part of the repertoire of dominance interactions in these species may have another function in *P. exclamans.*

MATERIALS AND METHODS

Two colonies were observed in New Jersey, about 20 miles east of Philadelphia, in 1973 and 1974. The observations, totalling about 200 hours, were made at irregular intervals, some being brief checks, others continuous for up to eight hours. The first nest was observed in its natural site. The second was transferred to a selected location. One observation of a third colony in 1975 is described below. All wasps were marked on the thorax or wing tips.

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[1] Accepted for publication: March 9, 1976

[2] 22 Bank Street, Princeton, N.J. 08540

ENT. NEWS, 87: 7 & 8: 218 - 222, September & October 1976

DOMINANCE CONFLICT

Each colony had only one foundress; however, a second female joined the 1973 nest on June 12, a full month after its initiation on May 11. The buzzing foundress chased the larger newcomer around the nest for more than an hour, ceasing only after dark. The newcomer retreated, but refused to leave the nest. No further dominance interactions were observed; however, the foundress began to tail-wag the next day. The newcomer was less active than the foundress but did forage and share the work of extending cell walls and feeding larvae. She was never observed to tail-wag.

On July 4, six days after the first workers emerged, two cells were slightly damaged, two eggs were missing, and one of the workers was seen to pull out and malaxate a pupating larva, sharing it with another worker, and feeding the flesh to larvae. Two days later the wasp which had appeared on June 12 was found dying on the ground, having remained as co-foundress for more than three weeks, longer than any observed in this species over several years by Hermann, Barron, and Dalton (1975). Hermann and Dirks (1975) report the disappearance of subordinate co-foundresses coincident with the emergence of the first workers in *P. annularis*.

The foundress, unlike other queens observed, continued to forage after workers emerged, and she disappeared on July 28. A few days of disruption (missing eggs, destroyed pupae, reduced foraging and increased aggressiveness) followed her loss, before one of the first six workers to emerge assumed dominance, laying eggs and regularly shaking her abdomen, and colony activity returned to normal. The pattern of destructive behavior consistently appeared upon the loss of a queen, or a challenge to the dominant wasp. Fluno (1972) suggests that abdomen shaking (often referred to as tail-wagging) in *P. exclamans* may be a solicitation of grooming as is a similar behavior in honey bees, but he reports no observations of grooming. My observations as well as those of West Eberhard (1969) and of Hermann, Barron, and Dalton (1975) associate tail-wagging with dominance, but not with grooming.

The queen on the 1974 nest never foraged and, except for the challenge period described below, left the nest only briefly, settling a few feet away to defecate or to groom herself. Late in July she was challenged by one of the other three wasps on the nest when it was transferred on July 4. The challenger had foraged regularly and was almost certainly a daughter-worker. The queen had engaged in regular tail-wagging, and on July 25 the subsequent challenger began to tail-wag too. On July 27 the previously subordinate wasp was absent all day. About noon of the 28th, after buzzing was heard, the queen flew off, and the challenger was found on the nest. The queen returned, buzzing, and the challenger flew off. Later that day the tip of one of the queen's wings was seen to be slightly torn, and some time after that a falling fight with buzzing was observed between the challenger and an unidentified wasp, almost certainly the queen, from which the challenger emerged victorious, returning to the nest. The two wasps changed positions nine times that day, leaving the challenger on the nest overnight and the queen missing. The next day there were further alternations ending with the queen on the nest, and the challenger was not seen again.

A second instance of an apparent mid-season challenge on this nest involved a worker which had been absent for nine consecutive days when she returned on August 14. Two days after her return the queen was observed laying eggs in cells which had previously contained eggs, signaling the possibility of dominance conflict. That evening the returned wasp was observed resting on the ceiling above the nest, a position sometimes assumed by subordinate challengers in *P. canadensis* (West Eberhard, 1969). She crawled down onto the nest and apparently received fluid from a large larva once that evening and once the next morning, but was not observed to interact with any adult. At the next observation, after a 28-hour interval, she was absent, and she never reappeared, evidently having lost out in her interactions with the resident queen. Observations suggest that mid-season challenges by daughter workers may be common in this species, perhaps thus assuring unfertilized eggs to provide the necessary male population late in the season.

SOCIAL GROOMING

Until very recently social grooming was unknown in social wasps. It has been reported in *Protopolybia* (Naumann, 1970) and in *Metapolybia* and *Parachartergus* (West Ebergard, personal communication). This behavior was observed in both these *P. exclamans* colonies and in a third observed in 1975. Seven of nine individual instances seen in 1973 were clearly attempts to remove the water-based paint markings. Six attempts to remove markings (model airplane paint) were observed in 1974, but four included biting or snapping and have been excluded from the count of 43 instances of non-aggressive grooming in the 1974 colony. Grooming not directed at painted areas was most frequently focused behind the head, between head and thorax. This behavior differs from dominance behavior in that two wasps sometimes collaborate in grooming a third and the grooming wasps never become increasingly aggressive as is common in the grooming-like chewing accompanying dominant behavior.

An hypothesis concerning the function of this behavior can be derived from two sets of observations. The first concerns the circumstances preceding two instances of general, colony-wide social grooming. In the first case a windstorm with heavy rain had drenched the 1973 nest and its occupants. The wasps removed water from each other, as well as from the nest surface, hanging head downward from the nest and dropping the water on the ground. The second case involved a well-developed colony in southern New Jersey which was transferred with all its occupants on a hot, humid, late-August evening in 1975. The wasps were partially anaesthetized by CO_2 and placed in a refrigerator while the nest was being attached in a plexiglas and screen "cage." When the wasps were placed in the cage and began to move about, virtually all became engaged in removing condensation from one another. In both cases the behavior, identical to the behavior in the individual instances of social grooming, was unquestionably devoted to removing moisture.

The second set of observations concerns the relation of grooming in the 1974 nest to the history of one particular wasp. This wasp, emerging on August 3, was inadvertently left under a glass from August 5 to August 10. The glass became thickly clouded with condensation on the inside, and the wasp was very feeble and wet when returned to the nest. She was attacked vigorously by three of her nest mates, though she antennated with another and was ignored by the rest. She was driven from the nest and did not return until the next day, When she was again briefly attacked but less vigorously by one of the same three, though ignored by the others. No further attacks by these three were seen but she was later groomed on two occasions by other wasps, once by two wasps together. The 43 grooming instances include 16 involving this wasp directly or indirectly: three instances of wasps grooming her and 12 instances in which the groomee had previously attacked, groomed, or antennated with her soon after her return to the nest.

Taken together with the instances of colony-wide grooming, these observations suggest that grooming is stimulated by the presence of moisture and perhaps also by other substances which pose a hazard and which may pass as contaminants from one wasp to another. This behavior, elicited by stimuli which threaten colony success, may be a forerunner of the dominance behavior observed in other species.

ACKNOWLEDGEMENTS

Thanks are due to M.A. McCarty for help in acquiring the 1974 nest; to Dr. M.J. West Eberhard for her encouragement and her criticism and suggestions concerning the manuscript; to Dr. R. Roberts of Rutgers University for his encouragement and suggestions; and to Dr. Arnold Menke at the U.S. National Museum for species determination.

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NEW STATE RECORDS OF FISHFLIES (MEGALOPTERA: CORYDALIDAE)[1]

D.C. Tarter[2], W.D. Watkins[3], M.L. Little[2], J.T. Goodwin[4]

ABSTRACT: Forty-three new state records of fishflies are reported after the examination of 3358 specimens from 38 states east of the Rocky Mountains.

DESCRIPTORS: State records, County records, fishflies, Megaloptera, Corydalidae.

Several authors, including Davis (1903), Parfin (1952), Hazard (1960), Flint (1965), Tarter and Watkins (1974), Watkins et al. (1975), Caldwell (1976), and Tarter et al. (1976), have reported distributional records of fishflies from the eastern United States.

Three eastern genera of fishflies, *Chauliodes* Latreille, *Nigronia* Banks, and *Neohermes* Banks, are found in the subfamily Chauliodinae. The larvae of *C. pectinicornis* (Linnaeus) and *C. rastricornis* Rambur are found in lentic habitats, primarily ponds and marshes. Generally, the larvae of *Nigronia fasciatus* (Walker) are confined to small, woodland brooks, whereas the larvae of *N. serricornis* (Say) are inhabitants of streams with high to intermediate gradient. At the present time, the larvae of *Neohermes angusticollis* (Hagen), *N. concolor* (Davis), and *N. matheri* Flint are unknown.

NEW DISTRIBUTION RECORDS

Forty-three new state records of seven species of fishflies are presented after the examination of 3358 specimens from 38 states east of the Rocky Mountains. County records are given in parenthesis.

Chauliodes pectinicornis has been reported from 21 states in the eastern half of the United States (Davis, 1903; Hazard, 1960; Tarter and Watkins, 1974; and Tarter et al., 1976) (Fig. 1). The following 12 states and the District of Columbia represent new records and range extensions for this species: Delaware (Sussex), Illinois (Carroll, Champaign, DeWitt, Hardin, Marshall, Piatt, Vermilion), Indiana (Dubois, Elkhard,

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[1] Accepted for publication: February 23, 1976

[2] Dept. of Biol. Sci., Marshall University, Huntington, W. Va. 25701

[3] Ashland Oil Inc., Res. and Dev. Dept., Catlettsburg, Ky. 41129

[4] USAF, Environ. Health Lab., Kelly AFB, Texas 78245

Knox, LaGrange, La Porte, Porter, Tippecanoe), Iowa (Winnebago), Kansas (Riley), Maine (Kennebec, Oxford, Penobscot, Piscataquis, York), Mississippe (Harrison, Lafayette, Lauderdale, Monroe, Oktibbeha), Nebraska (No county listed), New Hampshire (Carroll, Merrimack, Rockingham, Strafford, Sullivan), Rhode Island (Providence, Washington), Texas (Galveston), and Vermont (Orleans) (Fig. 1).

Chauliodes rastricornis has been recorded from 23 states in the eastern and southwestern parts of the United States (Davis, 1903; Hazard, 1960; and Watkins et al., 1975) (Fig. 2). Eleven new state records and range extensions are presented: Alabama (Lee, Mobile), Iowa (Story), Maine (Penobscot), Mississippi (Harrison, Lamar, Warren), Nebraska (Antelope, Cherry), New Hampshire (Belknap, Hillsborough), Rhode Island (Washington), South Dakota (No counted listed), Tennessee (Campbell, Chester, Shelby), Virginia (Greensville, Nansemond, New Kent, Sussex), and Wisconsin (Marginal counties only: Polk, Manitowoc, Rock, Vilas) (Fig. 2).

Nigronia fasciatus has been reported from 18 states in the eastern half of the United States (Davis 1903; Hazard, 1960, and Tarter and Watkins, 1974) (Fig. 3). Five new state records are reported for this species: Alabama (Clay), Delaware (New Castle), Louisiana (West Feliciana), New Hampshire (Grafton), and South Carolina (Greenville, Pickens) (Fig. 3).

Nigronia serricornis has been recorded from 25 states in the eastern half of the United States (Davis, 1903; Hazard, 1960; and Tarter et al., 1976) (Fig. 4). Five new state records are added to the distribution of this species: Connecticut (Fairfield, Hartford, Middlesex, New Haven, Tolland), Kansas (Cowley), Louisiana (St. Tammany, Washington), Rhode Island (No county listed), and South Carolina (Aiken, Anderson, Greenville, Kershaw, Newberry, Oconee, Pickens) (Fig. 4).

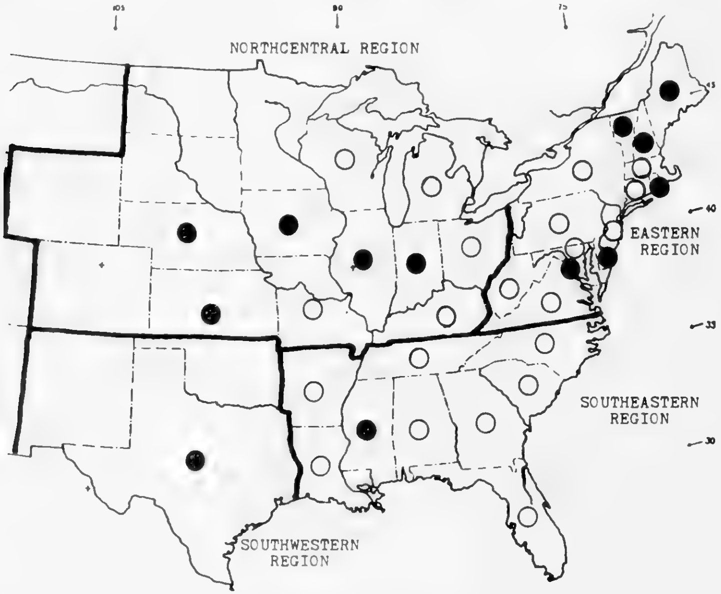

Figure 1. Distribution of *Chauliodes pectinicornis*.
Open Circles = Literature records; Closed Circles = New records

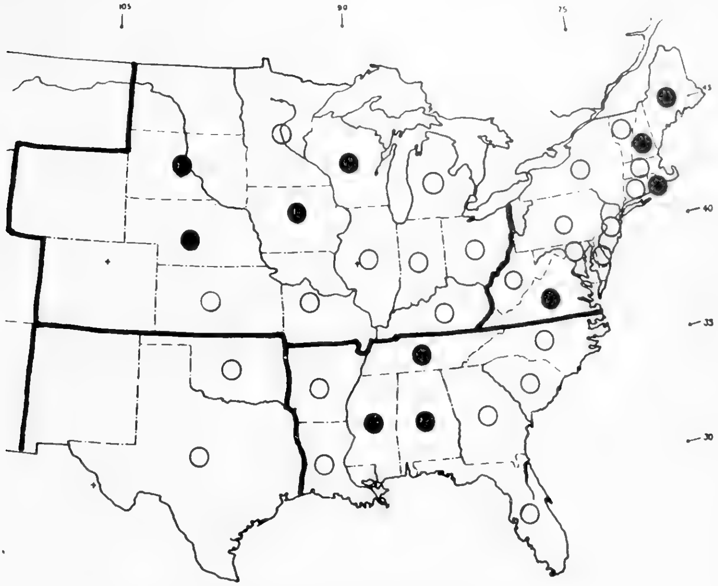

Figure 2. Distribution of *Chauliodes rastricornis.*

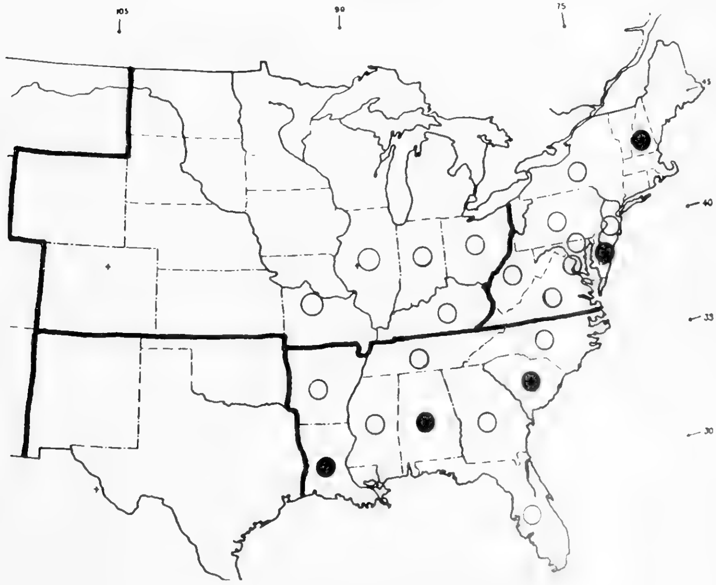

Figure 3. Distribution of *Nigronia fasciatus.*

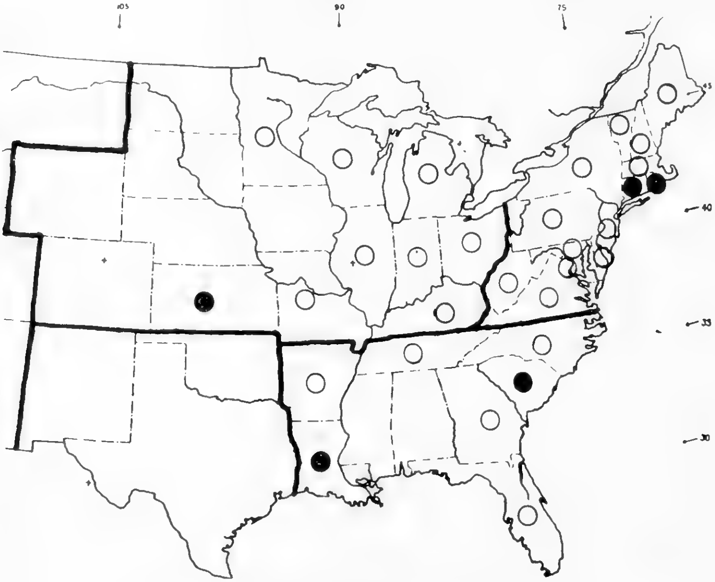

Figure 4. Distribution of *Nigronia serricornis.*

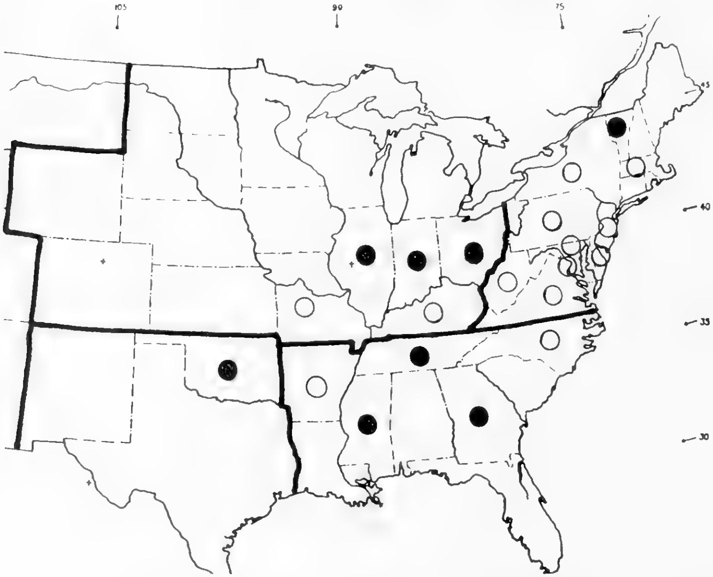

Figure 5. Distribution of *Neohermes concolor.*

Neohermes concolor has been reported from 13 states in the central and northeastern parts of the eastern United States (Flint, 1965 and Tarter et al., 1975) (Fig. 5). Eight new state records extend its distribution into the southeastern and southwestern portions of the United States; Georgia (Fulton), Illinois (Pope, Union), Indiana (Clark, Monroe, Tippecanoe), Mississippi (Lafayette, Warren), Ohio (Adams, Huron, Pike, Washington), Oklahoma (Latimer), Tennessee (Coffee, Marion, Morgan), and Vermont (Addison, Orleans) (Fig. 5).

Neohermes angusticollis has been reported from Georgia (Flint, 1965). One new record adds South Carolina (Greenville, Pickens) to its distribution.

Neohermes matheri is known only from Mississippi (Flint, 1965).

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ACKNOWLEDGEMENTS

The authors are grateful to the following who loaned specimens: Dr. G.L. Harp, Arkansas State University; Mr. P. Kittle and Dr. E.P. Rouse, University of Arkansas; Dr. C.L. Remington, Peabody Museum of Natural History; Dr. G.I. Stage, University of Connecticut; Dr. L.P. Kelsey, University of Delaware; Dr. Oliver S. Flint, Jr., United State National Museum; Mr. P. Carlson, Florida Agricultural & Mechanical University; Dr. E.I. Hazard, Insects Affecting Man Research Laboratory, Gainesville, Florida; Dr. H.V. Weems, Jr., Florida State Collection of Arthropods; Dr. F.E. French, Georgia Southern College; Dr. C.L. Smith, University of Georgia; Dr. W.U. Brigham and Dr. D.W. Webb, Illinois Natural History Survey; Dr. R. Wenzel, Field Museum of Natural History; Dr. A. Provonsha, Purdue University; Dr. R. Miller, Iowa State University; Dr. H.D. Blocker, Kansas State University; Dr. G.W. Byers, Snow Entomological Museum; Dr. D.L. Batch, Eastern Kentucky University; Mr. Larry Canterbury and Dr. C. Covell, University of Lousiville; Dr. G.L. DeMoss, Morehead State University; Dr. P.H. Freytag, University of Kentucky; Mrs. J.B. Chopin, Louisiana State University; Dr. M.E. Dakin, University of Southwestern Louisiana; Dr. K.E. Gibbs, University of Maine; Mrs. M.K. Thayer, Museum of Comparative Zoology; Mrs. B. Alford, Eastern Michigan University; Dr. R. Fischer, Michigan State University; Dr. T.E. Moore, University of Michigan; Dr. E.F. Cook, University of Minnesota; Dr. W.R. Enns, University of Missouri–Columbia; Dr. W.J. Morse, University of New Hampshire; Dr. R.A. Norton and Dr. F.E. Kurczewski, State University of New York; Dr. L.L. Pechuman, Cornell University; Dr. R.T. Schuh, American Museum of Natural History; Dr. H.H. Neunzig, North Carolina State University; Dr. R.L. Post, North Dakota State University; Mr. H.J. Lee, Jr., Fairview Park, Ohio; Dr. S. Teraguchi, Cleveland Museum of Natural History; Dr. C.A. Triplehorn, Ohio State University; Dr. W.A. Drew, Oklahoma State University; Mr. D.H. Bartow, Delaware County Institute of Science; Dr. K.C. Kim and Mr. D.J. Shetlar, Frost Entomological Museum; Dr. G. Wallace, Carnegie Museum of Natural History; Dr. K.E. Hyland, University of Rhode Island; Dr. J.C. Morse, Clemson University; Dr. D. Etnier, University of Tennessee; Dr. C.H. Nelson, University of Tennessee–Chattanooga; Dr. H.R. Burke, Texas A & M University; Dr. D.E. Foster, Texas Tech University; Dr. J.E. Gillaspy, Texas A & I University; Dr. K.W. Stewart, North Texas State University; Dr. R.T. Bell, University of Vermont; Dr. J.F. Matte, Old Dominion University; Dr. M. Kosztarab, Virginia Polytechnic Institute and State University; Dr. Linda Butler, West Virginia University; Dr. C. Coffman, West Virginia Department of Agriculture; Dr. W. Hilsenhoff, University of Wisonsin–Madison; Dr. D.H. DeSwarte, Milwaukee Public Museum; Dr. L.A. Schuh, University of Wisconsin–LaCrosse.

The authors are thankful to. Pattie Evans for typing the manuscript. Also, we acknowledge a summer research grant from the graduate school at Marshall University for supporting this project.

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE ANNOUNCEMENT

A.N.(S) 99

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. 33 part 1, 26th June, 1976).

896. *Tipula oleracea* (Diptera: TIPULIDAE): revised proposals for stabilizing names in species-group.
1117. *Beyrichia* M'Coy, 1846 (Crustacea: Ostracoda): proposed designation of type-species and neotype designation for that species.
2093. *Baboon and Mandrill* (Mammalia: Primates, CERCOPITHECIDAE): proposed determination of generic names.

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, S.W.7 5BD, England, if possible within 6 months of the date of publication of this notice. Those received early enough will be published in the Bulletin of Zoological Nomenclature.

26th June, 1976

OBSERVATIONS ON ADULT BEHAVIOR OF THE LYCID BEETLE *CALOPTERON TERMINALE* (COLEOPTERA: LYCIDAE)[1]

Horace R. Burke[2]

ABSTRACT: Observations were made on the mating, feeding and ovipositional behavior of *Calopteron terminale.* Individuals of this species were observed to repeatedly raise and lower their elytra while walking. A male was also detected with its mandibles inserted through an abdominal intersegmental membrane of a female upon whose body fluid it was presumably feeding. The possible significance of these behavioral traits is discussed.

DESCRIPTORS: Coleoptera, Lycidae, *Calopteron terminale* (Say), elytral movement, mating behavior, feeding habits, oviposition.

Knowledge about the biologies of beetles of the lycid genus *Calopteron* is primarily limited to occasional mention in the literature of their mimetic roles (Jones 1932, Linsley *et al.* 1961, Emmel 1965). Recent observations on *Calopteron terminale* (Say) made at Salmon, Anderson Co., Texas provide hitherto unpublished information on some rather unusual aspects of adult behavior of this species. These notes, although fragmentary, are presented now because involvement in other entomological studies precludes further investigation of this lycid in the near future.

C. terminale is widely distributed in the eastern half of the United States and Canada, having been recorded from Maine to Colorado and southward to Texas (Green 1952). The only significant biological information available for the species was presented in a paper by Young and Fischer (1972), wherein the pupa was described and illustrated and larval and pupal habits briefly discussed.

My first observation on adults of *C. terminale* took place on July 12, 1975 when an individual was seen walking about on hickory leaves opening and closing the elytra in a fairly regular manner. As no obvious attempt was being made to fly, this uncharacteristic behavior for beetles attracted my attention. This individual, a female, was captured and taken to the laboratory where the habit of opening and closing the elytra continued. Such

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[1] Accepted for publication: February 9, 1976

[2] Department of Entomology, Texas A&M University, College Station, Texas 77843

elytral movement occurred only when the beetle was walking. The elytra were frequently elevated ca. 45°, while occasionally they were raised to the apparent maximum extent, projecting nearly vertically above the body. In captivity, the elytra were sometimes opened and closed rapidly but usually this occurred in a slow and fairly regular manner. A male observed later also exhibited similar movement of the elytra but the opening-closing sequence took place less frequently and more irregularly than in the female. To my knowledge this habit has not been described for any species of *Calopteron.* Also, it has not been reported in the related genus *Lycus* which has been studied relatively extensively (Linsley *et al.* 1961, Eisner and Kafatos 1962, Selander *et al.* 1963).

Due to the lack of sufficient study, any attempt to explain the significance of the elytral opening-closing sequence in *C. terminale* at this time must be considered highly speculative. However, it seems likely that elytral movement in this species may function in one or more of the following ways: (1) aids in dispersal of a sex attractant or aggregation pheromone; (2) serves as a visual cue in location of mates; and/or (3) in some way enhances the aposematic coloration in protection of these beetles from predators.

The opportunity to make limited observations on the copulatory habits of *C. terminale* came about when a pair of individuals *in copula* was collected at the Salmon locality July 19. The somewhat smaller male was mounted dorsally on the abdomen of the female with its mouthparts closely applied to the region of the metathorax and first abdominal tergum. The front and middle legs of the male grasped the side of the abdomen of the female while the hind legs were held outward. Antennae of the male projected vertically between the elevated elytra of the female. The anterior portion of the body of the male was nearly completely covered by the metathoracic wings of the female. The apex of the male's abdomen was bent ventrally and coupling with the female was effected from a ventroposterior position. Copulation was observed to be quite prolonged, lasting for a period of several hours after collection. While the specimens were thus coupled it was possible to handle them extensively without interrupting copulation.

Specimens of both sexes held individually in petri dishes remained quiet for long periods of time and then became active for brief periods during which they crawled about and performed the elytral opening-closing sequence. When the two sexes were placed together the male would usually crawl upon the back of the female and attempt to burrow beneath her wings. In one case a male being observed under magnification mounted a female and inserted its angulate, sharply pointed mandibles into the intersegmental membrane between the metathorax and first abdominal segment where it presumably fed upon the body fluid of the female. The two individuals were not copulating at this time and no apparent attempt was being made to do so. Upon removal of the mandibles from the intersegmental membrane a small drop of yellowish body fluid welled up from the punctures but the bleeding stopped quickly. The intersegmental membranes on the anterodorsal portion of the abdomen are wide and when the female is receptive these membranes are exposed by spreading apart the tergites. An observation made by John A. Chemsak on *Calopteron* sp. (near *reticulatum* Fabr.) in the State of Chiapas, Mexico and cited by Linsley *et al.* (1961) is of considerable interest and has a bearing on the information presented here. Chemsak recorded that two males were seen feeding on droplets of a light colored fluid secreted from the thorax of the female. No openings of glands or any evidence of secretion of a fluid was seen in the few females of *C. terminale* examined. Based on the limited information presented here, injury in the form of puncturing of the integument may be required to release drops of fluid on which the males feed. Injury of females in the laboratory by puncturing the integument with a pin did not prove to be noticeably detrimental as bleeding, although momentarily profuse, ceased quickly. Linsley *et al.* (1961) observed the same reaction to artificially induced punctures in species of *Lycus.* In the present study females were never observed attempting to feed upon the body fluid of either males or other females, although several opportunities existed for them to do so. In view of the foregoing account it is of interest to note that a photograph of *Lycus fernandezi* Dugés included in the paper by Linsley *et al.* (1961) shows a male with its head beneath the elytra of a female. Perhaps a habit similar to that described above for *C. terminale* is practiced by this species of *Lycus.* The extent to which males of *C. terminale* normally feed upon the *body fluid of females remains to be determined by additional observation of this species.*

Adults of C. terminale observed in the laboratory readily took water but did not feed on several live larvae of a small weevil, *Cossonus* sp., which were placed in the dishes. Other live food was not offered so the question concerning feeding habits of these beetles also remains unanswered. On the basis of characteristics of the mandibles, Young and Fischer (1972) suggested that the adults may be predaceous. The mandibles are certainly not adapted for mastication of solid food as the latter authors pointed out, but due to the slow movement and lack of aggressiveness of these beetles it is also doubtful that they are able to subsist entirely as predators.

Since nothing is known about the eggs or ovipositional behavior of this species results of the following observations are presented. One female kept in the laboratory for 2 weeks, deposited about 40 eggs in a single mass immediately before dying. The eggs of this species are broadly oval, ivory-colored with a finely granulate chorion and measure ca. 0.62 x 0.79 mm. Another female deposited eggs in strings composed of several eggs each. Since the larvae of *C. terminale* live in decaying logs (Young and Fischer 1972), small pieces of rotten wood were placed in the petri dishes as potential oviposition sites; however, the females avoided these and deposited their eggs instead on paper toweling in the bottoms of the dishes.

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ELLIPSOPUS ORNATUS, A NEW GENUS AND SPECIES OF ACARIDAE (ACARI) PHORETIC ON THE BEETLE *BOLITOTHERUS CORNUTUS* (PANZER, 1794)[1]

A. Fain[2], G.S. Ide[3]

ABSTRACT: *Ellipsopus ornatus,* n.gen., n.sp., described here is known only from the hypopial stage (heteromorphic deutonymph). It has been found on the elytra and sternites of a beetle, *Bolitotherus cornutus* from U.S.A.

DESCRIPTORS: Acari, Acaridae, hypopus, *Ellipsopus ornatus* n.gen. and n.sp., *Bolitotherus cornutus* (Panzer, 1794).

Ellipsopus, n.gen.

Hypopus: General aspect normal for Acaridae. Palposoma short, bearing two apical solenidia and two lateral setae. Dorsum with two strongly sclerotized and pitted shields. Some dorsal setae, (d2, d3, d4, d5, 15, sci, and sce) broadly lanceolate with apically converging ridges; remainder, (d1, 11, 12, 13, 14, vi, ve, and scx) setiform. Epimera as in *Lackerbaueria* Zachvatkin. Suctorial plate with posterior suckers much larger than anterior; lateral and paramedian conoids situated on transverse line behind the posterior suckers (for nomenclature of these structures, see Fain, 1973, p. 172). Legs short and massive. Claws very strong, sessile.

Type species: *Ellipsopus ornatus* n.sp.

Ellipsopus ornatus n.sp.

(figures 1-4)

Hypopus: Idiosoma elliptical. Holotype 261 μ long and 153 μ wide; three paratypes (length by width) 264 μ x 141 μ; 255 μ x 150 μ; 246 μ x 126 μ. Palposoma short; palps not fused. Dorsal shields with dense pitted pattern. Pits in lateral parts of dorsum smaller than those of median area. Sejugal furrow transversely striated. Lyrifissure ia adjacent to d1. Ventrolateral regions of idiosoma bear fine longitudinal striations. Ventral surface of opisthosoma bears two pairs of lyrifissures, (ip and im); oil gland opening just posterior to sejugal groove.

Leg chaetotaxy: trochanters 1-1-1-0; femora 1-1-0-1; genua 2-2-0-0; tibiae 1-1-1-1; tarsus I with famulus rather long, narrow.

Solenidiotaxy: genua 1-1-0-0; tibiae 1-1-1-1; tarsi 2-1-0-0.

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[1] Accepted for publication: February 17, 1976

[2] Prins Leopold Instituut voor Tropische Geneeskunde, Nationalestraat 155, B-2000, Antwerpen, Belgium

[3] Entomology Department, Acarology Laboratory, The Ohio State University, Columbus, Ohio 43210

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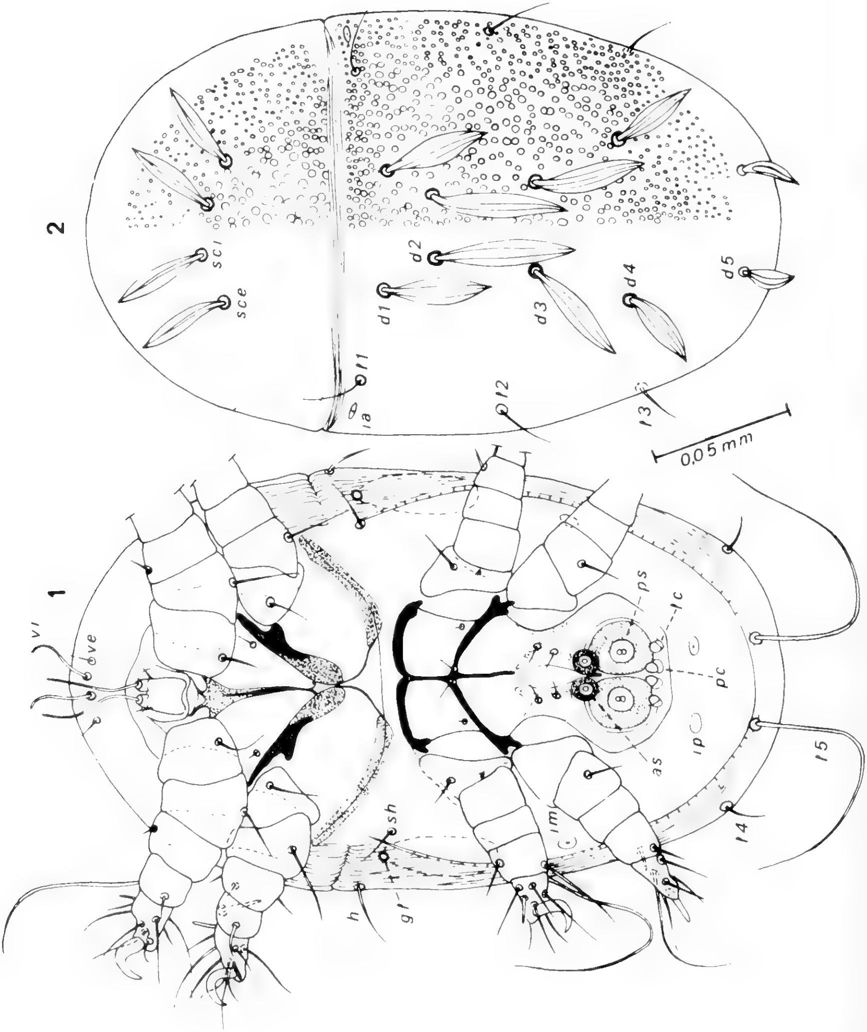

Fig. 1-2. *Ellipsopus ornatus* sp. n. Hypopus in ventral (fig. 1) and dorsal (fig. 2) view. (N.B.: as = anterior sucker; ps = posterior sucker; lc = lateral conoid; pc = paramedian conoid).

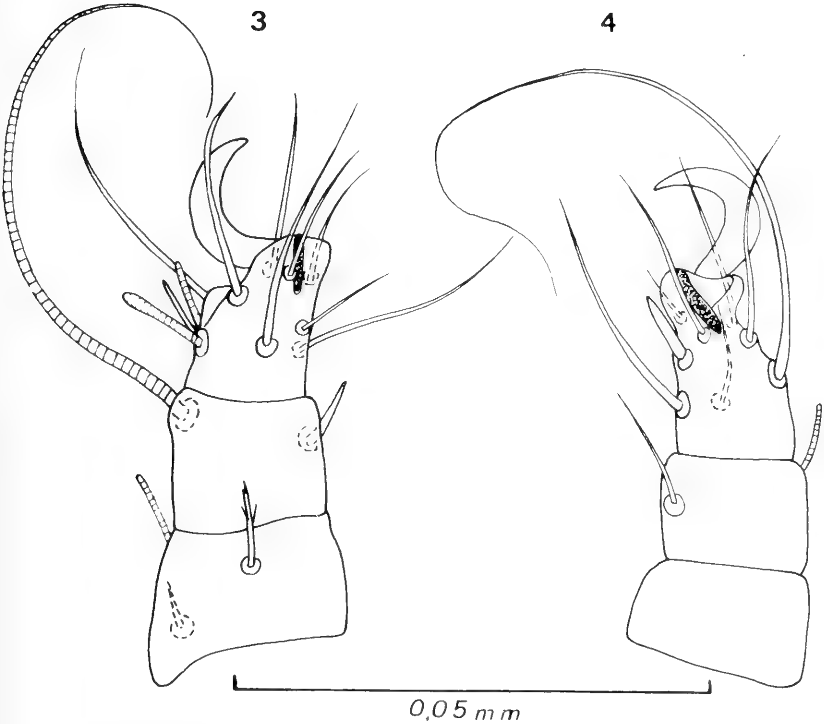

Fig. 3-4. *Ellipsopus ornatus* sp. n. Legs I (fig. 3) and IV (fig. 4).

The types series (holotype and twenty-seven paratypes) was removed from the elytra of *Bolitotherus cornutus* (Panzer, 1794) (Tenebrionidae) collected with a modified Tullgren funnel from an unidentified bracket fungus; Cedar Bog, Champaign Co., Ohio, U.S.A. 9.V.1975 (G.S.I.). The holotype has been deposited in the Systematic Entomology Laboratory, Beltsville, Maryland. Paratypes are in the collections of the authors.

Remarks

In addition to the type host, 173 museum specimens of *B. cornutus* were examined for infestation by *E. ornatus*. Of these, 52, (20 males, 32 females) were found to harbor this mite. The degree of infestation was as low as 1 to so dense that the host's integument was not visible. The mite is characteristically found in the deep puncta of the elytra.

B. cornutus is reported to be a common inhabitant of polypore fungi in forested areas, especially beech-maple, east of the Mississippi River (Liles, 1956). Specimens examined and found to bear *E. ornatus* were collected in Ohio, Kentucky, New York, and Illinois. The other instars of *E. ornatus* will probably be found to live in polypores.

ACKNOWLEDGMENTS

We thank C.A. Triplehorn for permission to examine the material of *B. cornutus* in the OSU Entomological Collection and D.J. Borror for making his personal collection of these beetles available for study. We also thank D.E. Johnston, Acarology Laboratory, The Ohio State University, for his assistance and encouragement during this study.

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BOOK REVIEW

THE SPHECID WASPS OF THE WORLD – A Generic Revision, R. M. Bohart and A. S. Menke. Univ. of California Press, Berkeley. IX + 695 pp. $42.50.

This is a monumental worldwide generic revision of the wasp family Sphecidae. As the authors state – it is designed to lay the groundwork for detailed revisions at the generic or tribal levels. They succeed admirably in fulfilling this aim. The introductory sections include behaviour, zoogeography, morphology (with clear illustrations and a glossary of terms used), systematics, evolution, a synonymic catalogue, a key to the subfamilies and an overall key to tribes. Under each subfamily there is, if necessary, a key to the included tribes. Each subfamily discussion includes categories such as – diagnostic characters, systematic characters and evolution. Generic keys are given for each tribe, if needed. For each genus, the diagnosis, zoogeographic range, systematics, biology and a checklist of included species and synonyms are included. A comprehensive literature cited and index close the volume.

It is unfortunate that the price of $42.50 will take it out of the range of most student budgets.

Selwyn S. Roback

RECENT COLLECTIONS OF *ANEPEORUS SIMPLEX* (WALSH) (EPHEMEROPTERA: HEPTAGENIIDAE) FROM THE WABASH RIVER, INDIANA[1]

Eugene R. Mancini[2], James R. Gammon[3]
and
Paul H. Carlson[4]

ABSTRACT: Four nymphs of *Anepeorus simplex* (Walsh) were collected from the Wabash River, Indiana, during the summer of 1973. These specimens represent a new state record and are the only recorded collection of the species from the Wabash River in thirty-one years.

DESCRIPTORS: Ephemeroptera, Heptageniidae, *Anepeorus simplex* (Walsh) Wabash River, Indiana, state record, drifting macrobenthos..

Burks (1953) reported the collection of 22 adults of *Anepeorus simplex* (Walsh) and 3 nymphs, which he believed were conspecific, from Illinois. The nymphs were collected from the Wabash River, Illinois, in 1942. Since then, specimens have rarely been found in North America and Lehmkuhl (1970) states that some authorities had considered the species to be extinct.

During June and July, 1973, four mature nymphs of *A. simplex* were taken during routine drift net collections at Public Service Indiana's Wabash Generating Station in Terre Haute, Vigo County, Indiana. The drifting macrobenthos of the Wabash River were comprehensively sampled at the intake flumes and discharge canal of the power plant during the spring, summer and fall 1973 (Mancini 1974). All of the nymphs were taken with a subsurface 570 micron mesh drift net and preserved in alcohol.

Three of the nymphs were collected at an intake flume immediately adjacent to the main body of the river. The first specimen was captured on June 12 at 2125 hrs.; the second on June 14 at 0438 hrs. and the third on June 22 at 2045 hrs. The fourth specimen was taken in the discharge canal on July 13 at 2155 hrs. Each drift net sample was of four minutes duration. The times given above represent the time of sample collection completion.

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[1] This paper is based on research which was supported by Public Service Indiana; James R. Gammon, Principal Investigator.

[2] Present address: Water Resources Laboratory, University of Louisville, Louisville, Kentucky 40208

[3] Present address: Department of Zoology, DePauw University, Greencastle, Indiana 46135

[4] Present address: Department of Entomology and Economic Zoology, Clemson University, Clemson, South Carolina 29631

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At first glance the nymphs appear very similar to *Stenonema* spp. Closer inspection, however, reveals a much broader head, predaceous mouthparts and dense fringes of fine hairs at numerous body locations as described by Burks (1953).

Photographs of mouthparts, gills and a nymph are planned for a manuscript in preparation. In addition, plans are being made for rearing the nymphs in order to positively associate the immature with the adult.

The collection of these nymphs indicates that a population of *A. simplex* still inhabits the Wabash River and also represents a new state record.

One specimen, each, is deposited at the National Museum of Natural History, Smithsonian Institution, Washington, D.C. and the Laboratory of Aquatic Entomology, Florida A&M University, Tallahassee, Florida.

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BOOK REVIEW

A FIELD GUIDE TO THE BUTTERFLIES OF THE WEST INDIES. Norman D. Riley. Quadrangle/The New York Times Book Co., 1976. 224 pp., 24 color plates. $12.50.

This is the first comprehensive guide to the identification of the butterflies of the West Indies, from the southern tip of Florida to the more South American fauna of Trinidad and Tobago. Following a concise introduction to the subject, each butterfly species is described individually, with local and scientific names, plate reference, notes on size, color, distribution, habitat and all special characters. The color plates, painted especially for this book, show both the upper and under sides of the wings and are usually life size. The book concludes with a very useful Checklist and Distribution Table, a bibliography and an index. This is a very fine volume following the general format of field guides.

H.P.B.

A RECORD OF SOME BAT FLIES (DIPTERA: NYCTERIBIIDAE) FROM TURKEY[1]

B.V. Peterson[2], R.L. Martin[3], F.W. Maurer, Jr.[4]

ABSTRACT: Although nycteribiid bat flies have been recorded from Turkey, there are few specific locality records for such species in this country. A report on the collection of five bat-fly species from Turkey, along with their host records, is presented here. The bat flies include *Penicillidia (P.) dufourii dufourii, Phthiridium biarticulatum, Nycteribia (N.) schmidlii schmidlii, N. (N.) pedicularia,* and *N. (N.) latreillii.*

DESCRIPTORS: Bat flies, Nycteribiidae, Turkey.

The Old World bat-fly fauna of the family Nycteribiidae is well known through many papers by many authors. Despite this vast literature, there are no papers that treat specifically the nycteribiid fauna of Turkey and, except for the works of Theodor and Moscona (1954), Aellen (1955), Theodor (1956, 1967), and Hůrka (1964b, 1972), there are very few papers that even list specific localities for such species in this country. However, a number of papers have been published which mention or deal with various aspects of the nycteribiid fauna of near-by countries or those having a common border with Turkey. The more useful, recent, and probably most reliable works include those of Aellen (1955, 1959), Chalupský (1956), Decu-Burghele (1962a, 1962b), Guéorguiev and Beron (1962), Hůrka (1958, 1962, 1963, 1964a, 1964b, 1968, 1969), Hůrka and Povolný (1968), Karaman (1936, 1939, 1961), Lewis and Harrison (1962), Maa (1968), Pieper (1965), Stackelburg (1928), and Theodor (1956). For other literature on the bat flies of the general area, Maa's (1971) bibliography of bat-fly literature should be consulted.

In view of the paucity of specific records from Turkey, it seems worthwhile to provide the following species records. A total of 58

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[1] Accepted for publication: February 13, 1976

[2] Biosystematics Research Institute, Agriculture Canada, Ottawa, Ontario, Canada.

[3] Department of Biology, University of Maine, Farmington, Maine, U.S.A.

[4] Department of Biology, University of Botswana, Lesotho, and Swaziland, Roma, Lesotho.

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bat fly specimens were obtained from a series of bats collected from Halkali, Küçük Çekmece, Instanbul, and recorded by DeBlase and Martin (1973). Five of the most common species of Nycteribiidae were represented in this collection, each of which is widely distributed throughout continental Eruope, North Africa, and West Asia (Theodor, 1967).

Penicillidia (P.) dufourii dufourii (Westwood) - 6♀♀, 2♂♂, from *Myotis myotis;* 1♀, 1♂, from *Myotis blythi;* and 2♂♂ from *Miniopterus schreibersi.*

Within its known geographical range, the typical subspecies of *P. dufourii* has been most frequently recorded from the following bats: *Rhinolophus ferrumequinum, R. euryale, R. hipposideros, Rhinolophus* sp.; *Myotis myotis, M. blythi oxygnathus, Miniopterus schreibersi, Nyctalus* sp., *Plecotus auritus, Vespertilio murinus.*

Phthiridium biarticulatum Hermann - 1♂, from *Rhinolophus eruyale.*

Within its geographical range, this species has been reported most frequently from the following bats: *Rhinolophus ferrumequinum, R. euryale, R. hipposideros, R. blasii, R. mehelyi, Rhinolophus* sp.; *Myotis myotis, M. blythi oxygnathus, M. capaccinii, M. emarginatus, M. daubentoni, Miniopterus schreibersi, Plecotus auritus, Pipistrellus pipistrellus, Vespertilio* sp.

Nycteribia (N.) schmidlii schmidlii Schiner - 2♀♀, from *Myotis myotis;* 8♀♀, 2♂♂, from *M. blythi;* 14♀♀, 2♂♂, from *Miniopterus schreibersi;* and 1♀, 1♂, from *Rhinolophus euryale.*

Within its geographic range, this species has been reported most frequently from the following bats: *Rhinolophus ferrumequinum, R. euryale, R. hipposideros, Rhinolophus* sp.; *Myotis blythi oxygnathus, M. capaccinii, Miniopterus schreibersi, Nyctalus* sp., *Plecotus auritus, P. auritus christiei, Vespertilio murinus; Tadarida teniotis.*

Nycteribia (N.) pedicularia Latreille - 3♀♀, 1♂, from *Myotis myotis; 1*♀, 1♂, from *M. capaccinii;* and 3♀♀, 4♂♂, from *Miniopterus schreibersi.*

Within its geographical range, this species has been recorded most frequently from the following bats: *Rhinolophus ferrumequinum, R. hipposideros, Rhinolophus* sp; *Myotis myotis, M. capaccinii, Myotis* sp.; *Miniopterus schreibersi.*

Nycteribia (N.). latreillii (Leach) - 1♀, 1♂, from *Myotis myotis.*

Within its geographical range, this species has been reported most frequently from the following bats: *Rhinolophus ferrumequinum, R. euryale, R. hipposideros; Myotis myotis, M. blythi oxygnathus, M. capaccinii, Miniopterus schreibersi, Vespertilio murinus.*

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REQUEST

Wanted: Acacia watchers. D.B.O. Savile of the Biosystematics Research Institute, Saunders Bldg., Central Experimental Farm, Ottawa, Canada, K1A 0C6, and K.A. Pirozynski have evidence that the compound teliospores of the rust genus *Ravenelia* evolved by mimicry of the compound pollen grains of *Acacia* and other mimosoids. (More details in Savile, *Evolutionary Biology,* 1976, in press). The pollen sheds freely onto the foliage, whence it is evidently gleaned by bees that also transport the rust spores. There is evidence that stingless bees, Meliponinae, are involved. Biologists planning to visit *Acacia* savannas in any part of the world are urged to collect any bees seen foraging on the foliage, for identification of the insects and analysis of the pollen-basket contents. Two tips: Do not bother with the specialized ant acacias, from which the ants promptly chew up pollen and spores to feed their broods; and do not disturb the nests of stingless bees, which bite furiously. Please copy this note for any potential co-operator.

NOTE ON THE FEEDING HABITS OF *CLINOTANYPUS PINGUIS* (LOEW) (DIPTERA: CHIRONOMIDAE : TANYPODINAE)[1]

Selwyn S. Roback[2]

In my 1969 paper on the feeding of the Tanypodinae, it was presumed that the Coelotanypodini *(Coelotanypus, Clinotanypus)* fed primarily on naid and tubificid worms. This was on the basis of oligochaete crochet setae being found in the digestive tracts of mounted specimens. This presumption was recently confirmed when a mature larvae of *C. pinguis,* in the process of swallowing an oligochaete, was collected and preserved.

Figure 1. shows the *Clinotanypus* larva with the partially ingested worm. As can be seen in the illustration, the worm is considerably compressed to pass between the mouth parts and through the pharynx and foregut. The digestive tract (foregut) filled by the worm remains narrow into the first thoracic segment but in the oesophageal area in the second segment it widens (Fig. 2). The body of the worm can be followed internally to the beginning of the third abdominal segment where, probably due to the digestive processes of the midgut, it begins to disintegrate. In the caudal end of A. III and into A. IV only scattered oligochaete setae, some debris and a diatom could be observed. At the time the *Clinotanypus* larva was collected and preserved approximately 13 mm of worm remained to be swallowed.

Some interesting questions still to be answered are 1-whether the rate of intake is at all related to the rate of digestion and absorption in the midgut; 2- the time it takes a chironomid to swallow a worm of 18 + mm length; 3- The number of worms a fourth instar *Clinotanypus* eats before pupation. A mature *Procladius* larva may simultaneously have 4-5 small chironomid larvae, a few ostracods and cladocerans in its digestive tract.

LITERATURE

Roback, S.S. 1969. Notes on the food of Tanypodinae (Diptera: Chironomidae). Ent. News 80: 13-18

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[1] Accepted for publication: June 1, 1976

[2] Curator, Department of Limnology, Academy of Natural Sciences of Philadelphia

ENT. NEWS, 87: 7 & 8:243-244 , September & October 1976

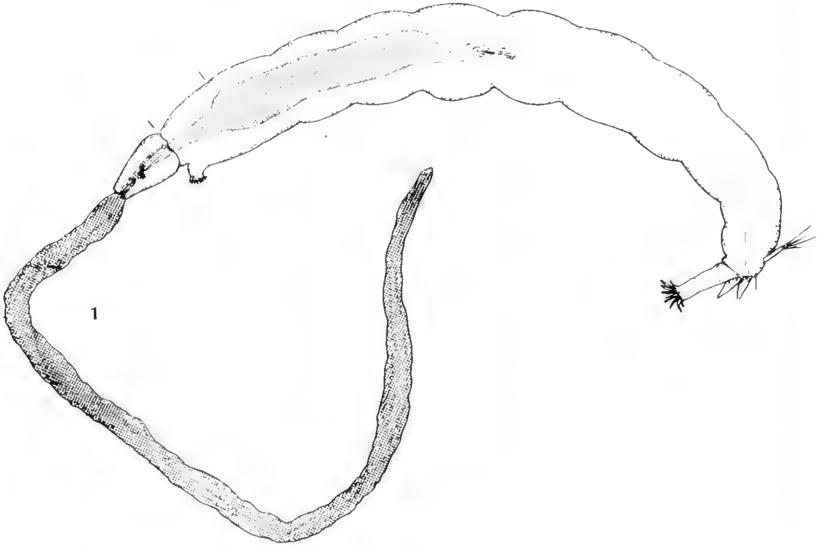

Fig. 1 – Lateral view of *C. pinguis* larva with partially swallowed oligochaete. Marks above thorax indicate area shown in Fig. 2.

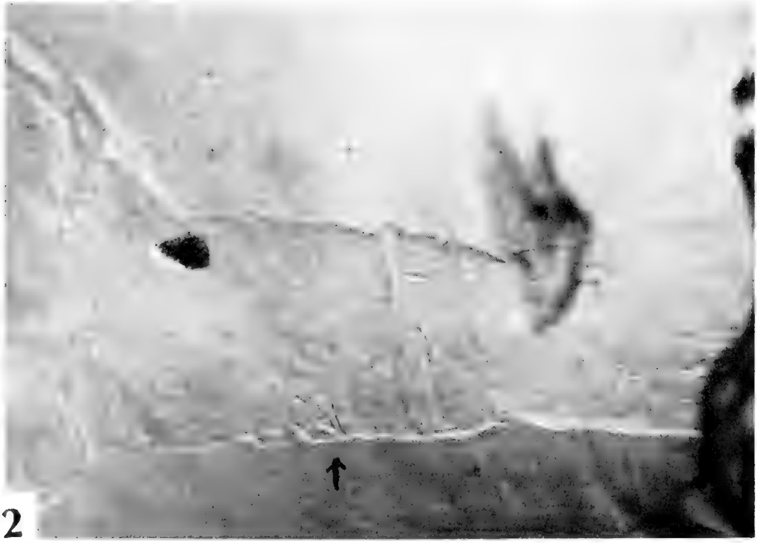

Fig. 2 – Portion of foregut of *C. pinguis* (78x). Arrow points to some visible oligochaete setae. The caudal margin of the head is visible at the right.

THE NUMBER OF GENERA AND SPECIES OF MAYFLIES (EPHEMEROPTERA)[1, 2]

Michael D. Hubbard, William L. Peters[3]

ABSTRACT: The number of genera and species in the various families of Ephemeroptera is listed.

In response to numerous inquiries and at the instigation of Dr. George F. Edmunds, Jr., University of Utah, we have decided to compile a list of families of recent mayflies of the world, together with an indication of the numbers of genera and species included in each, in the hopes that this list might be of use to others. The familial classification is based on that of Edmunds, Jensen, & Berner (1976, Mayflies of North and Central America, University of Minnesota Press, in press). The data are extracted from a catalog of the literature on Ephemeroptera in the files of the Laboratory of Aquatic Entomology, Florida A & M University.

In all there are 20 families of recent Ephemeroptera, which include approximately 213 genera and 2139 valid species.

The list of families in rough phylogenetic order follows below.

Table 1. List of families of recent Ephemeroptera, with numbers of included genera and species.

Siphlonuridae	26 genera, 163 species
Metrotopididae	2 genera, 7 species
Siphlaenigmatidae	1 genus, 1 species
Baetidae	17 genera, 519 species
Oligoneuriidae	9 genera, 49 species
Heptageniidae	28 genera, 378 species
Ametropodidae	1 genus, 4 species
Leptophlebiidae	62 genera, 377 species
Ephemerellidae	7 genera, 163 species (some workers divide this into as many as 20 genera)
Tricorythidae	13 genera, 122 species
Neoephemeridae	2 genera, 8 species
Caenidae	6 genera, 81 species
Behningiidae	3 genera, 5 species
Potamanthidae	7 genera, 27 species
Euthyplociidae	7 genera, 12 species
Ephemeridae	8 genera, 99 species
Polymitarcyidae	6 genera, 70 species
Palingeniidae	6 genera, 31 species
Baetiscidae	1 genus, 12 species
Prosopistomatidae	1 genus, 11 species

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[1] Accepted for publication: April 10, 1976

[2] This study was partially supported by a grant from The Cooperative State Research Service, U.S.D.A., Grant #616-15-20.

[3] Laboratory of Aquatic Entomology, Florida A and M University, Tallahassee, Florida 32307.

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.

BOOKS RECEIVED AND BRIEFLY NOTED

LES CARABIDAE DU QUEBEC ET DU LABRADOR, Andre Larochelle, Departement de Biologie, College Bourget, C.P. 1000, Rigaud, Quebec, Canada; postpaid $15.00 (Canadian money)

This 255 page catalogue deals with the Carabidae, including the Cicindelini, of Quebec and Labrador. The presentation is bilingual, both French and English.

REVISION OF THE GENUS PELIDNOTA OF AMERICA NORTH OF PANAMA (Coleoptera: Scarabaeidae: Rutelinae), Alan R. Hardy. University of California Publications in Entomology, Vol. 78. University of California Press, Berkley, CA., 94720. $3.00

EARWIGS OF CALIFORNIA (Dermaptera), Robert L. Langston & J.A. Powell. Bulletin of the California Insect Survey, Volume 20. University of California Press, Berkley, CA., 94720. $2.00

BOMBYLIDAE OF CHILE (Diptera: Bombyliidae), Jack C. Hall. University of California Publications in Entomology, Volume 76, 278 pages, 6 plates. Univ. of Calif. Press, Berkley, Ca., 94720. $12.00.

LIMNOLOGY Vol. 1, Pt. 1. G. Evelyn Hutchison. This very basic and authoritative volume, formerly available only in hard cover edition, is now available (1975) in this paperback edition at the greatly reduced price of $11.50. John A. Wiley & Sons, New York, 10016.

EXCRETION. FORTSCHRITTE DER ZOOLOGIE, Band 23, Heft 2/3. Redaktion by Dr. A. Wessing. The articles in this volume give a general view of the modern results of the comparative anatomy and physiology of excretion. Twenty papers cover extensive investigations in the fields of morphology and physiology among the most important groups of animals including insects, and were presented at an international symposium organized by the Academie der Wissenschaften und der Literatur zu Mainz. 1974. 362 pages. Gustav Fischer Verlag, Stuttgart.

BOOK REVIEW

INSECT HORMONES. (Second English Edition). Vladimir J.A. Novák. Halsted Press/John Wiley & Sons, New York, 1975. 600 pp., $49.50.

Endocrine control of the numerous processes associated with physiology and development in insects has been the subject of prolific research during the past decade. Since the last edition of this book, 1966, many more studies dealing with various aspects of insect hormones have appeared. Interest in this subject has also received a strong, new stimulus with the discovery of juvenile hormone analogues (juvenoids). Hundreds of papers have been published on the production, testing and investigation of over 1000 new substances with juvenile hormone activity. Since 1958, the number of references has more than quadrupled, from 1500 to over 6000. Concomitantly, there has been a similar increase in the number of papers dealing with various theoretical aspects of the subject.

In this revised edition, Professor Novák ably presents a wide range of material from a thorough appraisal of insect endocrine systems, to a complex discussion on the phylogenetic origin of neurohormones. One substantial chapter is devoted to the metamorphosis hormones and their direct and indirect effects, and how these endocrines affect development at the subcellular, cellular and physiological levels. There are chapters concerned with the activity of neuro- and proto-hormones; the alleged hormonal activity of incompletely known substances; and the application of insect hormones to zoological research in general. The author's comprehensive survey of the adaptation of insects to their environment by the integration of nervous and endocrine systems will be of particular interest to those workers concerned with the practical applications of insect endocrinology.

In summary, this volume is an excellent, updated, comprehensive survey of the entire field of insect hormones. Individuals in any way involved in this field can hardly afford to be without this valuable text. Unfortunately, however, its high price makes its purchase by students almost prohibitive.

H.P.B.

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

c/o British Musuen (Natural History) Cromwell Road,
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The following Opinions recently published by the Commission may be found by means of the reference given in each case:

Opinion No.	Subject	Bull zool. Nom.		
		vol.	pt.	p.
1038	*Argiope* Audouin, 1826 and *lobata, Aranea,* Pallas, 1772, placed on Official Lists (Arachnida, Aranea)	32	2	105
1039	Type-species of *Uloma* Dejean, 1821 *(Tenebrio culinaris* Linnaeus, 1758) and of *Phaleria* Latreille, 1802 *(Tenebrio cadaverinus* Fabricius, 1792) designated under the plenary powers; these names, with *Alphitobius* Stephens, 1829, and *Gnatocerus* Thunberg, 1814, and the names of their type-species, placed on Official Lists (Coleoptera)	32	3	136
1042	*Deuterosminthurus* Borner, 1901; *Smynthurus bicinctus* Koch, in Herrich-Schaeffer, 1840 designated as type-species under the plenary powers (Collembola)	32	4	212
1043	*Eusminthurus* Borner, 1900; *Podura viridis* Linnaeus, 1758 designated as type-species under the plenary powers (Collembola)	32	4	214
1049	*Macgillivraya* Grote, 1894 suppressed under the plenary powers; *Friesea* von Dalla Torre, 1895 (type-species *Triaena mirabilis* Tullberg, 1871) placed on Official List (Collembola)	32	4	235
1050	*Pediculus eurysternus* Burmeister, 1838 suppressed under the plenary powers; *Solenopotes* Enderlein, 1904 (type-species *S. capillatus* Enderlein, 1904) and *eurysternus, Haematopinus,* Denny, 1842, placed on Official Lists (Anoplura)	32	4	238
1051	*Rhopalidia* Lepeletier, 1836 suppressed under the plenary powers (Hymenoptera)	32	4	240
1053	*Formica maxima* Moore, 1842, suppressed under the plenary powers (Hymenoptera)	32	4	244
1054	*Crinocerus* Burmeister, 1835; *Cimex sanctus* Fabricius, 1775, designated as type-species under the plenary powers (Hemiptera)	32	4	246

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Opinion No.	
1055	(Bull. zool. Nom. 33 (1) page 11) *Gryllus hieroglyphicus* Johannes Mueller (Physiologist) 1826 (Insecta: Orthoptera): suppressed under plenary powers in favour of *Decticus hieroglyphicus* Klug, 1832.
1058	(Bull. zool. Nom. 33 (1) page 22) *Papilio actaeon* Fabricius, 1775 (Lepidoptera) suppressed under plenary powers in favour of *Papilio acteon* von Rottemburg, 1775.
1062	(Bull. zool. Nom. 33 (1) page 31) *Anobium* Fabricius, *1775: Grynobius* Thomson, 1859: *Priobium* Motschulsky, 1845 (Coleoptera) designation as type-species of *Ptinus punctatus* de Geer, 1774, *Anobium excavatum* Kugelann, 1791, and *Anobium carpini* Herbst, 1793, respectively.
1064	(Bull. zool. Nom. 33 (1) page 36) *Ptenura* Templeton, 1844: *crystallina, Podura,* Miller, 1776 (Collembola) suppressed under plenary powers in favour of *Heteromurus margaritarius* Wankel, 1860.

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Book wanted: Essig, E.O., Insects of Western North America. Write editor, ENT. NEWS, address inside front cover.

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Wanted: Correspondence with collectors interested in exchanging Carabidae: *Calosoma* specimens, worldwide. Charles M. Barksdale, 3756 Milan St., San Diego, CA., 92107

Wanted: Junk COLEOPTERORUM CATALOGUS # 86: W. Horn, Carabidae: Cicindelinae. 1926. H. Boyd, Editor, ENT NEWS.

VOL. 87 NOVEMBER AND DECEMBER 1976 NOS. 9 & 10

ENTOMOLOGICAL NEWS

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SIGNIFICANCE OF THE MORPHOLOGICAL CHARACTERS USED IN HIGHER-LEVEL NATURAL CLASSIFICATION OF COLEOPTERAN LARVAE[1]

M.G. de Viedma and M.L. Nelson[2]

ABSTRACT: Significance of the morphological characters used in higher-level natural classification of coleopteran larvae. The three suborders of Coleoptera (Archostemata, Adephaga, and Polyphaga) are differentiated by the larval morphology of the leg, mandible, and hypopharynx and prementum. Regarding the Polyphaga, various schemes have been devised to separate the superfamilies of this largest group. Peyerimhoff (1933) divided the Polyphaga into the Haplogastra and Symphiogastra based upon leg segmentation and urogomphi articulation. The Polyphaga is divided by Van Emden (1942) into three groups on the basis of maxillary lobe development: the first group has a dominant inner lobe (Staphylinoidea, Hydrophiloidea, and Scarabaeoidea); the second group possess two well-developed, free maxillary lobes (Dascilloidea and Malacodermata-Sternoxia); and the third group has a dominant outer lobe (Cucujoidea, Bostrychoidea, Chrysomeloidea, and Curculinoidea). Crowson's (1967) distillation and improvement of previous works is used to rank characters according to the number of superfamilies of Polyphaga they can separate and, consequently, this method rates the presence or absence of articulated urogomphi as the character of primary importance.

DESCRIPTORS: Coleoptera; Archostemata; Adephaga; Polyphaga; larval characters.

The literature (Boving and Craighead, 1931; Peyerimhoff, 1933; van Emden, 1942; Crowson, 1967; Viedma, 1972) has consistently shown that, at the several levels of a natural classification of coleopteran larvae, various morphological characters display different degrees of importance. As a result, certain characters are repeatedly used to separate the suborders and superfamilies of larvae, while other characters are restricted to the differentiation of lesser taxa. The present paper, recognizing this fact, attempts to describe and determine the relative significance of characters that, through the years, have been used to differentiate the higher taxa.

Several authors (Kolbe, 1908; Forbes, 1926; Boving and Craighead, 1931) have suggested the desirability of adding a third suborder, the Archostemata, to the two long-accepted suborders of Coleoptera, the Adephaga and

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[1] Accepted for publication: May 24, 1976.

[2] Contribution No. 351 from the Department of Biology, Wayne State University, Detroit, Michigan 48202, U.S.A.

[3] Department of Zoology and Entomology, School of Forestry, Polytechnic University of Madrid, Spain, and Department of Biology, Wayne State University.

Polyphaga. Boving and Craighead's work, which intentionally stresses larval characters, bases its separation of the Archostemata on its possession of an "almost extinct larval type."

The characters used in defining the larvae of the three suborders are shown in Table 1. As noted, the number of leg segments, including the claws, differentiates the Archostemata and the Adephaga from the Polyphaga. Two additional characters, the possible possession of a molar part by the mandibles and the degree of fusion and hardening of the hypopharynx and prementum, separate the Archostemata from the Adephaga. Peyerimhoff (1933) agrees with the formation of the suborder Archostemata, and he splits the Polyphaga into two groups. Within the larval Polyphaga, Peyerimhoff distinguishes between the Haplogastra (with five leg segments and absent or articulated urogomphi) and the Symphiogastra (with five leg segments, or less, or no legs, and with or without urogomphi, but never articulated).

Table 1

	Legs	Mandibles	Hypopharynx and Prementum
Archostemata	Six-segmented with a distinct tarsus and one or two claws	Possessing a strong molar part	Fused into a hard, strong unit
Adephaga	Six-segmented with a distinct tarsal joint and one or two movable claws	Lacking a molar part	Never united into a hard, strong unit
Polyphaga	Five-segmented; tarsal joint fused with a single claw into a tarsungulus; or less than five-jointed; or no legs present		

Van Emden (1942), in his discussion of British beetle larvae, separates the Adephaga and the Polyphaga, the two suborders he lists, on the number of leg segments. He notes that the Adephaga have the tarsus and tibia separate and possess six-segmented legs and, generally, two claws (not considered a segment). The Polyphaga, in contrast, have the tarsus and tibia fused and, if legs are present, possess ones with five or less segments and only one claw. He further divides the Polyphaga into three groups on the basis of maxillary lobe development. The first group, consisting of the superfamilies Staphylinoidea, Hydrophiloidea, and Scarabaeoidea, has a dominant inner lobe (i.e., mouthparts of Caraboid facies). In the second group, composed of the superfamily Dascilloidea and the Malacodermata-Sternoxia, are found two well-developed, free maxillary lobes. The last group, containing the Cucujoidea, Bostrychoidea, Chrusomeloidea and Curculinoidea, has a dominant outer lobe. Viedma (1972) agrees that the two characters used by van Emden, viz., leg segmentation and maxillary lobe development, are of primary importance at this taxanomic level.

A fourth suborder, Myxophaga, is suggested for the Coleoptera by Crowson (1967). Although he states that the larvae of the Myxophaga are "not yet satisfactorily characterizable," he finds in them some characters common to the Polyphaga. Based on his system, among the principal characters that divide the suborders is the presence (in the Adephaga and the Archostemata) or the absence (in the Myxophaga and the Polyphaga) of a distinct tarsus and claw. He also uses the sclerome of the hypopharynx: the Adephaga having a hypopharynx without sclerome; the Arcostemata a hypopharynx with a "characteristic heavy, dark sclerome;" and the Myxophaga and Polyphaga "without such a heavy sclerome." The Adephaga is further removed from the other suborders in having a labrum fused with the head capsule (that is, not free) and, as noted by Boving and Craighead, lacking a mandibular molar part (mola).

Among the repeatedly used, therefore, significant, characters for the differentiation of larvae in the suborders of Coleoptera are the legs (i.e., number of leg segments present) and, to a lesser extent, the mouthparts (the sclerome of the hypopharynx, the mandibular mola, and the maxillary lobes).

The relative significance of series-level characters is not considered here because the positions of the several series are not, at this time, generally accepted by coleopterists.

The study of characters differentiating the superfamilies of Polyphaga, which are the classic higher-level taxa, is facilitated by observing the characters used for separation in a so-called "natural key." Crowson's work (1967) has been chosen for this purpose because it is a distillation and improvement of previous keys. Obviously, the earlier a character appears in the key, the more important it is, involving, as it does, more groups in the key. In this respect, therefore, it is possible to assign to the characters a classificatory "weight" and, on that basis, a rank that corresponds with the number of superfamilies each differentiates (Table 2). Naturally, characters used to separate the same number of superfamilies, that is, having the same "weight", have an equal rank. Only the characters that are actually compared in the dichotomous key (i.e., those contained in both parts of a couplet) are used. Lesser characters stated in only one portion of a couplet are not comparable, and cannot be included. Additionally, if the several mandibular and maxillary characters are combined, these two encompassing characters will naturally achieve a higher classificatory weight, rank, and significance than will any of the characters from which they were derived. For that reason, the mouthpart characters are used specifically in superfamily determination, and, consequently, are kept separate in this discussion.

This procedure shows that the character of primary significance is the presence or absence of articulated urogomphi. This character separates the Scarabaeoidea, Hydrophiloidea, Staphylinoidea, and Histeroidea from other superfamilies lacking this character. Table 2 and the diagram that follows reflect this statement. It should be noted that the Scarabaeoidea lack articulated urogomphi (which is later stated in the key). This does not necessarily mean that the Scarabaeoidea belong to the Symphiogastra. In fact, according to Crowson (1970), the larvae of the Scarabaeoidea seem related to the Dascilloidea, while the adults seem related to the Haplogastra. He concludes that the relationship of the Scarabaeoidea to either of the above seems mutually exclusive. Therefore, inclusion of the Scarabaeoidea into the group possessing articulated urogomphi represents one of the few weak points in the key. The second most important character is the presence or absence of a distinct maxillary galea and lacinia. This character is used to differentiate three superfamilies of the Haplogastra and fourteen of the Symphiogastra. The third most important set of characters, and ones ranked equally, are the presence of long bristles on the tenth abdominal segment and, when legs are present, the lack of a trochanter. These characters diagnose the Stylopoidea and differentiate them from other superfamilies in the Symphiogastra. It should be noted here that the appearance of the Stylopoidea at this point in the key cannot be considered natural. This superfamily, with its strikingly different larvae, was once considered an order. Its position is not clear. Crowson later (1970) puts it in the Cucujiformia.

Another way of examining the significance of coleopteran larval characters at the superfamily level is shown by Diagram 1. In this representation of character-superfamily relationship, the cumulative number of superfamilies differentiated by a particular character is taken, as before, as indicative of relative importance. It demonstrates that the primary character (presence or absence of articulated urogomphi) separates all superfamilies of Polyphaga into two groups. Following this dichotomy, the character ranked second in importance (presence or absence of distinct galea and lacinia) is used to differentiate three superfamilies of the Haplogastra and fourteen of the Symphiogastra. In this manner the relative value of any character and its relationships to various superfamilies can be determined at once. It can be seen that some characters appear in the diagram more than once. This situation is caused by its use within different "branches" of the key (for example, character no. 2 in the Haplogastra and Symphiogastra), or its use (for example, in character no. 6) in conjunction with other characters at different points within the same "branch."

In summary, it appears to us that the taxonomic significance of different morphological characters varies with the level of the taxa being discussed. The most significant classificatory character used for the determination of the suborders in the larvae of Coleoptera is the degree of leg segmentation. The most important differentiating character at the superfamilial level, with respect to Polyphaga, is the presence or absence of articulated urogomphi. In a broader sense, therefore, it can be seen that, through the process of analyzing a key, it is possible to give scale and definition to the over-used and imprecise concept of "taxonomic importance." This process yields a hierarchy of characters according to the relative size of their spheres of influence (i.e., their actual taxonomic importance) and also indicates, at any given level, the most efficient method of utilizing characters.

ACKNOWLEDGEMENTS

The authors thank Professor S.K. Gangwere, Department of Biology, Wayne State University, and Mr. D. Bevan, Forestry Commission, U.K., for helpful comments and suggestions.

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Table 2

Character Number	"Weight"	Rank	Character
1	19	1	with or without (w/wo) articulated urogomphi
2	17	2	maxillae w/wo distinct galea and lacinia
3	15	3	10th abdominal segment w/wo long bristles
4	15	3	w/wo trochanters when legs present
5	14	4	w/wo corneous urogomphi
6	14	4	maxillae w/wo well-developed articulating area
7	14	4	mandibles w/wo mola
8	14	4	w/wo labrum free
9	10	5	w/wo well-developed legs (usually more than 2 segments)
10	7	6	maxillae w/wo distinct galea and spur-like lacinia
11	7	6	9th abdominal tergite w/wo distinct urogomphi
12	7	6	w/wo cribriform spiracles
13	7	6	w/wo finger-like galea
14	6	7	w/wo spiracles closed and tracheal gills present
15	6	7	mandibles w/wo distinct prostheca
16	5	8	w/wo mouth-parts possibly protracted
17	5	8	w/wo long epicranial suture
18	2	9	maxillae w/wo galea born on elongate palpiger
19	2	9	mandibles w/wo perforation or channelling along inner margins
20	2	9	general form cylindrical OR flattened
21	2	9	w/wo body soft and C-shaped
22	2	9	head w/wo distinct gula
23	2	9	w/wo tergal sclerites
24	2	9	w/wo prothorax enlarged
25	2	9	maxillary mala entire OR partially divided at apex
26	2	9	labium w/wo sclerotised transverse hypopharnygeal bar
27	2	9	antennae well-developed (3 segments) OR reduced (1 or 2 segments)

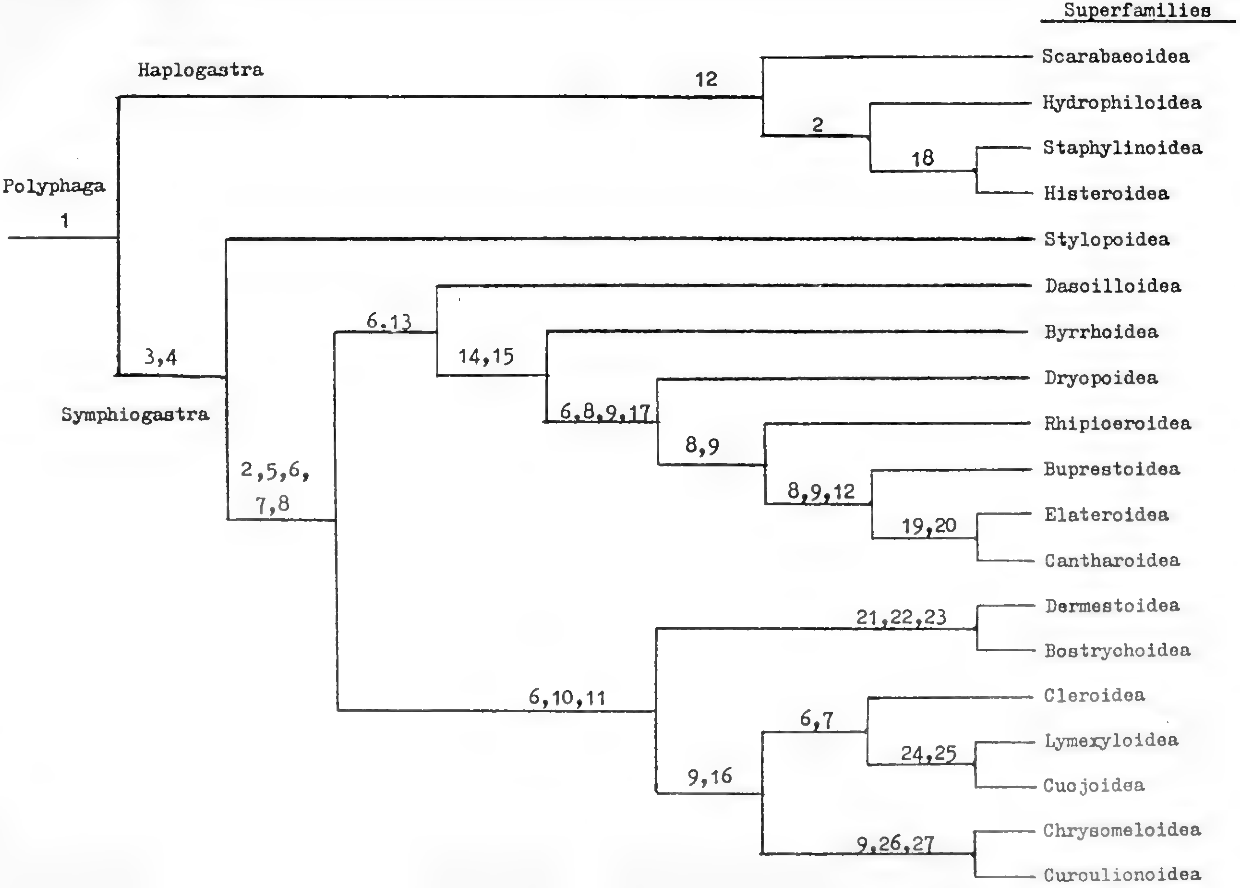

Diagram 1: Distribution of Larval Characters (using character numbers from Table 2).

SPREAD OF *PLATYSTETHUS CORNUTUS* GRAVENHORST IN THE UNITED STATES (COLEOPTERA: STAPHYLINIDAE)[1]

Ian Moore[2]

Opportunities to study the spread of a newly introduced species of insect seldom occur. Except for species of economic importance, new introductions often go unnoticed. One such study was done by Voris (1936) on *Philonthus cruentatus* Gmelin, a European species, 12 years after it was first reported from New York. By studying several hundred specimens from many collections, he was able to trace its spread across the continent to the state of Washington. Hatch (1953), in the introduction to his famous work on the Coleoptera of the Pacific Northwest, presented a list of introduced species giving the first date of report for each species; and later in the work, under each introduced species, mentioned "the earliest Northwestern specimen seen."

Moore and Legner (1971) reported the first occurrence of the European *Platystethus cornutus* Gravenhorst in America based on a single specimen from Lincoln, Nebraska. Three more specimens have now come to light: two from Rocky River Reservoir, Cleveland, Cuyahoga Co., Ohio, 4 April and 13 May, 1974, river flotsam and one from North Fairfield, Huron Co., Ohio, 13 July, 1975, black light, all collected by Harry J. Lee, Jr. This is more than 850 miles east of Lincoln, Nebraska, and indicates that the species is probably widely distributed in the north central part of the United States. In England, this species is reported by Tottenham (1954) to be very common on the muddy banks of ponds and rivers.

It will be interesting to trace the history of this new introduction as it spreads across those parts of North America to which it is adapted.

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[1] Accepted for publication: April 9, 1976

[2] Division of Biological Control, University of California, Riverside 92502.

SUBSTRATE AND MOISTURE PREFERENCES IN COMMON TOAD BUG, *GELASTOCORIS OCULATUS* (HEMIPTERA: GELASTOCORIDAE)[1]

D.L. Deonier[2], S.P. Kincaid[3], and J.F. Scheiring[4]

ABSTRACT: The diel preferences of 300 adult *Gelastocoris oculatus* were tested by simultaneously presenting them with four dry substrates of soil, sand, rocks, and vegetated soil. The subjects exhibited a strong daytime preference (147 of 300) for the rock substrate and a moderate daytime preference (89 of 300) for the vegetated substrate. In the nighttime tests, the toad bugs were more evenly distributed, but exhibited some preference for sand, rocks, and vegetated soil. Daytime and nighttime experiments with choices of four damp substrates had similar results, with the greatest number of subjects aggregated around and under rocks, whereas in experiments with wet substrates, no definite substrate preference was discernible in either the daytime or nighttime tests. Results of these and additional experiments as well as field observations show that adults of *G. oculatus* prefer damp substrates to water saturated, or wet, substrates, that they avoid direct sunlight when in a state of partial desiccation in dry habitats, and that they can and do suck water directly from the substrate.

DESCRIPTORS: Hemiptera: Gelastocoridae; *Gelastocoris oculatus*; substrate and moisture preferences; diel rhythm; behavioral temperature regulation.

Species of the genus *Gelastocoris* (commonly called toad bugs) are known only from the Western Hemisphere. *Gelastocoris oculatus* (Fabricius), the most common Nearctic species, is distributed, according to Todd (1955), from southern Canada into Mexico. Hungerford (1922) reported it to be predaceous in the nymphal and adult stages. Uhler (1884) stated that this species could be found on the low banks of brooks and streams where grouse locusts occur. Hungerford (1920, 1922), Blatchley (1926), Smith *et al* (1943), Ellis (1952), Todd (1955), Usinger (1956), and Wilson (1958) all indicate that the species occurs on mud and sand banks of streams, ponds, and swamps. Hungerford (1920) and Mackey (1972) noted that this species exists as spatially discrete colonies. Hungerford (1920, p. 49) stated, "A colony may be found in one spot along a given stretch of the stream and nowhere else." This isolation pattern of distribution may be related to the rarity or absence of flight in the species as reported by Todd (1955) and Parsons (1959).

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[1] Accepted for publication: May 10, 1976.

[2] Department of Zoology, Miami University, Oxford, OH 45056

[3] Environmental Branch, Northern Division, Naval Facilities Engineering Command, Philadelphia, PA 19112

[4] Department of Biology, University of Alabama, University Sta., AL 35486

ENT. NEWS, 87: 9 & 10: 257 - 264, November & December 1976

Torre-Bueno (1912) inferred from the collection of several second-instar nymphs in September on Long Island that *G. oculatus* could overwinter as a nymphal instar, but Hungerford (1920, p. 49) stated that, "Our Kansas forms winter as adults, burying themselves in the sand." Blatchley (1926) found both adults and larger nymphs hibernating in cavities in mud shores of streams and lakes in Indiana and in Missouri Froeschner (1962) found this species overwintering as adults under stream-drift debris. Overwintering adults were reported in southern Canada by Brooks and Kelton (1967).

According to Uhler (1884), there are two distinct generations of *G. oculatus* in the eastern United States, with the second developing in August. Recently, however, Mackey (1972) interpreted data on egg production, presence of sperm in females, and seasonal occurrence of instars as indicating that eastern Tennessee populations are univoltine and overwinter as adults. Polhemus (personal communication) collected adults in January and March of 1975 on the South Platte River at Waterton, Colorado. During the present study, the senior author collected one fifth-instar nymph and 17 adults in early October.

The objective of the present study was to determine the specific substrates where this species is most likely to be found under different moisture conditions in daylight and darkness. No previous research has been performed on this problem, although Hungerford (1922) performed a simple two-substrate preference experiment with *G. oculatus,* which was mainly related to the great color variation (apparently substrate-correlated) observed in *G. oculatus* by Hungerford and earlier workers. In addition, Hungerford (1920, 1922) established that, under certain conditions, *G. oculatus* will burrow into sand and mud.

Materials and Methods

The project was conducted in the spring of 1972 and the summers of 1973-74. The materials consisted of a fiber-board test chamber 50.7 cm long x 36 cm wide x 35.5 cm deep on legs 2.5 cm tall. A cardboard divider, which when placed in the chamber, divided it into four equal compartments each containing an individual substrate box. Each substrate box measured 24.3 x 17.8 x 3.8 cm and was lined with a clear plastic sheet. Four of these substrate boxes completely covered the bottom of the test chamber. A strip of smooth aluminum tape was placed horizontally around the inside of the test chamber 19.1 cm from the bottom to prevent escape of the toad bugs. The substrates tested were loam soil, sand, rocks, and vegetated soil. The rocks were underlain with sand and the vegetation box contained a mixed substrate of loam soil, stream sand, and small stones with a growth of scattered grasses and sedges. All substrates were obtained from the general habitat of the toad bugs (Bull Run Creek, Peffer Memorial Park, Oxford, Ohio). Voucher specimens of the gelastocorids tested are in the Miami University Insect Collection.

For the nighttime experiments, a fiber-board lid and black plastic cover were placed over the test chamber to shield it from artificial light. V-shaped cardboard guides glued on the middle of each inside wall of the test chamber facilitated rapid insertion of the compartment divider. The daylight condition was augmented by placing a 15-watt white fluorescent lamp (40.6 cm long) centrally and 61 cm above the substrates in the test chamber. The test chamber was maintained at 22°C.

Between experiments, the toad bugs were retained in 19-liter aquaria (supplied with sand, vegetation, and water from their habitat) and fed miscellaneous small live insects collected by sweeping. No prey or food was allowed in the test chamber.

In conducting each experimental replication, 100 adult toad bugs were passed through a paper funnel into the middle of the test chamber to the junction point of the four substrate boxes. Five hours of daylight and 10 hours of darkness were allowed for dispersion of the 100 insects in the substrate units. A longer dark period was deemed necessary because toad bugs move more slowly and less frequently in darkness (Deonier, unpublished data). At the end of each test period, the divider was rapidly, but carefully, inserted. Because toad bugs usually lower their bodies and remain still if disturbed, but not touched, and because no toad bugs were seen to jump about during this insertion, the authors have concluded that the distribution of the subjects was little affected by the slight disturbance of divider insertion.

The first series of experiments with soil, sand, rocks, and vegetated soil was performed in the following sequence: dry (day), dry (night), damp (day), damp (night), wet (day), and wet (night). For a control series, sand was used in each substrate box. Using the two substrates (rocks and vegetated soil) most preferred in this series, a second series of experiments was done with dry/damp and damp/wet as the paired contrasting moisture choices under day and night conditions. The controls consisted of four boxes of dry rock substrate and four boxes of damp vegetated soil. Each experiment of the two series had three replicates. All of the replicates of each experiment were combined for the final analysis since there was no significant statistical difference between the replicates of any one experiment.

In both experimental series, the terms dry, damp, and wet were defined as follows:

dry – dry to the touch, little or no moisture present in the substrate
damp – moist to the touch, but no standing water
wet – moist to the touch and with patches of standing water

A chi-square (X^2) analysis of the five control series showed that none of them deviated significantly ($p \geqslant .1$) from an expected random (even) distribution. Each of the series of preference tests were, therefore, compared to a random distribution by means of a chi-square analysis.

Results

In the first experiment involving dry substrates in the daytime (Fig. 1), the distribution of the toad bugs was significantly different from the expected random distribution ($X^2=121.15$, $p \leqslant .001$). The subjects exhibited a strong preference for the rock substrate and a moderate preference for the vegetated substrate. It was noted that the toad bugs in the soil and sand boxes had dug into the substrate. In the nighttime test (Fig. 1), the insects were more evenly distributed, but their distribution was still significantly different from the expected ($X^2=12.29$, $p \leqslant .01$). The sand, rocks, and vegetated substrates were preferred equally, but the soil substrate seemed to be somewhat less preferred.

The results of the daytime and nighttime experiments with damp substrates (Fig. 2) show similarities to those with dry substrates. In the day, the distribution of toad bugs was significantly different from the expected ($X^2=62.35$, $p \leqslant .001$) with the insects exhibiting a distinct preference for the rock and vegetated substrates, which in nature would offer some shelter from direct sunlight. Again, the greatest number aggregated around and under rocks. Most of those in the soil substrate were found under clumps of mud. The nighttime experiment showed a somewhat more equal dispersion, but this distribution also deviated significantly from the expected ($X^2=18.59$,

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Fig. 1. Distributions of 300 toad bugs on four dry substrates during day and night tests.

Fig. 2. Distributions of 300 toad bugs on four damp substrates during day and night tests.

Fig. 3. Distributions of 300 toad bugs on four wet substrates during day and night tests.

Fig. 4. Distributions of 300 toad bugs on dry and damp substrates during day and night tests.

Fig. 5. Distributions of 300 toad bugs on damp and wet substrates during day and night tests.

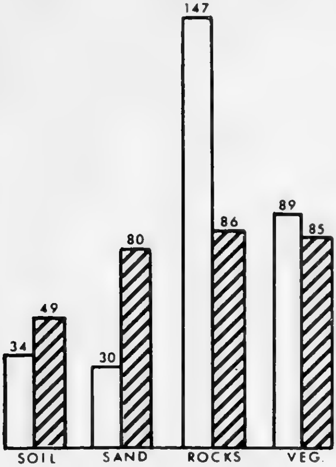

FIG 1

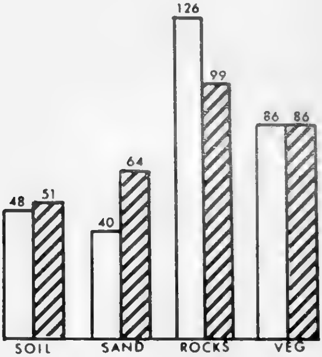

FIG 2

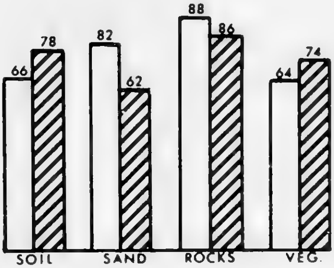

FIG 3

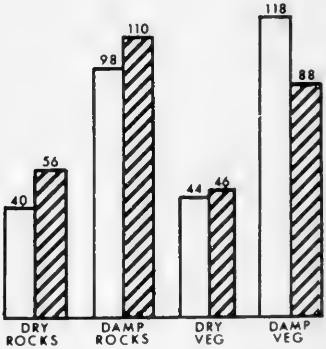

FIG. 4

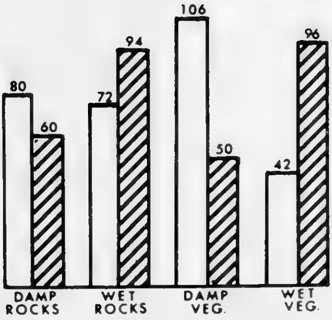

FIG. 5

☐ DAY

▨ NIGHT

$p \leqslant .01$). In this test, there was a slight preference for the rock and vegetated substrates.

In the experiments with wet substrates (Fig. 3), no definite preference was observed in either the daytime (X^2=5.60, $p \geqslant .1$) or nighttime (X^2=4.00, $p \geqslant .1$) tests. Also, the bugs did not dig into the sand and soil substrates nor did they exhibit any strong tendency to hide under rocks, clumps of soil, or in vegetation.

When comparing the distributions in two dry and two damp substrates (Fig. 4), the subjects showed a definite preference for the damp substrates under both day (X^2=60.85, $p \leqslant .001$) and night (X^2 = 34.61, $p \leqslant 001$) conditions. Those insects found in the dry substrates were hidden under rocks, in the soil, or under dry vegetation. The comparisons between damp and wet substrates (Fig. 5) showed a distinct preference for the damp vegetation during the day (X^2=27.79, $p \leqslant .001$) and a moderate preference for the wet rocks and wet vegetation during the night (X^2=22.03, $p \leqslant .001$).

In another experiment, subsequent to the substrate-preference tests, toad bugs were placed on a dry white-sand surface bearing one central cluster of small stones and irradiated directly with a 150-watt incandescent lamp. The dry sand ranged from 40-43°C and was saturated with water after 2.5 hours. In ten replications, each with a new group of three bugs, 18 sought shelter under the stones and 12 burrowed completely or partially into the sand during the first 0.5-1 hour, but only 4 remained continuously sheltered after saturation. Immediately upon saturation, all of the bugs probed their beaks into the wet sand and held them there for about 5 minutes. In the field, five toad bugs, when restrained in dry rocky habitat, took shelter from direct, intense sunlight after 0.5 to 1.25 hours. The substrate surface temperature was approximately 40°C. All probed into wet sand after their release.

Discussion

The results of the present study indicate that adults of *Gelastocoris oculatus* prefer damp substrates to water-saturated, or wet, substrates and that they avoid direct sunlight in dry habitats when in certain physiological states. That desiccation and supra-optimal body temperature are two of these states is indicated by the results, especially those from the additional field and laboratory tests.

In support of these interpretations, Bursell (1974) and Edney (1971) showed that exposure of insects to direct sunlight causes their temperature to rise measurably above the ambient air temperature. Insect size and shape as well as air current velocities were considered to be the significant factors affecting temperature excess of the exposed insects. *Gelastocoris oculatus* would appear to have a size and shape conducive to overheating. However, as Bursell (1974) noted, the heterogeneity of most natural insect habitats is such that indirect temperature regulation can be effected by appropriate shelter-seeking or avoidance behavior. Cloudsley-Thompson (1970, 1975) cited numerous examples which support his generalization that, "temperature regulation in arthropods is very largely behavioral." *Stizopina* tenebrionid beetles of the Namib Desert are arenicolous, but if stones are available they hide under them during the day instead of burrowing (Cloudsley-Thompson, 1975). Other examples cited by this author include three species of desert tenebrionids which respond to near-lethal temperatures by burrowing into sand and *Blaps sulcata,* a xerobiontic tenebrionid, which, in Israel, aggregates during the day under thick, flat stones.

In cases taxonomically closer to *Gelastocoris,* Heath (1967) reported that adult *Magicicada casini* seek shade when their body temperature exceeds 34°C, and Lindskog (1968) presented evidence that direct radiation from the sun affects body temperature and transpiration rate in *Saldula saltatoria* Linnaeus (Hemiptera: Saldidae). Furthermore, Lindskog found that, in the field, shore bugs of this species compensated for water loss by ingesting free water. He observed that adult *S. saltatoria* frequently bask in the sun and that afterwards they almost always drink at first contact with a moist substrate. Equally relevant to our results is his statement (1968, p. 466) that the nymphs of this species "succeed under certain conditions in completing their development on quite dry soil, provided there is sufficient shelter."

In conclusion, it appears that the burrowing behavior of *Gelastocoris oculatus* together with its facultative negative phototaxis and positive hygrotaxis (as revealed by the present study) equip this apparently flightless insect for survival on substrates of greatly varying moisture content and texture, which it undoubtedly traverses in the normal course of searching for prey and mates.

ACKNOWLEDGEMENTS

We thank Professor M.W. Boesel and Dr. J.T. Polhemus for their critical reviews of the manuscript.

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CARRION BEETLE RESPONSES TO POIKILOTHERM AND HOMOIOTHERM CARRION (COLEOPTERA: SILPHIDAE)[1]

Paul P. Shubeck[2]

ABSTRACT: Two traps baited with cold-blooded vertebrate carrion and two traps baited with warm-blooded carrion were in continual operation in Hutcheson Memorial Forest for 34 weeks during 1975. Of the seven species of Silphidae attracted to the traps five species were taken in numbers suitable for statistical analysis. *Nicrophorus orbicollis* manifested a significant difference (paired comparisons – Student's t-test) in its' response to fish carrion over chicken carrion. None of the other four species – *N. tomentosus, Silpha noveboracensis, S. inaequalis, S. americana* – showed a significant difference (paired comparisons – Student's t-test) in responding to poikilotherm and homoiotherm carrion.

DESCRIPTORS: Coleoptera, Silphidae; *Nicrophorus orbicollis, N. tomentosus, Silpha noveboracensis, S. inaequalis, S. americana;* cold-blooded carrion, warm-blooded carrion, Hutcheson Memorial Forest.

Observations have appeared in the literature which indicate that some silphid species prefer one kind of carrion over others. When writing about the insects of New Jersey, Smith (1910) stated that *Nicrophorus americanus* was found "... almost exclusively on reptiles," but that *N. marginatus* was found "Throughout the state, on carrion of all kinds ... " He also stated that *Silpha lapponica* was found "Throughout the state; specifically on fish; but also on snakes, toads and other reptilia." Jaques, in his guide to beetles (1951) stated that *N. americanus* was found "... under snakes." Dillon and Dillon (1961), when referring to *N. marginatus,* stated that "This species is found especially on cold-blooded vertebrate carrion." In regard to *S. lapponica* they stated that "This species occurs especially on dead frogs, toads, snakes, and other cold-blooded carrion." The preceding statements apparently are based on field observations and not on controlled experimental data.

The observations that some silphid species appear to prefer carrion from certain taxa does not seem to have greatly influenced the choices of carrion by researchers conducting ecological studies on the carrion microcosm. When examining several papers that have appeared during the past two decades I noted that two authors used fish (Walker, 1957; Pirone, 1974), one used lizards and toads (Cornaby, 1974), one used chicken legs (Shubeck, 1968, 1969, 1971), and three used mammals (Reed, 1958; Payne, 1965; Johnson, 1975). The choices of carrion type in each case seemed to be based on the anticipated availability of carrion supply during the course of the study.

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[1] Accepted for publication: May 17, 1976

[2] Biology Department, Montclair State College, Upper Montclair, N.J.

ENT. NEWS, 87: 9 & 10: 265 - 269, November & December 1976

In an attempt to obtain data on possible differences in drawing power of kinds of carrion on silphid species it was decided to design a study whereby carrion from a poikilotherm (cold-blooded vertebrate) as well as carrion from a homoiotherm (warm-blooded vertebrate) would be available simultaneously to the beetles. Since a major study on the species composition and phenology of carrion beetles in The William L. Hutcheson Memorial Forest had been planned for 1975, this project was incorporated into the major study. Hutcheson Memorial Forest (hereafter referred to as H M F) is a mature mixed oak forest on the Piedmont Plateau of New Jersey. It is located near East Millstone, in Somerset County.

Methods

This study was conducted in H M F about 70 meters south-east of the weather instrument shelter which is located at the north edge of the forest. The beetles were trapped in four No. 10 food cans, each of which was concealed in a wooden box with a rain cover. These traps have been described elsewhere (Shubeck, 1976). The traps were situated in a circle on the forest floor so that there was a north, east, south, and west trap along the arc of a circle having a radius of 5 meters. The north and south traps were baited with fish while the east and west traps were baited with chicken legs (drumsticks). It was not necessary to compensate for possible effect of wind direction since wind speed is negligible in the forest (Wales, 1967). The carrion bait in each trap consisted of one "fresh" fish or chicken leg in an 8 3/4 oz styrofoam cup and one "stale" fish or chicken leg in an 8 3/4 oz styrofoam cup. These traps were serviced once per week, during the study, at which time the oldest carrion (and cup) was replaced with fresh carrion (and cup) and the beetles collected and preserved in jars containing 70% alcohol. At all times, therefore, there were two traps baited with fish, each having a fish 1-7 days old (fresh) and one 8-14 days old (stale), and two traps baited with chicken legs, each having a leg 1-7 days old and one 8-14 days old. This technique (Pirone, 1974) resulted in the presence of fairly uniformly "attractive" carrion on a continual basis. The weight of each fish (smelt) and each chicken leg was about 90 grams. On occasion fresh smelt was not available and packaged frozen smelt (whole) was substituted. The latter were about 1/3 the size of the former so when used, three small fish (about 30 grams each) were substituted.

Results and Discussion

Although seven species of Silphidae were taken in Hutcheson Memorial Forest during the eight months of this study, two species, *Necrodes* *surinamensis* and *Nicrophorus pustulatus* were collected in very low numbers and these data were therefore not included in the statistical analysis that follows. Five species were collected in fair to abundant numbers and these species, as well as their attraction to poikilotherm and homoiotherm carrion are shown in Table 1. In an attempt to ensure the validity of the data used, the few "stragglers" of each species, that appeared earlier and later than the bulk of the population's individuals, were not included in Table 1 nor in the statistical analysis. The fact of the matter is that very few individuals were thus excluded! In the case of *Silpha noveboracensis,* 2032 out of 2033 individuals (99.95%) were included; all *S. inaequalis* were included; 564 of 572 individuals (98.6%) of *S. americana* were included; 181 of 200 individuals (90.5%) of *Nicrophorus tomentosus* and 311 of 316 individuals (98.42%) of *N. orbicollis* were included.

Superficial examination of the data for the five species shown in Table 1 made it appear that in all but one case *(Silpha inaequalis)* there was a preference for the poikilotherm (fish) carrion. However, statistical analysis of the data told a different story. The data was analyzed using the paired comparisons test. The analysis was designed to determine, for each species, if there was a significant difference in the number of beetles captured in the traps with cold-blooded carrion and the number of beetes captured in the traps with warm-blooded carrion. In each case the level of significance, α, was set at .01. The following are the conclusions. For the species *Silpha noveboracensis,* there is not sufficient evidence to say that there is a significant difference in the number at the respective carrion-type traps ($t = .920$). Although a slight majority of *S. inaequalis* was taken at the chicken-baited traps, there is not sufficient evidence to say that there is a significant difference ($t = -.577$). For *S. americana* ($t = .796$), there was again not sufficient evidence to say that there is a significant difference in the number at each trap. Turning to the genus *Nicrophorus,* the same conclusion holds for *N. tomentosus* ($t = 2.606$). However, for the species *N. orbicollis,* there is sufficient evidence to suggest that there is a difference in the number of beetles found in the two different types of traps ($t = 4.483$). This result is significant even for $\alpha = .0005$. Clearly then, *N. orbicollis* was found to be better able to distinguish between the cold-blooded carrion bait and the warm-blooded carrion bait, and it seems to prefer the cold-blooded. One might wonder why, of five silphid species tested in HMF, only one appears to be attracted more to one carrion bait (the cold-blooded one) than the other. It is possible that the answer may be found in a recent study conducted in HMF which showed that of the five species in question, only *N. orbicollis* was nocturnally active (Shubeck, 1971). The other four species were diurnal. It might be that the odors given off by decomposing cold-blooded carrion (specifically fish) are unique in some way and thereby make it easier for nocturnal carrion beetles to locate the carrion in the dark.

It is interesting to note also that none of the three silphids mentioned at the beginning of this paper was taken during 1975, or during the summers of 1961-1974 (published and unpublished data). Two of these species were supposedly common in N.J. and all of them were said to be found on cold-blooded carrion.

ACKNOWLEDGEMENTS

I would like to thank the Hutcheson Memorial Forest Committee of Rutgers University for permission and encouragement to work in the Forest, and the Montclair State College Development Fund Board for financial assistance. Special thanks are due Dr. Helen Roberts of the Mathematics Department of Montclair State College for revizing, reworking, and finalizing the statistics of the study.

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Table 1. Weekly collections of silphid species attracted to poikilotherm and homoiotherm carrion at Hutcheson Memorial Forest in 1975. The figures in the first column give the month and day of collection.

	Species A		Species B		Species C		Species D		Species E	
	Fish	Chick.	Fish	Chick.	Fish	Chick.	Fish	Chick.	Fish	Chick.
4-19	12	3	17	13						
4-26	6	2	17	3						
5- 3	8	5	11	18						
5-10	30	29	67	44	5	3			5	1
5-17	13	4	30	14	91	37			4	1
5-24	8	2	9	14	42	57			1	2
5-31	6	3	12	3	29	13			3	0
6- 7	1	2	4	6	10	2			4	5
6-14	1	0	37	43	3	5			6	1
6-21	38	146	22	148	5	13	6	4	2	1
6-28	238	284	74	102	4	10	26	20	11	0
7- 5	552	283	26	6	10	3	11	11	4	8
7-12	185	93	10	3	34	7	29	9	22	5
7-19	60	13	2	1	23	10	12	2	19	3
7-26	2	3			18	68	4	3	8	1
8- 2					2	7	0	1	1	0
8- 9					12	4	0	0	4	4
8-17					2	0	0	1	16	7
8-23					4	2	10	1	5	1
8-30					10	5	18	9	5	7
9- 6					2	0	3	1	11	2
9-13					4	2			10	5
9-20					4	0			37	17
9-27					2	0			21	6
10- 4									6	1
10-11									7	2
10-18									2	2
10-25									14	1
Totals	1160	872	338	418	316	248	119	62	228	83

Species A = *Silpha noveboracensis*
Species B = *Silpha inaequalis*
Species C = *Silpha americana*
Species D = *Nicrophorus tomentosus*
Species E = *Nicrophorus orbicollis*

A NEW MISSISSIPPI RECORD FOR *ZOROTYPUS HUBBARDI* CAUDELL (ZORAPTERA)[1]

Christina Sperka[2]

ABSTRACT: One adult male and one adult female of *Zorotypus hubbardi* Caudell were collected from Harrison County, Mississippi. This is a new county record.

DESCRIPTORS: Zoraptera, *Zorotypus hubbardi,* Mississippi.

Zorotypus hubbardi Caudell has been reported from 13 Mississippi counties (Lamar and Pearl River Cos. by Copeland, 1954; Holmes and Rankin Cos. by Riegel, 1963; Calhoun, Lafayette, Marshall, Panola, Pontotoc, Tishmingo and Stone Cos. by Darst et al., 1974; and Forrest and Oktibbeha Cos. by Mizell and Nebeker, 1976).

Two adult specimens are herein reported from Harrison County, Mississippi. One gravid, dealate female was collected from under the bark of a fallen dead pine tree along the Tuxachanie Trail, DeSoto National Forest, on 1 July 1975 by Roger Sperka. One alate male was captured in a blacklight trap operated by the author in the City of Gulfport, 26-27 August 1975.

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[1] Accepted for publication: April 13, 1976

[2] 102 Iroquois Court, Lexington, KY 40503

COURTSHIP BEHAVIOR IN *BATHYPLECTES ANURUS* (THOMSON) (HYMENOPTERA: ICHNEUMONIDAE)[1]

Gordon Gordh[2] and Robert Hendrickson[3]

ABSTRACT: We report information on *Bathyplectes anurus* (Thomson) courtship behavior.

DESCRIPTORS: Sexual behavior, courtship, biological control, Ichneumonidae, *Bathyplectes anurus* (Thomson).

Bathyplectes anurus (Thomson), a European species of ichneumonid, was imported as a biological control agent for the alfalfa weevil *Hypera postica* (Gyllenhal) and has become established. Although this report is incomplete, the difficulty of collecting material, the complicated diapause of *B. anurus,* the unavailability of additional material, and the usefulness of courtship display as a species-recognition character prompts publication of this paper so that field workers can use this information. We gratefully acknowledge the generous donation of material for these studies by W.H. Day, Beneficial Insect Research Laboratory, ARS, Newark, Delaware, who is coordinating the USDA biological control program against the alfalfa weevil.

Cocoons of *B. anurus* reared in the laboratory from parasitized hosts collected during 1974 in Pennsylvania were individually placed in gelatin capsules. After emergence, in the spring of 1975, virgin males and females were placed together in pairs in petri dishes and observed under a dissecting microscope. Some pairs that copulated were immediately fixed in alcoholic Bouin's, later stained in acid fuchsin, and slide mounted in Canada balsam. The following account is based on observations of 18 successful copulations.

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[1] Accepted for publication: March 24, 1976

[2] Systematic Entomology Laboratory, IIBIII, Agr. Res. Serv., USDA, c/o U.S. National Museum, Washington, D.C. 20560.

[3] Beneficial Insects Research Laboratory, USDA, Newark, Delaware 19713.

We never observed copulation or male excitation later than 11 A.M. although virgin pairs were placed together and observed during all daylight hours. The earliest observed copulation took place at 7:45 A.M. The male first walked around the container, vibrated his antennae in the air and on the substrate, and held the wings in repose over the abdomen. A change in this behavior occurred when a female was within 2 - 5 cm. at which time the male raised his antennae, vibrated them in the air at an angle of 50 - 80° with the substrate and spread 50 - 100°, fluttered his wings, and usually turned in 1 - 4 small circles. Turning was often pivotal and was not always noted, but the antennal vibrations and wing fluttering was always observed. Next the male would chase the female, who, if receptive, would stop.

After the female stopped, the male assumed a copulatory stance without additional observable courtship. During insertion of the aedeagus into the bursa copulatrix, the fore and middle tarsi of the male briefly touched the outer margins of the folded wings of the female.

The coital stance of the male (Fig. 1) was such that the tips of his wings touched the substrate, the hind legs were spread, and the tarsi also touched the substrate, which formed a tripod for support. The fore and middle legs were extended but did not touch the body of the female or the substrate. The antennae of the male were spread, subtending an angle of 20 - 70°, and slowly waved asynchronously. During coitus the female remained quiescent with antennae porrect and spread 40°.

Pairs remained *in copulo* 4:31 ± 0.57 min. (range 3:25 - 6:43). The union was terminated by either sex, but most often by the male. One female used her hind tibial spur to disengage the male genitalia, but she had considerable difficulty, and we are not sure that it was not the male releasing his genitalic grasp that caused the disengagement. One male that had been *in copulo* with a female for a minute was observed being dragged around the container by the female. Thus it would seem that the male does have considerable control over copulation once he has been received by the female. Postcoital courtship activity was not observed.

Figure 1. The coital stance of *Bathyplectes anurus* (Thomson).

Males that had copulated were not observed to show any subsequent interest in virgin females when they were provided with one during the first hour after coitus. However, one showed incipient interest after coitus by such activity as weak antennal fanning and wing flutters. Mated females always responded negatively to the attempt of a virgin male to copulate, that is, they flew or ran away when they came in contact with the male.

To determine the possible nature of the female attraction, we prepared homogenates of the female head, thorax and abdomen and offered each to virgin males. Homogenates of abdomens elicited male wing fluttering and turning.

Dissection of females that had been fixed immediately after copulation revealed a capsule in the genital tract which we believe to be a spermatophore.

Discussion

There have been no serious studies of sexual behavior in the Ichneumonidae and thus it is not possible to make comparative comments. From this preliminary study we suggest the following about sexual behavior in *B. anurus:*

1. An endogenous component may mediate sexual arousal in *B. anurus* males because virgin males demonstrated sexual excitement only during the morning.
2. The precopulatory behavior of the male and the activity produced by homogenates of the female abdomen may indicate the existence of a female sex pheromone.
3. The coital stance of the male is quite precarious. The female cooperation is essential for successful aedeagal intromission. However, once the male aedeagus is inserted into the bursa copulatrix of the female, the genitalic grasp of the male is seemingly sufficiently strong to maintain union despite female attempts at dislodgement.
4. Females appear to be monogamous, and males appear to have a relative refractory period during which females elicit no sexual arousal. The refractory period may be caused by sperm depletion or by the need to manufacture spermatophores.

SENSE ORGANS ON ANTENNAL FLAGELLUM OF *GRYLLOBLATTA CAMPODEIFORMIS* E.M. WALKER (ORTHOPTERA: GRYLLOBLATTODEA)[1]

Eleanor H. Slifer[2]

ABSTRACT: Sense organs of five different types were found on the antennal flagellum of *Gylloblatta campodeiformis* E.M. Walker. They are tactile hairs, thick-walled chemoreceptors, thin-walled chemoreceptors, coëloconic chemoreceptors and campaniform sense organs.

DESCRIPTORS: sense organs, flagellum, insect, mechanoreceptors, chemoreceptors.

The relationship of *Grylloblatta campodeiformis* and of several closely-allied species to other insects has long been a matter of controversy (Kamp, 1973). By some systematists these are included with the Orthoptera as one of its families; by others they are considered to be a suborder of the Orthoptera and by still others they are placed in an order of their own. Consequently, any new anatomical information concerning the group should be of interest.

One antenna of a female specimen, that had been preserved in fluid, was sent to the writer by Dr. A.B. Gurney of the National Museum in Washington. It had been collected at Mt. Edith Cavell in Jasper Park, Alberta, Canada in September 1928 by N. Ford. The antenna was prepared as an unstained whole mount and the sense organs on it examined. Since no other antennae from this rare insect were available, the techniques ordinarily used for study – special staining, scanning and transmission electron microscopy – could not be employed. Interpretation of the results, however, was not difficult for all of the sense organs found were of types seen in earlier studies with other species of insects (Slifer, 1970).

The flagellum was 8 mm long and composed of 23 subsegments. Dr. Gurney has informed me that the other antenna has 26

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[1] Accepted for publication: May 5, 1976

[2] Department of Entomology, Academy of Natural Sciences, 19th and the Parkway, Philadelphia, Pennsylvania 19103.

ENT. NEWS, 87: 9 & 10: 275 - 279, November & December 1976

subsegments. In an earlier examination of 24 intact antennae Gurney (1953) found that the number ranged from 24 to 27. This coincides with the range reported by E.M. Walker (1914) for the two females on which the order is based. The subsegments are cylindrical (fig. 1). The basal subsegment is 260 μ long and the terminal one 277 μ but between these the subsegments varied from 135 μ (subsegment 3) to 423 μ (subsegment 12). The diameter of the first subsegment was 154 μ and that of the 23rd was 85 μ.

The cuticle of the first subsegment is heavy and about 28 μ thick while that of the last is only 6 μ. The number of sense organs per unit of surface increases distally. On the basal subsegment a mean distance between sense organs of 34 μ was found and on the 23rd a mean distance of 17 μ. The distribution of sense organs on subsegment 10 is shown in fig. 1.

Five types of sensory receptors were identified – tactile hairs, thick-walled chemoreceptors, thin-walled chemoreceptors, coeloconic chemoreceptors and campaniform sense organs.

Tactile hairs are the most numerous of all the sense organs and are present on every subsegment. They have a tip so finely pointed

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Fig. 1. Diagram of lateral surface of subsegment 10 of antennal flagellum of *Grylloblatta campodeiformis* to show distribution of sense organs. The sockets of the receptors, except the coeloconic, have been indicated by dots. Most of the structures are tactile hairs and thick-walled chemoreceptors. The nearly transparent, thin-walled chemoreceptors are difficult to see at this magnification and have been omitted, as have also the sockets at the extreme edges. The sense organ nearest the distal edge is the campaniform sense organ. Coeloconic sense organs have been indicated by crosses. X 260.

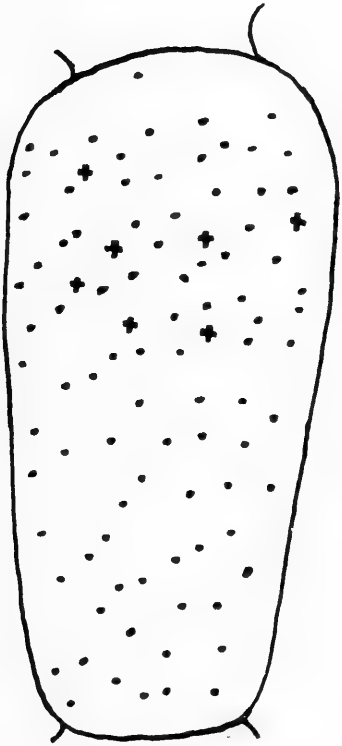
Fig. 2. Lateral view of tactile hair. Surface directed distad is at left. Note sharp tip. X 1000.

Fig. 3. Lateral view of thick-walled chemoreceptor. Surface directed distal is at left. Note rounded tip. X 1000.

Fig. 4. Lateral view of thin-walled chemoreceptor. Surface directed distad is at left. X 1000.

Fig. 5. Surface view of coeloconic chemoreceptor. Tip of peg is directed distad. X 1000.

Fig. 6. Campaniform sense organ from subsegment 1. Tip of projection is directed distad. X 1000.



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that it is difficult to see where it ends with the oil immersion lens (fig. 2). The mean length of 25 that were measured was 68 μ (range 40 to 105 μ). The longest tactile hairs are on the basal subsegments and the shortest towards the tip of the antenna.

Thick-walled chemoreceptors are present on all subsegments but are much less abundant than the tactile hairs. Superficially, they resemble the tactile hairs but the tip is definitely rounded (fig. 3) and the lumen more distinct. If a second antenna had been available it would have been treated externally with a dilute solution of crystal violet and the separation of the two types of hairs made easier since the stain enters the pore at the tip of a thick-walled chemoreceptor so treated while a tactile hair remains uncolored (Slifer, 1960). The mean length of 25 chemoreceptors measured was 70 μ (range 52 to 92 μ). As do the tactile hairs, they decrease in length distally.

Thin-walled chemoreceptors occur on all subsegments. The cuticle is very thin and the tip broadly rounded (fig. 4). As is common in other insects, there is considerable variation in the ratio of width to length and also in the curvature of the structure. The mean length of 25 measured was 24 μ (range 15 to 39 μ).

Coeloconic chemoreceptors were found on all subsegments except the first. Most are present on the lateral surface of the antenna. The maximum number found on a subsegment was 13 (22nd subsegment). On subsegments 1 through 8 the number present was 5 or fewer; all subsegments distal to 8 had 5 or more. These receptors have a peg, about 5 μ long, set in the floor of a cavity that is from 10 to 15 μ in diameter (fig. 5).

Campaniform sense organs are irregularly distributed on the flagellar subsegments. A total of 13 of these mechanoreceptors was found. There was one each on subsegments 1,2,4,6,8,10,11,13,14,15,16,18 and 20. These are situated at the distal margin on the subsegment on its lateral side and each is in line with similar structures on other subsegments proximal and distal to it. Those of the basal parts of the flagellum are largest and most conspicuous. They gradually decrease in size distally. Each consists of a flattened plate with a conical projection in its center (fig. 6). The plates measured had a diameter ranging from 7 to 11 μ and the projection was from 2.5 to 5 μ high. A cuticular sheath extends inwards from the underside of the plate. In other insects this sheath has been found to contain a single dendrite that is attached to the under side of the plate.

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NOTES ON THE BIOLOGY OF *CINARA ABIETICOLA* (CHOLODKOVSKY) IN MAINE AND DESCRIPTIONS OF SEXUALES (HOMOPTERA: APHIDIDAE)[1]

D.B. Struble[2], E.A. Osgood[3], J.O. Pepper[4]

ABSTRACT: Notes are presented on the biology of *Cinara abieticola* (Cholodkovsky). A technique for collecting alate males is described, and a detailed description of sexual forms is given.

DESCRIPTORS: Homoptera, *Cinara abieticola,* balsam fir, collecting technique, description of sexuales.

In a brief review of the synonomy and characteristics of *Cinara abieticola* (Cholodkovsky), Hottes (1960) stated that the species had been collected on *Abies, Picea,* and *Cedrus.* Eastop (1972) lists 11 species of *Abies* and *Cedrus deodora* (Roxb.) Loud. as hosts of *C. abieticola.* Bradley (1951) noted that each species of *Cinara* in eastern Canada was restricted to a single plant species or to plants of the same genus. The feeding sites, in early spring, late spring and summer, of *C. abieticola* on balsam fir, *Abies balsamea* (L.) Mill. are recorded by Bradley (1959), and other biological information on the species is recorded by Bradley (1961). Recently some additional information on the biology of this aphid on balsam fir has been collected and is reported in this paper. A technique for collecting males and descriptions of the apterous oviparous female and alate male are included.

BIOLOGICAL NOTES

Life Cycle and Behavior

Many colonies of *C. abieticola* were periodically observed in Old Town, Maine in 1971. Stem mothers were first observed on May 15 at the bases of buds. The aphids were generally found near the top of the small trees on the first branch whorl. Usually there were

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[1] Accepted for publication: May 24, 1976.

[2] State Forestry Department, Island Falls, Maine. 04747

[3] Dept. of Entomology, University of Maine, Orono, Maine 04473

[4] Dept. of Entomology, Pennsylvania State University, Univ. Park, PA 16802

one or two per branch, with a maximum of six being noted. Young nymphs were present on May 27, and by June 7 colonies were quite large and summer viviparae common. Colonies were generally located on the trunk just below the first whorl of branches.

Bradley (1961) noted that three species of *Cinara* including *C. abieticola* dropped when disturbed and that it seemed to be a predator escape mechanism. In our studies, when colonies were disturbed by shaking the tree or by touching some of the aphids, nearly the entire colony dispersed. Many apterous females dropped but others moved in all directions; up and down the stem and out on the branches. Dispersal was rapid and indeed appeared to be an excellent predator escape mechanism. Aphids often reformed in small groups on various portions of the trunk. Continuous observation of many colonies showed that these aphids frequently shifted position on the tree.

Colonies on fir trunks began to decline by mid-June as aphids moved to the root collar and roots. Some additional dispersal of apterous forms was noticed as they established themselves on the roots of nearby trees. Nearly all the colonies had left the trunks by June 19, but occasionally a colony persisted until the latter part of June. Bradley (1961) stated that few alates were seen even though the second generation was about half alatoid nymphs. He was quite certain that the alate females went directly to the roots of their new host tree, although Bradley did not observe the aphids doing so. We observed only two alate females in mid-June on the aerial portion of the tree and none were ever seen on the roots.

Apterous oviparae and eggs were first observed on October 12 and oviparae were observed as late as October 28. Oviparae were usually located at the bases of buds on the current years' tree growth.

Technique for Collecting Alate Males

When populations were low, an occasional alate male was found near an oviparous female in October, but many more were collected by use of the following technique. In early June a one gallon cardboard can was cut down one side and half way across the bottom and placed around the trunk of a small fir tree about four feet above the ground. The sides and bottom were then stapled together. The can, minus the top, was then nearly filled with soil and litter to simulate the natural soil and litter layers. If aphids were not already present on the terminal portion of the tree, they were introduced from other trees. In mid-June, at the usual migration time, they moved down the stem to the artificial litter layer and established colonies on the trunk instead of on the roots. When the colonies were established, the entire top portion of the tree, including the can, was caged using a fine meshed nylon cloth.

Natural root colonies were transient. Most did not last more than 3-4 weeks, possibly because of predation. Caging colonies on the stem prevented predation, and regardless of the reason, provided a stable colony that could be easily observed for the remainder of the season.

Oviparous females in caged colonies moved to the terminal portions of the tree in October in the normal manner. Bradley (1961) mentioned that males developed on roots in the fall and then moved up to the tops of trees to mate. For some unknown reason males were not produced in our two caged colonies as expected. However, many alate males from other trees outside the cages were attracted to oviparous females inside. They landed on the outside of the cage where they were easily collected. Many males were collected in this manner even when populations were very low and when males were nearly impossible to locate otherwise in the field. When the cage was removed, males were attracted to and copulated with oviparae. Eggs were laid and colonies developed on the trees the following spring. This collecting technique would probably work for other *Cinara* with similar habits and should be particularly useful when populations are low.

Natural Enemies

Bradley (1961) recorded species of attending ants, parasites, and predators of *C. abieticola* as did Heikinheimo (1963). We found larvae of *Metasyrphus medius* (Jones) (Diptera: Syrphidae) occasionally feeding on *C. abieticola* in June and unidentified cecidomyiid larvae were also seen within these colonies. Comparatively few observations were made when aphids were on the roots but a lacewing larva, possibly a hemerobiid, was noted in one colony. None of these predators have previously been associated with *C. abieticola.*

DESCRIPTION OF SEXUALES

Wellenstein (1930) published a brief description of the alate males and oviparae of *C. abieticola.* Collection data was not given, but was presumably from Germany. The type specimens are unknown and are presumed lost. *C. abieticola* is evidently holarctic in distribution and quite variable in the characteristics, hosts, and behavior. For these reasons it seems best to give a more complete description of the sexuale forms studied in this work.

Male. Color: – Antennal III light brown or basal half light brown and rest brown; IV, V, VI light brown. Fore femur basal half light and rest light brown; mid femur basal 1/3 light and rest brown; hind femur basal half light and rest brown. Tibiae brown. Abdomen light. Cornical dark brown.

Measurements: (All measurements are in millimeters, mm). Length of body, 2.54-3.06. Width of head, 0.61-0.73. Length of rostrum, 1.30-1.37; segment IV, 0.162-0.189; V, 0.081. Length antennal segments: III, 0.61-0.62; IV, 0.297-0.32; V, 0.30-0.32; VI, 0.23-0.259; unguis, 0.05-0.06. Width antennal segment III, 0.043-0.048. Length segments of hind legs: femur, 1.08-1.28; tibia, 1.84-2.07; tarsal I, 0.081-0.097; II, 0.297-0.35. Width of hind tibia, 0.064-0.075; width of cornicle, 0.216-0.297. Length of setae: head, 0.081-0.10; antennal III, 0.108-0.16; hind tibia, 0.160-0.20; hind tarsal II, 0.086-0.118; dorsum of abdomen, 0.102-0.108; cornicle, 0.075-0.097; eighth abdominal segment, 0.097; cauda, 0.102-0.13, genital plate, 0.075-0.08.

Structures: Male is alate. Number of sensoria: antennal III, 40-51; IV, 11-20; V, 7-13. Number of setae: base antennal VI, 9-10; each side rostral segment IV, 3-4; eighth abdominal tergum, 21-22; genital plate, many. One sensory peg on first segment of all tarsi.

Oviparous Female. Color: Antennal III, light with dark tips; IV, light base and dark apex; V, basal half light and rest brown; VI, brown. Femora basal 2/3 light and rest light brown. Tibiae, light with dark apex. Abdomen, light with two rows of black dots. Cornical brown.

Measurements: Length of body, 3.44-3.98. Width of head, 0.77-0.84. Length of rostrum, 1.96-2.02; segment IV, 0.23-0.243; V, 0.085-0.10. Length antennal segments: III, 0.57-0.68; IV, 0.25-0.28; V, 0.03-0.324; VI, 0.22-0.232; unguis, 0.054-0.059. Width antennal segment III, 0.055-0.064. Length segments of hind leg: femur, 1.47-1.62; tibia, 2.40-3.82; tarsal I, 0.08-0.11; II, 0.32-0.35. Width of hind tibia, 0.14-0.15; width of cornicle, 0.43-0.54. Length of setae: head, 0.12-0.14; antennal III, 0.12-0.14; hind tibia, 0.12-0.17; hind tarsal II, 0.10-0.11; dorsum of abdomen, 0.11-0.16; cornicle, 0.06-0.08; eighth abdominal segment, 0.15-0.16; cauda, 0.16; genital plate; 0.09-0.11.

Structures: Hind tibia swollen and entire length almost covered with small sensoria. Number of sensoria: antenna III, 1-2; IV, 1-3; V, 2. Number of setae: base antennal VI, 8-9; each side rostral segment IV, 4-5; eighth abdominal tergum, 22-26; genital plate; many. One sensory peg on first segment of all tarsi.

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COXO-STERNAL STRIDULATION IN *PHYLLOPHORA* (ORTHOPTERA: TETTIGONIOIDEA; PHYLLOPHORIDAE)[1] [2]

James E. Lloyd[3]

ABSTRACT: *Phyllophora* sp. aff. *lanceolata* when grasped stridulates vigorously by rubbing files on the hind coxae against toothed metasternal lobes. Each coxal stroke produces a single buzzy 'psss' sound with a mean duration of 0.046 sec and mean rate of 13.7 Hz. These sounds may be used defensively.

DESCRIPTORS: Orthoptera, Tettigonioidea, Phyllophoridae, *Phyllophora,* acoustics, sound production stridulation.

Phyllophora spp. adults have striated areas (files) on each hind coxa which are rubbed against toothed, metasternal lobes. Such coxo-metasternal stridulation is found more or less generally in the Phyllophoridae but not elsewhere among the Orthoptera. This is the usual method in scarab beetles and occurs in a cerambycid (Plagithmysus). Tegminal stridulation, the usual tettigonioid method, is not found in Phyllophoridae (Kevan, 1955; Dumortier, 1963).

In April 1975 while in the Banda Islands (Banda Sea, Indonesia)[4] I obtained a single female of *Phyllophora* sp. aff. *lanceolata* Brunner v. Wattenwyl. When grasped it stridulated vigorously, and the vibrations were easily heard and felt. Stridulation occurred on both forward and backward strokes of the coxae, and the coxae appeared to move independently. There are 8 and 9 teeth on each metasternal lobe. A single (proprioreceptive) seta projects laterally from the lobe near the base of each tooth.

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[1] Accepted for publication: April 29, 1976

[2] Florida Agricultural Experiment Station Journal Series No. 9088

[3] Department of Entomology, University of Florida, Gainesville, FL 32611. I thank T.J. Walker (Univ. of Florida) for technical assistance and comments on the manuscript; and F. Willemse (Egelshoven, Netherlands) for identifying the grasshopper.

[4] This study of the Alpha Helix Asian Bioluminenscence Expedition was supported by the National Science Foundation under grants OFS 74 01830 and OFS 74 02888 to the Scripps Institution of Oceanography and NSF grant BMS 74 23242 to the University of California, Santa Barbara.

ENT. NEWS, 87: 9 & 10: 285 - 286, November & December 1976

During stridulation the 4th tooth (counting from posterior) seemed to be most used, and this was stroked obliquely, not at right angles, with the file. Each of the two files is on the anterio-ventral surface of a hind coxa, is triangular with apex forward, and has approximately 70 corrugations. When I held the legs against the body the insect could sometimes still stridulate by using a rotary motion of the coxae within the coxal cavities. Stridulation under such circumstances suggests a defensive function.

Each coxal stroke produced a single buzzy 'psss' (a cycle of coxal movement produced 2 such sounds). Analysis of tape recordings[5] of the stridulations of a single coxa revealed that the sounds corresponding to coxal strokes had a mean duration of 0.046 sec and ranged up to 0.076 sec (s.d. = 0.016 sec, n = 122, 30.5°C.). Sounds shorter than 0.015 sec probably occurred but could not be identified positively on spectrograms and were not used in calculating the mean. During bursts of stridulation the mean rate of single-coxa stroking was 13.7 Hz (range 9.1 - 21.7 Hz, s.d. = 3.2 Hz).

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[5] Recorded with Uher 4000 Report L tape recorder, 7.5 ips: frequency response = 40 - 20,000 Hertz.

CLIMACIA AREOLARIS (NEUROPTERA: SISYRIDAE) IN LAKE TEXOMA, TEXAS AND OKLAHOMA.[1]

David S. White[2]

ABSTRACT: Blacklight collections of *Climacia areolaris* indicate five distinct broods per year. An abundance of females was observed during dusk flight periods; however, this is most likely balanced by a later flight period for males. Specimens collected during the day showed a sex ratio close to 1:1. The presence of third instar larvae in November and fresh pupal cases in mid-August indicated the overwintering stage to be a larvae or prepupae.

DESCRIPTORS: Neuroptera, Sisyridae, *Climacia areolaris,* flight periods, spongilla flies, Spongillidae.

Sponge feeding neuropterans are widely distributed throughout the United States and are often collected in aquatic surveys. Our knowledge of the biology of sisyrids is, however, surprisingly limited. Aspects of the life history of *Climacia areolaris* (Hagen) have been detailed by Brown (1952) with observations on this and other Sisyridae being summarized by Parfin and Gurney (1956) and Resh (in press). In 1974 a survey of the Lake Texoma benthic fauna was begun at the University of Oklahoma Biological Station. Both the freshwater sponges (Spongillidae) and *C. areolaris* were among the organisms most commonly encountered. Because of the ecological importance of *C. areolaris* in Lake Texoma, special attention was given to portions of its life cycle which previously have not been reported.

Methods

Throughout the latter part of 1974 and most of 1975, *C. areolaris* were collected from the boathouse enclosure of the Biological Station. Every 7 to 10 days, a Texas type blacklight trap was run for one hour beginning 30 min after sunset. These collections were supplemented on one occasion by a series of 30 min samples throughout the night. Additional adults were taken during the day from the walls of the boathouses, and larvae and host sponges were collected from the submarged portions of the boathouses and riprap breakwater.

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[1] Accepted for publication: May 6, 1976

[2] University of Oklahoma Biological Station, Kingston, Oklahoma 73439.

ENT. NEWS, 87: 9 & 10: 287 - 291, November & December 1976

Results and Discussion

Lake Texoma, completed in 1944, is a 38,050 ha reservoir on the Red River of Texas and Oklahoma. Prior to impoundment, the Red River, with its shifting sand bars and irregular flow, had a very sparse benthic fauna (Isley, 1925); and it is doubtful if sponges or spongilla flies occurred anywhere but in the upper reaches of tributaries. Sublette (1957) examined the benthos of Lake Texoma from 1949 to 1951 finding but a single colony of *Spongilla lacustris* (Linne) and no larval or adult spongilla flies. He noted that a subsequent collection in 1954 produced both *S. lacustris* and *Asteromeyenia radiospiculata* (Mills) indicating a wider distribution of sponges within the lake than originally observed. Since the mid-1950's, Brown (1974) finds that both sponges and the spongilla fly *Climacia aerolaris* have become common in Lake Texoma particularly around the boathouses at the Biological Station.

Surveys in 1974 and 1975 show sponges (*Spongilla* and *Meyenia* spp.) to be widely distributed throughout the lake. Colonies were intact until early December when water temperatures dropped below 10°C, and new colonies first appeared in mid-April as water temperatures rose above 10°C. From mid-April through early December, mature colonies, many with gemmules, were present in large numbers on submerged portions of the boathouses and the riprap breakwaters. Surprisingly, of the several hundred colonies examined, very few were inhabited by sisyrids or any other known predators of freshwater sponges.

Flight activity of *Climacia areolaris* (attraction to light traps) began in late April and at least a few were present in every collection through early October (Fig. 1). The emergence pattern does not directly correspond to water temperatures as seen in Fig. 1, but more likely is related to the production and life cycle of the sponge.

A total of 567 adults were taken in the one-hour dusk blacklight samples with greatest activity occurring in five distinct peaks (Fig. 1). The number of days between the observed peaks ranged from 31 to 45, slightly longer than the one-month cycle found by Brown (1952). Needham and Betten (1901) recorded two broods per year in New York, and Brown (1952) assumed

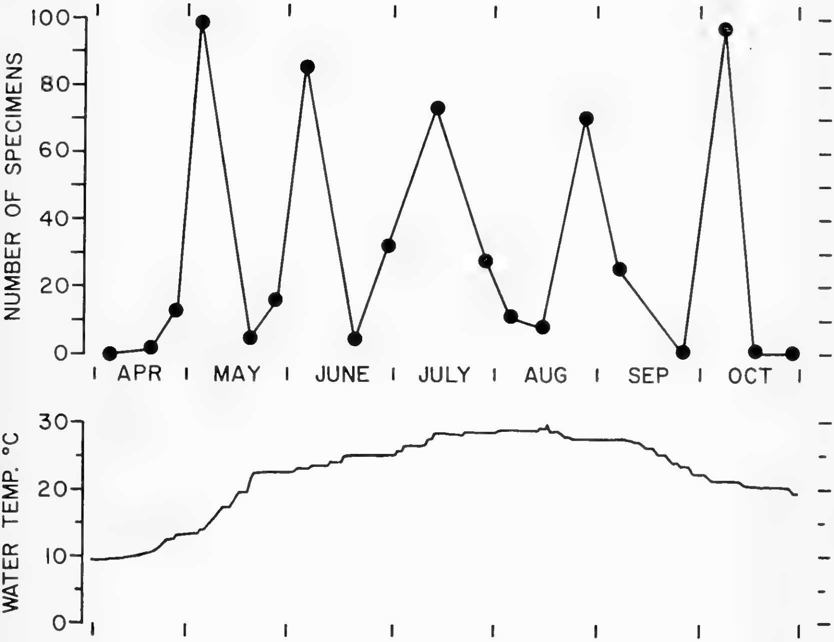

Figure 1. Numbers of *Climacia areolaris* in one-hour dusk blacklight samples during 1975, and water temperatures of Lake Texoma.

three broods and possibly a fourth in the western end of Lake Erie. Differences in climate, reflected in seasonal water temperatures from New York to western Lake Erie to southern Oklahoma, would allow a longer growing season for sponges and consequently the production of more broods of *C. areolaris.* The present study and those by Needham and Betten (1901) and Brown (1952) were in lake systems. It is interesting to note that Resh (in press), who observed *C. areolaris* flight patterns in the Salt River, Kentucky, found a continuous flight pattern throughout the summer with no distinct peaks.

Of the 567 adults collected at the dusk light traps, there were 442 females (77.9%) and 125 males (22.1%). A predominance of females in light trap collections for certain Trichoptera has been observed by Resh and Haag (1973) and attributed either to a greater number of females within the population, a difference in phototactic response, a different flight period for males, or a combination of these factors. Harris (1971) gives further evidence that some Trichoptera females have an earlier flight period. To determine if males were more active later in the evening, several 30 min samples were taken throughout the night during the July 1975 emergence period with the following results: 8:00-8:30 PM, 9 males, 48 females; 10:00-10:30 PM, 3 males, 2 females; 2:00-2:30 AM, 1 female; 5:00-dawn, 56 males, 12 females. It is hard to conclude much from the single series; however, it is highly likely that males and females do exhibit different flight patterns. Of 103 adults collected from the boathouse walls during 1975, 56 (54.4%) were females which also indicates a sex ratio closer to 1:1 than found by examining only dusk light trap samples.

Parfin and Gurney (1956) suggest that sisyrids, particularly *Sisyra,* overwinter as larvae or prepupae. This is probably true for *C. areolaris* in Lake Texoma. Third instar larvae were collected from sponge in late November 1974 although no emergence was indicated by light trap samples until the end of April 1975. Additionally, fresh pupal cases were first noticed on the boathouse walls in mid-April just prior to the May emergence peak.

At present, *C. areolaris* is the only sisyrid known to inhabit Lake Texoma. Two male *Sisyra vicaria* (Walker) were taken at the blacklight; however, *Sisyra* larvae have not been collected from the lake, and it is likely that these were immigrants from a nearby pond.

ACKNOWLEDGEMENTS

I wish to thank Harley P. Brown whose interest in sisyrids prompted this paper and Susan J. White who aided in all phases of this study.

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NEW RECORD OF ACARINE ECTOPARASITES ON THE NORTHERN PALM SQUIRREL, *FUNAMBULUS PENNANTI* WROUGHTON FROM INDIA[1]

Parshotam Singh Sandhu and V.C. Kapoor[2]

While going through the literature on acarine ectoparasites of squirrels in India, it was found that only two species of mites, namely *Gahrliepia ligula* (Radford, 1946) and *Trombicula longiseta* Womersley, 1952 are known from the squirrel *Callosciurus* sp. in India. *Gahrliepia ligula* has been recorded from Banital, Gurais, Jhangar, Kanzalwan, Naushera and Srinagar in Jammu and Kashmir; Kanha National Park in Madhya Pradesh; Ledo area and Imphal in Manipur and Binaguri and Jalpaiguri District in Bengal. It is found mostly on rats *(Bandicota indica, Rattus rattus bullocki, Rattus rattus narbadae, R. r. rufescens* and *R. manipulus),* mice *(Mus booduga booduga* and *Mus musculus homourus)* and shrews *(Anourosorex sanamipes* and *Suncus stoliczkanus)* and, rarely, on squirrels *(Callosciurus* sp.). *Trombicula longiseta* has been recorded from Kanglatongbi, near Imphal in Manipur, on both rat *(Rattus rattus bullocki)* and squirrel *(Callosciurus* sp.) (Prasad, 1974).

During a survey of the acarine ectoparasites of squirrels in Punjab, 94 specimens were collected from 43 specimens of *Funambulus pennanti.*

Of these acarines, 1 specimen belongs to the suborder Ixodides, 66 specimens (4 males, 20 nymphs and 42 females) to the suborder Mesostigmata, 5 specimens to the suborder Trombidiformes and 22 specimens to the suborder Sarcoptiformes. So far, we have been able to identify only the single specimen belonging to the suborder Ixodides, 25 female specimens belonging to the suborder Mesostigmata and 18 specimens belonging to the suborder Sarcoptiformes.

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[1] Accepted for publication: April 8, 1976

[2] Department of Zoology, College of Basic Sciences & Humanities, Punjab Agricultural University, Ludhiana.

Suborder I. IXODIDES
Family IXODIDAE

Rhipicephalus turanicus Pomerantzev

Collection Data[3] – 1L[4], 26. ix. 1975

Remarks – *Rhipicephalus turanicus* Pomerantzev has already been reported from the States of Andhra Pradesh, Gujarat, Jammu and Kashmir, Madhya Pradesh, Maharashtra and Tamil Nadu on buffalo, jungle cat, dog, donkey, goat, rat *(Rattus rattus rufescens)* and sheep (Dhanda & Rao, 1969). In Punjab it has been reported from a rat *(Millardia meltada)* by Miranpuri *et al.* (1975).

Suborder II. MESOSTIGMATA
Family 1 LAELAPTIDAE

1. *Androlaelaps zuluensis* (Zumpt)

Collection Data – 1F, 17. vii. 1975

2. Androlaelaps sp_1

Collection Data – 2F, 23.vi. 1975; 1F, 17.vii. 1975; 5F, Village Barewal (Ludhiana District), 5. viii. 1975; 10F, 26.x.1975.

3. Androlaelaps sp_2

Collection Data – 1F, 17.vii.1975.

Family 2. DERMANYSSIDAE

**Allodermanyssus sanguineus* (Hirst)

Collection Data – 2F, Village Barewal (Ludhiana District), 5.viii.1975

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[3] Unless otherwise mentioned all are collected from Ludhiana.

[4] L = larva, F = female

*recently recorded by Srivastava and Wattal (1973)

Suborder III. SARCOPTIFORMES
Family ACARIDAE

1. *Tyrophagus castrellanii* Hirst

Collection Data – 17F, Village Barewal (Ludhiana District), 5.viii. 1975.

2. *Tyrophagus lintneri* (Osborne)

Collection Data – 1F, 26.ix.1975.

It is interesting to note that all the above mentioned species of mites (except the one marked with asterik) are recorded for the first time in India.

Four specimens belonging to the house fly mite, *Macrocheles muscadomesticae* (Scopoly, 1972), have also been collected on this squirrel which might be due to contamination. The house fly mite, *Macrocheles muscadomesticae* is also recorded for the first time in India.

ACKNOWLEDGEMENTS

The authors are thankful to Professor S.S. Guraya, Prof. & Head, Department of Zoology, Punjab Agricultural University, Ludhiana for the facilities provided. They are also very grateful to Drs. Vijai Dhanda, S.M. Kulkarni, and A.C. Mishra, Virus Research Centre, Poona, for helping in the identification of the above mentioned acarines.

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NOTES ON SOME DAMSELFLIES OF CALCUTTA (ODONATA: ZYGOPTERA)[1]

A.R. Lahiri & Tridib Ranjan Mitra[2]

ABSTRACT: Fifteen species of damselflies were collected from Calcutta during a survey made by the authors from September 1966 to November 1970. Eight of these belong to the family Coenagrionidae and are reported here. Four species, *Pseudagrion malabaricum, Ischnura aurora aurora, Enallagma parvum* and *Agriocnemis pieris* are new records from eastern India; two species, *Enallagma malayanum* and *Agriocnemis dabreui* are new records from Bengal (the state of West Bengal of Indian Union and Bangladesh). Notes on the distribution of *Agriocnemis lacteola* and *Ischnura rufostigma* in Bengal are also given.

Introduction

A survey of the Odonate fauna of Calcutta was conducted during the period September 1966 to November 1970. During the survey fifteen species in the families Platycnemididae and Coenagrionidae were collected. Eight species in the family Coenagrionidae are particularly interesting.

The species reported in the present article are distributed over four genera and three subfamilies and are all old world species. Remarks are given on their geographical distribution, and any noteworthy variations from the descriptions of the species provided by Fraser (1933) are also reported.

Systematic Account

Family : Coenagrionidae
1.Subfamily : Pseudagrioninae
Genus : *Pseudagrion* Selys.

***Pseudagrion malabaricum* Fraser, 1924.**

Pseudagrion malabaricum Fraser, Rec. Indian Mus., 26: 428, 494-495 (1924).

Material examined: 1♀, 5th March, 1967, Rabindra Sarobar.

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[1] Accepted for publication: March 22, 1976

[2] Entomology Laboratory, Department of Zoology, University of Calcutta.

Remarks: This is the first record of its distribution in eastern India. Hitherto, it has been known to exist "throughout the Western Ghats in submontane and montane areas from South Kanara to Ceylon" (= SreeLanka) (Fraser, 1933).

2. Subfamily : Ischnurinae
Genus : *Ischnura* Charpentier

Ischnura aurora aurora (Brauer)

Agrion delicatum Hagen, Verh. zool-bot.Ges. Wien. *8:479 (1858).*

Agrion aurora Brauer, Vehr. zool-bot. Ges. Wien. 15: 510 (1865).

Material examined: 1♂, 16th October, 1966; Dakshineswar, 1♂, 23rd October, 1966, Dakshineswar; 1♂, 29th January, 1967, Eden gardens.

Remarks: This is the first report of occurrence of this species in Eastern India. Previously it has been recorded within the Indian Union from Maharastra (Laidlaw, 1919), Coimbatore, Cochin, Mercara, Kanara, Malabar, Nilgiris (Fraser, 1931), Mysore, Kerala (Fraser, 1933), Madras and Uttar Pradesh (Bhasin, 1953).

Ischnura rufostigma **Selys, 1876**

Ischnura rufostigma Selys, Bull. Acad. Belg. (2) 41: 283 (1876).

Material examined: 1♂, 5th March, 1967, Rabindra Sarobar.

Remarks: Although Laidlaw (1916) reported its occurrence in Calcutta (only reported locality in Bengal), Fraser (1933) remarked that he did not come across it in that neighbourhood. The present specimen constitutes only its second record in Bengal. It has also been reported from Bihar, Assam and Madhya Pradesh (Fraser, 1933) and Burma (Bhasin, 1953).

Genus: *Enallagma* Charpentier
Enallagma malayanum **Selys, 1876**

Enallagma malayanum Selys, Bull. Acad. Belg. 2 (41): 536 (1876).

Material examined: 2♂♂, 7th September, 1966, Alipore (near Zoo.); 1♀, 22nd September, 1966, Behala; 1♀, 8th October, 1966, Rabindra Sarobar; 2♀♀, 20th November, 1966, Dalhousie Square tank.

Remarks: This species has earlier been reported from Maharastra (Laidlaw, 1919) and Assam (Fraser, 1933) within the Indian limit. The present specimens constitute its first occurrence in Bengal. Besides India, Sreelanka (Laidlaw, 1951 and Fraser, 1933) and Indonesia (Lieftinck, 1954) have been recorded as places of its occurrence.

Enallagma parvum Selys, 1876

Enallagma parvum Selys, Bull. Acad. Belg., (2) 41: 537 (1876).

Material examined: 1♂, 5th March, 1967, Rabindra Sarobar; 1♀, 11th December, 1966, Beleghata Lake; 1♂, 27th November 1966, Dakshineswar.

Remarks: Although this species has earlier been reported from the Western Ghats (Fraser, 1924), the present specimens constitute its first occurrence in eastern India. Outside the Indian Union, Sreelanka (Fraser, 1933 and Laidlaw, 1951), Burma (Fraser, 1933) and Indonesia (Lieftinck, 1954) have been reported as places of its occurrence.

3. Subfamily : Agriocneminae
Genus : *Agriocnemis* Selys

Agriocnemis lacteola Selys, 1877

Agriocnemis lacteola Selys, *Bull. Acad. Belg.,* 2 (42): 144 (1877).

Material examined: 2♂♂, 22nd September, 1966, Behala.

Remarks: Although the species has previously been known from the Duars of Bengal, Sikkim and Assam (Fraser, 1933) and Bihar (Laidlaw, 1919), the present specimens constitute its first occurrence in Deltaic Bengal.

Agriocnemis pieris Laidlaw, 1919

Agriocnemis pieris Laidlaw, Rec. Indian Mus., 16: 179-180 (1919).

Material examined: 2♀♀ , 23rd October, 1966, Dakshineswar; 1♀, 27th November, 1966, Dakshineswar.

Remarks: This endemic Indian species has hitherto been reported from Kanara (Laidlaw, 1919), Mysore, TamilNadu and Kerala (Fraser, 1924). The present specimens constitute its first occurrence in eastern India.

Agriocnemis dabreui Fraser, 1919

Agriocnemis dabreui Fraser, Rec. Indian Mus., 16: 454-455 (1919).

Material examined: 3♂♂ , 3♀♀ , 13 November, 1970, Behala.

Remarks: The species has hitherto been reported from Assam and Madhya Pradesh in the Indian Union (Fraser, 1933 and 1919). The present specimens constitute its first occurrence in Bengal. Outside the Indian Union, it has been recorded from Burma (Lieftinck, 1948) and Bhasin (1953), Thailand and Malayasia (Lieftinck, 1954 and Fraser, 1933). The specimens do not have the anchor shaped mark on the terminal segments of the abdomen. In this feature, Calcutta forms agree with the forms of Burma and Thailand.

ACKNOWLEDGEMENTS

The authors are thankful to Prof. D.N. Ganguly, Head of the Department of Zoology, Calcutta University, for facilities and to Dr. D.N. Ray Chaudhuri of the same department for guidance.

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A STUDY OF *BRACON LEFROYI* (HYMENOPTERA: BRACONIDAE) FROM IRAN[1]

Manzoor Hussain, Ahmad Askari,
and Gholamhosein Asadi[2]

ABSTRACT: Parasitic behavior and biology of *Bracon lefroyi* (Dugeon and Gough) (Hymenoptera: Braconidae), an ectoparasitoid of the larvae of *Earias insulana* Boisduval, was studied in the laboratory. Adults of the parasite mated within 24 hours after emergence from pupal coccoons. The female parasite laid an average of 151-201 eggs during a 27-day oviposition period. Larger host larvae were prefered over smaller ones for oviposition, and a female laid as many as 20 eggs on a host larva. When reared at the room temperature of 21-23°C, egg to adult development required 15-20 days. This period was shortened to 11-15 days at 24°C, and 10-11 days at 28°C, when insects were reared at controlled temperatures in incubators. Higher mortality was recorded when insects were reared at lower temperatures. Eggs could be stored at a temperature of 5°C and 100% RH, but 50% mortality occurred.

DESCRIPTORS: Hymenoptera, Braconidae, *Bracon lefroyi,* parasite of *Earias insulana.*

Earias insulana Boisduval (Lepidoptera: Arctiidae) is such an important pest of cotton in Iran that in the absence of insecticide applications it has been reported to damage up to 70% of the bolls in some cottom fields in southern Iran (Hussain and Askari, 1975). Its ectoparasitoid *Bracon lefroyi* (Dugeon and Gough) has been reported from India (Husain and Mathur, 1921) and Burma (Stock, 1926), but not previously from Iran.

We found *B. lefroyi* parasitizing *E. insulana* larvae in a cotton field in Kooshkak near Shiraz, and studied its biology and behavior under laboratory conditions.

Methods and Materials

Cotton bolls infested with *E. insulana* larvae were collected from the cotton field during October 1975, and placed in experimental cages which were paper cups with screened tops. These were allowed to stand in a laboratory where the temperature ranged between 21 and 23°C. The emerging adult *Bracon lefroyi* parasites were transferred with a sterilized wet camel hair brush into new cages and provided with fresh *E. insulana* larvae. A cotton wick soaked in a saturated solution of sucrose was placed on the screen of the cage as a source of food for the parasite. The host larvae were not provided with cotton bolls. After recording the parasitizing behavior of the parasite, the latter was transferred to another cage and provided with

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[1] Accepted for publication: April 2, 1976

[2] Assistant Professor, Associate Professor, and Assistant Instructor respectively, Department of Plant Protection, College of Agriculture, Pahlavi University, Shiraz, IRAN.

fresh host larvae. The eggs deposited by the parasite on the host larvae were counted under a microscope and recorded. The life cycle of the parasite was studied at room temperature as well as under two controlled temperature regimes of 24 and 28°C. For the study under controlled temperature regimes, the host larvae with the parasite eggs attached to them were placed in sterilized petri dishes in Model Freas 818 incubators of Precision Scientific Company. The incubators had a fixed 14 h light.

Results and Discussion

Adult parasite insects resulting from the eggs mated within 24 hours after emergence. Prior to mating, the male, on approaching the female, became very excited and displayed a wing vibrating behavior. One male could mate with several females and mating lasted only a few seconds. Oviposition started 2 weeks after mating. Before oviposition, the parasite paralysed the host larva by repeated stinging and 15 to 20 minutes later, when the host had become immobile, the parasite started to lay eggs on it. The parasite, without exception, oviposited (Fig. 1) between and around the abdominal legs of the host first. Additional eggs, however, were laid on other parts of the host body, starting with the thoracic legs. When a combination of 1st to 5th instar larvae was offered, the parasite decidedly prefered to oviposit on the largest larvae first. Later, additional eggs were laid on the 3rd and 4th instars also. Although the 1st and 2nd instar host larvae were occasionally paralysed, no

Fig. 1. Different stages of *Bracon lefroyi*.
a – a male parasite; b – a female parasite;
c – a host larva with the parasite eggs on it;
d – a host larva with the parasite larvae on it.

eggs were deposited on them if larger host larvae were available. The parasite laid a maximum of 25 eggs in one day, with up to 20 on a host larva. The oviposition period lasted for an average of 27 days, and 151-201 eggs were laid by the female parasite. An average daily oviposition rate is plotted in Fig. 2. Maximum number of eggs were laid between 7th and 15th day after the female started to oviposit. This would correspond in the field with the last week of October.

Data related to the length of various stages of the parasite insect, when reared at different temperatures, are shown in Table 1. At room temperature, the majority of the insects required 15 to 20 days for egg to adult development. This process took 11 to 15 days at 24°C, and 10 to 11 days at 28°C. There was a greater mortality at lower temperatures than at 28°C, indicating susceptibility of the parasite to lower temperature.

Adults readily mated in captivity and the females laid fertilized eggs. However, parthenogenesis was found to occur and adults resulting from unfertilized eggs were all males.

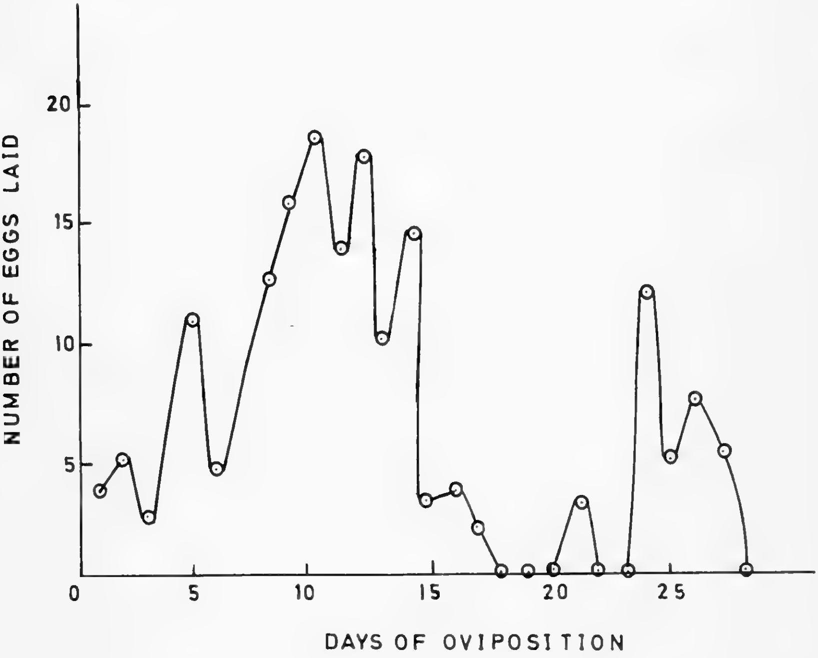

Fig. 2. Average daily oviposition rate of a female *Bracon lefroyi* on *Earias insulana* larvae.

In an attempt to study the effect of storage of the parasite eggs at cold temperature, *E. insulana* larvae with the parasite eggs on them were stored in a cold room at 5°C and 100% RH. After 11 days of storage, these were transferred into an incubator at 24°C. The eggs took 48 hours to hatch but there was a 50% mortality. However, the parasite larvae resulting from these eggs fed in a normal way on *E. insulana* larvae.

Under laboratory conditions, *B. lefroyi* was found to be an active parasite of *E. insulana* larvae, with a high rate of reproduction. However, in the field, the pest insect appears around August in southern Iran, whereas the parasite is not found to be active until late September. Thus, in order to use the parasite as a more effective control agent, it should be reared in the laboratory and released in the field earlier in the season when *E. insulana* larvae are doing a lot of damage to cotton bolls.

Table 1. Period of time required for completion of various life stages of *Bracon lefroyi*, when reared separately at different temperatures.

Temperature	Egg stage (hrs)	Larval stage (hrs)	Pupal stage (days)	% of insects completing egg to adult stage
Room (21-23°C)	48–72	48–72	11–14	36
24°C	24–48	48–72	8–10	59
28°C	24	48–72	7	91

ACKNOWLEDGEMENTS

We are grateful to Dr. Roy D. Shenefelt of the Department of Entomology, University of Wisconsin at Madison, for his assistance in identification of the parasite insect. This research was financially supported by the Pahlavi University, College of Agriculture Grant No. ARC-102-54.

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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.

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THE HUNGRY FLY. A Physiological Study of the Behavior Associated with Feeding. V.G. Dethier. Harvard University Press. 1976. 489 pp., $30.00.

Hunger is universal among animals. It has been more thoroughly studied in the black blowfly than almost any other creature except, possibly, man and the white rat. This book is an exploration of what we mean when we say that an animal is "hungry". It analyzes the concepts of motivation and drive as tested in extensive experiments on blowflies. The fly is incidental; concepts and experimental techniques for evaluating them are the main subject. In addition, it provides a complete review of the physiology of feeding in blowflies, thus making it more valuable to entomologists.

BACULOVIRUSES FOR INSECT PEST CONTROL: SAFETY CONSIDERATIONS. M. Summers, R. Engler, L. Falcon, P. Vail, editors. American Society for Microbiology. 1975. 186 pp., $9.00.

A collection of 52 selected papers from an EPA-USDA Working Symposium held April 15-18, 1974 at Bethesda, Maryland.

FIELD PHOTOGRAPHY. Beginning and Advanced Techniques. A.A. Blaker. W.H. Freeman & Co., 1976. 451 pp., 156 illus., $19.95.

The purpose of this volume is to make it possible for users to obtain and produce professional quality, publication grade nature photographs under a wide variety of field conditions. A Field-Use Data booklet accompanies each volume.

MAILING DATES
VOLUME 87, 1976

No.	Date of Issue	Pages	Mailing Date
1 & 2	Jan. & Feb.	1 - 60	Mar. 31, 1976
3 & 4	Mar. & Apr.	61 - 124	June 11, 1976
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7 & 8	Sept. & Oct.	189 - 248	Sept. 28, 1976
9 & 10	Nov. & Dec.	249 - 308	Nov. 30, 1976

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

1. Title of publication: *ENTOMOLOGICAL NEWS*
2. Date of filing: September 28, 1976
3. Frequency of issue: Bimonthly (every other month) except July and August
4. Location of known office of publication: Oak Shade Rd., Tabernacle Twp., RD 4, Vincentown PO, New Jersey 08088
5. Location of the headquarters or general business offices of the publishers: 1900 Race St., Philadelphia, Pa., 19103
6. Names and addresses of publisher, editor and managing editor:
   Publisher: American Entomological Society, 1900 Race St., Philadelphia, Pa., 19103. Editor: Howard P. Boyd, Oak Shade Rd., Tabernacle Twp., Box 617, Vincentown PO, New Jersey, 08088
7. Owner: American Entomological Society, 1900 Race St., Philadelphia, Pa., 19103
8. Known bondholders, morgagees and other security holders owning or holding one percent or more of total amount of bonds, mortgages and other securities: None
9. For optional completion by publishers mailing at the regular rates: signed
10. For completion by nonprofit organizations authorized to mail at special rates: The purpose, function and nonprofit status of this organization and the exempt status for Federal income tax purposes:
    Have not changed during preceding 12 months (checked)

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C. TOTAL PAID CIRCULATION	728	720
D. FREE DISTRIBUTION BY MAIL, CARRIER OR OTHER MEANS SAMPLES, COMPLIMENTARY, AND OTHER FREE COPIES	0	0
E. TOTAL DISTRIBUTION	728	720
F. OFFICE USE, LEFT-OVER, UNACCOUNTED, SPOILED AFTER PRINTING	272	280
G. TOTAL	1000	1000

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