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Journal of the New York Entomological Society

VOLUME LXXVI MARCH 29, 1968 No. 1

CONTENTS

A New Genus of Neotropical Stilt-Bugs (Hemiptera: Berytidae)

JOSEF M. ŠTUSÁK[1]

RECEIVED FOR PUBLICATION APRIL 20, 1967

Abstract: This paper contains the description of a new genus and species of neotropical Berytidae. **Acanthoberytus wygodzinskyi** n. gen. and n. sp., described from Peru, is related to *Acanthophysa* Uhler, 1893 and *Hoplinus* Stål, 1874, by having the head and pronotum armed with long spines. The new genus differs mainly by its wide unarmed hemelytra and by having large bullae on the membrane.

In identifying specimens of Berytidae loaned to me by the American Museum of Natural History, New York, an interesting South American stilt-bug was found. This is described as new below. In all illustrations, the scale represents 1 mm.

Acanthoberytus Štusák, new genus

DIAGNOSIS: Scutellum with a very long spine-like process. Head and pronotum armed with long spiniform processes. Hemelytra without spines, only the marginal vein of corium with a row of tiny spines directed obliquely down- and backwards. Hemelytron strongly widened externally, membrane with high bullae. Ostiolar processes relatively short and blunt.

DESCRIPTION: Body elongate, abdomen and hemelytra fusiform. Head armed with long spiniform processes along the midline. Inflated carinae on lateral portions of head. Head divided dorsally into anterior and posterior portion by well developed preocellar sulcus. Antennae very slender, only slightly longer than body. First antennal joint with apex clubbed, shorter than the second and third joints together. Third joint longer, fourth shorter than second.

Pronotum divided by transverse furrow into anterior and posterior lobe. Anterior pronotal lobe armed with long spiniform processes near its anterior margin. Posterior lobe armed with numerous long spines. A very long spiniform process situated on scutellum. Ostiolar processes small and straight with rounded apices, not reaching level of hemelytra.

Legs very long and slender, femora clubbed at apices; tibiae longer than femora. Posterior femora reaching beyond apex of membrane.

Abdomen very wide, fusiform, its dorsum centrally without tergites or other sclerites and without sutures between abdominal segments.

Hemelytra strongly widened on median portion and with conspicuous rib-like veins. Membrane of hemelytra very convex and with high bullae.

TYPE-SPECIES: **Acanthoberytus wygodzinskyi**, sp. n., by monotypy.

DISCUSSION: This new genus is related to *Acanthophysa* Uhler, 1893 and evidently also to the obscure and incorrectly described genus *Hoplinus* Stål,

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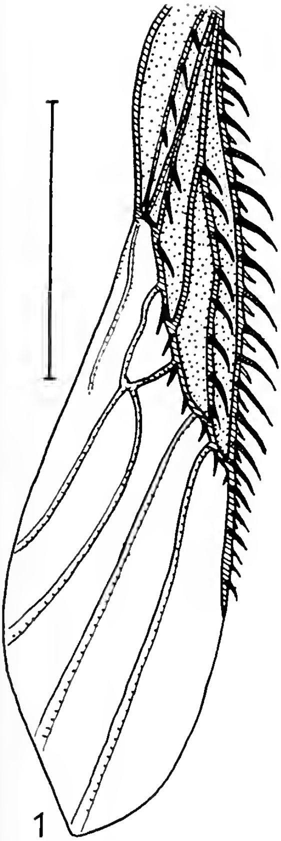
Acknowledgement: The author expresses his sincere thanks to Dr. Pedro Wygodzinsky, Curator of the Department of Entomology, The American Museum of Natural History, New York, for the loan of material of New World Berytidae for examination.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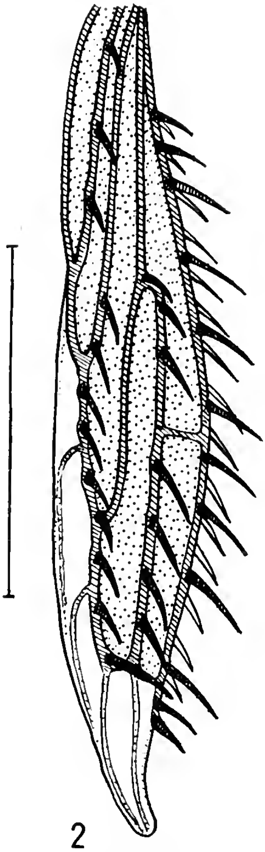
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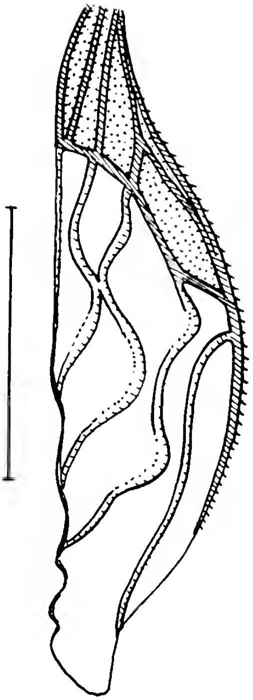
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FIG. 1. *Acanthophysa echinata* Uhler, macropterous form, right hemelytron.
FIG. 2. *Acanthophysa echinata* Uhler, brachypterous form, right hemelytron.
FIG. 3. *Acanthoberytus wygodzinskyi*, n. gen., n. sp., right hemelytron.

1874 where Signoret's species described from Chile—*Neides spinosissimus* Signoret, 1863—was placed by Stål. As follows from Signoret's (1863) description and from McAtee's (1919) discussion, *Hoplinus spinosissimus* (Signoret, 1893), has spines on head, pronotum as well as on hemelytra (on the longitudinal veins of corium and along the outer margin of corium), so that it is similar to *Acanthophysa* Uhler. *Acanthoberytus*, n. gen. is somewhat similar to *Acanthophysa* (especially to the brachypterous form) in the general appearance of head, pronotum and abdomen since the spiniform processes of head and pronotum and the inflated carinae are of a similar type. Also the ostiolar processes are of similar general structure but they are much shorter in the new genus. It also agrees with *Acanthophysa* by the absence of metathoracic wings in brachypterous specimens. The new genus, however, differs very considerably

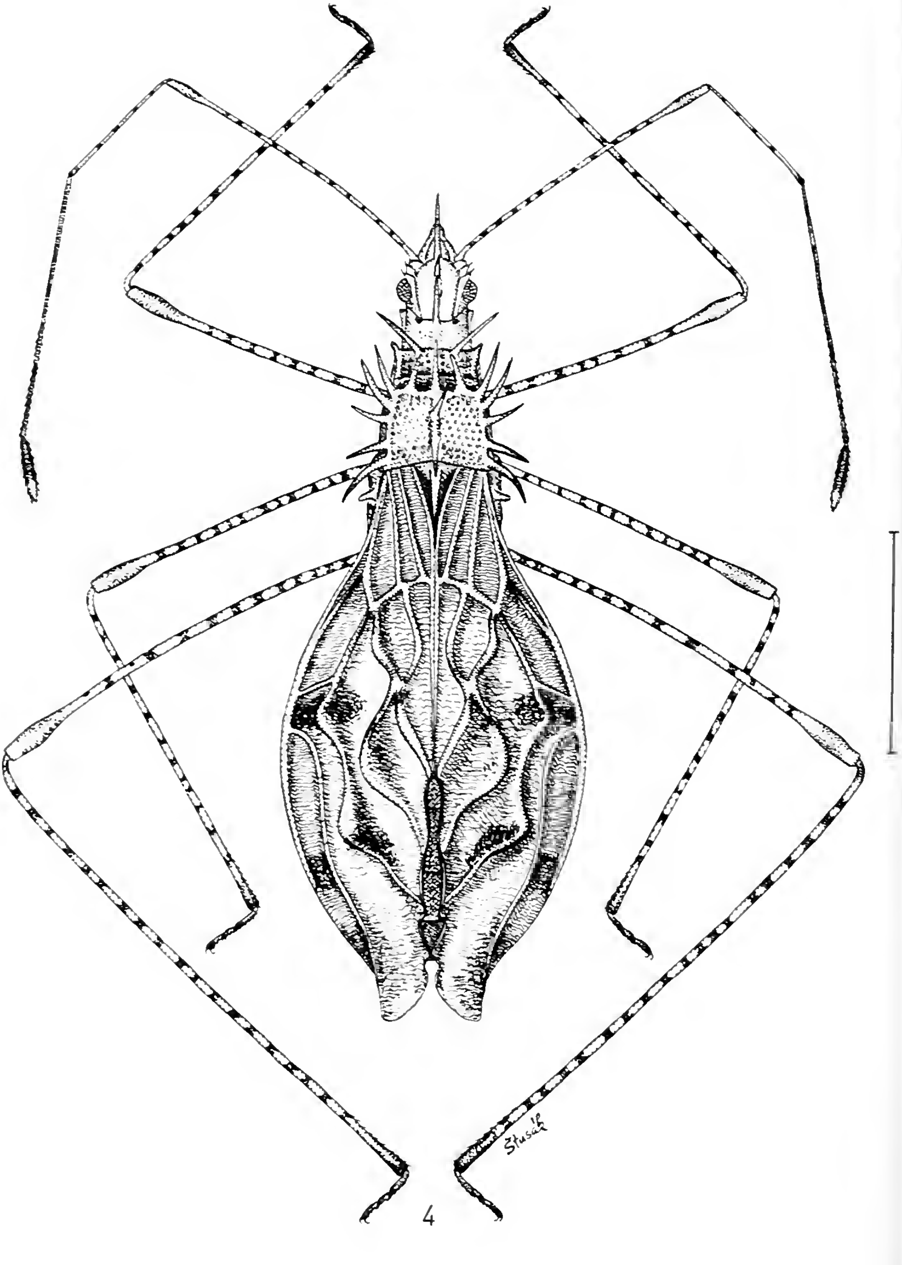

FIG. 4. **Acanthoberytus wygodzinskyi**, n. gen., n. sp.

from *Acanthophysa* Uhler as well as from *Hoplinus* Stål in the structure of its hemelytra: there are no spines (except the tiny spines on the outer marginal vein of the corium), the hemelytra are wider and there are conspicuous high bullae on the membrane (figs. 1, 2, 3, 7).

Acanthoberytus wygodzinskyi Štusák, new species

DERIVATION OF NAME: This species is named for Dr. Pedro Wygodzinsky, who collected this interesting new berytid.

DESCRIPTION: Brachypterous form. Body long, widened considerably in the abdominal region. General color light ochreous, legs and antennae annulated with piceous. Head almost 1.5 times longer than wide, and only slightly shorter than pronotum. Head ochreous brown but ventral portion (gula) somewhat darker. Spiniform processes and carinae of head very light-colored, almost whitish ochreous. Surface of head dull, under high magnification very finely punctured.

Dorsal surface of head armed with six light-colored spiniform processes on its midline, the processes placed as follows (fig. 5): two processes on clypeus directed forward and moderately downward; the first shorter than second. Three spiniform processes on the convex vertex, the first largest, larger than spines of pronotum but somewhat smaller than spiniform process of scutellum. The other two processes of head much smaller (less than half the length of the first process). Just behind preocellar sulcus, a large and elongate spiniform process (about as long as the first one of the vertex) directed obliquely forward and upward as spines of the vertex.

On lateral portions of head four slightly inflated carinae on each side. First percurring maxillary plate and extending to ventral margin of antenniferous tubercle. Second carina very short, situated laterally on upper margin of antenniferous tubercle. Third carina long, situated above eye; beginning approximately at level of anterior margin of eye, horizontally backward extending across preocellar sulcus, ending directly behind sulcus, at level of base of last spiniform process of head. A hardly distinguishable ocellus situated here at end of carina. Frontal angles of carina on antenniferous tubercle and of carina situated above the eye, somewhat produced sidewards; a stout seta on each of these prominent angles. Fourth carina (also with sidewardly projecting apical angle, but without seta) situated behind eye, extending horizontally backwards but not reaching anterior margin of prothorax. Ventral and lateral portions of head with scattered light-colored hairs extending to level of the eye. Eyes of almost circular shape, rather small, red in color.

First antennal joint very slightly shorter than half the body, and shorter than the second and third joints together. Third joint about twice as long as second. Fourth joint approximately half the length of second. First antennal joint light yellow-ochreous, annulated with piceous (about 12–14 annulations), apical clava ochreous-brown. Second joint somewhat darker, with about five faint annulations; third joint uniformly dark brown. Fourth joint slightly wider than the clava of the first joint, blackish with apical fourth brown. Small delicate hairs more conspicuous on distal half of third and on fourth antennal joint.

THORAX: Pronotum armed with 17 long and two small, short spines, and with two small processes (figs. 4, 5). Pronotum approximately 1.2 times longer than wide in dorsal view. Pronotal disc only very moderately convex on posterior third. Anterior pronotal margin almost straight (slightly convex), the whole posterior margin of pronotum concave. Pronotum light yellow ochreous. Anterolateral angles of pronotum each produced forward into a short and blunt horizontal process. A lighter colored carina extending from process in caudal direction, situated on lateral margins of pronotal disc, almost reaching postero-

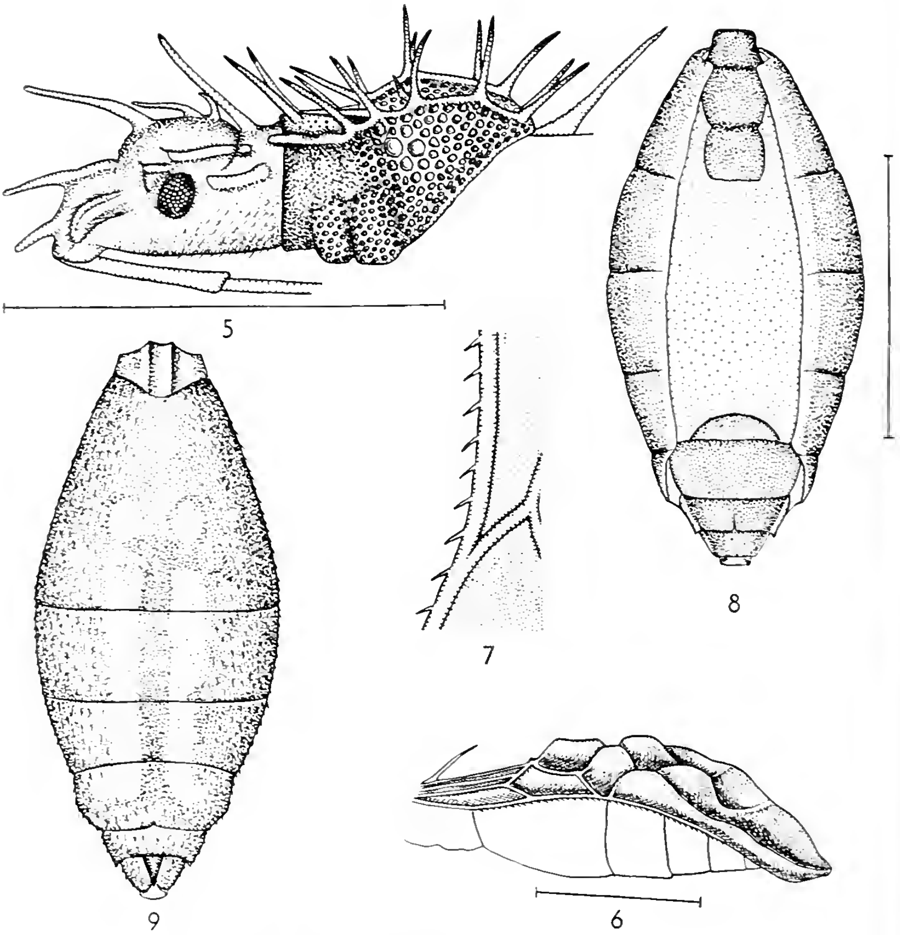

Fig. 5–9: **Acanthoberytus wygodzinskyi**
Fig. 5. head and pronotum, lateral view.
Fig. 6. hemelytron, lateral view.
Fig. 7. row of tiny spines on marginal rib of left hemelytron.
Fig. 8. dorsal surface of abdomen.
Fig. 9. ventral surface of abdomen.

lateral angles of pronotum. A rather wide transverse furrow situated approximately on first third of pronotum, dividing pronotum into anterior and posterior lobe. Furrow wide, somewhat darker in color and very finely punctured. Anterior pronotal lobe moderately convex towards sides, its surface less coarse in structure. Two long spiniform processes arising near anterior pronotal margin, their distance equal to about half the length of the anterior pronotal margin. These spines are directed divergently upward and moderately forward. Posterior pronotal lobe slightly convex, almost flat and only moderately sloping down to posterior pronotal margin. In addition to lateral carinae (mentioned already above) also a median carina situated on a rather long, low, laterally compressed bulla. All three carinae on posterior pronotal lobe armed with long spiniform processes.

On each of the lateral carinae five long and slender spiniform processes, approximately as long as half the length of posterior pronotal margin; processes light in color, only their tips piceous. Processes directed obliquely upwards; the first also somewhat forward, the last one slightly backwards. Three similar long spines situated on median carina; the first arising at the beginning of posterior pronotal lobe (immediately behind the wide furrow), obliquely up and forwardly directed. Median spine, situated at the highest region of pronotum, erect; posterior spine up and backwardly directed. Between the first lateral and the first median spines one long spine on each side of anterior margin of posterior pronotal lobe. These spines, however, adpressed to surface of pronotum, entirely horizontal, forwardly directed, extending over the wide furrow and reaching base of spines of anterior margin of pronotum with their tips. One much smaller rudimentary spine between the lateral and median rows of spines on each pronotal side, approximately at level of second to third lateral spine.

Pronotum, except carinae and spines, coarsely punctured (i.e., with minute pentagonal or hexagonal surface structure), these structure elements largest on disc and lateral portions of posterior pronotal lobe.

Scutellum about as long as wide, punctured, brownish and armed with a light colored spine with blackish tip, directed obliquely backward. This scutellar spine the largest of all the body spines.

Ostiolar process very small, straight and almost cone-shaped with rounded apex, not attaining level of hemelytron in lateral view.

Legs light yellow-ochreous, coxae and trochantera light-colored, femora and tibiae annulated with piceous. Apical clavae of femora brownish except their apices which are again light ochreous. Anterior femur with about 9–10, middle femur with 12, posterior one with 15 dark annulations. Anterior and middle tibia approximately with 11–12, posterior one with 19–20 annulations. Apices of tibiae moderately enlarged, piceous; tarsi piceous. First tarsal joint only a little shorter than second and third joints together, second joint only moderately shorter than third. Distal portions of tibiae and tarsi covered with fine hairs. Posterior femora reaching approximately to apex of abdomen but not surpassing apex of membrane.

Hemelytra surpassing abdomen, widest on their median portions, so that whole insect is widest here. Hemelytron about 1.9 times wider than head. Membranes of hemelytra not overlapping each other as in other Berytidae, but their inner margins touching, thus sutures between hemelytra situated along median bodyline. Inner margins of membranes undulate, carina-like, rising on posterior half. Venation of hemelytron carina-like, prominent, especially on the membrane where there are high laterally compressed bullae, with veins situated on their ridges. Each hemelytron with five large bullae on membrane. Corium as well as membrane wrinkled between the veins: membrane not very transparent, marked with brownish-black spots as in figure 4. Lateral vein-like margin of corium armed with very tiny spines which are only slightly shorter than width of this marginal vein. Spines directed obliquely down- and backwards (fig. 7). Metathoracic wings absent.

Midline of ventral surface of thorax with rostral sulcus attaining anterior abdominal segment.

Abdomen fusiform, widest at middle. Dorsally, dark brown tergites developed only at the base and apex of abdomen; median portions of dorsum only faintly sclerotized, light ochreous, lacking sclerites or sutures between segments (fig. 8). Ventral surface of abdomen piceous with two longitudinal brown stripes indistinctly bordered on posterior half. Lateral portions of ventral surface of abdomen covered with scattered light-colored short hairs; these hairs, however, absent along midline of abdomen (fig. 9).

MEASUREMENTS: (holotype) length of body 3.63 mm., maximal width of body 1.32 mm., length of head (without spines) 0.51 mm., width of head 0.35 mm., distance between eyes 0.26 mm., length of antenna 4.34 mm. (I : II : III : IV = 1.70 mm. : 0.77 mm. : 1.49 mm. : 0.38 mm.), length of pronotum (without spines) 0.57 mm., width of pronotum (without spines) 0.48 mm.

leg	femur	tibia	tarsus
anterior	1.28 mm.	1.57 mm.	0.26 mm.
middle	1.40 mm.	1.62 mm.	0.26 mm.
posterior	1.96 mm.	2.59 mm.	0.28 mm.

TYPE LOCALITY: Peru, Surco, Valle del Rio Rimac, Dept. Lima; 1800 m. (October 9, 1963; coll. P. Wygodzinsky).

Holotype (brachypterous female) in the collection of the American Museum of Natural History, New York.

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The North American *Microcrambus* (Lepidoptera: Pyralididae)*

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Received for Publication June 18, 1967

Abstract: The eight fully known species of *Microcrambus* Bleszynski occurring in North America are characterized and differentiated. The male genitalia of all are figured. Three of the species, *M.* **copelandi, kimballi** and **matheri,** are described as new.

The genus *Microcrambus* was erected by Bleszynski (1963, p. 167–172) for 15 species, all of which except *M. elegans* (Clemens) were Neotropical. *M. discobolus* Bleszynski (*ibid.*, p. 168–169, figs. 48, 53) was designated as the type species. This species, however, appears to be a subjective junior synonym of *Microcrambus discludellus* (Möschler) (1890, p. 323) (Bleszynski, 1966, p. 486). Further investigations by Dr. Bleszynski and the present author have revealed the presence of a number of additional species in North America and the tropics, as well as the advisability of transferring to *Microcrambus* a number of other species hitherto placed in *Crambus* Fabricius. The present article deals with the North American species; the much more numerous tropical ones will be dealt with by Dr. Bleszynski.

The genus is embarrassingly difficult to characterize positively, to some degree because of the considerable differences between some of the species. The size of individuals averages small, ranging in forewing length from 4.4–10.9 mm. None of the species has the clearly indicated, long, white discal streak, pointed distally, that characterizes practically all of the species of *Crambus* sens. strict.; and all have at least definite dorsal, as well as costal, indications of the transverse median-postmedian (m.-p.) line. In the largest group of species the pattern is much obscured by dark clouding and dusting. Vein R_5 of the forewing is consistently stalked on R_{3+4} as in other Crambini and Argyriini, and a few Chiloini. The male genitalia are extremely distinctive on the species level, but differ so widely from species to species that no distinctive generic characters can be detected. The female genitalia show a crambine, rather than argyriine or chiloine affinity in the rounded papillae anales, lack of expansion of the apophyses posteriores and great reduction of the apophyses anteriores. There is often a well sclerotized, sometimes strongly protruding and complex, structure at the ostium; there is often a deeply invaginated, sometimes well sclerotized genital pouch ventrally between the 7th and 8th segments; and the ductus bursae is very long and gradually enlarges to a bursa that may have one or two signa. The females have a dense ring of greatly enlarged, flattened scales arising from the caudal margin of the 7th segment and the intersegmental area caudad of this. Somewhat comparable scales occur in

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the females of a few other genera (e.g. *Parapediasia* Bleszynski) but are not so large and prominent.

Two main color and pattern groups are distinguishable. In the one, which includes *M. pusionellus* (Zeller), *biguttellus* (Forbes) and **copelandi** n. sp., the forewing is clear, satiny white, the transverse lines are yellow, more or less widened and infuscated dorsally, the fringes are often contrastingly metallic at the ends of cells M_3, Cu_{1a} & Cu_{1b}, and dark terminal dots are present only in these cells. In the other group, which includes *M. elegans* (Clemens), *minor* (Forbes), *polingi* (Kearfott), *discludellus* (Möschler), **kimballi** n. sp., **matheri** n. sp., and quite a number of neotropical species, largely unnamed, the forewing is a duller, dirtier white usually considerably clouded and dusted with fuscous scales; the markings are darker and more diffuse; the fringe is not metallic; and the dark terminal dots, if distinct at all, are not limited to the above mentioned cells. In the former group the species are easily distinguishable by color and pattern, but this is not true of the latter group, at least in the present state of our knowledge, distinction being chiefly by generalized characteristics and appearances. The male genitalia, however, show major and clear-cut distinctions, which are completely adequate for a species classification. Therefore, it seems best to publish this preliminary classification mostly on the basis of these structures, since it may be many years before adequate material is available for the study of safely correlated females, pattern differences and the largely unknown tropical fauna.

The names of institutions have been abbreviated as follows: American Museum of Natural History (A.M.N.H.); British Museum (Natural History) (B.M.); Cornell University (C.U.); Los Angeles County Museum (L.A.C.M.); University of California at Berkeley (U.Cal.B.); United States National Museum (U.S.N.M.). I am greatly indebted to the authorities of these institutions for permitting me to study their crambine material, sometimes on very extended loans; and to Dr. A. E. Brower of Augusta, Me., Charles P. Kimball of Barnstable, Mass. and Sarasota, Fla. and Bryant Mather of Jackson, Miss. for their generosity in lending and donating specimens. Dr. S. Bleszynski of Cracow, Poland has been most generous with information and advice.

Microcrambus pusionellus (Zeller) (1863, p. 16)

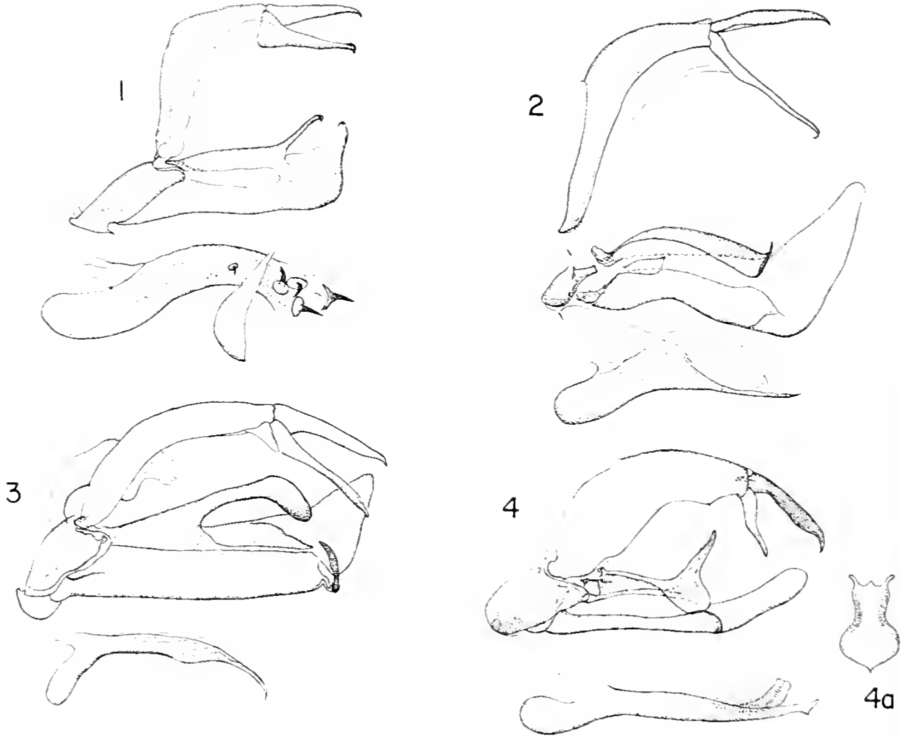
Records of this species from the United States are erroneous, having been based on specimens of the following species, which occurs in California and Arizona. The type locality of *pusionellus* is Venezuela. There is one specimen from Covani, Oaxaca, Mexico, 14 March 1931, Coll. C. C. Hoffmann, in the A.M.N.H. Two specimens from "West. N. A." in the Zeller Collection (B.M.) previously regarded as *pusionellus* are of the following species. The type of *pusionellus* is a ♂ in the B.M. labelled: "Zell. Coll. 1884; *Crambus pusionellus* Z. Mon. 16 Venezuela; G.A.B. 1938, 68," the last label referring to a genitalia dissection kindly made at the request of the present writer by the late G. A. Bisset. The A.M.N.H. has a good series of specimens from Venezuela. The chief characteristics of the male genitalia and color and pattern are given in the keys in this article (below).

Microcrambus copelandi, n. sp.

Forewing length 6.6–7.2 mm. Labial palpi white dorsally, brown ventrally. Head and thorax typically white, sometimes with some of the scales behind the antennae brown; and a short, brown, subdorsal line on each side of anterior thorax. Forewing satiny white. A very short, yellowish brown shade at extreme base of costa, and a similar one at base of dorsal (anal) margin. M.-p. line beginning on costa as a brown mark; thence narrow and yellowish, running diagonally distad and dorsad to distal end of discal cell; thence diagonally basad and dorsad to dorsad of cell at about base of Cu_{1b} (Cu_2 of old Comstock-Needham system) where it is more or less expanded as a fuscous mark; thence running diagonally basad and dorsad to about middle of dorsal margin, where it is considerably expanded into a yellow-fuscous or fuscous patch. S.t. line yellow to yellow-fuscous, double; beginning on costa at or just beyond end of R_1 with two brown marks; thence running diagonally distad and dorsad almost to outer margin in cell M_1; thence, becoming fuscous and gradually much widened, diagonally basad and dorsad to dorsal margin just basad of tornus; slightly offset distad at fold. A narrow black terminal line from apex to fold, with black terminal dots more or less indicated in cells M_1, Cu_{1a} and Cu_{1b}. Fringe whitish basally, brownish terminally, sometimes all white beyond cells M_1 and M_2; then brownish iridescent beyond cells M_3, Cu_{1a} and Cu_{1b}, then whitish to tornus. Hindwing white, more or less tinged with pale brownish costally, fringe white. Individuals differ greatly in the extent of the fuscous marks along the m.-p. and s.t. lines in the dorsal half of the forewing. Sometimes the lines are almost entirely yellowish with only a few fuscous scales; sometimes the fuscous markings are very brown and prominent. There is usually more fuscous along the s.t. line than along the m.-p. one.

MALE GENITALIA (Fig. 1): Tegumen broad, well sclerotized, tapering decidedly latero-ventrad, its posterior part (derived from segment 10?) well differentiated from its anterior part (derived from segment 9?). Uncus broad basally, tapering to a slender, slightly downcurved point. Gnathos broad basally, tapering terminally, slightly enlarged and downcurved terminally, about as long as uncus. Vinculum from lateral view with cephalic and caudal margins strongly diagonal and subparallel. Pseudosaccus extending slightly cephalad of cephalic margin of vinculum. Costa of valva well sclerotized, with a long, slender free process extending dorso-caudad and terminally sharply hooked mesad and ventrad. Cucullus of valva lightly sclerotized, broad basally, subterminally abruptly narrowing and running dorsad. Sacculus of valva scarcely discernible, without any process. Lower part of anellus forming a sclerotized penis support. Aedeagus very large, exceeding cephalo-caudal length of vinculum plus valva, curved, with broad coecum penis and 5 cornuti; these are short, curved spines, arising from discoid bases; the most basal is much smaller than the proximal 4.

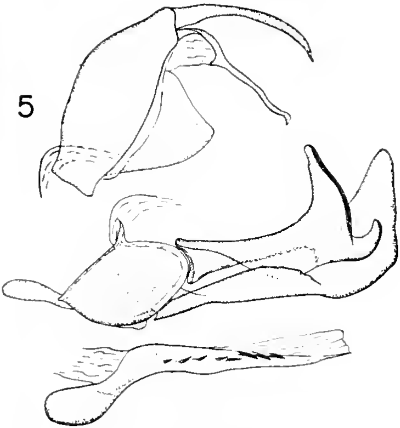
TYPE MATERIAL: Holotype ♂, Avalon, Santa Catalina I., Calif., May 27, 1932, leg. Don Meadows, genitalia praep. 25 June, 1965, #1, A. B. Klots. Allotype ♀, Avalon, Santa Catalina I., Calif., Oct. 2, 1931, leg. Don Meadows. Holotype and allotype in L.A.C.M. Paratypes as follows: 1 ♀, Avalon, as above, May 19, 1932; 3 ♀♀, Santa Cruz I., Calif., 12, 13 & 17 Aug., 1939, leg. Lloyd



Figs. 1–8. Male genitalia, North American *Microcrambus*. The genitalia are shown in left lateral aspect with the left valva removed so as to show the ental surface of the right valva. The detached aedeagus is at the bottom. In Figs. 2 & 5 the tegumen, uncus and fultura superior are shown disarticulated and moved slightly dorsad. Fig. 1. **M. copelandi,** →

Martin, in L.A.C.M. & A.M.N.H.; 1 ♀, 4 mi. W. of Pinecrest, Tuolumne Co., Calif., July 16, 1961, leg. J. G. Rozen, in A.M.N.H.; 2 ♀♀, Ramsay Canyon, Huachuca Mts., Ariz., 12 July, 1941, leg. A. B. Klots, in A.M.N.H. & L.A.C.M.; 1 ♀, Southwest Research Sta., nr. Portal, Cochise Co., Ariz., May 28, 1958, leg. M. Cazier, in A.M.N.H.; 1 ♀, Castella, Calif., 13 Jan., 1939, leg. Grace H. & John L. Sperry, in A.M.N.H.; 1 ♀, Southwest Research Sta. as above, Sept. 3, 1959, leg. D. D. Linsdale, in U.Cal.B.; 2 ♂♂, "West U.S.A., 89.93, Zeller Coll.," one with genitalia praep. 8 Jan. 1939, A. B. Klots, Pyralidae Slide No. 1687, Brit. Mus., in B.M.

DISCUSSION: This is the species that has been referred to in the literature as *Crambus pusionellus* Zeller, and on the basis of which that species has been recorded from North America. It is thoroughly distinct from *pusionellus* (see above, and keys, below). There is great variation in the extent of the dark postbasal and median markings in the dorsal part of the forewing, some specimens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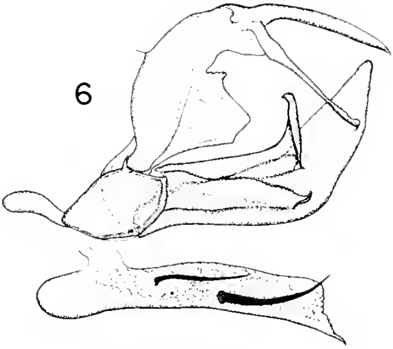
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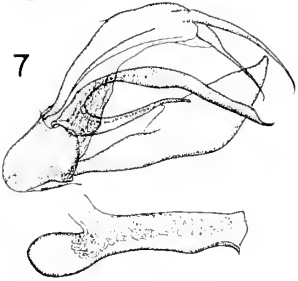
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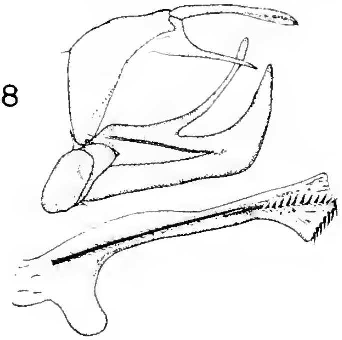
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n. sp., with sclerotized aedeagus support of anellus shown with aedeagus. Fig. 2. *M. biguttellus* (Forbes). Fig. 3. *M. polingi* (Kearfott). Fig. 4. *M. elegans* (Clemens). 4a Dorsal view of uncus. Fig. 5. *M. minor* (Forbes). Fig. 6. **M. kimballi,** n. sp. Fig. 7. *M. discludellus* (Möschler). Fig. 8. **M. matheri,** n. sp.

having these very heavy, others having them limited to a few dark scales. The holotype is the only male with good data seen. *M.* **copelandi** is named for Prof. J. J. Copeland of the Department of Biology of the City College of New York, staunch companion on many field trips and field botanist extraordinary.

Microcrambus biguttellus (Forbes) (1920, p. 219)

In addition to the type, I have studied specimens from southern Ontario, Michigan, New York, Connecticut, Pennsylvania, North Carolina, Florida and, surprisingly, Puerto Rico, the last correctly recorded by Schaus (1940, p. 398). The type, a ♂, is in C.U. It appears to be very local and largely limited to very wet, acid environments, often in association with *Thuya occidentalis* or *Chamaecyparis thyoides*; it may occur in true sphagnum bogs, but is not a bog obligate.

The male genitalia (Fig. 2) are quite peculiar in the great reduction of the vinculum and the lack of sclerotization of the dorsum of the penis. The female genitalia are extremely peculiar in having a long, slender, tapering, protrusible pouch, developed apparently from the caudo-ventral edge of the 7th segment. When extruded caudad this pushes the ostium, 8th segment and papillae anales up almost directly dorsad; and the ductus bursae makes a loop inside it. In 21 normally killed and dried ♀♀ it is not extruded in 2, is slightly extruded straight caudad in 3, and is strongly extruded and curved strongly dextrad in 16.

Microcrambus polingi (Kearfott) (1908, p. 382), new combination

In addition to the type I have studied specimens from Arizona: "southern Arizona" (type lot), Coyote Mts., Santa Catalina Mts., Santa Rita Mts. & Redington; and Mexico: 14 mi. S.W. of El Salto, Durango. The type, a ♂, is in the U.S.N.M. The Arizona specimens are considerably smaller (forewing 8.3–8.5 mm) than the 3 Mexican specimens (forewing 10.3–10.8 mm) and the Mexican specimens are darker and more heavily clouded, one of them greatly so. As discussed below, *Crambus polingi* Forbes (1923) is not this species but *Crambus minor* Forbes (1920). The male genitalia (Fig. 3) are highly distinctive, the costal process being very large, long and almost bulbous, the sacculus very long and bearing a strong, mesad and then dorsad curving process, and the aedeagus being small and weak, with a long, curved, ventral terminal filum.

Microcrambus minor (Forbes) (1920, p. 220), new combination

Forbes named this as a subspecies ("race") of *Crambus immunellus* Zeller (1872, p. 472, Pl. 2, fig. 6). The type ♂, from Biloxi, Miss., June 13, 1917 and a ♂ paratype from Schriever, La., June 17, 1917, are both in C.U. In the U.S.N.M. there is a ♀, also from Schriever, La., June 17, 1917, with additional labels: "*C. minor* Forbes; O.K. a c Forbes; Comp. w. type, C.U.; see note No. 29b; from type lot." This specimen is not, of course a part of the type material. Of these specimens the type and the ♀ are conspecific, but the ♂ paratype is of the different species that is being named *M.* **kimballi** in this article.

In The Lepidoptera of New York . . . (1923, p. 601) Forbes wrote "A form of *C.* [*Crambus*] *polingi* Kearfott has been taken a few times at Ithaca, New York, in July . . . ." In actuality the species to which he referred is not only thoroughly distinct from *C. polingi* Kearfott (see above) but is Forbes' own *Crambus minor*, as is shown by study and dissections of the genitalia of the type and a good series of specimens of both sexes. I have studied material of *M. minor* (Forbes) from Ontario, New York, Massachusetts, Connecticut, New Jersey, Maryland, North Carolina, Georgia, Florida and Louisiana. Although never common, it is, next to *M. elegans* (Clemens), the most widely distributed *Microcrambus* in North America. Northern specimens are larger (forewing 6.3–7.0 mm) and more clearly patterned than Florida and Louisiana ones (forewing 5.1–6.0 mm), which explains why Forbes failed to recognize them as *minor* and confused them with *polingi.*

M. minor is specifically distinct from *M. immunellus* (Zeller), to which it has a general size, color and pattern resemblance. The type of *immunellus*, which I have studied and photographed, is a ♂ from Ubaque, Colombia, Zeller Coll., Pyralidae Brit. Mus. Slide No. 2234 ♂, in the B.M. *M. minor* is also in some ways similar to *M. atristrigellus* (Hampson) (1919, p. 283) from Jamaica, of which the ♀ type is also in the B.M., and of which no ♂ is known. An accurate comparison will have to await the availability of more and better material of *atristrigellus*, especially of determinable ♂♂.

Microcrambus elegans (Clemens) (1860, p. 204)

Bleszynski (1963, p. 172) first transferred this species to *Microcrambus.* It is the commonest and most widespread species of the genus in North America, occurring from Ontario to Florida and the Gulf Coast, and from the Atlantic coast westward into Kansas. The type, lacking abdomen, is Type 7285 in the Academy of Natural Sciences, Philadelphia. The ♂ genitalia (Figs. 4 & 4a) most resemble those of *M. minor* but are easily distinguished by the extremely broad, spatulate uncus and very weak gnathos, the position of the process of the sacculus of the valva, which is not attached to the ventro-distal base of the process of the costa, and the lack of cornuti.

In color and pattern *M. elegans* can nearly always be recognized by the characters given in the keys, although specimens nearly everywhere show a great amount of variation in the extent of the dark markings and clouding, and specimens from Florida and the Gulf Coast average much smaller and greyer than those from the North.

Microcrambus discludellus (Möschler) (1890, p. 323)

This species was named from a ♀ from Porto Rico. The type is in the Institut für Spezialle Zoologie der Humboldt Universität, Berlin, where it has been studied by Dr. Bleszynski, who has kindly given me these data. *Microcrambus discobolus* Bleszynski, the type species of *Microcrambus*, Bleszynski (1963, p. 168, figs. 48 & 53) is a subjective junior synonym of *discludellus* (Bleszynski, 1966, p. 486).

I have studied material of *discludellus* from both Porto Rico (Adjuntas, June 8–13 and Cayey, May 30–31) and Florida (Royal Palm State Park, Dec. 4–10, Jan. 17, Feb. 5 & Feb. 17 and Ft. Lauderdale, Aug. 16) in the U.S.N.M. & A.M.N.H. It is a very small species (forewing 4.8–5.4 mm) with heavy, clouded dusting and much brown along the costal margin, but no really distinguishing characteristics of color and pattern. The ♂ genitalia (Fig. 7) are very distinctive, the exceedingly long, slender uncus and tegumen and the very large, subterminally swollen process of the costa being characteristic.

Microcrambus kimballi, n. sp.

Forewing length 4.4–5.8 mm. Labial palpi white, somewhat shaded ventrally with brown. Head and thorax white, with some scattering of brown scales. Forewing with costal edge broadly pale brownish to beyond middle. M.-p. line (two thin dark lines narrowly separated by whitish) strongly diagonal at costa, running dorso-distad out to an acute point beyond cell nearly reaching or, in extreme specimens, reaching, s.t. line by a long streak; thence, especially its outer dark line, running dorso-basad to about the middle of the dorsal margin. S.t. line (two thin dark lines narrowly separated by whitish) from costa preapically; thence, internally crenate between veins, almost straight to tornus; at tornus its inner dark line runs sharply basad a short distance to dorsal margin. Apex with a diffuse dark patch. Terminal space from subapically to tornus white, narrowing dorsally due to curve of wing margin, with black intervenous dots along margin in cells R_5–Cu_{1b}. Indications in some specimens of a dark terminal line below apex. A dark line, quite broad and diffuse, on dorsal margin at about 1/4, running costo-distad up to cell. An irregular scattering of dark scales in nearly all of the white areas. Fringes pale brown, with a dull sheen. Hindwing dirty, brownish white with a faint, darker terminal line and a faint dark line in fringe.

MALE GENITALIA (Fig. 6): Tegumen broad, well sclerotized, shorter cephalo-caudally than dorso-ventrally. Uncus long, slender, very slightly flattened, with a minute terminal ventrad hook, very sparsely clad with long, thin setae. Gnathos long, slender, shorter and thinner than uncus, very slightly curved ventrad, with a minute, terminal ventrad hook. Anellus forming a well sclerotized, caudad projecting hood dorsad of and around aedeagus, and a similar, smaller, cephalad projecting bulge ventrad of aedeagus. Vinculum more or less quadrangular in lateral aspect, its margins narrowly thickened. Pseudosaccus large and long, extending nearly half its length cephalad of cephalic margin of vinculum. Costa of valva long, well sclerotized, with a narrowly thickened ventral margin; its free process well sclerotized, long and thickened, with a rounded, setiferous edge, projecting almost straight dorsad and, terminally, slightly cephalad. Cucullus of valva long, slender, tapering to a blunt point, running dorso-caudad, with a fairly heavy brush of thin setae on its mesal surface. Sacculus of valva long, broad, tapering to a small, flat, dorso-mesad curved, free process near ventral margin of valva. Aedeagus large and thick, slightly longer than valva, with a broad, rounded coecum penis, a small, terminal ventral spine, and 2 large, heavily sclerotized, curved cornuti, the more distal one slightly longer and thicker than the more basal one.

TYPE MATERIAL: Holotype ♂, Homestead, Fla., Apr. 16, 1959, leg. D. O. Wolfenbarger, ex coll. C. P. Kimball, genitalia praep. 19 Nov. 1965, A. B. Klots, in A.M.N.H. Allotype ♀, Archbold Biological Station, nr. Lake Placid, Highlands Co., Fla., 17–31 July, 1948, leg. A. B. Klots, genitalia praep. 8 Nov., 1965, #1, A. B. Klots, in A.M.N.H. 2 ♂ paratypes, Homestead, Fla., leg. D. O. Wolfenbarger, ex coll. C. P. Kimball, Nov. 13, 1958 and March 6, 1959, both in A.M.N.H. Paratype ♂, Archbold Biological Station, Highlands Co., Fla., Feb. 17, 1963, leg. S. W. Frost, ex coll. C. P. Kimball, in A.M.N.H. Paratype ♂, Plummers I., Md., Sept. 6, 1903, leg. Aug. Busck, Slide 150, Feb.

10, 1930, Geo. G. Ainslie, in U.S.N.M. Paratype ♂, Schriever, La., June 17, 1917, Cornell U., Lot 542, Sub. 14, in C.U.; this specimen is the ♂ paratype of *Crambus immunellus minor* Forbes, 1920, as discussed above. Paratype ♀, Oak Station, Alleghany Co., Pa., Sept. 8, 1907, leg. Fred Marloff, Slide 152, Feb. 10, 1930, Geo. G. Ainslie, in U.S.N.M.

M. **kimballi** is named for Mr. Charles P. Kimball of West Barnstable, Mass. and Sarasota, Fla. in appreciation of his contributions to our knowledge of North American Lepidoptera, particularly those of Florida.

Microcrambus matheri, n. sp.

Forewing length 6.3 mm (Florida)–6.6 mm (North Carolina). Labial palpi, head and thorax white, considerably speckled with dark scales. Forewing sordid white, crisply speckled with fuscous scales. Costal edge clouded with brown, sometimes heavily, from base to slightly beyond middle. This is followed on costa by a diagonal white mark and a narrow, diagonal dark line (the m.-p. line) the latter running diagonally dorso-distad to end of cell and noticeably clear-cut. Area in disc of wing speckled with fuscous scales which stand out crisply and clearly, not forming a diffuse clouding. S.t. line narrow, distinct, clearly consisting of two thin dark lines enclosing a narrow white one, the outer dark line running from the apical triangle, the inner one leaving costa at an acute angle, then curving gently and evenly beyond cell and running straight to tornus, where it curves shortly basad on dorsal margin. Terminal space white, more or less dotted with fuscous scales, with terminal, intervenous, fuscous dots in cells R_4–Cu_{1b} inclusive. Sometimes a very thin, indistinct, dark terminal line. Fringe dull brownish, more or less shining. M.-p. line indicated on dorsal margin by a dark line curving disto-costad; and basad of this a similar, smaller dark mark curving likewise. Hindwing very pale brownish-white (perhaps darker in ♀♀) with an indistinct, dark terminal line; fringe brownish tinged white.

MALE GENITALIA (Fig. 8): Tegumen well sclerotized, broad dorsally, tapering ventro-laterally to rounded ends. Dorsal part of anellus with no sclerotization. Uncus long and heavy, considerably flattened but rounded dorsally, slightly flanged laterally, slightly spatulate. Gnathos long and slender, terminally slightly curved ventrad, shorter than uncus. Vinculum large, its cephalic and caudal margins diagonal and subparallel. Pseudosaccus small, about half as long as midventral width of vinculum. Ventral part of anellus forming a well sclerotized, cephalad bulge supporting aedeagus from beneath. Costa of valva long and well sclerotized, with a narrow, sclerotized ridge along its ventral, mesal edge, and a very long free process, more or less flattened and terminally rounded, that extends dorso-caudad and somewhat mesad. Cucullus long and slender, lightly setose, running strongly dorsad and tapering strongly. Sacculus lightly sclerotized and indistinct, with no process. Aedeagus long and slender, very weakly sclerotized dorsally, with a large coecum penis that is strongly inclined ventrad; one extremely long, thin, straight cornutus and a linear series of 18–24 very small ones. When the vesica is contracted within the penis the long cornutus lies basad of the series of small ones; but when the vesica is extruded these relative positions are reversed.

TYPE MATERIAL: Holotype ♂, Maxton, Robeson Co., N. C., 20 Sept. 1944, leg. A. B. Klots, genitalia praep. 10 Aug. 1965, A. B. Klots. 25 ♂ paratypes, same locality, 31 Aug., 6, 15, 20 & 22 Sept., 1944, leg. A. B. Klots. 4 ♂ paratypes Weeki Watchee Springs, Hernando Co., Fla., leg. J. F. May, 3 dated

Aug., 1954, one dated June 15, 1960. Holotypes and paratypes in A.M.N.H.; paratypes will be distributed to other museums. The North Carolina material was taken in a mosquito light trap on a highly disturbed Army Air Base with much artificially maintained grassland.

DISCUSSION: In addition to the type series there are in the A.M.N.H. 3 ♀♀ from Cassadaga, Volusia Co., Fla., dated 3 & 16 July, 1965 and 15 Sept. 1962, all leg. S. V. Fuller, at blacklight. In pattern and general appearance they seem to be **matheri**, and in genitalia they are quite different from any other known species. However, they are considerably larger than the Florida ♂♂ and have very dark brown hindwings, so that their identity is questionable. *M.* **matheri** is named for Bryant Mather of Jackson, Miss. in appreciation of his outstanding contributions to our knowledge of Mississippi Lepidoptera.

Microcrambus croesus Bleszynski

In addition to the species discussed above, another is known, from females only, from Florida and Texas. It is almost certainly the very recently published *M. croesus* Bleszynski (1967, p. 88, figs. 60, 76 & pl. 14, fig. 7) with which it agrees well in color, pattern and female genitalia. The ♂ type and a paratype ♀ of *M. croesus*, from Jalapa, V. C., Mexico 4680 ft., Sept., leg. C. C. Hoffmann, are in the A.M.N.H. The male genitalia of *croesus* are extremely distinctive, having a long, flattened uncus, a very weak gnathos, an enormous flat, spatulate, terminally almost circular process of the costa and a series of very small cornuti. The female, probably correctly associated with this male, has a long, slender, slightly ventrad curved, strongly protruding process at the ostium that is terminally rounded and has a short, sharp spine at each caudo-lateral angle. In color and pattern *croesus* falls, perhaps closest to *M. polingi*. The North American material at hand consists of ♀♀ as follows: Texas, Belfrage, in U.S.N.M.; Kerrville, Texas, Oct. '09, in U.S.N.M.; Tex., Oct., in A.M.N.H.; "Col.," Cornell U. Lot 139, Sub 5, in C.U. [Colorado seems an impossible locality for this]; and Sarasota Co., Fla., May 24, 1946, leg. C. P. Kimball, in A.M.N.H. However, until more positive association of males and females is possible, or until males from North America are known, it is best to record *croesus* as only probably North American.

Key to the Species by Male Genitalia

1. Free process of costa of valva longer than the part of the costa basad of it 2
1a. Free process of costa shorter than the part of the costa basad of it 4
2. Costal process non-tapering, terminally rounded; a short, heavily sclerotized, free process arising from distal end of sacculus (Fig. 3) .... *polingi*
2a. Costal process slender, tapering and pointed; sacculus with no free process 3
3. Aedeagus with no cornuti; uncus extremely thin, tapering to a very slender, sharp point; costal process narrow postbasally, greatly thickened submesally, then considerably thinner almost to tip, which is abruptly narrowed to a thin, curved point (Fig. 7) .... *discludellus*

3a. Aedeagus with one very long cornutus and 18 or more very short ones; uncus thicker, somewhat flattened and broadened subterminally; costal process gradually and evenly diminishing to tip (Fig. 8) .... **matheri**

4\. Aedeagus without cornuti 5

4a. Aedeagus with cornuti 7

5\. Uncus very wide, flat and spatulate; free costal process longer than dorso-ventral width of base of cucullus; penis with a mid-ventral, terminal filum that bears a ventral, subterminal blunt tooth (Fig. 4) .... *elegans*

5a. Uncus not greatly flattened, tapering gradually; free costal process small, shorter than dorso-ventral width of base of cucullus; penis terminating in a slender, tapering filum, or without filum 6

6\. Gnathos much thinner than uncus; costal process of valva extremely small, scarcely projecting dorsad of dorsal margin of valva; vinculum greatly reduced; pseudosaccus short but definite; penis greatly enlarged dorsally at about middle, distad of that tapering strongly and open dorsally for emergence of vesica, ending in a long, gradually tapering, pointed, mid-ventral filum (Fig. 2) .... *biguttellus*

6a. Gnathos as thick (from lateral view) as uncus; costal process of valva longer, protruding dorsad from dorsal margin of valva at least half its dorso-ventral length; vinculum not greatly reduced; pseudosaccus almost absent; penis normal, subcylindrical, with no terminal filum .... *pusionellus*

7\. Free process of costa of valva very slender, flattened, running dorsad and caudad and terminally bent mesad; vinculum narrow, much longer dorso-ventrally then cephalo-caudally; pseudosaccus short, scarcely protruding cephalad of vinculum (Fig. 1) .... **copelandi**

7a. Free process of costa flat, projecting dorsad with its caudal edge directed strongly mesad; vinculum broad, nearly as wide cephalo-caudally as long dorso-ventrally; pseudosaccus very long, projecting far cephalad of cephalic margin of vinculum 7

8\. Aedeagus with 8 or more very small cornuti; a small, projecting process very near, or attached to, ventro-caudal angle of costal process of valva (Fig. 5) .... *minor*

8a. Aedeagus with 2 very long cornuti; short, projecting process from caudal end of sacculus well separated from ventro-caudal angle of costal process (Fig. 6) .... **kimballi**

Key to the Species by Color and Pattern

1\. Ground color clear, satiny white, almost free of dark dusting; fringe shining iridescent beyond cells M_3, Cu_{1a} and Cu_{1b}, elsewhere dull; terminal dots when present plain only in cells M_3, Cu_{1a} and Cu_{1b}; m.-p. and s.t. lines chiefly yellow in costal part of wing, usually darker, browner and wider dorsally 2

1a. Ground color duller whitish, almost always dusted, often heavily, with dark scales; terminal dots when present not limited to cells M_3, Cu_{1a} and Cu_{1b} and fringe beyond these cells not iridescent or differentiated from fringe elsewhere; m.-p. and s.t. lines dark and infuscated, often obscured by dark dusting and clouding 4

2\. S.t. line acutely angled distad beyond end of cell (in cells M_1 and M_2), its outer element nearly reaching outer margin .... **copelandi**

2a. S.t. line gently and obtusely curved distad beyond end of cell 3

3\. S.t. line yellowish brown, clearly double, with an irregular offset where it crosses fold (in cell Cu_{1b}); a prominent, fuscous, angled spot on dorsal end of m.-p. line at about middle of dorsal margin and a smaller, but prominent, angled, fuscous spot, separated from the dorsal one, below cell near base of Cu_{1b}; m.-p. line angled at end of discal cell .... (*pusionellus*)

3a. S.t. and m.-p. lines yellow, often indistinct; s.t. line double only from costa to about M_3, dorsad of that its outer dark line missing, its inner line running smoothly to dorsal margin; both spots on m.-p. line dorsad of cell small and well separated from each other, the more dorsal one the larger; m.-p. line curved beyond end of discal cell .... *biguttellus*

4. A thin, distinct, dark terminal line from apex to tornus, but no marginal, intervenous dark spots; Arizona & Mexico .... *polingi*

4a. Terminal line, if indicated at all, diffuse and indistinct; a series of marginal, intervenous dark dots or short dashes, when complete in cells R_4–Cu_{1b} 5

5. No apical-subapical dark patch, costa white both distad and basad of distal dark line of s.t. line; this line only slightly thickened at costal margin, leaving costa at about 90°, running with only gentle curvature to tornus, clearly delimited basad for its whole length by white central line of s.t. line; distal part of pointed, white discal streak (basad of m.-p. line) usually distinct, often extending to dorsal margin; area basad of this considerably clouded and dusted with dark scales; dark markings warm, orange-brown to reddish-brown .... *elegans*

5a. Apical area with considerable dark dusting, usually forming a patch obscuring or fused with distal dark line of s.t. line at costa, and narrowing whitish terminal space apically; distal dark line of s.t. line often indistinct because of narrowing or filling in of central white line of s.t. line by dark scales; discal area seldom with much evidence of pointed, white streak, even distally, due to dark dusting and or indistinctness of distal dark line of m.-p. line 6

6. S.t. line with all elements distinct and clear-cut (2 thin dark lines separated by a thin whitish line), running dorso-distad from costa, gently curved beyond end of cell, thence only slightly curved to tornus .... **matheri**

6a. S.t. line more indistinct and less clear-cut, due to irregularities and more or less dentate extensions basad of its basal dark line, especially along veins M_3 and Cu_{1b}, to a partial filling in by dark scales of its whitish central line, and to general dark dusting of discal area 7

7. Disc of wing, especially distad of discal cell, white and relatively undusted; more distal dark mark on dorsal margin (dorsal part of m.-p. line) usually a large, almost black and rectangular patch; markings tending to greater contrast with white ground color; Ontario to Florida and Gulf Coast .... *minor*

7a. Discal area tending to cloudiness and fuscous dusting, sometimes very dense; more distal dark mark on dorsal margin usually smaller and narrower, often merely a curving line; markings tending to indistinctness; extreme South and tropical, rarely northern 8

8. Head, palpi and thorax white, more or less speckled with dark scales; distal line of s.t. line (as well as basal line) more or less crenate, sometimes strongly so; general discal area seldom heavily dark dusted, outline of white discal streak sometimes quite evident .... **kimballi**

8a. Head, palpi and thorax darker, with dark scales predominant; distal line of s.t. line straighter and not crenate, although basal line is usually crenate with dentate points extending basad; general discal area thickly dusted with dark scales, sometimes so as to obliterate all white areas .... *discludellus*

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The Proper Name for *Lycaena epixanthe* from Newfoundland and the Maritime Provinces

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Abstract: Two names, *amicetus* Scudder and *phaedrus* Hall have been used for the subspecies of Lycaena *epixanthe* Bois. from Newfoundland and the Maritime Provinces of Canada. Scudder's *amicetus* was published as an mss. name of Boisduval in a synonymy in 1876. No description or figure was associated with the name until Holland used it in 1931. Therefore, until that data *amicetus* was a *nomen nudum* until *amicetus* Holland 1931 was published. Hall's name (1924) should be used.

I was asked recently to preview a manuscript by Richard Holland about the butterflies he had collected in western Newfoundland. One of the statements that he made piqued my curiosity. He stated that the *epixanthe* he had collected were quite unlike Holland's (1931) figure of *amicetus* Scudder, reputedly a Newfoundland insect, but were the same as Hall's (1924) *phaedrus*. I turned to dos Passos's (1965) *Synonymic List* to see how he had treated the species and to get the years of publication for *phaedrus* and *amicetus*. There both names are treated as subspecies of *epixanthe* Boisduval & LeConte [1833].

The situation, so far as *phaedrus* Hall 1924 is concerned, is clear cut. Hall described a form of *epixanthe* the under side of the hind wings of which is pearly grey. His very brief diagnosis reads "Upper surface of wings much like *epixanthe*. Under surface lighter color, especially that of the hind wing which is pearly grey, differing from that of *epixanthe* in which the color has an ochreous tinge. The spots on the hind wing are smaller and the marginal orange band near the anal angle is much reduced in size." The holotype is a male from Dublin Shore, Lunenburg Co., Nova Scotia. Two male paratypes complete the type series, one from the type locality and the other from Crabbes, southwestern Newfoundland.

The situation for the name *amicetus* is extremely confusing. The root of the confusion is that Boisduval, probably in the 1840's, proposed three names for "Coppers" but did not publish them. These names were picked up by Doubleday and published in his list of Lepidoptera in the British Museum in 1847. Doubleday did not describe these insects, only listed the names and noted the number of specimens in the British Museum along with their sources. In other words, he published three *nomina nuda*. The three names are these: *hypoxanthe*, *anthelle* and *amicetus* all published by Doubleday as Boisduval manuscript names. The next indicative use of these names occurs in Kirby's (1871) catalogue. Kirby ignored *anthelle* and *amicetus* but included *hypoxanthe*. There he followed *epixanthe* with *Lycaena hypoxanthe* Kirby 1862, questionably from "Ukraine ?" and based upon Boisduval's manuscript name.

Scudder entered the fray in 1876 by publishing *amicetus* under *epixanthe* as a Boisduval manuscript name, and referred to Doubleday's use. He also published *anthelle* under *dorcas* as a Boisduval manuscript name, citing Doubleday's use in 1847. Scudder did not include *hypoxanthe*, apparently following Kirby's lead (1862, 1871). Note that Scudder, like Doubleday, published *nomina nuda*. He gave no indication of the meanings of the names other than assignment to known taxa. In this he took one step beyond Doubleday who published each name as an individual unassigned taxon.

According to the current Code (1964, (Art. 11(d)), either *anthelle* or *amicetus* are to be considered valid names only if previous to 1961 they were used as names with an indication of their characters and the original author and date, Doubleday, 1847. Article 16 (b) specifically states what does not constitute "an indication" and includes in subparagraph (i) type-locality—which could be the interpretation of Doubleday's inclusion of a locality from which he had seen a specimen, and (ii) in synonymy—which applies to Scudder's use of the names. Thus through 1876, Scudder's use of the names, we have no nomenclatorially valid application of either *anthelle* or *amicetus*, and they are *nomina nuda*.

The next step in the solution to the problem is found in Barnes and Benjamin's (1926) article on changes to be made in their check-list of the same year. On page 95 they treat *anthelle*, making it a synonym of *dorcas*. They stated "Boisduval manuscript name first listed by Doubleday who merely gives 'Polommatus anthelle Boisd. MSS. a–d. Martin's Falls, Albany River, Hudson's Bay. Presented by G. Barneston, Esq.' The first indication we find rendering the name available is that of Scudder, 1876. The Barnes Collection contains the Boisduval manuscript type." They were incorrect when they stated that Scudder's use of the name made it available. With the publication of this note by Barnes and Benjamin the name *anthelle* still was *nominum nudum*.

On pages 95–96, Barnes and Benjamin assigned *hypoxanthe* Boisduval manuscript and *hypoxanthe* Kirby, 1862, to *epixanthe* on the basis of three specimens from Boisduval's collection that were considered by Hofer as the types of the name, one of which carries a Boisduval manuscript label reading "Hypoxanthe Boisd. Canada."

Mr. William D. Field of the U.S. National Museum very kindly sent me Xerox reproductions of the pertinent pages from Kirby's *Manual of European Butterflies*. Examination of figures 11—upper and under sides of his *hypoxanthe* —produced a surprise. The butterfly figured does not look like a Copper but like a female Blue belonging to the genus *Lycaeides*. His brief original description reads "C. Hypoxanthe. 1″ 1‴—1″ 3‴. ♂ brown, spotted with black, and with faint traces of a marginal orange band. ♀ (fig. 11) with a much more distinct copper band enclosing black spots on h.-w.; f.-w. slightly tinged with copper in the centre. H.-w. in both sexes rounded, not emarginate. U.s. yellow with marginal copper bands; inner margin of f.w. in ♂, and the greater portion of the wing in ♀, copper.

"Larva unknown.

"A pair of this species exists in the British Museum enumerated in the catalogue of Lycaenidae as '*Polyommatus Hypoxanthe* Boisd. MSS.,' and stated to come from Polish Ukraine. I have carefully compared them with *C. Dorilis*; but, though closely allied, I cannot consider them identical with that species" (pp. 90–91).

The best match that I can make for Kirby's rather crude woodcuts and brief description is *Heodes tityrus* Poda (1761), which antedates *dorilis* Hufnagel (1766), a species rather generally distributed in one form or another in the Palearctic region. Without Polish and Ukrainian specimens for comparison nothing can be stated with conviction about the usefulness of Kirby's name. There is no question about dropping *hypoxanthe* Kirby from the list of North American butterflies. It is a Palearctic Copper. Thus *hypoxanthe* Kirby is a valid name but incorrectly considered in the past as a junior synonym of *epixanthe*.

On page 96, Barnes and Benjamin treat *amicetus*. They stated, "A Boisduval manuscript name listed by Doubleday who merely gives, 'Polyommatus amicetus, Boid. MSS. a-c Newfoundland. Presented by W. St. John, Esq.' The first indication we find which renders the name available is that published by Scudder, 1876. The Boisduval manuscript type appears to have been lost, so that all we can do is to accept the comparison with it made by Doubleday, and give the name of (sic) [to] the minor Newfoundland race of *epixanthe*, with priority over *phaedrus* (Hall)." Again their statement about the availability of the name is incorrect and *amicetus* retains its status as *nominum nudum*, and *phaedrus* Hall cannot be sunk as a synonym of *amicetus*.

Holland (1931) followed the lead of Barnes and Benjamin and in the revised edition of his Butterfly Book described (p. 250) and figured "(15) *Chrysophanus amicetus* Scudder (Boisd. MS) Pl. XXVIII, fig. 28 ♂; Pl. LXIV, fig. 41 ♂; fig. 42 ♀, under side (The Newfoundland Copper)." This action of Holland made the name *amicetus* valid. However, since he did not credit the name to Doubleday, 1847, according to Article 11 (d), the name must stand as *amicetus* Holland, 1931. Instead of *phaedrus* Hall, 1924, being the junior name, *amicetus* Holland is junior to *phaedrus* Hall.

Although the foregoing seems to settle the nomenclatorial position of *amicetus*, Klots (1936) added further clarification of the taxonomic situation. After noting (p. 165) the general confusion in the literature about *dorcas* and *epixanthe* and pointing out (p. 166) that *anthelle* undoubtedly is a manuscript synonym of *dorcas* on the basis of Boisduval's manuscript type, he notes that the situation regarding *amicetus* is not wholly clear. "Both of these Boisduval MSS. names [*anthelle* and *amicetus*] were listed by Doubleday . . . but as *nomina nuda*, ... Perhaps this is as well, for he very evidently had reversed Boisduval's application of them. This is shown by the fact that three of the four specimens which he mentioned under the designation 'Polyommatus anthelle Boisduval MS.' are still in the British Museum, and are certainly *epixanthe* according to Mr. N. D. Riley, who very kindly examined them for me. Presumably Doubleday's other series, which he designated as "amicetus" were *dorcas*; these specimens have been lost."

Since there fly on Newfoundland only two *Lycaena*, *epixanthe* and *dorcas*, and it appears that Doubleday applied *anthelle* Boisd. Mss., to an *epixanthe* form from the Albany River region of Hudson's Bay, it is reasonable to consider that his *amicetus* from Newfoundland represented the other species, *dorcas*. Thus Scudder's reference of the name *amicetus* to *epixanthe* upon the authority of Doubleday is open to serious question. It also questions Holland's reference of the name *amicetus* for a form of *epixanthe* to Scudder. What is certain is that Holland's name *amicetus*, the only valid use of the name, postdates Hall's use of *phaedrus* for the same taxon. No earlier use of the name *amicetus* is nomenclatorially valid and Holland's use cannot claim earlier date than 1931.

The original description of *amicetus* Holland (1931) does not contain specific designation of either a type or type locality. This is understandable since Holland believed that he was using a name established by Scudder. To remedy this lack I wrote to Mr. Harry K. Clench at the Carnegie Museum about the situation. He examined the material used by Holland and reached a conclusion about it which he communicated to me by letter.

There are three figures in Holland (1931: pl. 28, f. 28; pl. 64, ff. 41, 42) that represent *amicetus*. All three of them are from Newfoundland and certainly those on pl. 64 are from the Theodore L. Mead Collection. Mr. Clench selected the male figured as 41 on plate 64 to be the lectotype of *amicetus* Holland 1931.

The selection of a type locality more restricted than "Newfoundland" is based upon letters from W. H. Edwards to Henry Edwards and from Theodore L. Mead to W. H. Edwards. From the letters to Henry Edwards we know that Mead left for Newfoundland late in July 1880. From a letter written by Mead to W. H. Edwards after his return (see W. H. Edwards, 1880, "Papilio VIIIB") we learn that Mead had stayed in Newfoundland for three weeks and in that time had collected extensively in the region around St. John. Thus the types of *amicetus* Holland were taken late in July or early in August, 1880, on the Avalon Peninsula, S. E. Newfoundland, in the general vicinity of St. John.

Dr. Cyril F. dos Passos and I have corresponded voluminously about this problem and we both agree that *amicetus* Holland 1931 is a valid name. Whether it is available or not is problematic. We agree that the proper name for the relative of *Lycaena epixanthe* Boisduval & LeConte found in the maritime provinces and Newfoundland is *phaedrus* Hall 1924.

The check-list arrangement for *epixanthe* thus becomes:

442. epixanthe (Boisduval & LeConte), 1833
    a e. epixanthe (Boisduval & LeConte), 1833
    b e. phaedrus (Hall), 1924
        anthelle (Doubleday), 1847, *nom. nud.*
        amicetus (Scudder nec Doubleday), 1876, *nom. nud.*
        amicetus (Holland), 1931.
    c e. michiganensis (Rawson), 1948.

The name *amicetus* (Doubleday), 1847, must be transferred to *dorcas* Kirby, 1837.

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Changes in Reducing Carbohydrates and Trehalose During Development of Eggs from Young and Old *Tenebrio molitor* L.

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Abstract: Reducing compounds, expressed as glucose, increased in weight in both groups. In eggs from young mealworms, the weights were 0.13, 0.15, and 0.18 mg. on 0, 1, and 2 days, respectively. Corresponding values for eggs of old beetles were 0.13, 0.15, and 0.19 mg. A reduction in trehalose occurred from 0.36 on 0, to 0.29 on 1, and to 0.22 mg. on 2 day eggs of young beetles, and from 0.37, to 0.29 and to 0.23 mg. on corresponding days in those of old beetles. Trehalose may be converted to glucose for use by the developing embryo. Neither reducing carbohydrates nor trehalose can account for differences in rates of larval growth between offspring of young and old beetles.

Ludwig (1956) reported that the offspring produced by old adults of the yellow mealworm, *Tenebrio molitor*, have a shorter duration of the larval stage and that the adults do not live as long as those produced by young parents. Tracey (1958) observed that these larvae grow more rapidly at an earlier age than those from young parents. In an effort to trace these differences in the two sets of offspring, Ludwig, Fiore and Jones (1962) compared some of their physiological activities. The offspring of old adults have a higher alpha-glycerol phosphatase activity during the greater part of their adult life. Since these phosphatases are concerned with the intermediary metabolism of foods, particularly of carbohydrates and fats, it was postulated that the difference in the rate of growth may be traced to a difference of metabolites stored in the egg.

Ludwig and Ramazzotto (1965) studied changes in glycogen and fats during embryogenesis of this insect and found that glycogen is the main source of energy. A loss of 2.42 mg./100 eggs, representing 51.5% of the available supply, occurred during the 5 days of embryonic development at 30°C. During this time, the loss of free fat was only 0.42 mg./100 eggs, representing 10.3% of the initial amount. A comparison of the initial content of glycogen between the eggs of the two parental age groups showed nearly twice the amount in those from young parents (unpublished data). Recent studies have demonstrated that trehalose constitutes a major carbohydrate component of insect hemolymph (Wyatt and Kalf, 1956). Kilby (1963) discusses the formation and storage of this disaccharide in the insect fat body. It appears to be a form in which reserve carbohydrate is stored in insects. Since no information is available concerning the trehalose content of insect eggs, it is possible that its utilization may account for differences in the life cycle of insects from the different parental age groups.

The present experiments were undertaken to investigate the possible role of carbohydrates in the nutrition of *Tenebrio molitor* eggs. A comparison was made of reducing sugars and of trehalose in the eggs from the two parental age groups.

MATERIALS AND METHODS

Newly emerged beetles were collected from stock cultures and placed in labelled dishes containing chick growing mash, at a temperature of 25°C. Moisture was supplied by covering each culture with a damp cloth, which was moistened twice a week. At the end of 1 week, the beetles were transferred to other dishes containing white flour, and kept at the same temperature as the stock cultures. A vial of water, plugged with moist cotton, provided moisture. Eggs were collected daily by sifting the flour. They constituted the eggs from young parents. Since parental age effects first appear between the fourth and sixth weeks following emergence (Ludwig and Fiore, 1960), the beetles were returned to the dishes of chick growing mash when they were 4 weeks old. Six weeks after emergence, they were again placed in flour and the eggs collected. This group provided eggs from old parents. This procedure was followed with each batch of newly emerged adults. The eggs were incubated at a constant temperature of 30°C., and determinations carried out on eggs 0 to 5 days old.

Glucose determinations were made on groups of 100 eggs from each parental age group by the method of Hagedorn and Jensen (Hawk, Oser and Summerson, 1954).

Trehalose determinations were made on eggs from both parental age groups by the method of paper chromatography (Evans and Dethier, 1957). The spots were separated by the method of Gray and Fraenkel (1954). The paper was developed overnight by continuous ascending chromatography employing *n*-butanol-ethanol-acetone-water (5:4:3:2 v/v). The spots were developed by the silver method of Trevelyan, Proctor and Harrison (1950). Readings of optical density were made on a photovolt densitometer before the strips were completely dry. A standardization graph (Figure 1) was constructed as follows. A row of samples containing 0.006 to 0.01 mg. of trehalose was applied to the paper and developed as described above. The readings of 10 chromatograms were averaged and the optical densities plotted against concentration by the method of least squares. When extended, the line cuts the x-axis at 0.0031 because of the residual color left on the chromatogram even after bleaching with 6 N ammonium hydroxide and washing in running water. The residual color makes it impossible for concentrations lower than 0.0031 mg. to be determined by the densitometer.

OBSERVATIONS

The changes in reducing compounds, expressed as glucose, are shown in Table 1. The weight of glucose increased from an average of 0.13 per 100 eggs for 0 day, to 0.15 for 1 and to 0.18 mg. for 2 day, in eggs from young parents. The last 2 values constitute statistically significant increases from 0 day. (Two means are statistically different if they possess a "t" value of 2 or more). The overall increase from 0.13 on 0 to 0.21 mg. on 5 day eggs is also significant.

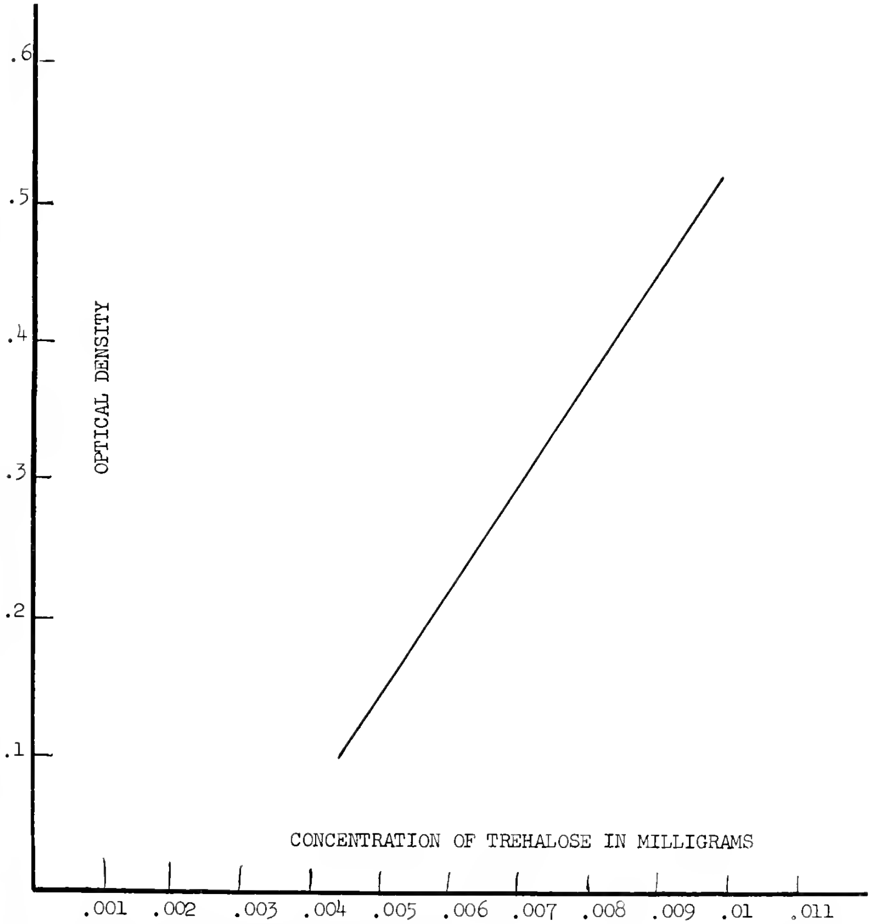

FIG. 1. Standardization graph showing relation between different concentrations of trehalose and optical density.

Comparable increases were observed from 0 to 5 day eggs from old beetles, but there was a decrease from 2 to 3 day eggs which was significant in the latter group. A day to day comparison of glucose in the eggs of young with those of old parents showed no significant differences.

The changes in trehalose content of the eggs from the 2 parental age groups are given in Table 2. The weight of trehalose showed a marked decrease during the first 2 days. It decreased from 0.36 mg. for 0 day, to 0.29 for 1 and to 0.22 for 2 day, in the eggs of young mealworms. This constitutes a significant decrease. No other significant differences were noted during the remainder of embryogenesis. Corresponding values for the eggs of old beetles were 0.37, 0.29,

Table 1. Changes in weight of glucose during embryonic development. Weights are given per 100 eggs with their standard errors. Each value is an average of 10 determinations.

Eggs from young beetles			Eggs from old beetles		
Age of eggs	Wt. of glucose (mg.)	"t" value	Age of eggs	Wt. of glucose (mg.)	"t" value
0 day	0.13 ± 0.008		0 day	0.13 ± 0.005	
1 day	0.15 ± 0.007	2.18	1 day	0.15 ± 0.007	2.27
2 day	0.18 ± 0.014	1.76	2 day	0.19 ± 0.006	5.29
3 day	0.18 ± 0.011	0.17	3 day	0.17 ± 0.008	2.26
4 day	0.18 ± 0.010	0.07	4 day	0.20 ± 0.006	3.23
5 day	0.21 ± 0.020	1.18	5 day	0.21 ± 0.012	0.74

and 0.23 mg., respectively. A comparison of trehalose content in eggs of the 2 groups shows a significant difference only in the 4 day eggs, where the values were 0.24 and 0.19 mg., respectively.

DISCUSSION

These experiments indicate that there are no important differences in the concentrations of reducing compounds or of trehalose between the eggs of young and old beetles. The increase in glucose during the first 2 days of embryonic development at 30°C. may be correlated with the decrease in trehalose. It appears that trehalose is converted to glucose and thus made available for metabolic activity.

Since the glycogen content is lower in the eggs of old than in those of young beetles, and the amounts of both trehalose and reducing compounds are almost identical, the metabolite which accounts for differences in rates of larval development may be of a nitrogenous nature. Kelly and Ludwig (1967) reported that approximately 24% of total nitrogen of mealworm eggs was converted from water soluble to insoluble nitrogen during the embryonic development of this insect. He also observed that almost 50% of this material was albumen which was converted to globulin, nucleoprotein and scleroprotein. These observations

Table 2. Changes in weight of trehalose during embryonic development. Weights are given per 100 eggs with their standard errors. Each value is an average of 10 determinations.

Eggs from young beetles			Eggs from old beetles		
Age of eggs	Wt. of trehalose (mg.)	"t" value	Age of eggs	Wt. of trehalose (mg.)	"t" value
0 day	0.36 ± 0.013		0 day	0.37 ± 0.022	
1 day	0.29 ± 0.029	2.41	1 day	0.29 ± 0.029	2.21
2 day	0.22 ± 0.014	2.00	2 day	0.23 ± 0.017	1.92
3 day	0.22 ± 0.013	0.21	3 day	0.24 ± 0.013	0.38
4 day	0.24 ± 0.016	0.78	4 day	0.19 ± 0.014	2.48
5 day	0.24 ± 0.023	0.14	5 day	0.22 ± 0.019	1.18

were made on eggs of recently emerged beetles. A comparable study on the nitrogenous content of eggs from old beetles may show important differences in the utilization of albumen and other nitrogenous fractions.

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Distributional Notes on *Metamasius* (Coleoptera: Curculionidae)

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Abstract: New information is presented on the distribution of six species of the neotropical weevil genus, *Metamasius*, subfamily Rhynchophorinae.

The records given below represent extensions of range or new localities of interest for species of this large genus of 101 species. The order of the species is the same as that of the recent revision of the genus (Vaurie, 1966 and 1967).

Species Group I

Metamasius fasciatus (Olivier) of subgroup *fasciatus*. Two specimens (dissected females of 16 mm.) in the Muséum National d'Historie Naturelle, Paris, extend the range of this species farther south. They are from Loja, in southwestern Ecuador (Abbé Gaujon, collector), whereas the dozen specimens examined previously were from Caracas, Venezuela, and from Panama and Costa Rica. The specimens from Ecuador differ by having the lower edge of the red of the elytra at about the middle of the elytra, not behind the middle, as stated in my key (1966, p. 243). The red elytral band is separated into two large irregular spots, each spot extending from the first to the sixth interval. The amount of color is variable in this species; some specimens being entirely black.

M. mosieri Barber of subgroup *fasciatus*. I have seen only seven specimens of this small, stout species which was described from southern Florida and Cuba, and found later in the Dominican Republic. A second specimen from Cuba, a female in the collection of the Zoologisches Museum, Berlin, was examined after publication of my revision. It is colored as in the type from Florida, rather than as in the paratype from Cuba.

M. cerasinus Vaurie of subgroup *canalipes*. This species was recorded from Panama, Trinidad, Venezuela, and French Guiana. I have now seen two males from Brazil, one without further locality at the British Museum (Natural History), and one from Serra da Neblina, Rio Tucano, Amazonas, south of the Rio Uaupes. The latter specimen was collected in April, 1965, by Dente, and is in the collection of the Departamento de Zoologia, São Paulo. In my key to the species (1966, p. 243) I used locality as one of the characters to separate this species from the very similar *canalipes* (Gyllenhal). The locality is no longer valid, however, as *canalipes* occurs also in Brazil. The two species can be separated on the color of the abdomen and of the apex of the elytra, as well as on the shape of the aedeagus.

M. tectus Vaurie of subgroup *hebetatus*. Surinam is still another country to add to the many countries where this species occurs (French and British Guiana, Brazil, Colombia, Ecuador, Peru, and Bolivia), as shown by a female from Anapaike, Rio Lawa, Marowijne District, collected by Boris Malkin in November, 1963.

Species Group III

M. ohausi (Günther) of subgroup *sanguinolentus*. Western Brazil should be added to Peru and Ecuador as part of the range of this species. A female from Benjamin Constant, Amazonas, collected by Parko in April, 1942, was sent to me recently by J. Becker of the Museu Nacional, Rio de Janeiro. This is the yellow phase with black borders which occurs, along with the black phase with red dots, also in Peru.

M. limulus Vaurie of subgroup *sanguinolentus*. A sixth specimen of this small, narrow species extends the range westward to the slopes of the Andes. It is from the Rio Coca, Ecuador, collected by L. Peña in May, 1965, and in the collection of Dr. E. L. Sleeper, Long Beach, California. The species was known previously from northwestern Brazil along the Amazon River from Banjamin Constant east to Belem.

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On the Authorship of the Generic Name *Tagalis* and the Invalidity of the Family-Group Name "Tagalidae" (Hemiptera: Reduviidae)[1]

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Abstract: On the authorship of the generic name *Tagalis* and the invalidity of the family-group name "Tagalidae" (Hemiptera, Reduviidae). *Tagalis* must be credited to Stål (1860); it is a *nomen nudum* in Dohrn (1859) and Baerensprung (1860). Tagalidae Dohrn (1860) was a *nomen nudum* when published, and has been a *nomen oblitum* ever since.

In his "Catalogus Hemipterorum," Anton Dohrn (1859, p. 47) listed 3 genera of "Reduvina" in a new family-group taxon to which he gave the name "Tagalidae." These were *Tagalis* Stål, *Acanthothorax* Costa, and *Saica* Amyot and Serville. *Acanthothorax* and *Saica* were available names in 1859, though the former was later found to be preoccupied and has been replaced by *Polytoxus* Spinola. *Tagalis*, however, had not yet been published by Stål when Dohrn's catalog appeared, and can not be credited to Stål in 1859 or any prior year. Indeed, Dohrn himself (1860, p. 254), in a later paper, cited this nominal taxon as "*Tagalis* Stål (mscr.)."

It is also impossible to credit *Tagalis* to Dohrn, 1859. Article 12 of the International Code of Zoological Nomenclature (1964) states that, to be available, " . . . a name published before 1931 must have been accompanied by a description, definition, or indication." Article 16(a)(v) of the Code determines that the word "indication" applies, in the present case, to "the citation, in combination with a new genus-group name, of one or more *available* specific names" (emphasis ours).

Dohrn (1859) listed 2 specific names under *Tagalis*, namely, *inornata* Stål and *sanguinea* Dohrn. Nowhere did he explain why these names (and [*Acanthothorax*] *Bowringi*, a few lines below) were printed in italic type; these are the only specific names so treated in the entire catalog. He may have intended to indicate that these were manuscript names, but he did not give similar treatment to the names of numerous emesine species that were not validly published until the following year (Dohrn 1860).

Stål's *Tagalis inornata* was not available until 1860, as we show below. *Tagalis sanguinea* Dohrn and *Acanthothorax Bowringi* Dohrn are strictly nomina nuda, as no such species were ever described by Dohrn. While he failed to include *Acanthothorax sanguineus* Costa in his catalog, there is

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[1] This contribution is a by-product of a project carried on by the senior author with aid from Grant no. GB-112 from the National Science Foundation.

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nothing there to indicate that he was transferring that species to *Tagalis* and erroneously wrote "*sanguinea* Dohrn" instead of "*sanguinea* Costa."

Therefore, neither of the 2 species-group names which Dohrn (1859) placed under *Tagalis* was available in the sense of Article 10 of the International Code adopted in 1958 by the International Congress of Zoology in London. This fact precludes crediting the genus-group name *Tagalis* to Dohrn, 1859.

The name "*Tagalis* Stål" appeared again the next year in another catalog, that of Baerensprung (1860). It is immaterial whether this work was published earlier or later than that of Stål (1860) which we discuss below. The only specific name listed by Baerensprung under *Tagalis* was "*sanguinea* Dohrn." This, as we have shown, was a nomen nudum and thus could not be available to validate the name *Tagalis* in Baerensprung, 1860.

One other contemporary reference to these taxa may well have been written in 1860, though it did not appear until the following year. Fieber (1861, p. 386), in the "Anhang" to his "Europäischen Hemiptera," wrote, "Die Gattung Tagalis Stăl mit der Art *T. sanguinea* Dohrn aus Italien, ist mir nur dem Namen nach bekannt." It is of interest to note, in passing, that *Acanthothorax* (or *Polytoxus*) *sanguineus* Costa was not mentioned by either Baerensprung of Fieber, and that while Fieber listed *Acanthothorax siculus* Costa at 2 places in his indices, neither the genus or the species was treated at the cited page or anywhere else in his work.

Tagalis was validly published by Stål (1860, p. 76) in Part I of his "Bidrag till Rio Janeiro-traktens Hemipter-fauna." There he described the genus (which was stated to be new) and its only included species, *T. inornata* Stăl. The year 1858 appears on the title page of this work, but only as part of the date (January 12, 1858) when the paper was submitted to the Royal Swedish Academy of Sciences. The complete volume of the Academy's "Handlingar" which contains this work by Stål is dated 1860 on its title page. Stăl himself, in later papers such as the 5 parts of his "Enumerato Hemipterorum" (1870–76), always gave 1860 as the publication date for the new taxa described in Part I of the "Rio Janeiro-traktens Hemipter-fauna." These included 28 new genera; *Tagalis* was the only one prematurely listed and erroneously assigned a European representative by Dohrn (1859).

Some subsequent authors (e.g., McAtee and Malloch 1925, 1933) have cited this work as dating from 1862. Kirkaldy (1909, p. xxxvi), although adopting 1860 as the publication date of Part I, noted that the separata of Stål's "Rio Janeiro-traktens Hemiptera-fauna" bore the date 1862 on their covers. This is true of the copy owned by one of us (R.F.H.). This copy, however, contains not only Part I, but also the separately paged Part II of Stål's work, and this latter part did appear in the Royal Swedish Academy's "Handlingar" in 1862. Thus the 1862 date on the separata apparently indicates the completion date of the entire work, and can not be used with reference to Part I. Article 21(d) of the International Code states, "If parts of a work were published on different days, the date of each is reckoned independently."

In view of the above, we hold that the genus-group name *Tagalis* must be credited to Stål, and must date from 1860.

As we noted above, Dohrn (1859) included *Tagalis* in a family-group taxon which he named "Tagalidae." If this name were valid, it would antedate by several months the subfamily name "Saicinae" which was first published as "Saicida" by Stål (1859, p. 328). Dohrn's preface is dated July 1859; Stål's new taxon was published on the very last page of Band 3 of the Berliner Entomologische Zeitschrift, presumably issued in December 1859.

"Tagalidae," however, can not be regarded as valid. Article 11(e) of the International Code says of family-group names, "A family-group name must, when first published, be based on the name **then valid** for a contained genus . . . " (emphasis ours). Since *Tagalis* was first validly published by Stål in 1860, it could not be used in 1859 as the basis for a family-group name. "Tagalidae" was not recognized by Baerensprung or by Fieber, and has not appeared even in synonymies in more recent publications. Dohrn himself (1860, p. 254) abandoned it in favor of Stål's designation, which he amended to "Saicidae." "Tagalidae" was a nomen nudum when it was published, and has been a nomen oblitum ever since.

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A New *Leptocentrus* (Homoptera: Membracidae) from the Congo

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Abstract: A new species of membracid *Leptocentrus* ***rufotibialis*** is described and figured.

LEPTOCENTRUS **rufotibialis** N. SP.

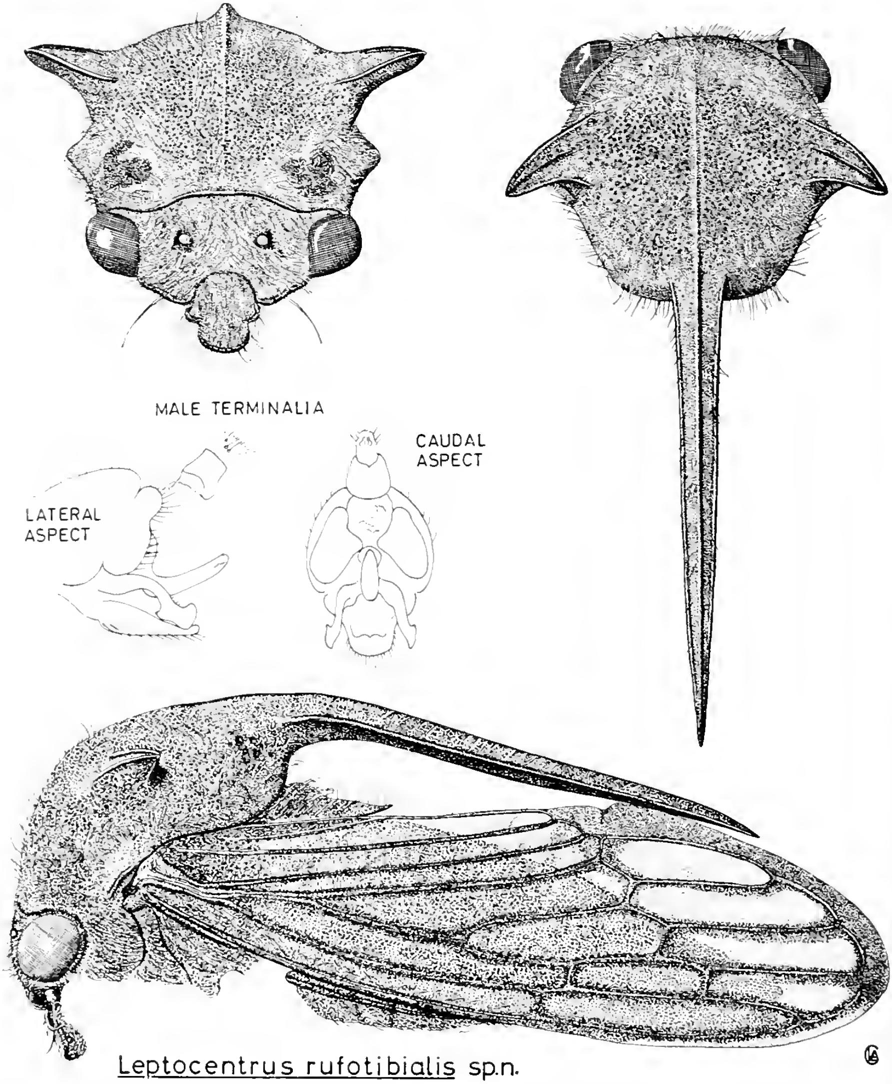
This species is immediately distinguishable from all known members of this genus by the bright red tibiae. Morphologically it appears to be closest to *basilewskyi* Capener, but the suprahumeral horns are more strongly backwardly directed.

FEMALE

HEAD: Vertical, vertex subplanate, weakly moulded, about one and a half times wider than long, black, punctate with rather long coppery-golden suberect pilosity, upper margin shallowly arcuate and sinuate, lower margins carinate, oblique and curved to frontoclypeus; eyes a little oblique, sordid succineous to blackish, ocelli rather large, succineous, closer to eyes than to each other and situated just above the centro-ocular line, frontoclypeus slightly declivous, a little longer than wide across lobes, black and longly pilose, extending about two thirds its length below lower margins of vertex, lobes prominently rounded with margins broadly carinate, extending about half distance between lower margins of vertex and tip, tip carinate and broadly rounded.

THORAX: Pronotum very dark brown to black, humeral angles and propleura paler, strongly punctate with suberect coppery-golden pilosity, median carina percurrent, humeral angles prominent and blunt, posterior angles rounded, posterior margin a little arcuate over base of scutellum, metopidium about vertical, convex, supraocular callosities black impunctate and rather large, disc convex and curving backwards into posterior process. Suprahumeral horns emerging below level of disc, strongly quadricarinate, about half as long as distance between their bases, extending beyond humeral angles, very slightly elevated above horizontal and obliquely backwardly curved, tips bluntly acute, dorsal surface bisected by a strong median carina, lateral surface longitudinally raised in middle, posterior surface apically hollowed and basally convex. Posterior process emerging from and slightly elevated above disc, ventrally vertically from posterior margin and curving backwards above scutellum, strongly tricarinate with sharp median dorsal carina and ventrally shallowly "V-shaped," dorsally longitudinally hollowed between lateral and median carina, tip acuminate and sharp, impinging on anal angles of tegmina and extending almost full length of fifth apical cell but not as far as tip of abdomen. Scutellum a little wider than long, triangular, basally medially convex, strongly punctate with erect golden pilosity, tip deeply roundedly emarginate, apices strongly acute. Tegmina about three times as long as wide, hyaline, basal seventh brownish coriaceous and punctate with suberect golden hairs, veins broad, dark brown margined with erect golden hairs, a brownish suffusion at anal angles, along apical limbus and margins of apical veins, limbus moderately broad, wider at anal angle, tip rounded. Sides of thorax rather densely pilose with golden hairs. Legs with tibiae bright red except for apex which is black, basal joints dark brown to black, tarsi brownish, apically black with tips of claws red, hind tarsi with apical joint about as long as first and second together, hind tibiae strongly spinose at tip.

Male similar to female. Figures of the terminalia are presented without comment as little material is available for comparison.



Leptocentrus rufotibialis sp.n.

MEASUREMENTS: Length frontal margin to tips tegmina ♂ 8.45–8.58 ♀ 9.90–10.16 to tip posterior process ♂ 7.26 ♀ 8.55–8.71; width across tips suprahumeral horns ♂ 3.83–4.09 ♀ 4.68–4.88, at humeral angles ♂ 3.37–3.50 ♀ 3.83–3.96, at eyes ♂ 2.97–3.17 ♀ 3.30–3.43 mm. Holotype ♀, allotype ♂, 9 ♂ and 3 ♀ paratypes, Lubutu, Congo, 29 Jan. 1915, coll. Lang & Chapin. HOLOTYPE: Allotype, 1♀, 5♂ paratypes in the American Museum of Natural History; 2♀, 4♂ paratypes in Nat. Coll. Insects, Pretoria.

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Alloperla (Chloroperlidae: Plecoptera) of the Northeast with a Key to Species

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Abstract: *Alloperla concolor* is removed from synonymy. New notes and figures for the recognition of *Alloperla idei* are presented. *A. onkos* is shown to have only a very restricted range and not to replace *A. mediana* in the northeast as hitherto believed. A figure of the previously unillustrated female of *A. voinae* is given. Extensions of the range of several species are given and a key to northeastern and central *Alloperla* is presented.

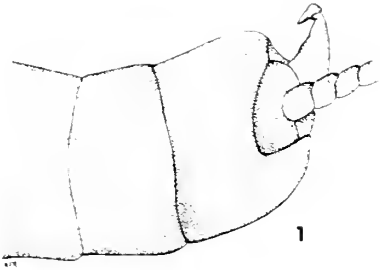
Members of the genus *Alloperla* are yellow or green stoneflies that can be swept in late spring from bushes or grass near permanent streams. They occur from coast to coast but are northern in distribution except at higher elevations. Generally, they do not occur in fast rocky mountain streams. Thus several species are found in the Maritimes and the St. Lawrence River plain but are not found a few miles south in the Green and White Mountains. Their range swings farther west and then south into New York, Pennsylvania, and points south and west.

Although many new species have been described, there has been no general revision since Needham and Claassen's 1925 monograph.

Alloperla neglecta Frison
Alloperla concolor Ricker

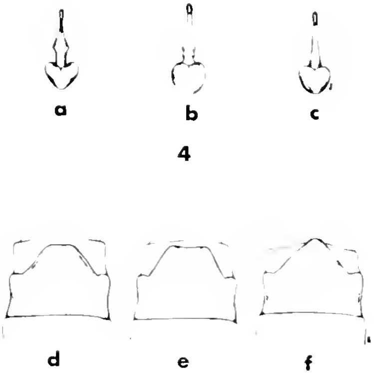
Alloperla concolor Ricker was synonymized by Frison with *A. neglecta*. Ricker apparently agreed with this synonymy (Frison 1942). However, in his original description Ricker (1935b) had stated that *A. concolor* had the distal end of the epiproct finely serrate. In neither Frison's (1935, 1942) descriptions or figures is there any indication that *A. neglecta* had such serrations. Through the kindness of H. H. Ross of the Illinois Natural History Survey, I have had the opportunity to examine a specimen of *A. neglecta* that had been compared with the holotype. Although there were minor differences in the epiproct (fig. 2) from that in Frison's figures, there was no indication of any serrations.

Over the past few years, I have captured several specimens of *Alloperla* that fit Ricker's original description of *concolor*, but consistently differ from that of *neglecta*. Sometimes under considerable magnification they may be seen to have minute serrations, sometimes not. More obvious is the shape of the epiproct in lateral view (figs. 1 and 1a). Ricker's *concolor* is flattened at the end resembling the head of a duck. Frison's *neglecta* is more rounded. The supra anal body of *concolor* lifts the epiproct higher and at more nearly



1

1a



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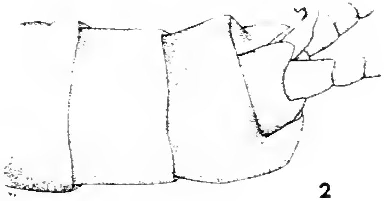

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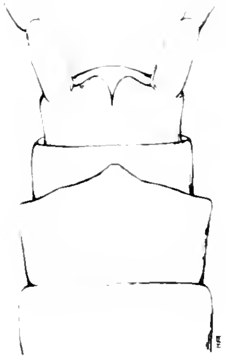

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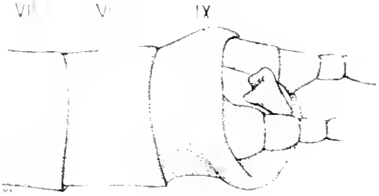

3

3a

Fig. 1. Lateral view male *A. concolor*; 1a distal end of epiproct.

Fig. 2. Lateral view male *A. neglecta*.

Fig. 3. Lateral view male *A. idei*; 3a distal end of epiproct.

Fig. 4. a–c dorsal view male epiproct *A. mediana*; d–f ventral view female genital plate.

Fig. 5. Ventral view female *A. voinae*.

a right angle. In dorsal view, the epiproct of *concolor* is nearly as wide as long, whereas with *neglecta* it is clearly longer than wide.

Moreover, the anterior sclerotization of the 10th tergite in *neglecta* is sharply and deeply emarginate forming a U shape; the emargination reaching the anterior margin of the segment. In *concolor* this emargination is not so deep or narrow, forming a deep but wide V, not reaching the anterior margin of the segment. There is a darker sclerotized wing on each side of this emargination in *concolor* connecting to the sclerotized rods on each side of the median groove in the 10th tergite.

Concolor, therefore, is apparently a good species. Its exact range is not known but does include New England and Ontario.

Specimens of *concolor* were collected in Connecticut at Barkhamstead V–20–60, VI–1–67, Hartland VI–14–66, Ellsworth VI–7–67; Vermont at Pittsford V–29–66; and New Hampshire at North Woodstock VI–13–64.

Alloperla idei (Ricker)

This small species is rare, only the holotype having been recorded. Ricker's (1935a) description suggested that the holotype had a trace of a brown dorsal line. Moreover as the holotype was a pinned, dried specimen, the description and figures did not make clear some of the details of the epiproct.

While collecting at Bolton Centre, Quebec, very near the source of the type specimen, I captured a male *Alloperla* that appeared to be somewhat like Ricker's figures. I submitted drawings of my specimen to Mr. T. Yamamoto of the Royal Ontario Museum and he very kindly compared them with the type specimen. He stated that the pinned holotype has no trace of dorsal pigmentation on either the thorax or abdomen and that the distal end of the epiproct is produced ventrally as a pair of triangular projections. He further stated that the epiproct of the holotype was concordant with my drawings as shown in fig. 3 and 3a of this paper.

On the basis of this, Ricker's original description should be modified to eliminate any reference of a dark dorsal line, thus placing *idei* into the subgenus *Alloperla* s.s. In addition to lacking the dark dorsal line, my specimen does not have the 9th abdominal tergite raised into a cowl as described by Ricker and this latter character may be caused by distortion in drying of the holotype.

Gaufin (1956) lists *A. idei* as being found in Ohio, but as he later (Gaufin 1964) lists it in the subgenus *Sweltsa*, which is characterized by having a dark dorsal stripe, this Ohio record is probably in error.

To facilitate further identifications of this species, I am presenting new figures of the male (figs. 3 and 3a). The second recorded specimen of this species was taken at Bolton Centre, Quebec, VI–27–67. Several females were taken at the same time, but none could be identified surely as being this species.

Alloperla onkos Ricker
Alloperla mediana Banks

There are several means of distinguishing *onkos* from *mediana* according to the figures and descriptions of Ricker (1935b, 1952): 1) *onkos* has a well developed tubercle on the ninth tergite, *mediana* has no process or it is "weak and often undistinguishable"; 2) the terminal hook of the epiproct is broader and blunter in *onkos*; 3) the basal part of the epiproct, in lateral measure (not extended), is twice the length of the knife-like portion in *mediana*, but only half again as large in *onkos*; 4) *onkos* has four lobes at the base of the epiproct whereas *mediana* (presumably) is smooth; 5) the female subgenital plate is either trilobed (Ricker 1935) or more usually smoothly rounded in *onkos* (Ricker 1952) whereas in *mediana* it is narrower and more nearly truncate; and 6) *onkos* is from New York, Ontario, and eastward, *mediana* more southern from Tennessee and Virginia.

Collections from New England show that there is a great deal of variation in most of these characters with no general pattern appearing. There is no indication that specimens vary from a *mediana* southern type to an *onkos* northern type. In accord with the differences noted above, the following variations may be found in single collections; 1) the process on the male ninth tergite varies from a barely distinguishable hump to a darkly sclerotized projection; 2) the shape of the terminal hook varies somewhat but generally is closest to the *onkos* type; 3) the length of the basal body of the epiproct to the "knife" varies from 1.5 to 2 times; 4) the margins of the epiproct are generally smooth in dorsal view but occasionally are slightly lobed and exceptionally are notched (fig. 4a–c); 5) the subgenital plate of the female is usually truncate at the tip but may be bilobed or rounded (fig. 4d–f).

From the above, it is clear that there is no certain way to distinguish northern "*onkos*" from southern "*mediana*." However the type series of *onkos* from Horning's Mills, Ontario, apparently is different from other collections in that the holotype male epiproct is four-lobed basally and the allotype and at least one female paratype have a trilobed subgenital plate. It may be that *onkos* represents the extreme of a variable *mediana* population, but until further collections are made, it would be best to consider *onkos* restricted to the type locality and other northeastern specimens to be *mediana*. Gaufin (1964) may have reached similar conclusions as in his list of the Chloroperlidae he likewise restricts *onkos*, for unexplained reasons, to the type locality.

Mediana is closely related to *Alloperla lateralis* and appears to be a connecting link to those species that have an inflatable supra anal body covered with fine satiny hairs. This supra anal body may be somewhat swollen in *mediana* but apparently does not lift the epiproct as in these other species.

The notched epiproct illustrated is the greatest variance from the normal I have observed, although in long series there are occasional specimens with thickened or narrowed margins. There were eleven males in the series from which this specimen came, two of which showed this notching.

This is probably the most common of all *Alloperla* and collections are too numerous to note in detail. In Connecticut I have found adults from May 5th to June 12th. In more northern areas it appears later, to at least June 25th in Vermont and June 29th in New Hampshire according to my collections.

Alloperla lateralis Banks

This is a common eastern species of trickles and small streams whose range extends from Maine to Georgia. The epiproct is variable in shape, sometimes being winged halfway down its length. This wing varies from a slight bump to projections that resemble miniature elephant ears. As there are graduations between specimens, these differences are not of specific value although the extremes might make it appear so. New collections were made in Connecticut at Mt. Carmel V–25–59, VI–3–59, V–15–62, V–25–64, VI–4–64; Cheshire V–21–59, V–23–59; Bethany VI–8–62; Union VI–9–66; East Hartford VI–1–67; in New Hampshire at Lincoln VI–29–67; Kancamaugus Highway VI–29–67; and in Vermont at Bloomfield VI–28–67. Although usually considered diurnal, one specimen of this species was taken at a blacklight trap at Mt. Carmel, Connecticut, on V–22–64.

Alloperla voinae Ricker

This uncommon species, previously only found at a few widely scattered points in New York, Quebec, and Nova Scotia, was collected at Wallace Pond, Vermont, on VII–1–67. The female, not previously illustrated, is shown in figure 5.

Alloperla naica (Provancher)

New collections of this species were taken from tributaries of the Pemigewassett River at Lincoln, New Hampshire, VI–29–67 thus adding another state to its known range.

Alloperla marginata (Banks)

Only one new collection of this species adds a new state to its distribution at Jeffersonville, Vermont, VII–24–65.

Alloperla imbecilla (Say)

New extensions of the range of this species are found in collections made in Connecticut at Lebanon VI–12–59, VI–6–60; Union VI–9–66; from Vermont at Pittsford V–30–60, Lemington VI–28–67, Wallace Pond VII–1–67, Bloomfield VI–28–67; from New Hampshire at Pittsburg VII–1–67; and Quebec at Stanhope VI–27–67, and Bolton Centre VI–27–67.

Alloperla chloris Frison

This insect, not previously found in Connecticut, was collected at Salisbury VI–29–60, West Cornwall VI–29–60, and Easton VI–15–65, VII–14–65.

Alloperla caudata Frison

This species has probably one of the widest ranges of any *Alloperla*, occurring from Newfoundland to Oklahoma. New state records are from Connecticut at Union VI–9–66; Vermont at Londonderry VI–24–66, Brandon VI–25–66, Lemington VI–28–67, Bloomfield VI–28–67; New Hampshire at Twin Mountains VI–29–67; and Quebec at Stanhope VI–27–67.

This paper brings the number of *Alloperla* known from northeastern and midwestern America to sixteen. As more than half of these have been described since a key to the species was available, it would seem worthwhile to append a provisional key to aid in their identification. As a further aid, I have noted where illustrations for each of these species may be found.

Provisional Key to the Male *Alloperla* of Northeastern and Central North America (*quadrata* not known)

1. With dorsal abdominal stripe 2
   Without dorsal abdominal stripe 6
2. Inward pointing process at base of each cercus .... *marginata*
   (Needham and Claassen 1925, p. 335, fig. 10–11)
   No process at base of cercus 3
3. Epiproct in lateral view with subcircular base and upturned process at tip; prothorax with obscure center stripe, not margined with black line 4
   Epiproct not as above; prothorax margined with black line 5
4. Proximal end of epiproct in dorsal view with four lobes .... *onkos*
   (Ricker 1935b, fig. 10, 11, 13)
   Epiproct in dorsal view smoothly margined or notched .... *mediana*
   (Needham and Claassen 1925, p. 333, fig. 4–5; this paper fig. 4)
5. Epiproct long, slender, upturned .... *lateralis*
   (Needham and Claassen 1925, p. 333, fig. 6–7)
   Epiproct flattened, broad in dorsal view, "almost pestle shaped" .... *naica*
   (Needham and Claassen 1925, p. 335, fig. 1; Frison 1942, fig. 125)
6. Epiproct recurved, slender, sclerotized, gradually tapering to a point .... *imbecilla*
   (Needham and Claassen 1925, p. 331, fig. 1–2)
   Without above combination of characters, epiproct variously shaped from oval to reniform, often lifted by an inflated body 7
7. Epiproct with two rounded triangular projections extending ventrally near distal end .... *idei*
   (this paper, fig. 3, 3a)
   Epiproct variously formed, but not as above 8
8. Sclerotized part of epiproct slender with parallel sides, truncate distally with two sharp laterally directed projections .... *leonarda*
   (Ricker 1952, fig. 132; Harden and Mickel 1952, fig. 7, 8)
   Epiproct rounded or elongate-oval and without two laterally directed projections

distally 9

9\. Sclerotized part of epiproct much broader than long, reniform .... *voinae*
(Ricker 1948, fig. 3)
Sclerotized part of epiproct at least as long as broad 10

10\. Epiproct in dorsal view more than twice as long as wide and with a terminal tuft of hairs .... *banksi*
(Frison 1942, figs. 123 a–c (not d); Ricker 1952, fig. 138)
Epiproct not more than twice as long as wide, or if twice as long as wide then without a terminal tuft of hairs 11

11\. 9th tergite notched posteriorly; epiproct somewhat pear-shaped in lateral view .... *vostoki*
(Ricker 1948, figs. 4–6)
9th tergite not notched; epiproct not pear-shaped 12

12\. Epiproct subtriangular in dorsal view .... *chloris*
(Frison 1934, figs. 9–11)
Epiproct oval or subrectangular in dorsal view 13

13\. Epiproct covered with fine appressed hairs giving silky sheen except for a glabrous circular area at the distal end .... *caudata*
(Frison 1942, fig. 121)
Epiproct without silken sheen 14

14\. In lateral view, epiproct evenly narrowed to tip, somewhat resembling the head of a duck .... *concolor*
(Ricker 1935b, fig. 8,9; this paper fig. 1, 1a)
In lateral view, epiproct subparallel on margins, tip rounded, "hot dog" like .... *neglecta*
(Frison 1935, figs. 13, 14, 35; this paper fig. 2)

Provisional Key to the Female *Alloperla* of Northeastern and Central North America
(*idei* not known)

1\. With dorsal abdominal stripe 2
Without dorsal abdominal stripe 6

2\. Pronotum with dark lateral margins 4
Pronotum without dark lateral margins, but with an obscure pronotal center stripe 3

3\. Subgenital plate with three lobes .... *onkos*
Subgenital plate single or double lobed .... *mediana*

4\. Subgenital plate with narrow tongue-like protrusion .... *lateralis*
Subgenital plate broadly rounded 5

5\. Subgenital plate extending over full length of 9th sternite .... *marginata*
Subgenital plate not extending to posterior margin of 9th sternite .... *naica*

6\. Subgenital plate scarcely projecting beyond hind margin of 8th segment, very similar to hind margins of other segments .... *chloris*
Subgenital plate projecting well beyond posterior margin of 8th segment, or with narrow median projection extending beyond margin 7

7\. Subgenital plate with small quadrate projection, less than one tenth the width of the segment .... *quadrata*
Subgenital plate without small quadrate projection 8

8\. Subgenital plate with narrow tongue-like protrusion 9
Subgenital plate rounded, without narrow tongue-like protrusion 10

9\. Basal width of subgenital protrusion about ⅓ width of segment and extending

posteriorly ½ way across following segment .... *imbecilla*
Basal width of subgenital protrusion less than ⅕ width of segment and extending posteriorly ⅓ way across following segment .... *leonarda*

10. Subgenital plate long, reaching posterior margin of 9th sternite .... *vostoki*
Subgenital plate shorter, not reaching posterior margin of 9th sternite (*neglecta, concolor, caudata, banksi, voinae*)

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A Study of Area Occupation and Mating Behavior in *Incisalia iroides* (Lepidoptera: Lycaenidae)

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Abstract: Males of this thecline butterfly occupied a perch site during midday hours, flying out at insects which passed nearby. Mating occurred after 3:00 P.M., and pairs remained *in copulo* until after dark, usually 4–6 hours. Both unmated males and pairs after separation remained at the perch site overnight, leaving by 8:00 or 9:00 A.M. The principal perch site under observation was occupied by successive males over periods of several days each, and these occupants mated with different females each day. Sixteen days longevity and five matings were the maxima observed for marked males. Details of mating, territorial, and sunning behavior are described.

Members of the genus *Incisalia* are small, brown butterflies which fly in spring. A widespread West Coast representative, *I. iroides* (Boisduval), is considered by some authors to comprise a geographical race of *I. augustinus* (Westwood) of eastern North America. In California this butterfly occupies diverse ecological situations and is known to use unrelated host plants for larval food (Powell, 1968), while its eastern counterpart is limited to Ericaceae for oviposition and larval feeding site so far as is known (Cook and Cook, 1904, 1906; Clench, 1961).

In 1963 I made a few observations on mating pairs of *I. iroides* which indicated that mating late in the day is a normal behavioral feature (Powell, 1964). During 1965 and 1966 I studied the field habits of this species further, at the same locality used in 1963, Walnut Creek, Contra Costa County, California. Some 30 mating pairs were recorded during the three seasons.

The study period was limited to one month in each of the two years, beginning on April 25 in 1965 and on May 3 the following year. Although other species of *Incisalia* are said to be strictly univoltine, with a short flight period, it appears that *iroides* is at least partially double brooded. Comstock and Dammers (1933) recorded emergence of second spring generation adults in confinement by mid May in southern California. Records compiled by Opler (1968) for Contra Costa County do not indicate a clear-cut bimodal pattern in the flight period of this species, but they show an exceptionally long flight if the species is univoltine. At Walnut Creek my records suggest a second generation. Not only was the flight period prolonged (March 3 to at least June 1 in 1963, April 5 to at least June 14 in 1964), but individuals which looked to be freshly emerged continued to appear through this period. Thus it is probable that my observations concern a mixture of late emerging individuals from overwintering pupae and early emerging offspring resulting from spring mating.

STUDY AREA

The Walnut Creek site is a suburban yard located on a small hill in a former oak-grassland association. Dominant vegetation in the immediate area includes small to large mixed deciduous trees, pines and eucalyptus within a few meters in all directions. A small, bushy citrus tree about one meter in height repeatedly served as a perch site for males of *Incisalia iroides* during the five spring seasons I made observations there. Oviposition was not observed, and the location of the larval colony from which the butterflies came is unknown.

The citrus tree was used only as a perch and mating site, and no reason for its attractiveness to the butterflies was evident. The tree did not bloom at any time, and no *iroides* were witnessed visiting nectar sources at this site. I assume that the citrus tree was somehow physically more suitable for courtship purposes than other similar sized shrubs in the area. It is possible that landscaping in the yard acted to form a "flyway" in which the citrus tree was located and along which butterflies tended to move (fig. 1).

Several times, especially in the 1966 season, a larger, nectarine tree (about 3 m in maximum height and situated about 1.5 m higher on the hill) was used as a perch site, and occasionally male *iroides* interspersed visits to the citrus with stops at one of three rose bushes which were growing about one meter away and were of about the same height as the citrus. However, no mating pairs were observed on other than the citrus tree. Possibly this was in part owing to the accessibility of surveillance of a bush of this size after dark and to concentration of my efforts on this site, since it was the most often used as a perch during the daytime.

WEATHER CONDITIONS

The spring weather pattern at Walnut Creek is variable. Occasional storms during late April and May bring periods of cloudy, cool conditions, although usually no heavy rainfall, as this is the beginning of the dry season. During periods without storm fronts, daytime Fahrenheit temperatures ranged from the mid 60's to 80°, occasionally rising as high as 90°. Nightly minima were less variable, not exceeding a range of 38–50° in 1965 and 46–54° in 1966. A corresponding drop in Relative Humidity to 35–45% accompanied warm days, rising again to nearly 100% every night by 8:00 or 10:00 P.M.

Temperature and humidity data were recorded throughout the study by a Bendix-Friez Hygro-thermograph, located in a weather shelter about 15 meters from the principal perch site used by *iroides*. Accuracy of readings from the graphs are within ± 2° F. and 5% R.H. In many instances I confirmed the reading and recorded temperatures by use of a dry bulb mercury thermometer at the time of the observations.

MARKING TECHNIQUE

The habit consistently shown by mating pairs and often by unmated males to remain on the tree at night, enabled successful marking of individual *I. iroides*. The technique employed was as follows. In evening after the butterflies had become torpid, an individual was grasped gently by the forewings with forceps, held against a hard surface and touched with a felt-tipped, Esterbrook "Flo-Master Ink" marker on the underside. The ink was instant drying, and the insect was replaced on the tree without apparent effect, since it remained perched there, in a quiescent state. Permanency of the marks and apparent lack of deleterious effects to the lycaenids were evidenced by repeated observations of four males (of 11 marked) 6 to 16 days after marking. In all, 27 individuals were marked in 1965 and 1966; each was identified and pictorially recorded by the shape and position of one or two marks on either the fore- or hindwing, or both. Marks on the forewings were restricted to the costal margin and apex because the forewing is nearly entirely concealed by the hindwing when the insect is at rest.

DAILY BEHAVIORAL CYCLE

The daily activity rhythm of *Incisalia iroides* at the perch site followed a rather consistent cyclic pattern. Intermittent observations throughout the day were made on about 14 days; surveillance during the rest of the study was limited to evening hours.

If the day was warm a male usually began perching at the citrus tree between 10:00 and 11:00 A.M. (P.S.T.). During midday the male displayed territorial behavior, flying out at other flying insects which passed nearby, usually returning to the citrus bush after a few seconds.

Perching generally was limited to the upper few centimeters of the foliage, but no preference for a particular exposure or side of the shrub was shown. The flight horizon was not so limited, the butterflies often pursuing other insects or one another a meter or two above the height of the perch. Periods of perch activity were sometimes interrupted by intervals of 30 minutes or more in which the male was away from the area. Usually the same male returned, and only a single male attended the citrus perch during midday. If a second male took up residence at the bush, prolonged flights ensued in which the two flew together continuously within a few centimeters of the foliage. These flights were repeated or continued until one of the males flew away or, when it occurred in mid-afternoon, until a female arrived on the scene and mating ensued.

In mid to late afternoon, usually between 3:00 and 4:00 P.M., often one or more females flew into the area and briefly engaged in flights with the male at the perch site. After the courtship flight the two alighted on the citrus foliage and copulation took place.

Pairs remained *in copulo* during a several hour period, until after darkness.

In one instance a pair separated before sunset, after not more than two hours, 40 minutes of mating, but in most other cases copulation lasted four to six hours and occasionally as long as seven or eight hours. At termination of mating one or both individuals crawled away a short distance, after which neither moved for the remainder of the night. Often males which had not engaged in mating during a given day remained at the citrus tree after activity ceased, prior to sunset, spending the night on the foliage.

In early morning individuals which had used the perch tree as a resting spot overnight became active when the temperature had risen sufficiently or possibly as soon as the sun's rays reached their resting position. In one case neither member of a pair had moved by 7:30 A.M., nearly two hours after sunrise, but they were positioned on the shady side of the bush. The butterflies assumed a "sunning" attitude and sometimes made short flights prior to leaving the area. Males did not engage in aggressive appearing behavior at this time. Usually all individuals had left the area by 8:30 or 9:00 A.M., if the morning was warm. On cool, partially cloudy mornings, the sunning behavior was prolonged. On one morning after a matinal low of 50°F., a male and female were still there at 10:30, with the temperature at 57°. The female had departed by 11:15 and the male by 11:30; during this hour the temperature had risen only 2°.

The minimum temperature at which *iroides* carried out daytime activities appeared to be about 60°F. In addition to evidence from morning departure records, both presence and absence of midday activities indicated a threshold of about 60–65° for territorial perch behavior by males. On two occasions when surveillance was carried out all day, the maxima were 58 and 60°F. and no males were active. On the cooler of these days a male remained inactive in the foliage through midafternoon. Normal perch residence by two successive males and mating took place once when the temperature ranged 62–65°. It was this pair which separated prior to sunset (with the temperature at 59°).

TERRITORIALITY

The term territoriality in reference to insect behavior has been variously defined; usually little other than "defense" of an area or "home range" is implied. Although the concept has been applied primarily in studies of vertebrates (Carpenter, 1958, review), comparable behavior has been recorded for various insects. Thus, maintenance of a "defended area" by male dragonflies has been shown by several workers (e.g., Kormondy, 1961, review). In these cases, both feeding and mating are considered to be objectives, while in robberflies a modified territorial response is used, possibly for predaceous feeding alone (Powell and Stage, 1962). Similarly, territoriality is known in several genera of bees where courtship is not known to be an object of the territory defense (Linsley, 1965, review). In other bees (Stage, 1962) and wasps (Bohart and Marsh, 1960) mating appears to be the primary function of males in defended areas near female nesting sites. In butterflies territorial behavior is accepted as commonplace by lepidopterists, for example in collecting techniques, especially in the case of certain Nymphalidae and Hesperiidae. However, there seems to be a paucity of documentation of the phenomenon in butterflies.

MacNeill (1964) studied male behavior in skippers of the genus *Hesperia* (Hesperiidae) and attempted marking experiments without success. He concluded that activities of these insects could not be included within the "classical" definition of territoriality and used the term "area occupation," described as a reflection of passive territoriality. In *Hesperia* the length of time an area was occupied varied with population density. When density was high, males showed a shorter duration of residency (e.g., 1–15 minutes) and moved frequently, sometimes rotating among several adjacent areas; when density was low, males remained in one area longer. MacNeill also pointed out that in "defense" of an area, the darting flight of these skippers could be interpreted as one of attempted solicitation of female response and not aggressive behavior. This concept is also applicable to *Incisalia*; that is, when another male is the object of the flight, continued close proximity in flight might be the result of continued effort on the part of one or both males to elicit a female recognition response. Indication of mutual recognition and negative mutual response by males, however, is shown by the fact that males become dispersed when not feeding.

Better adherence to an accepted definition of insect territoriality was shown by males of *Incisalia iroides* at Walnut Creek. In each of the two years successive males occupied the perch station over a period of several days each and mated repeatedly (Table 1). Thus, in 1965, male No. 3, marked on May 7, was the "principal occupant" every day until May 12, after which two days of cool weather passed when no butterflies used the site. The area was next assumed by male No. 1, which had also been marked on May 7 but not sighted since. During May 16 to 23, No. 1 occupied the site each day except May 18 and 19 which were cloudy with light rain and no *iroides* were seen.

During the 1966 season, a similar pattern developed; male No. 17 was marked on May 6, and it occupied the perch through May 11, despite the fact that May 8–10 were cool and rainy and the species was not active. Later in the season, male No. 28 was observed on three successive days and a probable fourth, but no matings took place during this time (May 28–31).

The seven other males marked, in addition to these four principal occupants, were not resighted.

In each case when daytime observations were made, the principal occupant male was the first to appear and begin perch behavior. All flying insects which passed nearby were "chased." On one occasion, a male of *Erynnis tristis* (Boisduval) (Hesperiidae) took up similar occupation of the area, using the citrus tree and a small peach tree nearby as perches. The two butterflies engaged in repeated flights, as though they were attempting to chase one another from the site. When, on other occasions, a second *iroides* male began occupation of the perch tree during midday hours, prolonged, rapid flights (10 minutes or more in duration) ensued in which the two butterflies maintained an encounter while flying round and round the bush within a few centimeters of the foliage. I was never able to mark the second male, because it eventually left the area prior to the late afternoon mating period. The same or different males sometimes appeared again in the mating period (3:00–4:00 P.M.), however; and despite whirling, rapid flights involving two or more males, successful courtship was affected when females arrived.

I do not have conclusive evidence that the principal occupant was the first to mate when more than one mating occurred. In no case did an unmarked male succeed in mating first when the principal occupant remained at the site during my surveillance, whereas the reverse was true on two occasions. An unmarked male was successful in mating once, when the principal occupant had been in residence during 2:00–3:00 P.M., but the principal occupant had departed before evening. Whether this occurred before or after the mating was initiated is unknown.

Although unmated males frequently used the citrus bush as a night resting site, this rarely occurred when a mating pair was also there. In contrast, multiple matings on the tree were recorded on seven occasions (Table 1).

No standardized experiments were performed to test sight stimuli of *iroides*. However, in tests where I tossed small rocks or sticks across the perch area, no response was elicited. This kind of stimulus will cause chase flights by male bot flies (Catts, 1964), and hesperiids (MacNeill, 1964: p. 23; Burns, 1964: p. 6), and I have observed similar behavior on the part of limenitidine butterflies (Nymphalidae). Possibly the type of movement of the object of chase flights is of importance in response by *Incisalia iroides*, as is known in the European butterfly, *Eumenis semele* (L.) (Satyridae) (Tinbergen, 1951: p. 40).

Between flights, prior to arrival of females, males' hindwings were alternately moved backward and forward in characteristic hairstreak fashion. This habit, which was noted for *Incisalia augustinus* by Scudder (1889), is also exhibited by female Theclini, as for example, in *Callophrys* (Brown and Opler, 1967). Male *iroides* perched with the abdomen extended below the level of the hindwings, so that it appeared to rub along the leaf substrate. In contrast, individuals at rest at night and sunning in morning held the abdomen up between the wings, out of sight.

The maximum longevity recorded for male *iroides* was 16 days, in the case of male No. 1, which was not observed from the second to ninth days after marking. Its marking was preceded by two cool days when observations showed no activity, and the 16th day for No. 1 was the final day of my 1965 study.

TABLE 1. Occurrence and duration of copulation by *Incisalia iroides*.

Date	Marked No.	Marked No.	Last seen alone	Pair first seen in cop.	Pair last seen in cop.	Pair first seen separated
IV-29-65	—	—	—	5:00[1]	6:00	—
IV-30-65	—	—	—	6:00	6:00	6:45
V- 1-65	—	—	—	3:30	3:30	10:00
V- 2-65	—	—	—	3:00	7:00	10:00
V- 3-65	—	—	—	5:45	8:30	10:30
V- 7-65	1	2	—	6:00	—	—
V- 7-65	3	—	—	6:00	—	—
V- 8-65	3	4	2:30	3:00	7:00	8:15
V- 8-65	5	6	—	4:30	8:15	9:00
V- 9-65	3	7	3:35	3:35	6:00	10:00
V- 9-65	—	—	3:35	3:42	3:42	—
V-10-65	3	8	—	5:45	10:00	—
V-10-65	9	10	—	5:45	10:00	—
V-10-65	11	12	—	5:45	10:00	—
V-12-65	3	—	3:00	5:00	5:00	8:00
V-16-65	1	13	3:00	7:00	10:00	—
V-22-65	1	—	—	5:30	—	—
V-23-65	—	—	3:00	±5:00	—	—
V- 5-66	17	18	—	—	—	10:30
V- 6-66	17	19	—	—	—	11:20
V- 6-66	20	21	—	11:20	11:20	—
V- 7-66	17	22	2:50	4:00	6:00	12:00
V-11-66	17	23	—	4:00	4:00	8:30
V-11-66	24	25	—	4:00	4:00	8:30
V-15-66	26	27	3:20	3:40	5:00	6:00

[1] Times given in Pacific Standard Time.

Male No. 17 was recorded over an 11-day period, although it did not mate after the sixth day following marking.

MATING

Copulation by *Incisalia iroides* took place only during mid to late afternoon hours and continued into an apparently inactive period in evening. Table 1 summarizes data on mating periods for 25 pairs observed in 1965-66. The earliest mating recorded was 3:00 P.M., the courtship having taken place between 2:30 and 3:00 P.M. The latest time which the onset of copulation was recorded was between 3:35 and 3:42. Most pairs were first observed between 4:00 and 6:00 P.M., but in these cases the butterflies were not witnessed prior to the beginning of the coupling.

Many butterflies, such as pierids, satyrids, and plebejine Lycaenidae are often sighted at rest or are startled into flight *in copulo* during midday hours (Miller and Clench, 1968). In contrast, copulation by Theclini in general appears to be more rarely seen, and previously I indicated that crepuscular mating might help explain this (Powell, 1964). It is therefore noteworthy that representatives of two additional, unrelated hairstreak genera, *Hypaurotis* and *Satyrium*, have been recorded as mating in evening (Chambers, 1963; Miller and Clench, 1968). Neither precise periods of courtship nor information on the duration of copulation were given in those cases.

Fig. 1 (left). Field study area at Walnut Creek, California; arrow indicates the small citrus bush used by *Incisalia iroides* as a perch and mating site. Fig. 2 (right), typical mating posture of *I. iroides* prior to evening quiescent posture.

The only report of mating by *Incisalia* which I have seen is that of Cook (1907) who witnessed it in *I. henrici* (Grote and Robinson). The observation was made at 10:30 A.M., and the pair separated after 10 minutes of subtle disturbance by the observer. If typical for the species, this suggests a behavioral difference between the two *Incisalia* species, since *I. iroides* at Walnut Creek never remained *in copulo* overnight, and males did not engage in territorial courtship behavior before 10:00 A.M.

Precopulatory flights by females were not distinguishable. Evidently females dispersed from midday activities, such as feeding or oviposition, and by chance flew near the perch site under observation. Upon nearing a perch territory occupied by a male, presumably the female was engaged in a courtship flight by the male. Courtship flights at the citrus tree were of undetermined duration, but even when two males were present and both mated, the sequence of aerial engagements of both, with successive females lasted no more than 20 minutes. When a single male occupied the station, the flight during which the female responded probably was much shorter.

As a response to male courtship, females alighted on the foliage. The courtship and coupling once the butterflies were on the bush was observed twice. The two lycaenids alighted on the same leaf, the male oriented head-to-head alongside of the female, rapidly vibrating his wings and extending the abdomen. The female responded by parting her wings at slight angle, so that the upperside was visible. No other *iroides* was ever seen to do this. The male then moved around her, backing up to her with his abdomen extended and curled towards her; coupling then occurred quickly and the pair assumed the typical tail-to-tail posture (fig. 2) with the wings closed and still. The whole process required an estimated 10 seconds after alighting on the leaf.

While *in copulo*, pairs showed little activity. They usually remained stationary or moved only a few centimeters during late afternoon. During this time the antennae were slowly moving, extended somewhat upward from the body plane and parted at approximately a 45° angle. The costal portion of the forewings were visible, not concealed by the hindwings. Late in the day the pairs engaged in "sunning," described below. As the temperature dropped in evening, the mating butterflies assumed a resting posture in which the forewings were drawn back, almost entirely hidden under the hindwings. The antennae were held forward, closely adjacent, at a slight downward angle from the body axis, often touching the substrate. This antennal posture when at rest was also described for *Incisalia irus* (Godart) by Scudder (1889).

Cook (1907) called attention to a peculiarity in posture of mating *Incisalia henrici.* He noted that the abdomens were held upward so as to meet at approximately a 45° angle, whereas he stated that during copulation the two sexes of a number of Lycaenini and Plebejini in the New York area held the abdomens in approximately a straight line. My photographs indicate the uptilted abdominal position is normal for *I. iroides* (fig. 2).

During *coitus* the pairs were remarkably insensitive to external stimuli. Prodding could cause them to walk along to another leaf, or even onto an observer's finger. Either male or female walked forward, depending upon the stimulus. Activity of children in close proximity to the low citrus bush on several occasions failed to dislodge the pairs. After dark, when the resting position was assumed, both individuals could be grasped with forceps for the purpose of marking, and often they were returned to the bush without their having separated. Sometimes the procedure resulted in disengagement of the pair, at which time a butterfly not grasped by the forceps usually dropped or flipped to a lower leaf on the bush.

Owing to their immobility and the prolonged copulation, it is likely that *iroides* is subject to predation at this time more so than many insects. Once I discovered a large *Vespula* (Vespidae) devouring an *I. iroides* at the mating site at 6:00 P.M.

The duration of mating by individual pairs varied considerably. Usually separation occurred between 8:00 and 10:00 P.M., but not by 11:20 in one instance. Two pairs disengaged, apparently without external stimulus, prior to 7:00, one by 6:45, after sunset on April 30, and one by 6:00, well before sunset on May 15. The mating period ranged from about 1.5–2.5 hours to as much as 7.5–8.5 hours, but it usually ranged about 4 to 6 hours.

A well defined correlation of termination of mating with temperature was not shown. Varying with weather conditions, separation usually occurred in a temperature range of 57–47° F., and once when the evening was abnormally warm, three pairs remained *in copulo* until 10:00 P.M. with the temperature at 59°. However, on May 15, 1966, two pairs separated by 8:30, with the temperature above 59°.

After separation one or both individuals usually crawled away, to the underside of the same leaf or to another leaf, up to 20 cm, remaining there for the rest of the night.

Principal occupant males mated repeatedly, when weather conditions were favorable. Mating by the same individual was recorded on several successive afternoons (Table 1). Five matings was the maximum number recorded for one male.

Females did not engage in repeat matings at the citrus perch site. Only one female was resighted after having been marked. Female No. 23, which had mated and was marked on May 11, was observed at the citrus tree at 6:40 A.M. on May 17, evidently having spent the night there. The area had been examined for mating pairs on the preceding evening, but no *iroides* were discovered. Although females did not return to this site for mating, several of those which were marked during copulation were noted to be in worn condition (as compared with males known to have been active for ten days or more). Therefore, it is assumed that females also mate more than once, but by chance their dispersal prevented returns to the perch site under observation.

SUNNING

During cool spells many butterflies engage in a behavior commonly called "sunning" by lepidopterists. Usually the wings are held in a particular fashion, exposing a broad expanse to the sun's rays in a posture which is not typical of the species during warmer periods. The phenomenon has been analyzed as one of thermoregulation by Clench (1966), who discusses behavioral devices and patterns employed by various butterflies. In many groups the uppersides of the wings are presented, while in *Hesperia*, the hindwings only are spread to expose the dorsal surface. In that genus the behavior is more characteristic of males than of females (MacNeill, 1964).

Incisalia iroides consistently engaged in sunning, both early and late in the day ("Matutinal" and "vesper warming" of Clench, 1966). The two sexes separately and mating pairs exhibit the behavior. As with most hairstreak butterflies, the wings are always held together when individuals of *Incisalia* are perched, and their sunning orientation places the underside of one pair of wings at right angles to the solar rays ("lateral basking" of Clench). In early morning this often required relatively little tilting, but later, by 9:00 or 10:00 A.M., the butterflies leaned markedly, so that the wings were not perpendicular to the substrate. Both body and wings were tilted relative to the leaf surface, with the legs spread widely on both sides. The sensory mechanism for this behavior may be one of sight, as postulated by Clench (1966), since one male was observed in a strongly tilted, lateralbasking posture, with the wings in the shade of overhanging leaves and the head exposed to the sun.

Mating pairs exhibited the sunning habit similarly; evidently one individual takes the initiative in the orientation and the other follows. Pairs remained occupied thusly until sunset.

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Melanism in Connecticut *Charadra deridens* (Guenée) (Lepidoptera: Noctuidae)

ALEXANDER B. KLOTS
AMERICAN MUSEUM OF NATURAL HISTORY

RECEIVED FOR PUBLICATION OCTOBER 9, 1967

Abstract: Melanism appears to be becoming predominant in the population of this moth in northeastern Connecticut, and to be acting as a genetic dominant. Counts are given of wild-caught individuals and of a batch of individuals reared from a very strongly melanistic, wild-caught female.

In a previous article (Klots, 1964) the writer called attention to a considerable amount of melanism in the pantheine noctuid *Charadra deridens* at Putnam, Windham Co., Connecticut. Re-examination and study of the material reported on, all of which was collected in 1961, has convinced the author that he erred in calling most of the specimens "normal," i.e. light grey with darker markings, that the great majority are, in fact, melanistic to a considerable extent, and that a corrected listing of the 21 specimens taken in 1961 should read:

Fully melanic	4 ♂♂
Very strongly melanistic	5 ♂♂
More or less melanistic	10 ♂♂
Normal	2 ♂♂
Total, 1961	21 ♂♂

Since then only a few specimens of this species have been taken; added to the above they give a total catch for 1961–1966 as follows:

Fully melanic	9 ♂♂
Very strongly melanistic	7 ♂♂, 1 ♀
More or less melanistic	10 ♂♂
Normal	2 ♂♂, 1 ♀
Total, 1961–1966 incl.	28 ♂♂, 2 ♀♀

In 1966 a batch of eggs was obtained from a very strongly melanistic ♀, from which 39 individuals were reared to adults. These were as follows:

Very strongly melanistic	7 ♂♂,	7 ♀♀
Strongly melanistic	4 ♂♂,	8 ♀♀
Normal	7 ♂♂,	6 ♀♀
Total reared	18 ♂♂,	21 ♀♀

In a recent article (Klots, 1966) on melanism in the pantheine *Panthea furcilla* (Packard) in Putnam the writer discussed the environmental conditions in that region and his reasons for considering that the increase in melanism in that species is probably due to selection affected by a general darkening of the environment; and that this is caused by the increase of dark, shaded forest areas and not by industrial pollution. There is no reason not to consider that this factor is also responsible in the same way for the melanism in *C. deridens*.

The reared individuals divide quite clearly and sharply into the three categories listed. The 14 "very strongly melanistic" individuals are almost wholly black except for the postmedian line, which is narrowly white. The 12 "strongly melanistic" individuals have this line and other markings more broadly white, and a considerable admixture of white scale-hairs on the thorax, but are all very different from the 13 "normal" individuals. One might postulate that melanism in general is acting as a dominant, subject to one or more modifying factors, and that no sex-linkage is involved. The larvae, which are white and hairy and hide during the day in loose, individual leaf nests, were uniform and thus showed no differences to correlate with their appearances as adults.

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Rediscovery of the Type of the Milliped, *Harpaphe telodonta* (Chamberlin) (Diplopoda: Eurydesmidae)

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Systematic Entomologist, California Department of Agriculture

and

Michael R. Gardner
University of California, Davis, California

Received for Publication October 19, 1967

Abstract: The holotype of *Harpaphe telodonta* (Chamberlin) has been relocated and is redescribed herein. Illustrations of gonopods of the male and shape of body segments are presented. The present location of the holotype is in the United States National Museum, Washington, D. C.

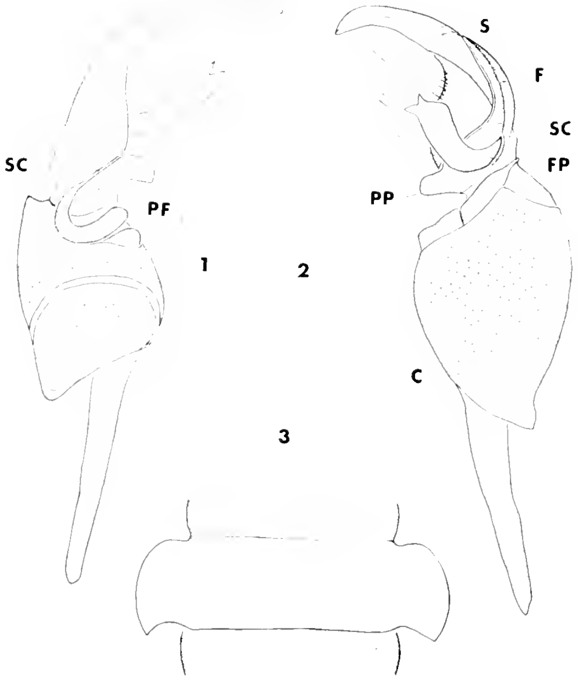
For the past several months we have been conducting research in preparation of a revision of the little known genus *Harpaphe* Cook. In the course of this work we have visited several institutions and studied their collections. While recently examining the California Department of Agriculture, Bureau of Entomology collection, it was our pleasure to discover the apparently misplaced holotype of *Paimokia* (=*Harpaphe*, in part) *telodonta* Chamberlin. The label in the specimen vial contained the following information: "*Paimokia telodonta*, ex ground, Arcata, Humboldt Co., Calif., CDA# 42L197, det. Chamberlin." Examining the CDA accession records, originated and maintained through the foresight of Mr. H. H. Keifer, the date of collection, December 21, 1942, and the name of collector, Earl Mills, were obtained. These data correspond precisely to that presented by Chamberlin (1943) in the original description of the species. Since Chamberlin had obtained but a single male specimen, which he designated as holotype, it seemed probable that we had located the holotype. Dr. George Edmunds of the University of Utah most graciously searched through Dr. Chamberlin's collection for the type of *telodonta*, but without success. On the basis of the above evidence, therefore, the identity of this specimen as the holotype of *H. telodonta* is believed to be fixed.

Since the original description is unusually incomplete, we take this opportunity to redescribe the holotype.

Harpaphe telodonta (Chamberlin)

Paimokia telodonta Chamberlin, 1934, Bull. Univ. Utah, biol. ser., 8(2): 17, fig. 33.
Harpaphe telodonta, Chamberlin, 1949, Proc Biol. Soc. Washington, 62: 129, fig. 11; Chamberlin & Hoffman, 1958. Bull. U.S. Natl. Mus., No. 212, pp. 35–36; Buckett, 1964, Annotated list of the Diplopoda of California, p. 8.

HOLOTYPE MALE: Length 33 mm (specimen slightly distended); width 4.5 mm. Body slender, nearly uniform in width; first five segments becoming broader from 3.5 mm to



All figures were drawn from the holotype of *H. telodonta* (Chamberlin).
Fig. 1. Male gonopod, anterior view.
Fig. 2. Male gonopod, posterior view.
Fig. 3. Sixth body segment, dorsal aspect.
C—coxa; F—femur; FP—femoral process; PF—prefemur; PP—prefemoral process; S—solenomerite; SC—seminal canal.

4.5 mm, this greater width being evident through segment 17. Head both dark and light brown, reticulate, glabrous; coronal suture well developed, with margins smooth and even; a prominent pair of setae present on both sides of coronal suture at its midpoint; three setae present on each side of frons in straight line between median juncture of frontal sutures and lateral margins of labrum; genae (laterad of clypeus and ventrad of antennae) each with two closely situated setae; antennae separated by distance equal to length of third antennal segment; total antennal length 5 mm; first antennal segment as broad as long, with prominent dorsal seta; antennal segments two through five subequal in size and shape, two and three sparsely setose, with a single erect large subterminal dorsal seta; sixth antennal segment slightly shorter and more evenly conical, seventh antennal segment about one-fourth as long as sixth, cylindrical, with four terminal sense cones; antennal segments four through seven densely setose, without prominent setae. Collum narrower than second body segment, its anterior margin evenly convex, posterior margin slightly medially concave, laterally convex, ventrolateral corners rounded. Dorsum of tergites strongly convex; paranota relatively small, produced laterad and slightly ventrad, making a distinct obtuse angle with the curvature of the tergite; anterior and lateral margins of paranota thickly rounded, posterior margins sharp; repugnatorial pores opening on posterolateral margin of paranota; surface of tergites finely and shallowly reticulate-sculptured; second segment with anterior and posterolateral corners rounded, not produced; in following four segments, posterior corners increasingly developed and lateral margins increasingly convexly curved (as in fig. 3), prevailing to penultimate segment; anal tergite broader than long, subtriangular, with concave lateral margins, truncate apex, two dorsal, four lateral, and six terminal setae; anal scale projecting beyond anal lip; anal lips smooth, moderately produced; preanal scale broad, subtriangular with convex sides and base, possessing one pair of lateral setae. Pleural region coriaceous, glabrous, posterior margin well defined. Sterna of metazonites essentially flat, raised beyond level of prozonites and separated by a shallow depression; sternites glabrous, not much produced on legs; sternal aperture of seventh segment wider than distance between coxae of eighth legs, front margin straight, lateral margins strongly convex and posterior margin weakly convex. Legs with each coxa possessing one prominent slender seta and several smaller ones; prefemur with ventral triangular spine at apex, a long slender ventral seta and many shorter ones; femur with numerous short setae; tibia longer than postfemur, with several spines; tarsus more heavily setose, equal in length to previous two segments combined; tarsal claws strongly developed. Gonopods attached to one another by a weak band of connective tissue, the solenomerites crossing in situ; coxal apodeme fairly long, tapering gradually; coxae enlarged, slightly elongate; prefemur much narrower than coxa, setose, and with horizontally directed sub-rectangular prefemoral process; femur whitish in color, densely short-setose, and rather broad and thin, with an elongate upcurved femoral process emerging at right angle to telopodite; femoral process with apex wide, blade-like, bidentate; solenomerite, remainder of telopodite, blade-like, evenly curving to horizontal direction; solenomerite narrowing gradually to pointed apex; seminal canal originating on caudal face of coxa, progressing distad of prefemoral process to cephalic face of femur, up the telopodite between femur and solenomerite, over to caudal face of the solenomerite and along it to apex; seminal canal thus making a full 360° circuit. Color (in alcohol) pale brown, but described by Chamberlin (1943) as being "brown . . . with the keels yellow."

TYPE DEPOSITION

Through the courtesy and suggestion of Mr. George T. Okumura, Program Supervisor Taxonomy Section, of the California Bureau of Entomology, the holotype is placed in the United States National Museum, Washington, D.C.

RANGE

Since the original collection, additional records have been presented by Chamberlin (1949). The presently known range includes Humboldt and Del Norte Counties, California.

RELATIONSHIPS

Harpaphe Cook is composed of a closely related group of species and subspecies; nonetheless, *H. telodonta* stands out both by its unusually broad, dentate femoral process of the gonopods and the strongly produced posterior corners of the paranota. On the basis of these modifications, plus the fact that its range is restricted to the relict redwood forest of the Pacific Northwest, we believe *telodonta* may be the only known extant species of a line which possibly arose early in the evolution of the genus.

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Journal of the New York Entomological Society

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CONTENTS

Undescribed Species of Crane Flies from the Himalaya Mountains (Diptera: Tipulidae), XVI[1]

Charles P. Alexander
Amherst, Massachusetts

Received for Publication October 17, 1967

Abstract: Six new species of Eriopterine crane flies are described, all from Assam, these being *Gonomyia* (*Protogonomyia*) **acucurvata** n.sp., *Erioptera* (*Teleneura*) **laetipes** n.sp.; *Ormosia* (*Ormosia*) **furcivena** n.sp.; *O.* (*O.*) **idioneurodes** n.sp.; *O.* (*O.*) **idiostyla** n.sp., and *O.* (*O.*) **neopulchra** n.sp.

Part XV of this series of papers was published in the Journal of the New York Entomological Society, **75:** 183–187, 1967. As in earlier papers the materials were collected by Dr. Fernand Schmid in Assam, representing the eastern Himalayas and their southern extensions. I again express my deepest thanks to Dr. Schmid for the privilege of retaining the types in my personal collection of these flies.

Gonomyia (*Protogonomyia*) **acucurvata** n.sp.

Generally similar to *megalomata*; size large (wing of male to 7.5 mm); body blackened, heavily pruinose; male hypopygium with the flange of outer lobe of basistyle very large, semicircular in outline; outer dististyle a slender rod with a conspicuous knob near base, apex of inner style an acute spine.

MALE: Length about 6–6.5 mm; wing 7–7.5 mm; antenna about 1.7–1.8 mm.

Rostrum, palpi and antennae black. Head brownish black, sparsely pruinose to appear opaque, more conspicuous on anterior vertex.

Thorax black, heavily pruinose to appear gray, the central praescutal stripe darkened anteriorly; dorsopleural membrane brown. Halteres blackened. Legs black. Wings weakly darkened, stigma very long and narrow, brown; veins darker brown. Venation: Sc_1 ending nearly opposite fork of *Rs*, Sc_2 removed from tip, Sc_1 alone longer than *m-cu*; R_{2+3+4} variable in length from about one-third to nearly one-half *Rs*; cell R_3 very extensive at margin; *m-cu* at or close to fork of *M*.

Abdomen, including hypopygium, black. Male hypopygium with the glabrous flange of outer lobe of basistyle very large, semicircular in outline, terminating the lobe. Outer dististyle a slender rod, near its base with a conspicuous knob; intermediate style longest, stem narrow, setiferous, at apex with two blackened blades, the more slender one lying transversely across the face of the second triangular point; inner style narrowed outwardly, its apex bent laterad into an acute spine, the latter with small weak setae near its base. Aedeagus with terminal hook strongly curved.

HOLOTYPE: ♂, Kelang, Kameng, North East Frontier Agency, Assam, 6,000 feet, July 2, 1961 (Schmid). Paratopotypes, 3 ♂♂, with the type.

The most similar regional species are *Gonomyia* (*Protogonomyia*) *acustylata* Alexander and *G.* (*P.*) *megalomata* Alexander, which similarly have the outer

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[1] Contribution from the Entomological Laboratory, University of Massachusetts.

flange of the lobe of basistyle large and flattened, all three species differing among themselves in details of hypopygial structure.

Erioptera (Teleneura) **laetipes** n.sp.

General coloration of mesonotum medium brown, lateral praescutal borders and posterior sclerites more yellowed; pleura chiefly dark brown, meron yellowed; legs with femora and tibiae yellowed, appearing more darkened by vestiture, tarsi and tips of tibiae clear light yellow; modified scales of legs elongate, subequal in size to the setae; wings tinged with brown, prearcular and costal fields slightly darker.

FEMALE: Length about 5–5.5 mm; wing 5–6 mm.

Rostrum and palpi black. Antennae black throughout, verticils elongate. Head clear light yellow.

Pronotum obscure yellow. Mesonotum chiefly medium brown, lateral praescutal borders and area surrounding the wing root broadly yellow, mediotergite paler brownish yellow. Pleura chiefly dark brown, meral and dorsopleural regions extensively more yellowed. Halteres brownish black, base of stem yellow. Legs with coxae and trochanters brownish yellow; femora and tibiae yellowed but appearing darker from the abundant vestiture that includes elongate scales that are subequal in size to the normal setae, tarsi and tips of tibiae light yellow. Wings tinged with brown, prearcular and costal fields slightly darker; veins pale brown, trichia darker. Venation: Cord at near two-fifths the wing length; R_{2+3+4} from two-fifths to one-half *Rs*; R_{2+3} and R_2 subequal; veins beyond cord long and generally parallel to one another, as in the subgenus; vein *2nd A* gently sinuous.

Abdomen brownish black; valves of ovipositor horn-yellow.

HOLOTYPE: ♀, Talung Dzong, Kameng, North East Frontier Agency, Assam, 7,800 feet, June 6, 1961 (Schmid). Paratopotypes, 2♀♀, pinned with the type.

Erioptera (Teleneura) laetipes is distinguished most readily from other generally similar species with unpatterned wings by the light yellow tarsi, the most similar species being *E. (T.) ctenophora* Alexander and *E. (T.) parallela* Brunetti. A key to the species was provided by the writer at the time of defining the subgenus *Teleneura* (Philippine Jour. Sci. **46:** 286–287; 1931). Edwards (Jour. Fed. Malay States Mus. **17:** 277; 1933) indicates that *Erioptera nigribasis* Edwards, placed in *Teleneura* on venational characters, lacks the modified scales on the legs as possessed by other species and its position here may be in question.

Ormosia (Ormosia) **furcivena** n.sp.

Size large (wing of female 7 mm); mesonotal praescutum obscure yellow with three light brown stripes, posterior half of central one with a dark brown median line; femora yellow with basal and subterminal darkened bands; wings medium brown, conspicuously variegated by whitish yellow areas chiefly before the cord, outer radial field uniformly brown; small darkened spots along cord and elsewhere on disk; vein *2nd A* with a strong supernumerary vein to the wing margin bisecting the cell.

FEMALE: Length about 6.5 mm; wing 7 mm; antenna about 1.4 mm.

Rostrum brown; palpi black. Antennae with scape light brown; proximal six flagellar segments large, weakly bicolored, pale brown with yellowed apices, outer segments darker. Head dark brown, with abundant yellow setae.

Pronotum brown. Mesonotal praescutum obscure yellow with three light brown stripes, posterior half of the broad central one with a narrow dark brown median vitta; posterior sclerites of notum light brown. Pleura dark brownish gray. Halteres yellow. Legs with coxae brownish gray; trochanters obscure yellow; femora yellow with a nearly basal diffusely darkened ring and a narrower subterminal band, the extreme tip yellow; tibiae brownish yellow with darkened vestiture; tarsi dark brown. Wings medium brown, variegated by large whitish yellow spots before cord, beyond cord with cells R_3 to *2nd* M_2 uniformly of the ground; the major whitened areas include cell R_1 and adjacent cell *Sc*, and a small post-stigmal brightening; further pale marks in both ends of cells *R* and *1st A*, outer end of cell *M*, base of *2nd A*, and at base and near apex of *1st* M_2; vestiture of wings dark in the brown portions, yellow in the whitened areas; veins light brown, darker along cord, R_2, *m*, and vein *2nd A*, including the fork; all longitudinal veins excepting R_5 and *1st A* vaguely darkened at margins. Venation: R_2 close to radial fork; *m* transverse; *m-cu* shortly before fork of *M*; vein *2nd A* at near midlength with a strong branch that attains the posterior margin.

Abdomen dark brown, provided with abundant yellow setae. Ovipositor horn-yellow, the acute tips of cerci narrowly blackened.

HOLOTYPE: ♀, Hkayam Boum, Manipur, Assam, 8,500 feet, June 22, 1960 (Schmid).

Ormosia (*Ormosia*) *furcivena* is most similar to species such as *O.* (*O.*) *idioneura* Alexander and *O.* (*O.*) *idioneurodes* n.sp., being told by the pattern of the legs and wings and by the venation, especially the supernumerary crossvein in cell *2nd A*. The uniformly darkened outer radial field of the wing is noteworthy.

Ormosia (*Ormosia*) **idioneurodes** n.sp.

Allied to *idioneura;* general coloration of body brownish yellow and dark brown; antennae of male relatively long; halteres pale yellow; legs brown, bases and tips of femora yellowed; wings with ground whitened, patterned with light brown; a supernumerary crossvein in cell R_3; male hypopygium with two very unequal dististyles, the larger one with tip acute, gonapophyses appearing as flattened dark-colored blades.

MALE: Length about 4.5 mm; wing 4.6 mm; antenna about 1.4 mm.

Rostrum and palpi black. Antennae relatively long, more than one-fourth the wing, brown; flagellar segments long-oval, the more proximal ones with very long verticils exceeding twice the segments, much shorter outwardly. Head dark brownish gray, with abundant porrect yellow setae.

Pronotal scutum dark brown, scutellum and pretergites pale yellow. Mesonotal praescutum brownish yellow with a darker central stripe that is margined narrowly with darker brown, sides of sclerites similarly darkened; pseudosutural foveae oval, blackened, conspicuous; scutum with the broad central area dark brown, lobes obscure brownish yellow, dark brown laterally; scutellum and postnotum dark brown, the former with very long yellow setae. Pleura dark brown, dorsopleural region slightly paler; propleura and dorsal pteropleurite with very long yellow setae. Halteres pale yellow. Legs with coxae and trochanters dark brown; femora with base and apex yellowed, with more than the central half darker, the color produced especially by dark setae; tibiae and tarsi light brown. Wings with ground whitened, base and costal region more yellowed, most veins seamed with light brown to produce a variegated appearance; veins brown, more yellowed in the costal interspaces. Venation: Sc_1 ending about opposite R_2, Sc_2 far retracted; R_2 at radial fork; a supernumerary crossvein in cell R_3 at near two-thirds the length beyond which vein R_4 is strongly upcurved; cell *2nd* M_2 square at origin, *m* being transverse, with a short spur at the angulation; *m-cu* nearly its own length before fork of *M*; vein *2nd A* strongly sinuous.

Abdomen, including hypopygium, dark brown. Male hypopygium with tergite conspicuous, subrectangular in outline, outwardly parallel-sided, posterior border gently emarginate. Basistyle short and stout, outer setae very long. Dististyles two, very unequal, one a small pale lobe that narrows to the obtuse tip; second style very large, a powerful blackened rod, its outer third curved to an acute point. Phallosome with each gonapophysis a flattened dark blade, nearly parallel-sided, apex turned laterad into an acute point, outer margin with a few microscopic denticles; aedeagus subequal in length, narrowed gradually outward, tip truncate.

HOLOTYPE: ♂, Sirhoi Kashong, Manipur, Assam, 7,500 feet, June 9, 1960 (Schmid).

The larger *Ormosia* (*Ormosia*) *idioneura* Alexander, of northeastern Burma, likewise has a supernumerary crossvein in cell R_3 of the wings, differing in the more heavily patterned wings, with *m-cu* close to the fork of *M*. The male sex of *idioneura* is unknown.

Ormosia (*Ormosia*) **idiostyla** n.sp.

Allied to *geniculata*; mesonotal praescutum light brown with a narrow dark brown central stripe, posterior notum and pleura dark brown; knobs of halteres weakly darkened; femora black, tips very narrowly pale yellow, tibiae and tarsi black, posterior tarsi light brown; wings weakly darkened, variegated by whitened areas, arranged almost as in *geniculata*; male hypopygium with dististyles long and slender, outer style terminating in a long acute spine and bearing a small bispinous blade at near midlength, inner style extended into a long black spine; gonapophyses compact, each bispinous at apex.

MALE: Length about 4.5–4.8 mm; wing 4.8–5.3 mm; antenna about 1.5–1.6 mm.

FEMALE: Length about 4 mm; wing 4.5 mm.

Rostrum dark brown, palpi black. Antennae with scape brown, pedicel large, whitened; flagellum dark brown, the apices of the individual segments pale, outer six segments uniformly darkened; proximal flagellar segments with very long verticils, the longest about two and one-half times the segment, outer verticils shorter. Head dark brown.

Pronotum dark brown, sides of scutellum and anterior pretergites pale yellow. Mesonotum light brown, praescutum with a narrow dark brown central stripe that is slightly interrupted behind the tuberculate pits; scutum light brown, scutellum and postnotum dark brown. Pleura dark brownish gray, indistinctly lined with short black marks, dorsopleural membrane darkened. Halteres with stem yellow, knob weakly darkened. Legs with coxae dark brown, trochanters slightly paler; femora brownish black, tips very narrowly pale yellow, including the vestiture; tibiae and tarsi black, posterior tarsi light brown. Wings weakly darkened, variegated by whitened areas, these arranged almost exactly as in *geniculata*, before cord including major spots in cells *R*, *M*, *Cu* and anals, beyond cord with arcuate bands, the posterior one almost a circle, bisected by vein M_4; veins brown, paler in the prearcular and stigmal regions. Costal fringe variegated yellow and dark, those of the stigmal region unusually conspicuous. Venation: *m-cu* shortly before fork of *M*.

Abdomen, including hypopygium, black. Male hypopygium with tergite transverse, the outer end more expanded, truncate, with microscopic pubescence, with larger setae from the base of the head caudad. Basistyle stout, with some of the outer apical setae very long, yellow, the more proximal ones smaller, those of mesal face of style very small and delicate. Outer dististyle shorter and stouter than the inner, long and narrow, produced into a slender black spine, beneath which is a slightly broader blade that terminates in a narrowly blackened point, the lower margin membranous, with small setae; outer margin of style at near midlength with a small blade that forks into two unequal black spines, the outer one shorter and stouter; inner style long and slender, before midlength twisted, gradually narrowed into a long slender spine. Phallosome with gonapophyses short and compact, terminating in two divergent short black spines.

HOLOTYPE: ♂, Rumkhang, Khasi-Jaintia, Assam, 2,000 feet, March 20, 1960 (Schmid). Allotopotype, ♀, 5,500 feet, March 24, 1960. Paratopotype, ♂, with the allotype.

While similar in general appearance to *Ormosia* (*Ormosia*) *geniculata* (Brunetti), the present fly differs in the blackened tibiae and tarsi and especially in the very different hypopygium, including the tergite, both dististyles, and the gonapophyses.

Ormosia (*Ormosia*) **neopulchra** n.sp.

Generally similar to *pulchra;* general coloration of thorax gray, praescutum with a brown central stripe; antennae relatively long, flagellum brownish black; femora yellow, conspicuously patterned with black; wings light brown with conspicuous whitened spots that include a marginal series; male hypopygium without acutely pointed dististyles.

MALE: Length about 5–5.2 mm; wing 5.4–5.8 mm; antenna about 1.6–1.7 mm.

Rostrum dark brown, palpi black. Antennae relatively long, as shown by the measurements; scape and pedicel testaceous yellow, flagellum brownish black, the incisures of the more proximal segments restrictedly yellowed; flagellar segments subcylindrical, the longest verticils of the intermediate segments about two and one-half times the segments, the erect whitish pubescence conspicuous. Head gray.

Pronotum brownish gray, paler laterally; pretergites light yellow. Mesonotum gray, praescutum with a brown central stripe, the lateral pair scarcely differentiated from the ground; vestiture of praescutum and scutum long and conspicuous. Pleura gray, ventral sternopleurite paler. Halteres yellow. Legs with coxae brown; trochanters yellowed, tips narrowly darkened; femora yellow, conspicuously banded with dark brown, on middle femora bases broadly yellow, central darkened ring narrow, fore and hind femora more uniformly dark brown, bases not or scarcely brightened, yellow subterminal ring much narrower than the restricted yellow apex; tibiae and tarsi light brown, outer segments darker. Wings light brown with conspicuous whitened spots, the most evident being marginal in cells R_2 through *2nd* M_2 and in cell *1st A* at the bend of vein *2nd A*; remaining whitened areas more extensive but less distinct, in bases of cells *R* and *M* and most of R_1 and M_2; stigma darker than the ground; veins brown. Venation: R_2 near fork of R_{2+3+4}; tips of veins R_3 and R_4 strongly upcurved; vein *2nd A* sinuous, with a strong loop at and beyond midlength that narrows the cell.

Abdomen brownish black. Male hypopygium with median tergal lobe broad, apex shallowly emarginate. Longest dististyle a narrow gently curved rod, apex subobtuse, blackened, with an oval pale lobe on outer margin at base; inner style slightly broader, tip very obtuse to subtruncate. Each gonapophysis a broad subtriangular blackened plate, with two slender acute points additional to the stouter apex.

HOLOTYPE: ♂, Rahung, Kameng, North East Frontier Agency, Assam, 7,000 feet, April 25, 1961 (Schmid). Paratypes, 2♂♂, Chug, Kameng, 7,300 feet, April 17, 1961.

The most similar regional species are *Ormosia* (*Ormosia*) *kashmiri* Alexander, *O.* (*O.*) *pulchra* (Brunetti), and *O.* (*O.*) *subpulchra* Alexander, differing among themselves chiefly in hypopygial structures. All of the above species have the dististyles terminating in spinous points, not obtuse as in the present fly.

The Influence of Weather on the Activity and Behavior of Greenhead Flies, *Tabanus nigrovittatus* Macquart and *Tabanus lineola* Fabricius[1]

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Abstract: The influence of weather conditions on the activity and behavior of greenhead flies, *Tabanus nigrovittatus* and *T. lineola*, was determined. Trap catches correlated with weather records showed that fly activity was related to maximum temperature, average temperature, and cloud cover, but not to the wind speeds and minimum temperatures observed. Fly behavior towards the traps used was influenced by wind speed and direction. Data indicated that greenheads dispersed randomly with respect to both compass directions (trap locations) and prevailing wind directions. More greenheads were found on the marsh near the upland than farther out, and significantly more fly at a height of 1.5 to 3 ft. above the marsh surface than at 3 to 5 ft.

INTRODUCTION

Tabanus nigrovittatus Macquart and *Tabanus lineola* Fabricius are two "greenhead" horseflies found in close association on New Jersey coastal salt marshes. MacCreary (1940), Bailey (1947), Hansens (1952), and Jamnback and Wall (1959) have noted the marked influence which weather conditions, especially temperature, cloudiness, and wind, have upon the activity of these species. A great influence of meteorological factors on such activity is also shown by studies on other Tabanidae (Tashiro and Schwardt, 1949; Roth and Lindquist, 1952; Miller, 1947). Especially important is the effect of weather on the response to trapping or census methods noted by Jamnback and Wall (1959), who utilized adhesive coated boards.

At Leeds Point, New Jersey, the complex of greenheads consists of 90–95% *T. nigrovittatus* and 5–10% of *T. lineola*. In studies during the summer of 1966 the objective was to separate daily activity from seasonal population trends and to analyze the effect of weather on activity. Primarily the effect of wind speed and direction on the dispersal of the greenheads and their behavior toward "sticky" traps was considered. Data were also obtained on the vertical flight distribution and the horizontal distribution of greenheads over the marsh, and the effect of temperature and cloud cover on activity.

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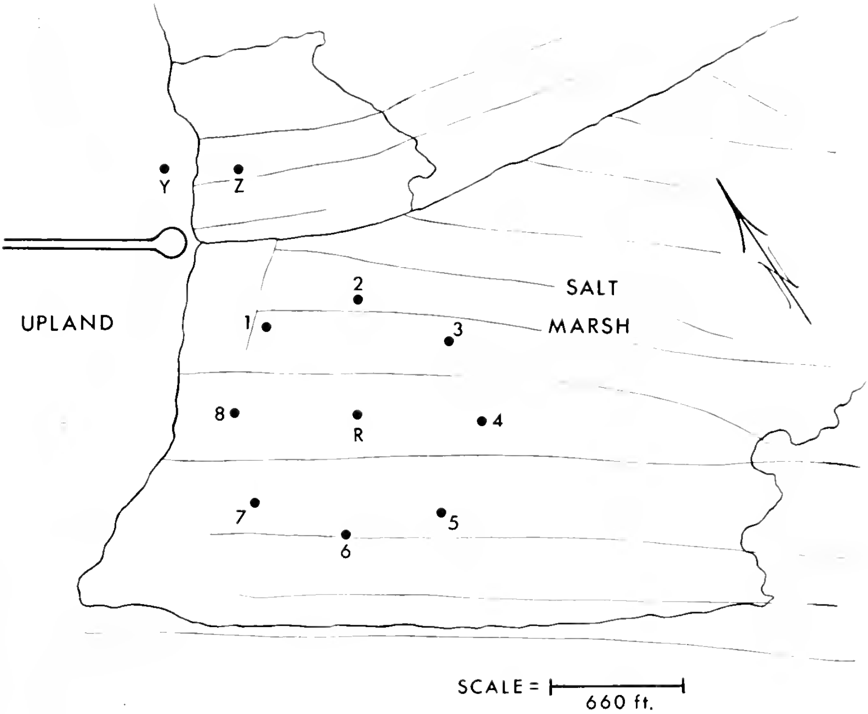

Fig. 1. Study area at Leeds Point showing the circle traps (1 through 8). The weather station and release points (R) and vertical traps (y and z). The lines on marsh (to right) show ditching.

MATERIALS AND METHODS

The relative population census and activity data were taken by counting the numbers of flies caught in Tanglefoot on metal traps set in a circular pattern on the marsh. The traps consisted of sheet metal panels attached to the 4 sides of vertical stakes to form 4 vanes; each stake, therefore, held 8 collecting surfaces, each 1 sq. ft. in area. Eight traps were placed at equal distances along the circumference of a circle of 400-ft. radius; the traps were painted black to attract the flies and covered with Tanglefoot. The traps were so arranged that the vanes were centered at 18 in. above the marsh. Two traps similarly constructed, but consisting of 4 sets of 4 vanes each, with centers at 9, 24, 39, and 54 in., from the marsh surface were used to determine the vertical flight distribution. Sticky black traps catch female greenheads but few males, and are effective only for relative population measurements.

The circle traps (Fig. 1, 1 to 8) were located in a fairly uniform area of the marsh and ranged from 400 to 1200 ft. from the upland or edge of the marsh.

Table 1. Flies trapped, temperature, cloud cover, and wind speed. July 28 to Aug. 30, 1966.

Date	No. Flies Trapped[a]	Max. Temp. °F	Min. Temp. °F	Average Daytime Temp. °F	Cloud Cover (10ths)	Average Wind Speed (mph)
July						
28	1			71	9	9.5
29	24	83	64	78	8	3.3
30	1	65	59	63	10	4.8
31	2	72	57	68	4	7.7
August						
1	20	85	56	78	1	6.5
2	3	72	62	70	8	11.0
3	7	75	57	69	3	5.0
4	15	75	52	71	6	3.2
5	0	71	59	69	10	6.5
6	8	78	55	75	3	3.7
7	7	74	55	70	8	3.0
8	3	78	65	72	7	5.0
9	2	74	65	70	10	5.0
10	18	80	66	74	6	6.0
11	9	79	66	76	6	9.7
12	2	79	63	73	6	3.0
13	—	—	—	—	—	—
14	—	—	—	—	—	—
15	—	—	—	—	—	—
16	—	—	—	—	—	—
17	10	83	65	78	0	6.0
18	19	81	57	78	1	4.3
19	13	84	65	72	5	—
20	4	73	66	74	7	—
21	6	78	65	—	—	—
22	9	80	70	—	—	—
23	8	86	65	—	—	—
24	3	78	56	—	—	—
25	9	76	56	—	—	—
26	—	—	—	—	—	—
27	—	—	—	—	—	—
28	—	—	—	—	—	—
29	—	—	—	—	—	—
30	10	80	64	—	—	—

[a] Average on 32 sq. ft. traps.

The two vertical traps were located at about 25 ft. and 400 ft. from the upland (Fig. 1, y and z).

A recording weather station was established at the center of the circle of traps. It consisted of a hygrothermograph, a poteniometer-type wind vane (Rochester Instrument Co., Coeur D'Alene, Idaho), and a generator-type cup anemometer (Model F420C, Electric Speed Indicator Co., Cleveland, Ohio). Both of the wind instruments were combined with Rustrak Model 88/135-8 cordless (battery) recorders (Rustrak Instrument Co., Inc., Manchester, N. H.) to make constantly recording self-powered units for field use. The anemometer was calibrated with the recorder in a wind tunnel by establishing a curve of wind speed

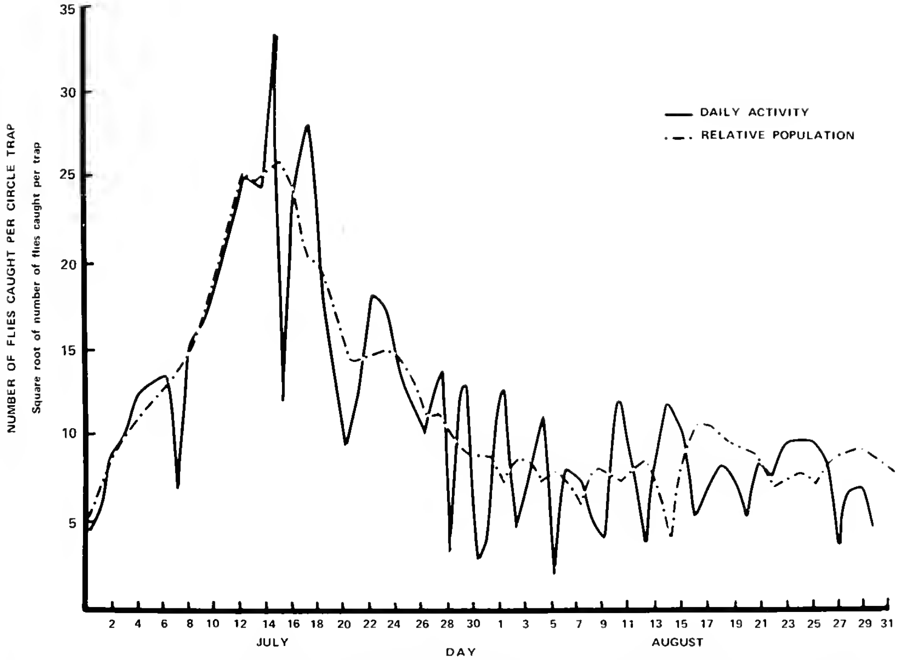

Fig. 2. Daily greenhead (*T. nigrovittatus, T. lineola*) activity expressed as the square root of the number of flies captured on each circle trap each day (solid line), and the relative seasonal population trend, obtained by taking 5 day running means of above (dashed line).

versus the meter reading with the aid of a calibrated anemometer. The instruments were located about 2.5 ft. from the marsh surface, well within range of normal greenhead flight. In addition, observations of cloud cover (percent of sky covered with clouds) were recorded.

The data from this field station were augmented by data from ESSA weather stations at Pamona, N. J., and Atlantic City, N. J. Observations at 3-hr. intervals and daily averages were used from these stations.

Data were collected from the 8 circle traps twice daily by counting and removing the flies caught on each side of each vane of a trap. On the vertical traps, flies were counted once daily. Weather data recorded during each catch period were subsequently compared with the catch of flies.

Correlation coefficients (r) were calculated for the degree of association of average daytime temperature (8 AM–8 PM), daily maximum temperature, daily minimum temperature, cloud cover, and wind speed with numbers of flies trapped. The afternoon fly counts were used for this analysis because the weather was more uniform during this period. Activity was interpreted as the daily changes in fly catch on the circle traps, and relative population trends were separated from activity by 5-day running averages of the daily fly catches.

TABLE 1a. Correlation of variables during observation period July 28 to August 30.

Variables	Correlation Coefficient r	Significance t
Max. daily temp. vs. fly activity	0.653	17.070**
Daytime (8 AM–8 PM) temp. vs. fly activity	0.553	10.141**
Min. daily temp. vs. fly activity	–0.037	0.023 None
Cloud cover vs. fly activity	–0.492	8.575**
Cloud cover vs. daytime temp.	–0.601	10.169**
Wind speed vs. fly activity	–0.251	1.076 None
Wind dir. vs. dir. of trap catching least flies	0.939	134.542**
Wind speed vs. index of high catching two sides over low catching two sides	0.706	28.769**

** Significant at the 1% level.

All data were subjected to an analysis of variance for variability due to time (days) and to location for the circle traps, and to time, location, and height in the case of the vertical traps.

The data from the two sides facing a given compass direction on each circle trap were combined for all 8 traps and analyzed with the wind direction recorded during each catch period. Also, the tendency for greater numbers to be caught in one direction with increasing wind speed was analyzed by comparing index of the greatest number of flies caught on any 2 sides facing a given direction with the number of flies caught on the 2 sides facing the opposite direction (usually the smallest number). Linear correlation analysis was used to determine the intensity of association of these variables with wind measurements.

For dispersal studies, live flies caught by various methods were anesthetized with CO_2, counted, marked with daylight fluorescent powder in a bag, and released in the center of the circle of traps. Releases were made in late afternoon until it was discovered that better recovery resulted from releases at about noon. To determine the effect of wind on dispersal, trapped marked flies were recorded during the regular counts on the circle traps and these data were later compared with the wind data from the time of release to time of counting.

RESULTS AND DISCUSSION

Data showing daily activity and relative seasonal population trends expressed as the square root of the fly collections appear in Fig. 2. Results indicate that

TABLE 2. Dispersal of Greenheads with Respect to Trap Direction.

Trap No.	1	2	3	4	5	6	7	8	Total
Direction from Release Point	N	NE	E	SE	S	SW	W	NW	Total
Nos. Observed	11	10	19	9	11	9	5	10	84
Nos. Expected	10.5	10.5	10.5	10.5	10.5	10.6	10.5	10.5	84

Chi Square = 10.48, not significant.

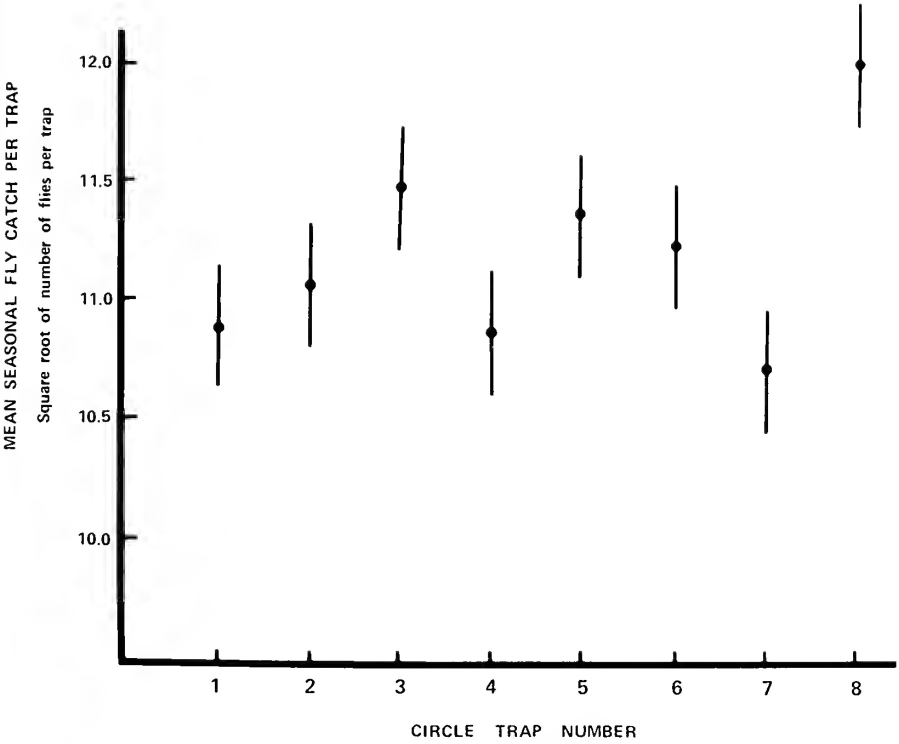

Fig. 3. Seasonal mean fly catch for each circle trap, with 95% confidence limits.

on a given day all the flies were not always active, so that the true population is actually higher than that shown. Detailed examination of data showed that temperature is one of the major factors affecting fly activity. For example, the temperature dropped suddenly from a maximum of 85°F the preceding day to a maximum of only 70°F on July 15, 1966. This resulted in decreased fly activity to only 13% of the preceding day (Fig. 2). The following day, 4 times more flies were caught, as the maximum temperature rose to 74°F. More of the population was thus active on warmer days than on cooler days.

This is verified by correlation of fly activity and temperature (Table 1 and 1a.). High correlation was found between average daytime (8 AM to 8 PM) temperature and greenhead activity ($r = 0.553$), but fly activity showed greater correlation with daily maximum temperature ($r = 0.653$), indicating that the daily maximum temperature had a greater influence on activity than average temperature. Daily minimum temperature showed no correlation with fly activity, indicating that the minimum temperatures observed were not a factor in greenhead activity. Thus, the higher the daily maximum temperature, the more active the greenheads.

Table 3. Dispersal of Greenheads with Respect to Wind Direction.

Dispersal c respect to wind:	With ($^3/_8$)	Against ($^3/_8$)	Perpendicular to ($^2/_8$)	Total
No. of Greenheads Observed	30	34	20	84
No. of Greenheads Expected	31.5	31.5	21	84

Chi Square = 0.59, not significant.

A significant correlation was found between indices of cloud cover estimate and fly activity (r = 0.492). Strong correlation, however, also existed between cloud cover and temperature (r = 0.601), as cloud cover decreased temperature by decreasing the solar insolation. Thus, cloud cover and temperature showed similar degrees of correlation with fly activity. Temperature appeared to be the primary factor to which the flies reacted, as indicated by higher correlation coefficients.

No correlation was found between average wind speeds up to 11 mph and fly activity. Wind had the greatest significance, however, in the behavior of the flies toward the traps. The two sides of the trap facing the direction from which the wind came always caught the least number of flies, and the sides away from the wind always caught the greatest number (r = 0.939). As the wind speed increased, the tendency for the flies to be caught on the sides of the trap away from the prevailing wind direction increased. These data suggested that, as the flies approached the trap surface to alight, they oriented into the wind so as to land on the leeward side of the trap. Field observations confirmed this hypothesis. Before landing, flies first circle the traps, and then, flying into the wind, approach them.

Of 7000 flies marked and released in the dispersal study, 84 (1.2%) were recovered on the circle traps. The dispersal was found to be random both with respect to trap directions (Table 2) and with respect to wind direction (Table 3), by use of the chi square test. It is, however, interesting that almost 4 times more flies moved eastward (Trap 3) from the release point than westward (Trap 7).

An analysis of variance of the circle trap data by use of Tukey's procedure for calculating confidence limits (Fig. 3) (Table 4) showed significant differences

Table 4. Analysis of Variance for Circle Traps.

Source of Variation	Degrees of Freedom	Sums of Squares	Mean Squares
Days	61	21379.22	350.48
Positions (Traps)	7	84.14	12.02
Residual (Error)	427	384.77	0.90
Total	495	21848.13	

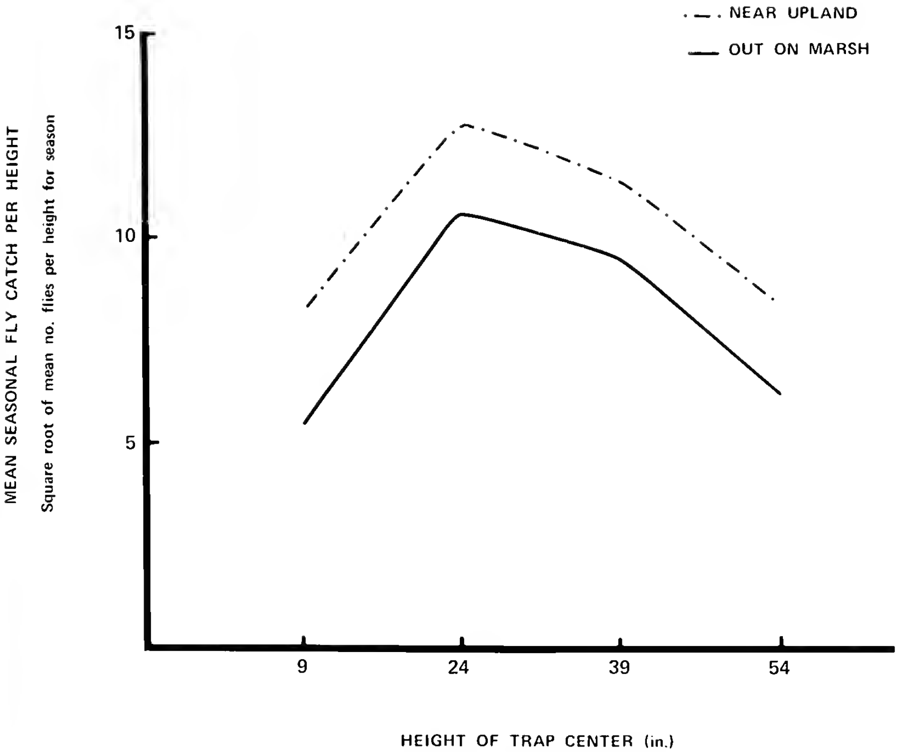

Fig. 4. Mean seasonal fly catch of vertical traps at four heights above the marsh.

among the seasonal mean catches of the 8 traps. Data taken indicate a possible orientation to and a congregation near the upland. Large aggregations of greenheads were also noticed consistently in the vicinity of Trap 3. Aggregation may have occurred elsewhere, but if so was not evident from the data.

An analysis of variance on the vertical traps (Table 5) showed significant differences in fly catches between the two locations and the height at which

Table 5. Analysis of Variance for Vertical Traps.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	"F"
Days	58	15984.19	275.59	
Locations (Traps)	1	646.15	646.15	143.59**
Heights	3	1821.98	607.33	134.96**
Location × Height	3	65.31	21.77	4.84**
Error	406	1892.01	4.50	
Total	471	20346.64		

** = significant at the 1% level.
"F" = 13.3** for traps (significant at the 1% level).

flies were trapped (Fig. 4). The trap within 25 ft. of the upland caught 23% more flies than the one 400 ft. out on the marsh. The mean numbers of flies caught at 9 and 54 in. were not significantly different from each other, but were significantly different from those caught at 24 and 39 in. About 60% of the total flies were caught on the traps centered at 24 and 39 in. Thus more flies are caught at a height of 1.5 to 3 ft. from the marsh surface and closer to the upland. Jamnback and Wall (1959) in New York and Rockel (1967) in New Jersey obtained similar data.

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The Relative Abundance of Two Digger Wasps, *Oxybelus bipunctatus* and *Tachysphex terminatus*, and Their Associates, in a Sand Pit in Central New York

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Abstract: Two areas in a sand pit at Groton, New York, each 105 × 50 × 15 cm, were excavated and sifted through a screen. The nest contents of digger wasps, their cocoons, and their parasites were sorted and identified. In both areas, nests of the sphecid *Oxybelus bipunctatus* were more numerous than those of other digger wasps and parasitic flies combined. Puparia of at least two species of miltogrammine sarcophagids, *Phrosinella fulvicornis* and *Senotainia trilineata,* were next most abundant. Nests of the digger wasp *Tachysphex terminatus* were third most numerous.

Oxybelus bipunctatus Olivier and *Tachysphex terminatus* (Smith) are two common digger wasps in sand pits in the northeastern United States. Both species have nested in large numbers in a sand pit at Groton, New York, since 1960; perhaps since shortly after the beginning of the pit in the late nineteen forties. In 1960 females of *O. bipunctatus* were about three times as numerous as those of *T. terminatus.* In 1967 there was a greater disparity in the numbers of nesting females of these species. In order to determine the relative abundance of each species two areas of sand, each 150 × 50 cm, and separated by about 2 meters, were excavated to a depth of 15 cm with a trowel on August 1 and 2, 1967. The sand was sifted through a fine screen to ensure that the contents of the cells would not be lost. The cells are easily distinguishable: *O. bipunctatus* stores small flies, *T. terminatus,* small grasshoppers; cells of *O. bipunctatus* are usually about twice as deep as those of *T. terminatus* at the same time of year; cocoons of *O. bipunctatus* are smaller and more uniform in color than those of *T. terminatus.* Nest cells of *O. bipunctatus* are easily confused with those of *O. uniglumis quadrinotatus* Say, a larger species with similar behavior; the latter

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TABLE 1. Number of cells, including cocoons, of *Oxybelus bipunctatus, Tachysphex terminatus,* and other digger wasps, and puparia and parasitic larvae in two 105 × 50 × 15 cm areas in a sand pit at Groton, New York.

	Area A	Area B	Total
	SPHECIDAE		
Oxybelus bipunctatus	97	65	162
Tachysphex terminatus	12	12	24
Plenoculus davisi	1	5	6
Bembix spinolae	3	0	3
	PARASITES		
Puparia of *Phrosinella, Senotainia*	35	29	64
Larvae of *Phrosinella, Senotainia*	11	9	20
Larvae of *Anthrax* sp.?	7	3	10
Pupae of *Anthrax* sp.?	3	0	3

species, once common at this locality, is now scarce. Cells of *T. terminatus* cannot be confused with those of any other sphecid in this region. No other species stores small grasshoppers and builds shallow nests.

In the two areas, and undoubtedly others in the sand pit, cells of *O. bipunctatus* were closer together and more numerous than those of *T. terminatus* (Table 1). Groups of three or four cells of either species were exposed close together, probably multicellular nests or one-celled nests in series. Puparia and maggots of at least two species of miltogrammine sarcophagids, *Phrosinella fulvicornis* (Coquillett) and *Senotainia trilineata* (Wulp), were also numerous. Both species of flies are known parasites in the nests of many species of digger wasps, including *O. bipunctatus* and *T. terminatus* (see Allen, 1926; Olberg, 1959). Two puparia were often found near a single wasp cell, suggesting that more than one maggot per cell may be laid. Occasionally, three or four puparia were exposed close together. The attacks of such a miltogrammine thus might be focused on one wasp nest at a time, including most or all of the cells. Several cocoons of *T. terminatus* each contained either a larva or pupa of a bombyliid, possibly a species of *Anthrax*. A pupa of *Anthrax albofasciatus* (Macquart) was found inside each of 6 of 15 (40%) cocoons of *T. terminatus* taken from the same sand pit in May, 1962. Marston (1963), in his revision of the *Anthrax albofasciatus* group, gives further information on this fly-digger wasp relationship. Scattered groups of cells of two other sphecids, *Bembix spinolae* Lepeletier and *Plenoculus davisi* Fox, were occasionally uncovered. The former species hunts large flies and constructs long cells, the latter, small mirids and small cells. Cells of some other digger wasps known to be nesting in the sand pit were deeper than 15 cm and not exposed during the excavations. These species included *Philanthus politus* Say and *Tachytes validus* Cresson.

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BOOK REVIEW

The Ecology of Insect Populations in Theory and Practice. L. R. Clark, P. W. Geier, R. D. Hughes, and R. F. Morris. Barnes and Noble, Methuen, 1967, 232 pp., price $8.00.

This book discusses the ecological considerations underlying the economic control of insect pests, a narrower topic than the one indicated by its title. However, it is one of the best books of its kind, and, if the misleading title encourages wide readership, that is all for the good, for it is to be commended to readers with many different interests. Ecologists will find the book a valuable guide to the better ecological work being done by applied entomologists, an area too much neglected in ecology courses and review papers. Economic biologists will benefit from seeing such a fine example of modern ecological methodology and theory presented in relation to their own research interests. Other biologists, both professional and amateur, will discover a readable and enjoyable account of how population ecologists look at the lives of insects.

Of the seven chapters, I and II are introductory, III is a critique of the theories of population limitation, IV explores ways of viewing insect populations and their environments as "life systems" and gives nine case histories as examples of this approach, V is an appraisal of current ecological methodology, VI deals specifically with pest control, and VII is a brief look at the future of applied insect ecology. Chapter IV comprises about half of the book, and to many readers it will be the most interesting. This is because all of the case histories are excellent ecological studies, and many of them are much less known than they should be. (Incidentally each of the authors of the book participated in one of the studies reported in Chapter IV.)

The book is well indexed, and the subject headings, figures, and table of contents are excellent. There are remarkably few errors. The authors' penchant for reviewing little noted but excellent studies in applied ecology makes the bibliography especially interesting.

It is important for pest control biologists to get a sound background in ecological principles, and for this reason this fine book should be considered for use as an introductory text for students of applied entomology.

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Vespula maculifrons (Hymenoptera: Vespidae) Preying on the European Earwig *Forficula auricularia*

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Abstract: The earwig *Forficula auricularia* is reported as prey of a Nearctic vespine wasp, *Vespula maculifrons*, for the first time. Ten percent of 120 prey collected from provisioning workers on 7 August 1967 proved to be adult earwigs. Most individuals had parts of their head, legs, and cerci amputated by the wasps. Some of the captured dermapterans exhibited rhythmic movements of the appendages.

The social wasps or vespids feed their larvae primarily with food of animal origin (Bohart, R. M. 1951. *In* Muesebeck, C. F. W., *et al.*). In the genera *Vespa*, *Vespula*, and *Dolichovespula* the food consists chiefly of chewed-up insects. The insects are captured and then macerated with the mandibles. The sting which serves to paralyze and preserve the prey in the solitary, hunting wasps functions primarily as a weapon of defense in the social wasps.

Duncan (1939) summarized the recorded insect prey of species of Vespinae. He found that adult Diptera form a "large percentage" of the records. Larval and adult Lepidoptera are also an important source of food. Few Homoptera are known to be taken by the wasps. However, in July, 1967, I observed workers of *Vespula maculifrons* (Buysson) carrying adults of an unidentified species of tree-hopper to their nest. Beetles are almost never preyed on by vespine wasps. Odonata and Orthoptera are rarely used as prey. Certain Hymenoptera are frequently captured, including honeybees, sawflies, chalcids, and winged ants. Janet (1903) reported finding the wings of a mecopteran among the food debris in a nest of *Vespa crabro* L. Rau (1930) reported *Dolichovespula maculata* (L.), the bald-faced hornet, capturing and killing "Vespa germanica" [= *Vespula maculifrons* (Buysson) ?], suggesting that large vespines may prey on small ones.

Two papers on the biology of *Vespula pensylvanica* (Saussure) give details on the capture of other hymenopterans. Smith (1956) observed workers during cold weather foraging inside honeybee hives. The wasps easily made their way

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past the "guard" bees at the entrances. At an air temperature of 33° F the worker bees were in clusters inside the hives and could offer no defense against the wasps. At other times, presumably during warmer temperatures, the honeybees drove the yellow jackets out of the hives. Some of the vespines were later found dead near the hives.

Chapman (1963) noted workers of *V. pensylvanica* "catching and eating" winged males and females of the ants *Formica subnuda* Emery and *Leptothorax muscorum* Nylander. "The wasps would fly alongside . . . , then dart in and capture an ant. They were observed . . . to alight near the point of capture and chew their prey. . . . The heads of *Formica* were often bitten off soon after capture. The wasps continually shifted and turned the ants while chewing them; then, . . . would drop the chewed fragments and fly away." Chapman (1963) believed the wasps fed only on the body juices of the ants. He did not observe workers carrying ants to the nest.

On 7 August 1967 I collected 120 provisioning workers of the yellow jacket *Vespula maculifrons*. Twelve (10%) of these wasps were carrying adults of the earwig *Forficula auricularia* L. On 15 August 1967 other workers were observed taking earwigs into the nest. Later in the month discarded pairs of earwig cerci were found almost daily beneath the nest entrance. Nearctic vespine wasps have never before been recorded to prey on Dermaptera.

The wasps' nest was built in a wall beneath the side door of my home in Marcellus, New York. The workers flew in with provisions every few seconds and attempted to take the captured insects into the nest. Workers that carried earwigs were readily distinguishable from those that carried other insects. They flew slowly, obviously burdened with a "heavy" load, and provided a large "target" easily spotted against a white background.

The damp conditions which prevailed during the midsummer of 1967 probably contributed to the production of large numbers of earwigs. They were numerous in my backyard under practically every piece of bark, between and under boards, stones, and leaves and in the debris at the bases of tree trunks. About 50 individuals occupied a crack where a gate closed against a fence. Parts of their bodies, usually abdomens and cerci, protruded from it. Yellow jackets were seen patrolling this area, flying in, and capturing the earwigs. The protruding bodies apparently provided visual stimuli to the hunting wasps. It was not possible to observe the manner of capture because the workers with prey flew off too rapidly. According to Duncan (1939) workers of Vespinae distinguish a "suitable" prey by its size, color, and contrast with the background. He observed workers of *Dolichovespula maculata* repeatedly attempting to capture the nailheads on a whitewashed cannery wall.

I collected two workers which would not release the earwigs. These prey were each clutched head forward and dorsal side up against the ventral side of the wasp's body. This does not mean, however, that the earwigs were captured and killed in this position. Two other prey dermapterans were apparently not dead. They exhibited rhythmic movements of the appendages.

Nine of the 12 earwigs had most of the head and parts of the legs and cerci amputated. Amputation of parts of the legs included mostly the femora, tibiae, and tarsi. The two dermapterans, which exhibited rhythmic movements of the appendages, had much of the head intact; the head of a third one had been masticated into a pulpy, though recognizable, head-shaped mass. The coxae of 11 individuals were intact on at least one side of the body. Nine earwigs had the abdomen intact of which six had the cerci at least partly amputated. The last segment of the abdomen, including the cerci, were missing in three prey. The dorsal surface of the thorax and most of the abdomen were undisturbed in the 12 dermapterans. The wings were in place and seemingly untouched. In general, each of the earwigs was easily recognizable as belonging to the Dermaptera. None had been masticated to the extent that it had lost its characteristic appearance.

Duncan (1939) also found that vespines often discard certain parts of their prey, including legs and wings, "because of their high percentage of heavily sclerotized integument and their relatively non-nutritious character." The head and abdomen are sometimes also discarded. He believed that the weight of the prey is important in determining the amount of amputation.

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The Homologies of the Female Genitalia in the Pentatomoidea (Hemiptera-Heteroptera)

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Abstract: The homologies of three medial structures are established: the *triangulin* is the fused first valvulae; the *arcus* is the fused second valvulae; and an unnamed more posterior structure is the fused second valvifers. The eighth paratergites are connected by an "interparatergal bridge," as are also the ninth paratergites.

Several of the sclerites of the pentatomoid ovipositor are often absent or very much reduced, and some primitively bilateral ones may be fused across the midline as well. This makes them hard to homologize with structures in other heteropteran groups, and the resulting confusion is reflected in the literature by an incorrect use of standard terms and by the invention of new ones (e.g., *arcus* and *triangulin,* Verhoeff, 1893).

My purpose is not to correct misinterpretations or the poor labelling of others; Dupuis (1955, 1963) has done this admirably, although I do not agree with some of his terminology (see below). I want merely to suggest here a terminology for the female genitalia of the Pentatomoidea which takes into account the probable homologies of the group's much reduced ovipositor. This terminology will be used in a more detailed study, now in progress, of the comparative morphology and relationships of the Pentatomoidea.

Dupuis prefers to restrict the term "ovipositor" to those Heteroptera with elongate laciniate valvifers and valvulae; where these have been reduced to plate-like structures, as in the Pentatomoidea, he speaks of "genital plates." I disagree. Both are ovipositors, in the etymological sense that both function in depositing eggs: laciniate ovipositors *into* crevices, and platelike ovipositors *onto* a substrate. Morphologically, all parts can be completely homologized, and indeed Dupuis uses the same terms for these parts. Also, the flattening and reduction of the ovipositor has probably occurred at least three times independently, in the Pyrrhocoroidea, the Coreoidea, and the Pentatomoidea (Schaefer, 1964; Stys, 1964; McDonald, 1966). It seems better, then, to refer to both sets of structures as "ovipositors," and to distinguish between "laciniate" and "platelike" or "flattened" ones.

The chief terminological and morphological confusion in the Pentatomoidea is over the triangulin, a median sometimes triangular, rather poorly defined sclerite. Verhoeff (1893, pp. 328–9), who coined the term, believed it to be formed by the fusion across the midline of the first valvulae, and he is followed by Dupuis (1955, p. 225), and, tentatively, by Kumar (1962, p. 49) and Stys (1964, p. 244). Scudder (1959, p. 414) suggests it may be a new structure, and Tay (1966) describes it in some Pentatomini as a *pair* of structures attached to *each* first valvifer. Her homologies are unlikely and the description does not fit that usually given of the triangulin.

The relationships of the triangulin to the first valvifer (Fig. 1) suggest to me that it does indeed represent the fused first valvulae, probably incorporating as well some of the intervalvular membrane (Kumar, 1962). Each latero-anterior "corner" of the triangulin is articulated via a small membrane to the inner wall of the corresponding first valvifer; the small membrane is probably the remnant both of the first ramus and of the valvula-valvifer juncture. There is a line of fusion visible along the midline of the triangulin in *Euschistus,* of the highly evolved Pentatomini. In *Pangaeus* of the more primitive family Cynidae, the first valvulae are loosely joined by a membrane across the midline, as is common in other families with platelike ovipositors (Schaefer, 1964). Each valvula in *Pangaeus* articulates via a ramus with its valvifer.

Another fusion that has been misinterpreted is the arcus. Verhoeff (1893, p. 329) coined the term for a small, somewhat ∧-shaped, medial sclerite posterior to the triangulin and near the origin of the spermathecal duct. He suggested it was the fused remnants of the first and or second rami, but Dupuis (1955, p. 210*n*) has since homologized it with the second valvulae. Dupuis' interpretation certainly seems the correct one. In *Euschistus* these structures are associated with the ring sclerites (not shown in Fig. 1), as are other, better developed second valvulae in other heteropteran groups. They are more or less fragmented in pentatomids, lightly sclerotized, and without a visible line of fusion.

The second valvifers are also fused across the midline, posterior to the arcus (Fig. 1). Although all authors recognize this well sclerotized median structure to be the second valvifers, morphological evidence for the homology has not been given. That evidence is as follows: In *Euschistus* the structure is closely applied to, but separated by a slight membrane from, the ninth paratergite, and thus bears the same relationship to it as do the second valvifers in other heteropteran groups (e.g., Coreidae). There is a lateroanterior extension of the structure towards the remnant of the second valvulae, and this extension thus resembles the second rami of heteropterans with less reduced ovipositors. These extensions are too thick to be rami themselves, but may be the vestiges of that part of the second valvifers on which the rami originate and along which they run for a short distance.

The Cydnidae provide more evidence. This family is less advanced than the Pentatomidae, and there has been less fusion and reduction of genitalic parts. The important structures bear the same relation to each other in cydnids as in pentatomids, but their connections are retained.

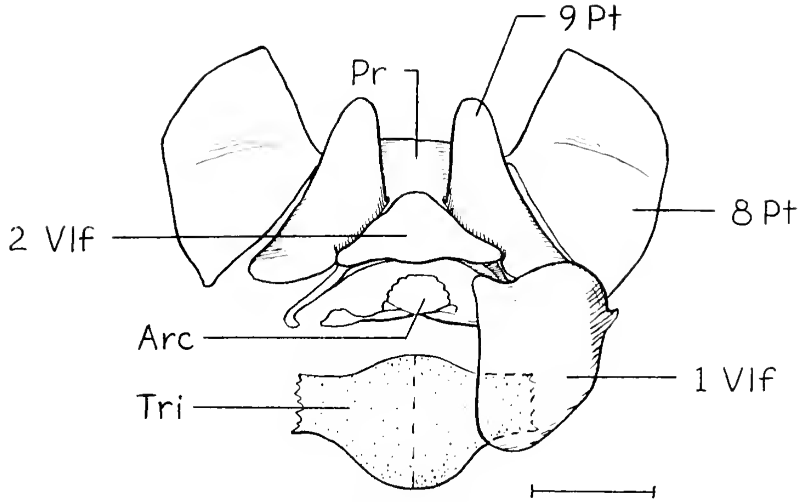

FIG. 1. *Euschistus tristigmatus* Say (Pentatomidae: Pentatominae: Pentatomini), female genitalia, outer (ventral) view, with first valvifer on left side removed to show underlying structures. Abbreviations: Arc, arcus (fused second valvulae); Pr, proctiger (tenth sternum); 8, 9 Pt, eighth, ninth paratergite; Tri, triangulin (fused first valvulae); 1, 2 Vlf, first, second valvifer. Scale, 0.5 mm.

The cydnid (*Pangaeus*) second valvifers are clearly joined via the second rami to the second valvulae, which are large, semi-membranous, and joined across the midline. As McDonald (1966, p. 55) notes, the fusion of the second valvifers is incomplete, the two valvifers being separated by a small membrane. This incompletely fused structure is clearly homologous to the median structure of the Pentatomidae; it is located in the same region relative to other sclerites, particularly the ninth paratergite. The double origin of this structure is also shown in *Apateticus cynicus* Say (Pentatomidae: Asopinae), by a membranous line of fusion along the midline. Moreover, a large stout apodeme extends dorsoposteriorly from the dorsal border of the second valvifers in *Pangaeus*. Smaller stout apodemes occur at the same positions of the structure in *Euschistus,* and this structure is clearly the fused second valvifers.

Posterior to the second valvifers in *Pangaeus* the small tenth sternum is much thickened and divided medially (as McDonald notes, 1966). This could be confused with the median structure of pentatomids, but the relationships of the two sclerites are different. The median structure in the Pentatominae may be more or less closely associated with the tenth sternum, sometimes being separated from it only by a narrow strip of membrane. In an as yet undescribed genus of the Sailerolinae (Urostylidae), the second valvifers are separated and far removed from the heavily sclerotized tenth sternum.

The gonangulum in *Pangaeus* is well defined and articulated loosely to the ninth paratergite. The region of the union appears to have been somewhat desclerotized, and it is possible that the apparent loose connection is a derived, not a primitive character. The fusion is complete in other trichophorans, including the Pentatomidae, and in this family (and perhaps others) the free part of the gonangulum has been lost.

The paratergites in the Pentatomoidea may be joined by a sclerotized strip just dorsal to the proctiger. In the case of the eighth paratergite, this could be part of the eighth tergum separated from the main body of the tergum. There is no ninth tergum and the ninth inter-paratergal strip may represent it. However, in *Pangaeus* the region between the two eighth paratergites is membranous. This may indicate that the once sclerotized region became desclerotized, but it may be that this is the eighth–ninth inter-tergal membrane, within which a sclerite later develops in the evolution of the Pentatomoidea. If the latter is the case, the inter-paratergal bridge is a new structure, not a detached part of the eighth tergum. Finally, Stys' (1964) study of the primitive pentatomoid family Thaumastellidae suggests this bridge is the result of a medial extension and fusion of the eighth paratergites.

The bridge between the ninth paratergites may be semi-membranous laterally, before it reaches the paratergites (*Pangaeus*); the medial sclerite is probably the one McDonald (1966, p. 55) considers the remnant of the eighth inter-paratergal bridge. Again, it is difficult to determine whether or not this is the ninth tergum or a new structure.

The eighth inter-paratergal bridge is absent in the tessaratomine *Tessaratoma javanica* Thunberg, and the ninth paratergites are much enlarged and meet on the midline where they are partially fused.

In conclusion, the following homologies seem established: The triangulin is the fused first valvulae, perhaps including the first rami and part of the first intervalvular membrane; the arcus is the fused second valvulae; and the well defined medial sclerite between the arcus and the tenth sternum is the fused second valvifers.

The following species of Pentatomoidea were studied:

Cydnidae:	Cydninae	*Pangaeus bilineatus* (Say)
Scutelleridae		*Chrysocoris purpureus* Westw.
Urostylidae		*Urolabida* sp.
Pentatomidae:	Asopinae	*Apateticus cynicus* Say
	Tessaratominae	*Tessaratoma javanica* Thunb.
	Pentatominae: Pentatomini	*Euschistus tristigmatus* Say
		Mormidea lugens Fabr.
		Acrosternum hilare Say

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Further Notes on Melanism in Connecticut *Panthea furcilla* (Packard) (Lepidoptera: Noctuidae)

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Abstract: In the noctuid moth *Panthea furcilla* (Packard) melanism is increasing rapidly in Putnam, Connecticut, an area not subject to appreciable industrial pollution. Wholly melanic and very strongly melanistic are dominant over normal gray, and wholly melanic is dominant over very strongly melanistic. Larval melanism is independent of adult melanism. Results are given of unbiased collections of adults, the reared progeny of wild-caught females and crosses of such progeny.

In two previous articles (Klots, 1964 and Klots, 1966) data were given on the incidence of melanism in *P. furcilla* and other moths at Putnam, Windham Co., Connecticut during 1962–1965. The present article adds further data secured in 1966 from the capture of specimens, the rearing of the progeny of wild-caught females and the crossing of some of these progeny.

WILD-CAUGHT SERIES

As before, all specimens of *P. furcilla* that came to black light were taken, so that the counts are unbiased by collector selection. The total catches of 1962–1965, already reported (Klots, 1966, p. 96), were as follows:

Wholly melanic	51 = 17.8%
Very strongly melanistic	120 = 42.0%
Slightly to strongly melanistic	56 = 19.6%
Normal (light gray)	59 = 20.6%

In 1966 (July–Sept.) the total catch of ♂ *P. furcilla* at the same black light was as follows:

Wholly melanic	39 = 33.8%
Very strongly melanistic	30 = 26.1%
Slightly to strongly melanistic	16 = 13.8%
Normal	30 = 26.1%

Combining these figures, the totals for 1962–1966 are:

Wholly melanic	90 = 22.4%
Very strongly melanistic	150 = 37.4%
Slightly to strongly melanistic	72 = 18.0%
Normal	89 = 22.2%

REARINGS FROM WILD-CAUGHT FEMALES

1966. ♀ Pf M-1. wholly melanic, laid about 70 eggs. A total of 64 pupae was obtained. The larvae were all of the red-brown, normal type. The pupae were kept indoors at temperatures from 60–70° F. (15–21° C.). The adults emerged 5–28 November, showing no sign of a diapause. They were as follows:

Fully melanic: ♂♂ 27; ♀♀ 16; total 43 = 74.1%
Normal: ♂♂ 0, ♀♀ 15 total 15 = 25.9%

At first glance this seems to show a complete dominance of wholly melanic over normal in an almost exact 3 : 1 ratio, making it most likely that only a single allele, wholly melanic vs. normal, was involved. However, the complete absence of normal males is striking, and so is the preponderance (27 : 16) of melanic males over melanic females. Perhaps some factor or factors in the rearing selected against normal males and fully melanic females. However, the probability is that fully melanic was completely dominant over normal and that both parents were phenotypically wholly melanic and genetically heterozygous. There was no significant correlation between the type of moth and the dates of emergence. See also cross 1966 Pf F_1 (1) below.

1966, ♀ Pf Ms-1, very strongly melanistic, laid 42 eggs. Most of these hatched, but there was considerable 1st instar larval mortality. The larvae showed the definite dimorphism commented upon in an earlier article (Klots, 1966, p. 96) being almost evenly divided (17 melanic : 16 normal). Finally, 24 adults were obtained, all emerging indoors 5–17 November, which were as follows:

Fully melanic: ♂♂ 4, ♀♀ 10; total 14 = 58.3%
Very strongly melanistic: ♂♂ 4, ♀♀ 6; total 10 = 41.7%

Melanic larvae reared through:

Wholly melanic ♂♂	1
" " ♀♀	2
Very strongly melanistic ♂♂	2
" " " ♀♀	2
Total	9

Normal larvae reared through:

Wholly melanic ♂♂	3
" " ♀♀	6
Very strongly melanistic ♂♂	2
" " " ♀♀	4
Total	15

The larval dimorphism, like that reported in 1966 (loc. cit.) appeared to occur in a 1 : 1 ratio and to have no correlation with either adult melanism or sex. The adult ratios suggest a complete dominance of wholly melanic over very strongly melanistic, and that the latter is a distinct factor in itself and not due to a heterozygous condition. In support of this be it noted that the very strongly melanistic individuals are homogeneous, none showing any intergradation to normal or to wholly melanic.

1966. ♀ Pf Ms-2. very strongly melanistic, laid 37 eggs. All of these hatched, but there was heavy early larval mortality, so that only 17 pupae were obtained, from which the adults emerged indoors 29 October–11 November, as follows:

Very strongly melanistic ♂♂	6	
" " " ♀♀	7	
Total	13	= 76.5%
Normal ♂♂	0	
" ♀♀	4	
Total	4	= 23.5%

The numbers are too low to warrant definite conclusions. However, the absence of any sign of intergradation between the very strongly melanistic and normal phenotypes is significant and, as in 1966, ♀ Pf Ms-1, suggests that very strongly melanistic is a discrete factor. The absence of normal males, as in 1966 ♀, Pf M-1, is to be noted as possibly having some significance.

Crosses of individuals from the above rearings were attempted, but were mostly unsuccessful because of lack of successful matings and to the lack of proper rearing facilities during the winter. However, two successful matings took place, and from one of these a significant number of F_1 individuals was reared through.

Cross 1966 Pf (1): ♂ wholly melanic × ♀ wholly melanic, both from lot 1966, ♀ Pf M-1 (above). All larvae were normal. A total of 8 ♂ and 10 ♀ adults was secured, all of which were wholly melanic. It is reasonable to suppose that both the parents and all offspring were homozygous for wholly melanic, and that this was completely dominant.

Cross 1966 Pf (7): ♂ wholly melanic × ♀ normal, both from lot 1966 ♂ Pf M-1 (above). Only a few eggs were laid. The larvae were normal. F_1 individuals were reared through as follows:

Wholly melanic ♂♂ 4, ♀♀ 1; total 5
Normal ♂♂ 0, ♀♀ 3; total 3

DISCUSSION

All the available data lead to the conclusion that in the Putnam area melanism, as expressed in both wholly melanic and strongly melanistic individuals, has become genetically dominant, although not completely so, as is shown by the very considerable proportion of somewhat melanistic individuals flying. Since the area does not seem to be subject to any appreciable darkening due to industrial pollution, the writer believes that the chief selective factor must be the darkening of large parts of the environment, but by no means of all of it, due to natural reforestation, particularly of white pine.

Acknowledgments: The writer is greatly obliged to Alice Gray of the American Museum and Albert Poelzl of the New York Entomological Society for larval food unpolluted by airborne metropolitan wastes.

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Obituary Notice—WILLIAM T. M. FORBES

Word has been received from a nephew of Dr. Forbes that the grand old lepidopterist died on April 12, 1968 in a nursing home in Worcester, Mass. after an illness of over two years.

Dr. Forbes joined the New York Entomological Society in 1910, and at the January 21, 1964 meeting he was honored by the Society as one of its four 50-year members. At the time of his death he was second oldest in length of membership in the Society.

A Zodariid Spider from Pennsylvania (Araneida: Zodariidae)

Beatrice R. Vogel[1]

Received for Publication January 8, 1968

Abstract: *Zodarion fulvonigrum* (Simon) is described and figured, and a diagnosis for *Zodarion* is given. This is the first record of the genus for this continent. The distribution of *Zodarion* and the occurrence of the family Zodariidae in North America is briefly reviewed.

Five specimens of a small spider were collected in western Pennsylvania and have been identified as a French species *Zodarion fulvonigrum* (Simon) by W. J. Gertsch of the American Museum of Natural History, New York. The specimens are deposited there.

The genus *Zodarion* contains about 70–80 species, more than 50 of them from Europe, the rest from North Africa, Asia Minor and Russia. One species *Zodarion luzonicum* Simon was described from the Philippines in 1893, and *Z. trispinosum* Suman was described from Hawaii in 1967. The occurrence of *Z. fulvonigrum* in Pennsylvania represents an interesting introduction of a European species some distance from a port.

North American fauna contains only ten other species of the rather large family Zodariidae, and mature specimens are rare in collections. The genus *Lutica* consists of four species, three of which are endemic to the Channel Islands off the California coast, and the fourth species is known only from beaches on the mainland. *Storena* is a large genus, about 100 species, ranging throughout the southern hemisphere, particularly in Australia, the Pacific and southeastern Asia. Two species are known from the Near East, but none from Europe. There are six species of *Storena* in North America: one from the Bahamas and five from Mexico. *Zodarion fulvonigrum* is the first zodariid species to occur in the north temperate zone of this continent.

Zodarian Walckenaer *in* Savign & Audouin, 1825

Enyo [praeoc.] Savign & Audouin, 1825, p. 135 (gen. nov.)
(= *Zodarion*) Savign & Audouin, 1827, p. 349.
Complete bibliography in Bonnet, 1959, p. 4970.

DIAGNOSIS: (after Simon, 1893a, pp. 423, 435–436.) Eyes greatly dissimilar. Ocular area wider than long, semicircular, sometimes trapeziform, narrower behind. First eye row more or less procurved. Second eye row strongly procurved, posterior median eyes situated behind lateral eyes, posterior median eyes further from each other than from posterior lateral eyes.

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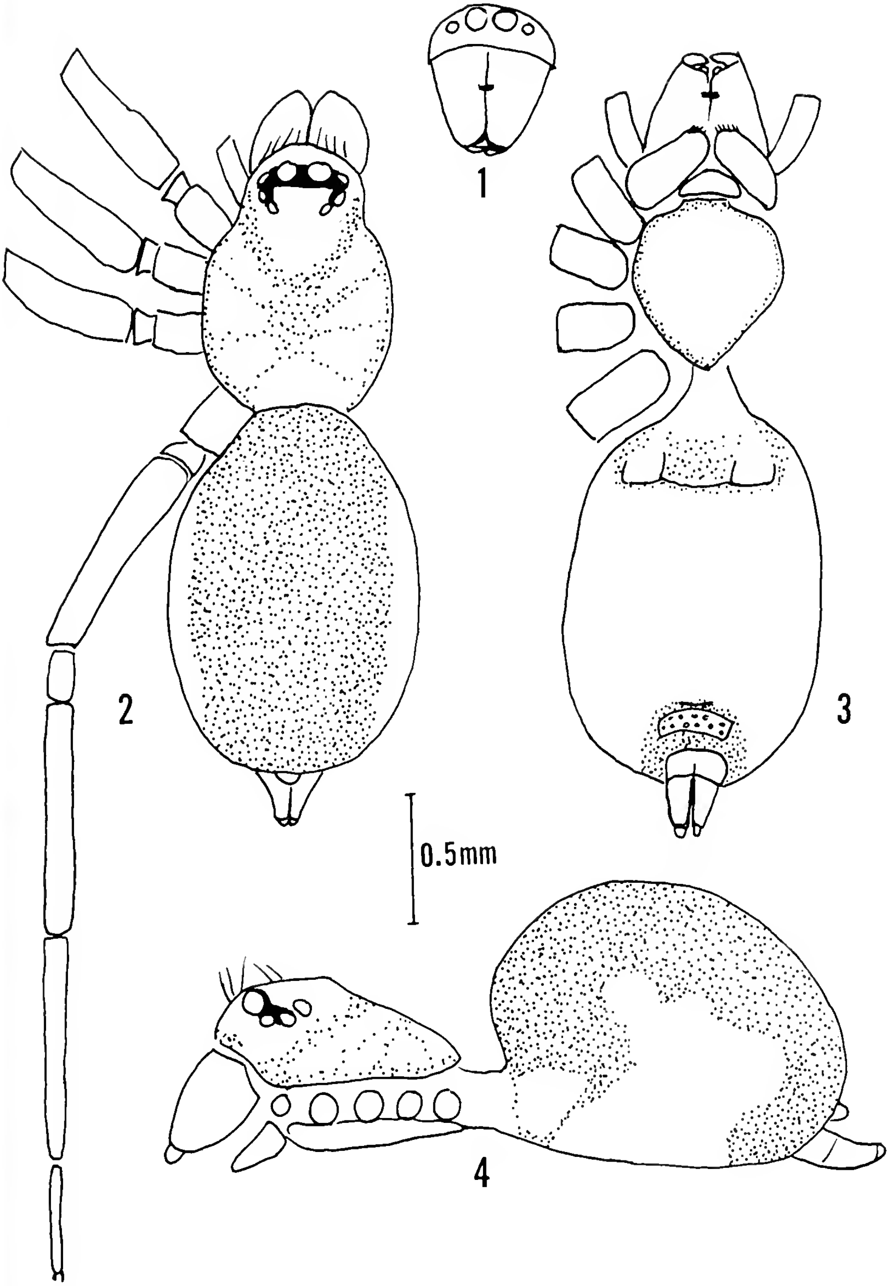
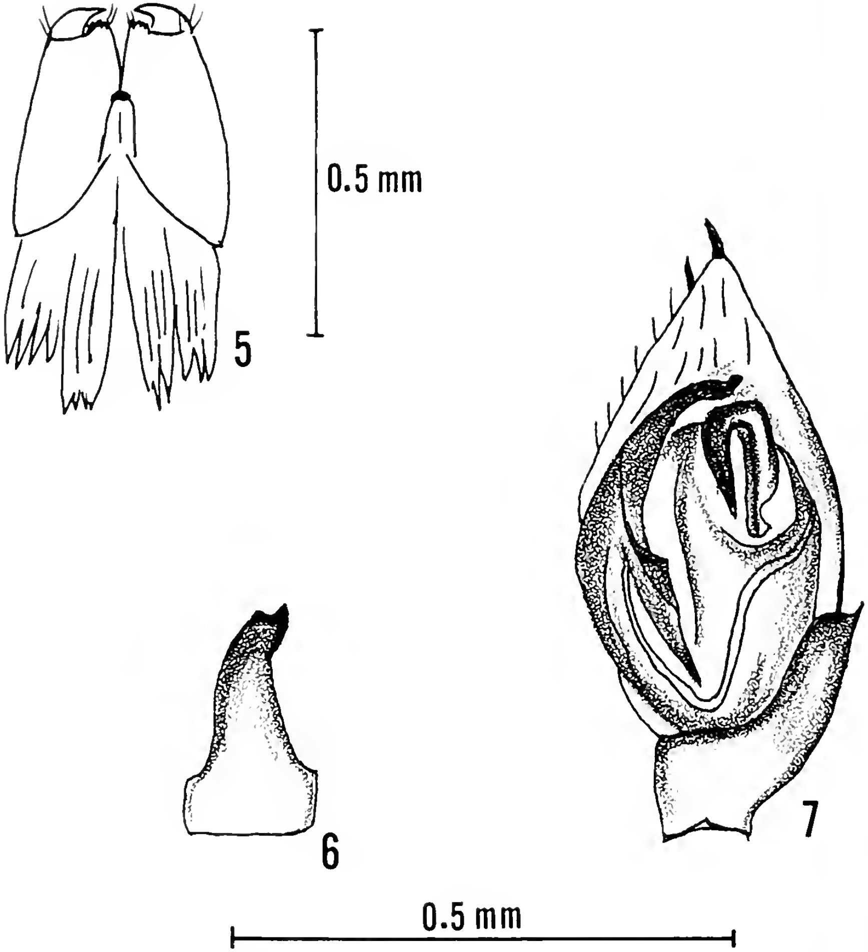
Acknowledgments: I thank Dr. W. J. Gertsch, Curator of Spiders, American Museum of Natural History, New York, for identifying the spider and for his advice and assistance in preparing this note.



Figures 1–4.



Figs. 1–7. *Zodarion fulvonigrum* (Simon). 1, face; 2, penultimate male, dorsal, stippling indicates purple color; 3, ventral; 4, lateral; 5, dissected chelicerae of immature specimen, ventral; 6, tibia of left pedipalp, mature male, lateral; 7, left palp, ventral.

Anterior median eyes large, close together and black. The other 6 eyes small, white, oval or sub-angular. Clypeus more or less porroct, about as wide as ocular area. Chelicerae robust, fangs short, thick and subquadrangular. Labium not much longer than wide, strongly attenuate and obtuse. Endites converging, subparallel and rounded apically. Sternum a wide heart shape, posterior edge projecting briefly between coxae. Coxae all long, cylindrical, parallel and equally spaced. Leg formula 4123, long and thin. Tarsi with 3 small claws and no claw tufts.

Zodarion fulvonigrum (Simon)

Enyo fulvonigrum Simon, 1874, p. 251.
Enyo nigrofusca [lapsus]: Becker, 1882, p. xxxviii.
Zodarion fulvonigrum: Simon, 1914, pp. 233, 234. Reimoser, 1919, p. 132. Denis, 1937, p. 11. Bonnet, 1959, p. 4974.

MALE MEASUREMENTS: Total length, 2.10 mm. Carapace, 1.05 mm. long, 0.75 mm. wide. Abdomen 1.05 mm. long, 0.75 mm. wide.

	I	II	III	IV
Femur	0.96 mm.	0.85 mm.	0.80 mm.	1.15 mm.
Patella	0.35	0.30	0.30	0.35
Tibia	0.80	0.65	0.55	1.00
Metatarsus	0.75	0.75	0.75	1.15
Tarsus	0.55	0.55	0.45	0.60
Total	3.50 mm.	3.10 mm.	2.85 mm.	5.25 mm.

Leg formula 4123. Fourth leg five times the length of carapace. Fourth femur longer than carapace. Carapace yellow, slightly marked with purple. Black pigment in eye region. Legs yellow, moderately covered with flattish hairs. Chelicerae and pedipalpi yellow except sclerotized parts which are darker. Abdomen purple dorsally, generally yellow ventrally with yellow patches laterally as indicated in Fig. 4. Venter with faint purple markings in genital region and around spinerets. Carapace: broadly oval, constricted posterior to eyes, anterior end rounded, thoracic furrow longitudinal and indistinct. Eyes: first eye row slightly recurved, anterior median the largest, about half their diameter apart. Anterior lateral eyes half the size of anterior median eyes. Second eye row strongly procurved, eyes subequal. Posterior median eys oval, widely separated, closer to posterior lateral eyes than to each other (Fig. 2). Chelicerae: vertical, stout, fused about half their length. No teeth on promargin of fang furrow, a serrate keel on retromargin. Fangs short, stout, limited articulation (Fig. 5). Endites: converging, longer than wide, sides subparallel, rounded distally, and with a scopula. Labium: wider than long. Abdomen: ovoid; transverse sclerotized plate anterior to spinerets on venter; one pair of spinerets evident, terminal segments short; anal tubercle short; spiracle not evident.

Male palpus as illustrated in Fig. 7. Embolus heavily sclerotized, with a thick curved tip ending in a blunt hook. Median apophysis a heavy, inverted U-shaped hook lying near embolus in unexpanded bulb. Cymbium with a false claw at tip, and a row of stiff bristles on mesal edge. Femur of pedipalp of moderate length, about three times as long as broad. Patella about one and a half times as long as broad. Tibia shorter than patella, about as long as broad, bearing a strong carpoblem ending in a blunt hook.

FEMALE: Not yet collected in North America.

RECORDS: Pennsylvania, Lawrence Co., Wampum. Immatures, 16 April 1967; male, 21 May 1967, B. Vogel.

DISTRIBUTION: Western Pennsylvania and France.

ECOLOGY: This very interesting spider lives on the undersides of rocks with several other species of spiders, isopods and pseudoscorpions. It is one of the first animals to react to the disturbance of rock-turning, very swiftly runs around the rock and presumably drops off. The collecting site at Wampum is an abandoned limestone quarry above ¼ mile above the Beaver River. The quarry has probably not been worked for 50 years, judging from the size of trees growing in the bottom. In April and May the site is mesic; the ground underfoot is moist and the dirt in talus slopes and under rocks is damp. There is a permanent pond in the quarry, with cat-tails. By early July the site is much hotter and drier; all the ground away from the pond is completely dry, and so is the earth under the rocks. There are few if any animals to be found by turning rocks during mid-summer. An unsuccessful attempt was made 7 July 1967 to secure more specimens.

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Additional Records of Spiders from Western Pennsylvania

Beatrice R. Vogel[1]

Received for Publication January 8, 1968

Abstract: This list reports 86 species not previously reported from western Pennsylvania, and contains additional records for species reported from Carnegie Museum's Powdermill Nature Reserve.

Since the publication of a list of spiders from the Powdermill Nature Reserve of Carnegie Museum (Vogel, 1966), additional species have been collected in western Pennsylvania. A program of pitfall trapping at Powdermill from October 1966 to July 1967 produced nearly all of the 65 additional species for the Reserve, bringing its total to 220. Spiders from other localities were collected by picking, sweeping, rock turning, and occasionally by sifting leaf litter. These collections yielded 21 species found neither at Powdermill nor at Presque Isle where Truman (1942) collected, as well as others found at either of those two localities. This study increases the spider species to 306 from western Pennsylvania.

Most of these species are known to those who have collected in this region, but collectors have neglected to publish their findings. This paper reports the spiders not previously recorded from this region which were collected in this recent program, and it contains additional records for species already recorded from Powdermill Nature Reserve. These names are preceeded by an asterisk (*). Species are listed with County and date of collection, and a complete Locality Data list is included.

ANTRODIATIDAE

**Antrodiaetus unicolor* (Hentz)
Allegheny Co.; 19 May 1967
Westmoreland Co.; 19 Oct., 13 Nov. 1966; 3 July, 27 July 1967

ATYPIDAE

Atypus niger (Hentz)
Westmoreland Co.; 15 June 1967

AMAUROBIIDAE

**Callobius bennetti* (Blackwall)
Allegheny Co.; 18 Sept. 1966

Titanoeca americana Emerton
Lawrence Co.; 21 May 1967

DICTYNIDAE

**Dictyna foliacea* (Hentz)
Butler Co.; 28 June 1967
Dictyna longispina Emerton
Armstrong Co.; 6 June 1967
Dictyna minuta Emerton
Armstrong Co.; 6 June 1967
**Dictyna sublata* (Hentz)
Armstrong Co.; 6 June 1967
Butler Co.; 6 June 1967

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Acknowledgments: I am greatly indebted to W. J. Gertsch and W. Ivie of the American Museum of Natural History for their kind help in identifying some of the specimens and confirming some of my identifications.

Lathys pallida Marx
Armstrong Co.; 6 June 1967
Tricholathys ohioensis Chamberlin & Ivie
Lawrence Co.; 6 June 1967

ULOBORIDAE

Hyptiotes cavatus (Hentz)
Fayette Co.; 13 Sept. 1966
Westmoreland Co.; 28 Aug. 1966

DYSDERIDAE

Dysdera crocata C. L. Koch
Allegheny Co.; 29 May 1966; 14 June 1967

TETRAGNATHIDAE

Pachygnatha tristata C. L. Koch
Westmoreland Co.; 28 Aug. 1966
Tetragnatha laboriosa Hentz
Westmoreland Co.; 10 July 1965
Tetragnatha pallescens F. O. Pickard-Cambridge
Butler Co.; 6 June 1967

THERIDIIDAE

Achaearanea rupicola (Emerton)
Westmoreland Co.; 10 May 1967
**Achaearanea tepidariorum* (Koch)
Allegheny Co.; 1 Nov. 1966
**Steatoda borealis* (Hentz)
Allegheny Co.; 18 Sept. 1966a
**Steatoda triangulosa* (Walckenaer)
Allegheny Co., 1 Nov., 12 Nov. 1966
**Theridion spirale* Emerton
Butler Co.; 28 June 1967
Thymoites unimaculata (Emerton)
Butler Co.; 28 June 1967

ERIGONIDAE

Ceraticelus emertoni (Pickard-Cambridge)
Fayette Co.; 13 Sept. 1966
Ceratinopsis interpres (Pickard-Cambridge)
Butler Co.; 28 June 1967
Hypselistes florens (O. Pickard-Cambridge)
Armstrong Co.; 6 June 1967
Butler Co.; 28 June 1967

LINYPHIIDAE

Bathyphantes weyeri (Emerton)
Westmoreland Co.; 10 May 1967
Centromerus cornupalpis (O. Pickard-Cambridge)
Westmoreland Co., 10 Apr., 27 Apr., 20 June 1967
Centromerus latidens (Emerton)
W. Va., Wood Co.; 14 May 1967
Frontinella communis (Hentz)
Westmoreland Co.; 13 Sept. 1966
Helophora insignis (Blackwall)
Allegheny Co.; 18 Sept. 1966b
Lephthyphantes appalachia Chamberlin & Ivie
Westmoreland Co.; 27 Apr. 1967
**Meioneta fabra* (Keyserling)
Fayette Co.; 13 Sept. 1966
Meioneta unimaculata (Banks)
Westmoreland Co.;10 May 1967
Microneta viaria (Blackwall)
Westmoreland Co.; 27 May 1967
Pusillia mandibulata (Emerton)
Allegheny Co.; 14 June 1967
Tapinopa bilineata Banks
Westmoreland Co.; 19 Oct. 1966
Taranucnus durdenae Ivie
Westmoreland Co.; 3 July 1967

ARANEIDAE

**Acanthepeira stellata* (Walckenaer)
Westmoreland Co.; 27 May 1967b
**Araneus marmoreus* Clerck
Fayette Co., 13 Sept. 1966
**Araniella displicata* (Hentz)
Butler Co.; 28 June 1967
**Cyclosa turbinata* (Walckenaer)
Fayette Co.; 13 Sept. 1966
Westmoreland Co.; 27 May 1967b
Mangora placida (Hentz)
Butler Co.; 6 June 1967
Mastophora bisaccata (Emerton)
Westmoreland Co.; 13 Sept. 1966
**Neoscona arabesca* (Walckenaer)
Butler Co.; 28 June 1967
Neoscona benjamina Clerck
Westmoreland Co.; 28 Aug. 1966
Neoscona minima F. Pickard-Cambridge
Allegheny Co.; 18 Sept. 1966a
**Singa pratensis* Emerton
Butler Co.; 28 June 1967
Singa truncata Banks
Westmoreland Co.; 20 June, 3 July 1967

AGELENIDAE

Agelenopsis naevia (Walckenaer)
Fayette Co.; 13 Sept. 1966
Westmoreland Co.; 28 Aug., 13 Sept. 1966

**Agelenopsis pennsylvanica* (Keyserling)
Allegheny Co.; 18 Sept. 1966a, 18 Sept. 1966b, 13 Oct. 1966
Fayette Co.; 13 Sept. 1966
Agelenopsis utahana (Chamberlin & Ivie)
Fayette Co.; 13 Sept. 1966
Westmoreland Co.; 28 Aug. 1966
**Cicurina brevis* (Emerton)
Fayette Co.; 13 Sept. 1966
Cicurina robusta Simon
Westmoreland Co.; 30 March., 27 April., 10 May, 15 June 1967
Coras juvenilis (Keyserling)
Westmoreland Co.; 9 Oct., 19 Oct., 13 Nov. 1966
Tegenaria domestica (Clerck)
Allegheny Co.; 1 Sept. 1966, 25 Jan., 25 Apr. 1967
Wadotes hybridus (Emerton)
Westmoreland Co.; 19 Oct. 1966, 10 May 1967

HAHNIIDAE

Neoantistea agilis (Keyserling)
Westmoreland Co.; 21 April., 27 July 1967
Neoantistea radula (Emerton)
Westmoreland Co.; 27 July 1967

OXYOPIDAE

Oxyopes sclaris Hentz
Butler Co.; 28 June 1967

PISAURIDAE

**Dolomedes scriptus* Hentz
Armstrong Co.; 6 June 1967
Fayette Co.; 13 Sept. 1966

LYCOSIDAE

Lycosa carolinensis Walckenaer
Allegheny Co.; 12 Sept. 1966
Butler Co.; 28 June 1967
Westmoreland Co.; 13 Nov. 1967
**Lycosa helluo* Walckenaer
Armstrong Co.; 6 June 1967
Lycosa modesta Keyserling
Westmoreland Co.; 9 Oct. 1966
Lycosa permunda Chamberlin
Westmoreland Co.; 19 Oct. 1966, 3 July 1967
Lycosa punctulata Hentz
Westmoreland Co.; 19 Oct., 13 Nov. 1966, 30 Mar., 15 June 1967
Lycosa rabida Walckenaer
Westmoreland Co.; 19 Oct. 1966, 27 July 1967
Pardosa fuscula (Thorell)
Westmoreland Co.; 27 May 1967b
**Pardosa lapidicina* Emerton
Armstrong Co., 6 June 1967
**Pardosa milvina* (Hentz)
Lawrence Co.; 21 May 1967
**Pardosa moesta* (Banks)
Allegheny Co.; 30 May 1967
Armstrong Co.; 6 June 1967
Butler Co.; 28 June 1967
Pardosa xerampelina Keyserling
Westmoreland Co.; 10 May 1967, 27 May 1967b
Schizocosa bilineata (Emerton)
Westmoreland Co.; 15 June, 3 July, 27 July 1967
Schizocosa crassipalpis (Emerton)
Westmoreland Co.; 15 June, 20 June, 2 July 1967
**Schizocosa crassipes* (Walckenaer)
Fayette Co.; 13 Sept. 1966
**Schizocosa saltatrix* (Hentz)
Lawrence Co.; 21 May 1967
Trochosa avara (Keyserling)
Westmoreland Co.; 13 Nov. 1966, 30 Mar., 11 Apr., 27 May, 15 June, 3 July 1967
Trochosa sepulchralis Montgomery
Westmoreland Co.; 15 June 1967

ZODARIIDAE

Zodarion fulvonigrum (Simon)
Lawrence Co.; 21 May 1967
(Note: A description of this species appears in this issue of the **Journal**, pp. 96–100.)

GNAPHOSIDAE

Drassyllus frigidus (Banks)
Westmoreland Co.; 13 Nov. 1966, 30 Mar., 11 Apr., 27 Apr., 10 May, 27 May, 3 June, 27 July 1967
Drassyllus niger (Banks)
Westmoreland Co.; 27 May, 15 June 1967
Haplodrassus signifer (C. L. Koch)
Lawrence Co.; 21 May 1967
Westmoreland Co.; 27 Apr., 10 May, 27 May, 15 June, 3 July 1967

Sergiolus capulatus (Walckenaer)
Allegheny Co.; 1 Sept. 1966
Westmoreland Co.; 3 July 1967
Zelotes kentzi Barrows
Westmoreland Co.; 27 Apr., 27 May, 15 June, 2 July 1967
Zelotes laccus (Barrows)
Westmoreland Co.; 20 June, 3 July 1967

ANYPHAENIDAE

Anyphaena celer (Walckenaer)
Westmoreland Co.; 3 July 1967
Anyphaena pectorosa L. Koch
Fayette Co.; 13 Sept. 1966
Ashya gracilis (Hentz)
Westmoreland Co.; 20 June 1967

CLUBIONIDAE

Agroeca pratensis Simon
Westmoreland Co.; 27 Apr., 15 June 1967
Castianeira variata Gertsch
Allegheny Co.; 29 June, 15 July 1967
Chiracanthium mildei (L. Koch)
Allegheny Co.; 10 Feb., 5 May, 30 June, 18 July 1967
Clubiona johnsoni Gertsch
Westmoreland Co.; 11 Apr. 1967
Clubiona spiralis Emerton
Westmoreland Co.; 27 May, 15 June, 27 July 1967
Phrurolithus pugnatus Emerton
Westmoreland Co.; 10 May 1967
Phrurolithus redemptus Gertsch
Lawrence Co.; 21 May 1967
W. Va., Wood Co.; 14 May 1967
Phrurotimpus alarius (Hentz)
Westmoreland Co.; 15 June, 20 June, 3 July 1967
W. Va., Wood Co.; 14 May 1967
Phrurotimpus borealis (Emerton)
Allegheny Co.; 18 Sept. 1966a
Lawrence Co.; 5 July 1967
Westmoreland Co.; 19 Oct. 1966, 3 July 1967
Phrurotimpus minutus (Banks)
Westmoreland Co.; 3 July 1967

THOMISIDAE

Misuminae

Misumena vatia Clerck
Westmoreland Co.; 13 Sept. 1966
**Misumenops asperatus* (Hentz)
Butler Co.; 28 June 1967
**Misumenops oblongus* (Keyserling)
Butler Co.; 28 June 1967
Xysticus bicuspis Keyserling
Westmoreland Co.; 27 Apr., 10 May, 27 May, 15 June, 20 June 1967
Xysticus gulosus Keyserling
Westmoreland Co.; 15 June 1967
Xysticus luctans (C. L. Koch)
Westmoreland Co.; 27 May, 15 June 1967
Xysticus punctatus Keyserling
Westmoreland Co.; 11 Apr. 1967
**Xysticus trigutattus* Keyserling
Butler Co.; 28 June 1967

Philodrominae

Ebolatithorax (Keyserling)
Westmoreland Co.; 10 May, 20 May, 27 May, 3 July 1967
Philodromus imbecillus Keyserling
Butler Co.; 28 June 1967
**Philodromus placidus* Banks
Butler Co.; 28 June 1967
Philodromus washita Banks
Westmoreland Co.; 17 July 1962
Thanatus formicinus (Olivier)
Lawrence Co.; 16 Apr. 1967
Westmoreland Co.; 19 Oct. 1966, 11 Apr., 27 Apr., 27 May 1967

SALTICIDAE

Habrocestum pulex (Hentz)
Allegheny Co.; 29 May, 14 June 1967
Butler Co.; 28 June 1967
Lawrence Co.; 5 July 1967
Habronattus borealis (Banks)
Westmoreland Co.; 27 May 1967b, 3 July 1967
Habronattus calcaratus (Banks)
Westmoreland Co.; 9 Oct. 1966
Habronattus viridipes (Hentz)
Westmoreland Co.; 27 May 1967
Icius elegans (Hentz)
Westmoreland Co.; 27 July 1967
**Marpissa lineata* (C. L. Koch)
Allegheny Co.; 14 June 1967
Metaphidippus canadensis Emerton
Westmoreland Co.; 19 Oct. 1966

Metaphidippus protervus (Walckenaer)
Armstrong Co.; 6 June 1967
Butler Co.; 6 June, 28 June 1967
Westmoreland Co.; 13 Sept. 1966,
27 July 1967
*_Neon nelli_ Peckham
Allegheny Co.; 14 June 1967
Lawrence Co.; 21 May 1967
*_Phidippus rimator_ (Walckenaer)
Butler Co.; 28 June 1967
Phidippus variegatus (Lucas)
Westmoreland Co.; 20 June 1967
Talavera minuta (Banks)
Westmoreland Co.; 20 June 1967
*_Zygoballus bettini_ Peckham
Butler Co.; 28 June 1967

LOCALITY DATA

PENNSYLVANIA

Allegheny Co.:	
18 Sept. 1966a	4 mi. east of Oakmont, near Barking
18 Sept. 1966b	4 mi. east of Verona, Little Plum Creek
13 Oct. 1966	Millvale
19 May 1967	O'Hara Township
all other dates	Pittsburgh, Penn Hills Township
Armstrong Co.:	
6 June 1967	3 miles northwest of Slate Lick, junction of Rough Run and Buffalo Creek
Butler Co.:	
6 June 1967	2 miles north on Fenelton, Buffalo Creek
28 June 1967	Jennings Blazing Star Prairie, 5 miles southeast of Slippery Rock
Fayette Co.:	
13 Sept. 1966	Ohiopyle
Lawrence Co.:	
16 Apr. 1967	McConnell's Mill State Park
21 May, 5 July 1967	Wampum
Westmoreland Co.:	
all dates	Powdermill Nature Reserve, 3 miles south of Rector
27 May 1967b	Laurel Ridge, 2750′, 6 miles southeast of Rector

WEST VIRGINIA

Wood Co.:	
14 May 1967	Leachtown, 10 miles southeast of Parkersburg

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Biological Notes on *Colletes compactus compactus* and its Cuckoo Bee, *Epeolus pusillus* (Hymenoptera: Colletidae and Anthophoridae)

JEROME G. ROZEN, JR. AND MARJORIE S. FAVREAU[1]

RECEIVED FOR PUBLICATION JANUARY 11, 1968

Abstract: Information is recorded (1) on the nests and larval development of *Colletes c. compactus* Cresson and (2) on the female searching behavior, egg deposition, larval activity, and development of *Epeolus pusillus* Cresson. This information is compared with similar data concerning some related bees.

This paper treats the biology of the wide-ranging *Colletes compactus compactus* Cresson and of its nomadine parasite, *Epeolus pusillus* Cresson. Although Rau and Rau (1916) and Rau (1922) described the mating activity of *C. c. compactus*, other aspects of its life history have not been reported. With the exception of a paper by Graenicher (1906) on the adult searching activity of *E. minimus* (Robertson), nothing has been written about the biology (other than host associations) of any North American *Epeolus*. We record here fragmentary information (1) on the nests and larval development of *C. c. compactus* and (2) on the female searching behavior, egg deposition, larval activity, and development of the cuckoo bee.

Mr. Richard Brumley, University of California, Davis, kindly confirmed the identification of adults of *E. pusillus*.

Habitat: The nests of *C. c. compactus* were located in Lewisboro, Westchester County, New York, in two areas approximately two miles apart. Both sites were excavated by Favreau between September 27 and October 14, 1967. At the first site, on Favreau's property, at least six burrows entered a five-foot stretch of a vertical, south-facing bank, 1½ feet high. The bank was exposed to the sun during the heat of the day but surrounding trees shaded it both in the morning and again starting in mid-afternoon. The soil, a rich loam on the top of the bank, became gradually sandier below, so that the cell area consisted of sand and pebbles interlaced with the roots of shrubs and trees. The soil was moist because of normal periodic rains.

At the second site, only two nests were found, one on the side of an abandoned gravel pit where the surface sloped more than 45 degrees from horizontal, and the other on the horizontal surface 15 feet from the rim of the pit. Both nest entrances were exposed to the sun during the entire day. On the side of the pit, the soil consisted of loose coarse sand, pebbles, and small rounded stones, with

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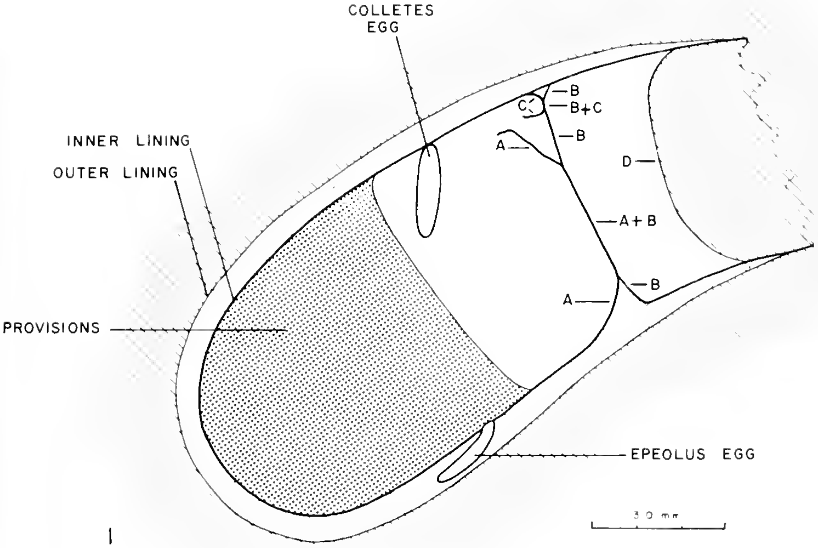
[1] Department of Entomology, the American Museum of Natural History. This study was partly supported by National Science Foundation Grant GB-5407X.



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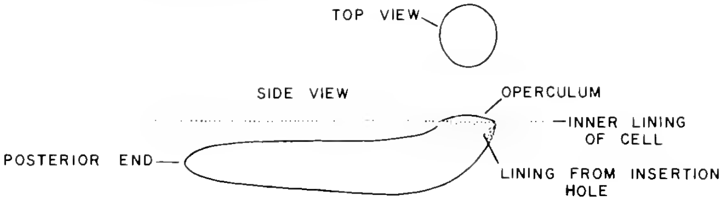

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Fig. 1. Cell of *Colletes c. compactus*, side view. See text for explanation.
Fig. 2. Egg of *Epeolus pusillus*, top and side views. Scale refers to Figure 1.

finer sand at the cell level; 15 feet from the pit the soil was sandy and contained roots and dead organic material.

Nests: The nest entrances of *C. c. compactus* were open in all cases, presumably even after the burrows were finished. The one entrance found on the horizontal surface exhibited a tumulus at one side of the entrance. Circular in cross section and with a diameter of between 6.0–7.0 mm., each main tunnel extended nearly horizontally at first, and then quickly angled downward so that most of the tunnel, though meandering, was vertical. At the gravel pit site each of the two burrows (still being visited by *Colletes* females) had only a single cell, but at the other site each burrow had a number of cells, grouped in a stratum between 15–25 cm. below the nest entrances. Three side tunnels, filled with soil after the cells were closed, ranged in length from 10 mm. to 15 mm. Their diameter was perhaps slightly less than that of the main burrow.

The cells, apparently all tilted roughly 35 degrees from the horizontal, were approximately 7.5–8.5 mm. in maximum diameter and 17.5–20.0 mm. long (measured from where the lining began to the rear of the cell). The floor was somewhat flatter than the roof (Fig. 1). Unlike the cells of *C. ciliatoides* Stephen (Torchio, 1965), they had a slightly greater diameter than that of the tunnel.

As is the case with almost all colletids, the cells had a pronounced waterproof cellophane-like lining, which loosely adhered to the cell wall. The wall itself gave no indication of being impregnated with secretions. The cellophane-like lining, like that of the cells of *C. ciliatoides*, was distinctive in that it consisted of two layers, an outer, fragile one and an inner, tougher one. Numerous threads of silk ran between the two envelopes, which were separated by about 1 mm. in most places.

In all cells the closure unvaryingly consisted of a complicated pattern of folds of the cell lining (Fig. 1). The lower part of the inner envelope (A) was drawn toward the roof of the cell near the cell mouth after the female had provisioned the cell and deposited the egg, and the upper part of the inner envelope (C) was folded downward a short distance. She then constructed a strong septum (B) that incorporated part of both the upper (B + C) and lower (A + B) folded ends of the inner lining. The septum effectively closed the mouth of the cell. A second septum (D), more fragile than the first and convex on the inside, was then constructed several millimeters farther toward the lateral so that between the two septa there was an open lumen. After the second septum had been constructed, the female loosely packed soil against the second septum and filled the remainder of the cell and the lateral.

The semiliquid, orange provisions filled the rear part of each cell. The amount of provisions was variable, in a few cases measuring in length from 7 to 9 mm. The variability may depend on the amount of fermentation occurring before the provisions are measured.

Development: In all cases, the single, translucent white, smooth, shiny egg of *C. c. compactus* (approximately 2.55 mm. long and 0.45 mm. in maximum diameter) was attached rigidly by its anterior end to the roof of the cell several millimeters from the provisions. The eggs hung at a uniform angle and no freshly deposited egg touched the provisions. The attachment of the egg was secure and presumably was a result of some secretion applied during oviposition. After the eggs became larvaform, each curled somewhat and its posterior end touched the provisions. Eggs remained in this position for a sufficiently long period to suggest that the contact between the posterior end of the egg and the provisions was required for eclosion. Perhaps liquids necessary for building body pressure prior to hatching were drawn from the provisions; an attempt should be made in the future to investigate eclosion using vital dyes. Eventually the larvae hatched and slipped into the provisions where they fed curled upon their sides. As we have noted in the case of both *C. thoracicus* Smith and an unknown species of *Colletes*, the larvae of *C. c. compactus* fed and developed unusually slowly compared with larvae of other bees. Some, but not all, of the larvae of *C. c. compactus* had consumed the provisions by November 14.

Biology of *Epeolus pusillus*: The widely scattered adults of *Epeolus* were found only at the gravel pit though identical *Epeolus* eggs were uncovered from cells at both sites. Only *Epeolus pusillus* was collected in the region so that we assume that it was responsible for the parasitism in all nests. Numerous cells of another smaller species of *Colletes* were excavated during the same period but none was parasitized. Female *Epeolus* traveled swiftly within 6 to 8 inches of the ground and slowed down or retraced paths over features presumably resembling nest entrances. In one case a female discovered a *Colletes* burrow from which Favreau had collected the host bee previously. Without hesitation, the *Epeolus* flew to the burrow, immediately descended, and reemerged in less than a minute with pollen adhering to the tip of her metasoma. When excavated, the open cell had an *Epeolus* egg attached.

From the two sites, four parasitized cells were uncovered, each with a single egg or egg chorion attached. One had not been closed as yet by the *Colletes*, a fact indicating that *Epeolus*, like other Nomadinae, enters open cells being provisioned. The eggs were inserted through punctures made in the inner envelope so that the anterior end of each egg was essentially flush with the inner surface of the envelope and so that the length of the egg was between the inner and outer envelopes (Fig. 1). Thus the eggs did not come in contact with the soil. The ragged edge of the hole in the inner envelope adhered closely to each egg (Fig. 2), probably because some substance glued the torn lining and chorion into a seemingly watertight connection. This substance dissolved when an envelope and egg were gently boiled in a solution of potassium hydroxide. The anterior end of each egg was directed toward the cell closure and the longitudinal axis more or less paralleled that of the cell. Each of the four eggs was attached either at the level of the provisions or further to the rear, so that the emerging *Epeolus* larva would have to pass through the semiliquid mixture to reach the surface. Two eggs were attached to the floor of the cell, another to the side.

Circular in cross section and with the anterior end flattened into an operculum, the *Epeolus* egg tapered posteriorly to a rounded point (Fig. 2). More elongate than the eggs of *Colletes* and uniform in appearance, they measured 2.25 mm. long with a maximum diameter of about 0.45 mm. The chorion was transparent white, somewhat dulled, though without distinct reticulations. The flattened anterior end was rimmed by thicker chorion where the inner cell envelope abutted it. As is the case with other Nomadinae, the chorion remained intact after the first instar crawled away. On hatching, the egg split along the anterior rim of the operculum.

TABLE 1. Differences in Cell Structure, Provisioning, and Egg Deposition between *Colletes compactus compactus* and *C. ciliatoides*.

compactus compactus	*ciliatoides*
Maximum cell diameter greater than tunnel diameter	Cell diameter same as that of tunnel
Cell with flattened floor	Cell apparently symmetrical along longitudinal axis
Egg attached to envelope on side not used for major fold of inner septum	Egg attached to envelope on side later folded to form inner septum
Only two cellophane-like septa closing cell, an inner one incorporating inner envelope, and an outer one against which soil plug is placed	Two to four layers of cellophane-like material between these two septa
Closed, provisioned cell with large area not occupied by food	Cell nearly completely occupied by provisions
Anterior end of egg attached to cell wall	Posterior end of egg presumably attached to cell wall

The single first instar examined was active, elongate, tapered posteriorly, and bore a pigmented, prognathous head capsule with long curved mandibles and elongate labral tubercles. The anteroventrally directed maxillary palpi were extremely long and slender. The tip of the abdomen possessed two eversible posterolaterally directed processes that were used as pygopods for crawling. The larva is similar to those of other Nomadinae and will be described in a subsequent paper treating the first instars of the Nomadinae. The first instar, upon hatching, immediately found the host egg and killed it. The one *Epeolus* larva reared grew normally rapidly; it consumed the provisions, defecated, and started diapause before any of the host larvae, collected at the same time, had consumed even half of the provisions. The mature larva of *Epeolus pusillus*, described by Rozen (1966), does not spin a cocoon.

E. pusillus is also a parasite of *Colletes ciliatoides* (Torchio, 1965).

DISCUSSION

Torchio (1965) described in considerable detail various aspects concerning the cell structure, provisioning, and oviposition location of *C. ciliatoides*. *C. c. compactus* agrees closely with this species in that both construct cell linings consisting of a thin outer envelope and a thicker inner one. Cells of both are closed by the apical portion of the inner envelope being folded over the lumen. However, in numerous other respects the two species differ, as indicated in Table 1.

Evolutionary parallelisms can be observed between the oviposition of *Epeolus pusillus* in the cells of *Colletes c. compactus* and that of the South African cuckoo bee genus *Pseudodichroa* in the cells of the colletid *Scrapter* (Rozen and Michener, *in press*). Though both genera of parasitic bees belong to the Nomadinae, they are not closely related, and independently evolved mechanisms that enable them to attack the cells of colletids. Both colletids construct cells with cellophane-like linings though in the case of *Scrapter* the lining consists of only a single envelope. The eggs of both parasites are similar in shape and appearance and both have a somewhat flattened operculum that is flush with the cell wall. They are oriented so that the anterior end is directed toward the cell closure, a device presumably directing the emerging first instar toward the air space in the cell when its egg has been laid below the level of the provisions. In both genera the operculum splits along the anterior rim at the time of hatching.

Though similar to the extent described above, the biologies of the two parasitic genera differ in two ways. First, most of the egg of *Pseudodichroa* is embedded in the soil that surrounds the cell because there is only one cell envelope. Secondly, the egg of *Pseudodichroa* possesses a transparent flange (Rozen and Michener, *in press*, Figs. 9, 10) that stretches over the lining surrounding the operculum. This flange is nearly invisible and can be seen only after the lining and egg are heated in a solution of potassium hydroxide. The flange apparently accounts for the waterproof connection between the egg and lining. The egg of *Epeolus* has no such flange, and the ragged edge of the punctured lining glued to the shaft of the egg seems to provide the waterproof connection.

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A New Species of the Pseudoscorpion Genus *Syarinus* (Arachnida, Chelonethida: Syarinidae) from the Northeastern United States[1]

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Abstract: The new species, *Syarinus* **enhuycki**, is described and compared with other known species of the genus. It is apparently widely distributed through the northern Appalachian mountain region.

The genus *Syarinus* has been known for many years from the western United States, where three species have been recognized, namely, *S. obscurus* (Banks), *S. granulatus* Chamberlin, and *S. honestus* Hoff (cf. Hoff, 1958). Hoff and Bolsterli (1956) have briefly described an adult female specimen from Wisconsin which they assign to *S. granulatus*. More recently, Kaisila (1964) has described a new species, *S. palmeni*, based upon a single male specimen from Newfoundland. The present paper describes yet another species, which is apparently widespread through the northern part of the Appalachian mountain system and perhaps includes the form from Wisconsin.

Syarinus **enhuycki**, new species

(Figs. 1–3)

MATERIAL: The holotype male (WM 40.01003), one male, two female, two tritonymph, and one deutonymph paratypes taken from under rocks in damp deciduous woodland at the E. N. Huyck Preserve, Rensselaerville, Albany County, New York on 30 June 1955. Other paratypes, including two females and a number of nymphs collected in similar situations at the Huyck Preserve on several occasions between 22 June and 18 July 1955. In addition to the type series, the following specimens are at hand: one female and one deutonymph from under a log and a rock in deciduous woods in Allegany State Park, Cattaraugus County, New York on 4 May 1957 and 10 May 1958; one deutonymph from beneath a log in maple woods about 10 miles north of Kane, McKean County, Pennsylvania on 26 June 1966; one tritonymph from under a rock in deciduous woods about three miles south of Blossburg, Tioga County, Pennsylvania on 7 July 1963; and one female, one tritonymph, one deutonymph, and one protonymph from under rocks in mixed woods about two miles east of Meriden, Sullivan County, New Hampshire on 26–27 June 1967. All collections were made by the author. Types are deposited in the collection of the American Museum of Natural History.

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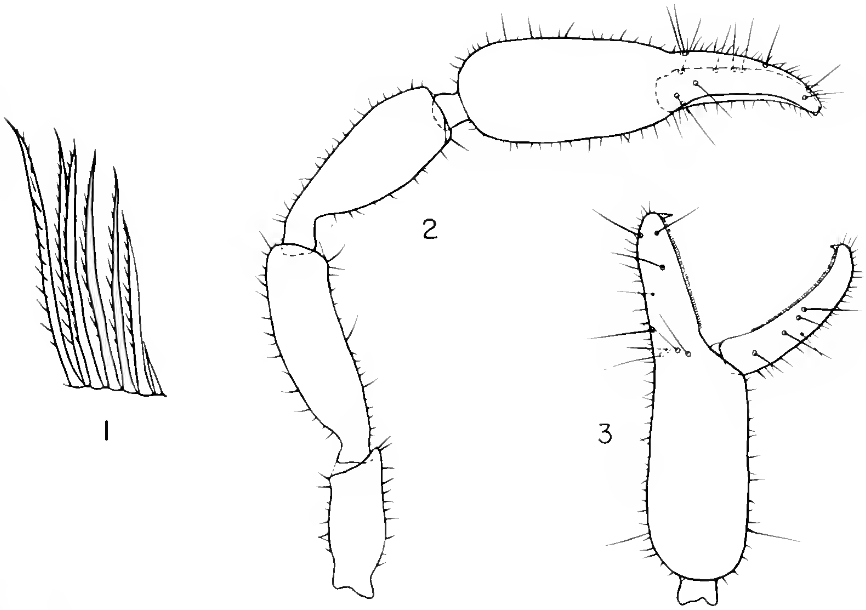

FIGS. 1–3. *Syarinus* **enhuycki,** new species. 1. Paratype female; flagellum of right chelicera. 2. Holotype male; left palp, dorsal view. 3. Holotype male; right chela, lateral view.

DESCRIPTION: MALE: (Measurements are given first for the holotype, followed in some instances in parentheses by those for the paratype.) Generally similar to *S. granulatus* Chamberlin. Body rather slender and light tan in color; palpi fairly slender, of dark reddish-brown color; legs rather short and stout, of same color as body; all setae acuminate. Carapace nearly square in outline, but with the anterior margin convex; no epistome; one weakly developed eye on each side, about two ocular diameters from the anterior margin; surface smooth. Carapacal setae total 43–44, with four near the anterior margin and 10 near the posterior margin.

Abdomen long ovoid, not much wider than carapace; surfaces of tergites and sternites smooth; pleural membranes longitudinally striate. Tergal chaetotaxy 14 : 15 : 15 : 17 : 16 : 15 : 15 : 16 : 14 : 16 : T1T2T1T : mm. Genital area typical. Sternal chaetotaxy 33 : (6)23 (6) : (6)16(6) : 19 : 17 : 15 : 16 : 16 : 13 : T2T2T1T : mm.

Chelicera moderately stout, a little more than half as long as carapace; movable finger and exterior surface of hand with scale-like sculpturing. Right palm with six and left palm with five setae (five setae on each palm in paratype); fixed finger with 15 conical teeth, spaced along the entire finger margin; movable finger with about 12 irregular teeth, closely grouped near the level of the galeal seta; galea submedially divided into three slender, simple branches, barely reaching past the end of the finger, and in turn barely surpassed by the tip of the galeal seta; serrula interior with 14–15 blades, all but the four basal ones being serrate along the posterior margins; serrula exterior with 25 or 26 blades; flagellum with seven setae, all but the small basal one being strongly denticulate on the anterior margins (Fig. 1).

Palps moderately slender; surfaces smooth, except for well-defined granules on extensor surface of trochanter, flexor surface of femur, and a small area on the flexor surface of the chelal hand at the base of the fingers. Proportions of the palpal segments shown in Figure 2. In addition to the usual tactile setae, each chelal finger carries a prominent "pseudotactile" seta, of the same size as the tactile setae but set in an areole little larger than those of the vestitural setae; positions of the tactile and "pseudotactile" setae shown in Figure 3. Fixed finger with 47 (43) obtusely pointed teeth; movable finger with 53 (51) similar teeth. Trochanter 2.7 (2.5), femur 3.3 (3.2), tibia 2.7 (2.6), and chela without pedicel 3.4 (3.3) times as long as broad; hand 1.9 (1.8) times as long as deep; movable finger 0.81 (0.86) times as long as hand.

Legs fairly stout; surface smooth; shapes and proportions similar to those of other members of the genus, but no indication of a "strip-shaped process" on the posterior margin of coxa III as described for *S. palmeni* (Kaisila, 1964, p. 53). Leg IV with tactile seta on tibia 0.43 (0.41) and on metatarsus 0.30 (0.30) the length of the segment from the proximal end.

FEMALE: (Description based on four paratypes). In color, size, and proportions, the female is very similar to the male. Carapacal setae total 41–46 with four near the anterior margin and 9–11 near the posterior margin. Tergal chaetotaxy like that of male; sternal chaetotaxy 18 : (6)18(6) : (6)15(6) : 20 : 19 : 18 : 18 : 14 : 17 : T2T2T2T : mm.

Chelicera like that of male, except that the galea of the female is divided subbasally into three long, stout rami, each with two to four short, sharp, terminal branches; the rami are of nearly equal length and extend beyond the tip of the finger by more than half their length. Palm with five or six setae. Flagellum usually with seven setae, but occasionally with eight.

Palps like those of male in most respects. Fixed finger with 42–47 teeth; movable finger with 48–52 teeth. Trochanter 2.3–2.5, femur 3.0–3.3, tibia 2.4–2.6, and chela 3.1–3.5 times as long as broad; hand 1.8–2.0 times as long as deep; movable finger 0.86–0.91 times as long as hand.

Legs as in the male. Leg IV with tactile seta on tibia 0.37–0.41 and on metatarsus 0.26–0.33 the length of the segment from the proximal end.

The females from Cattaraugus County, New York and Sullivan County, New Hampshire are essentially similar to the paratype females.

TRITONYMPH: (Based upon nine paratypes). Generally similar to adults, but smaller and slightly lighter in color. Carapace with 31–37 setae, of which four are at the anterior margin and 8–11 at the posterior margin.

Chelicera with five setae on the palm. Galea like that of the female in shape and relative size, that is, trifid with each branch terminally divided and extending well beyond the tip of the finger. Flagellum of six (rarely seven) setae, all but the basal one being denticulate along their anterior margins.

Palps with three tactile setae on the movable finger (lacking *sb*) and seven on the fixed finger (lacking *ist*); long, heavy, "pseudotactile" setae are present as in the adults. Two specimens, which are otherwise similar to the other tritonymphs, lack seta *t* as well as *sb* from the movable finger. Fixed finger with 33–37 marginal teeth; movable finger with 41–45 teeth. Trochanter 1.9–2.3, femur 2.9–3.2, tibia 2.2–2.4, and chela 3.1–3.4 times as long as broad; hand 1.7–2.0 times as long as deep; movable finger 0.83–0.92 times as long as hand.

DEUTONYMPH: (Based upon seven paratypes). Carapace with 20–26 setae, of which four are at the anterior margin and 7–8 at the posterior margin.

Chelicera with four or five setae on the palm. Galea like that of female and tritonymph. Flagellum of five or six setae; the sixth seta, when present, is a very short acuminate one at the basal end of the row; all others are denticulate along their anterior margins.

Palps with two tactile setae on the movable finger and six on the fixed finger; it has not been firmly established which setae are missing beyond *sb* and *ist,* which are missing from the tritonymph. Fixed finger with 23–30 marginal teeth; movable finger with 31–38 teeth. Trochanter 1.9–2.1, femur 2.7–3.1, tibia 2.1–2.3, and chela 3.2–3.4 times as long as broad; hand 1.7–1.8 times as long as deep; movable finger 0.88–0.96 times as long as hand.

MEASUREMENTS: (in mm.). MALE: Body length 3.15 (2.81). Carapace 0.76 (0.72) long; ocular width 0.62 (0.54). Chelicera 0.42 (0.38) long by 0.23 (0.20) broad; movable finger 0.32 (0.32); galea 0.056 and 0.064 (0.062) long. Palpal trochanter 0.56 (0.52) by 0.21 (0.21); femur 0.83 (0.77) by 0.25 (0.24); tibia 0.78 (0.73) by 0.29 (0.28); chela 1.34 (1.30) by 0.39 (0.39); hand 0.75 (0.72) by 0.39 (0.40); movable finger 0.61 (0.62) long. Leg I: basifemur 0.26 (0.25) by 0.16 (0.15); telofemur 0.26 (0.26) by 0.15 (0.15); tibia 0.35 (0.34) by 0.11 (0.10); metatarsus 0.13 (0.13) by 0.08 (0.07); telotarsus 0.21 (0.20) by 0.07 (0.07). Leg IV: basifemur 0.26 by 0.20; telofemur 0.51 by 0.20; tibia 0.48 (0.45) by 0.13 (0.12); metatarsus 0.17 (0.15) by 0.10 (0.09); telotarsus 0.23 (0.22) by 0.09 (0.09).

FEMALE: Body length 2.9–3.9. Carapace 0.75–0.79 long; ocular width 0.60–0.62. Chelicera 0.39–0.44 long by 0.22–0.25 broad; movable finger 0.30–0.32 long; galea 0.090–0.104 long. Palpal trochanter 0.53–0.58 by 0.21–0.23; femur 0.79–0.86 by 0.25–0.26; tibia 0.73–0.78 by 0.28–0.32; chela 1.27–1.38 by 0.37–0.42; hand 0.72–0.76 by 0.36–0.40; movable finger 0.63–0.66 long.

TRITONYMPH: Body length 2.26–3.04. Carapace 0.56–0.64 long. Chelicera 0.29–0.32 long by 0.17–0.18 broad; movable finger 0.20–0.26 long; galea 0.070–0.079 long. Palpal trochanter 0.33–0.38 by 0.16–0.19; femur 0.56–0.60 by 0.18–0.20; tibia 0.47–0.51 by 0.20–0.23; chela 0.85–0.95 by 0.25–0.29; hand 0.46–0.53 by 0.25–0.30; movable finger 0.42–0.45 long.

DEUTONYMPH: Body length 1.2–2.0. Carapace 0.44–0.47 long. Chelicera 0.20–0.24 by 0.12–0.13; movable finger 0.15–0.18 long; galea 0.053–0.065 long. Palpal trochanter 0.23–0.25 by 0.11–0.12; femur 0.37–0.40 by 0.12–0.15; tibia 0.29–0.34 by 0.14–0.16; chela 0.60–0.66 by 0.18–0.20; hand 0.31–0.36 by 0.18–0.20; movable finger 0.29–0.32 long.

REMARKS: *Syarinus* **enhuycki** is easily distinguished from *S. palmeni*, the only other species of the genus known from eastern North America, by its larger size, more slender palps and the nature of the cheliceral galea of the male, which is trifid in *S.* **enhuycki** but simple in *S. palmeni*. *S.* **enhuycki** is rather similar to *S. granulatus* and *S. honestus* from the western United States, but can be distinguished from those species by the following criteria. The palpal segments, particularly the tibia, are generally somewhat stouter in *S.* **enhuycki**; the cheliceral galea of the male of *S.* **enhuycki** is trifid, while that of *S. granulatus* or *S. honestus* is bifid or simple; the cheliceral galea of the female is significantly longer in *S.* **enhuycki** than in *S. granulatus*, indeed the galea of the tritonymph of the former species is nearly as long as that of the adult female of the latter (the female of *S. honestus* is not known); finally, specimens of *S.* **enhuycki** are slightly larger in most dimensions than the other species.

Representatives of *S.* **enhuycki** have been found at widely distant points in the Allegheny, Catskill, and White Mountains. Like *Pseudogarypus banksi* Jacot, this species is apparently a relict which has survived in the cool, northern parts of the Appalachian mountain system.

Through the courtesy of Dr. W. J. Gertsch of the American Museum of Natural History, it has been possible to restudy the female specimen from Wisconsin mentioned by Hoff and Bolsterli (1956, p. 163), and to mount and study a tritonymph collected along with that female. The adult female conforms more to *Syarinus* **enhuycki** than to *S. granulatus* in the stouter proportions of the palpal segments and in the length of the cheliceral galea. In addition, the length of the galea of the tritonymph is in the range of that of tritonymphs of *S.* ***enhuycki***. On the other hand, the adult female is the same size as *S. granulatus* and the position of the tactile seta on the fourth metatarsus is different from that in specimens of *S.* **enhuycki**. These specimens from Wisconsin are probably to be referred to *S.* **enhuycki**, but until further collections are made in the central United States their exact status must remain uncertain.

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BOOK REVIEW

A Survey of the Parasites of Wild Mammals and Birds in Israel. Part One—Ectoparasites. O. Theodor and M. Costa. Jerusalem, The Israel Academy of Sciences, 1967, iii + 117 pp., 3 maps, paperbound, 6″ × 9½″, $4.00. Distributed in the U.S. by Daniel Davey and Co., Inc., New York, N.Y. (IUP Catalog No. 3652).

Parts Two and Three of this series are still in preparation. Part Two, by A. Zuckerman, will deal with blood and tissue Protozoa; Part Three, by G. Wertheim, with helminths. In Part One, a three-page introduction to the series is followed by a systematic list of 1837 species of mammals and 357 species of birds, together with their "permanent" ectoparasites. This list includes preliminary data on Protozoa, worked out to genera by A. Zuckerman. General distribution in Israel is given for each host species, as well as the number of individuals examined and the number of parasites collected. Birds, in addition to their systematic listing, are identified as to their status as residents, winter visitors, summer breeders, or passing migrants. Pages 51–111 list the ectoparasites according to their own systematic position. Hosts are indicated for many species, and there are brief introductory notes on most of the major groupings. Siphonaptera and Ixodoidea are dealt with in more extensive notes on individual species. Nest-inhabiting mites (chiefly from rodents' nests) as well as parasitic mites are listed. Pages 112–115 are devoted to a discussion of zoogeographical problems in Israel. Finally, there are lists of the localities of collections and three small scale maps to accompany these. Careful editing, clear printing, wide margins and a good grade of paper will help to make this book useful as a partial check list for students of the various groups. For details, the reader will have to consult the publications (several by the same authors) listed in the bibliographic references for the major groups.

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The Revision of the Tribe Chalepini of America North of Mexico. II. Genus *Chalepus* Thunberg (Coleoptera: Chrysomelidae)[1]

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Abstract: Five species compose the genus *Chalepus* in the region under consideration. These are *bacchus* (Newman), *bellula* (Chapuis), *bicolor* (Olivier), *hebalus* Sanderson, *walshii* (Crotch), and a new subspecies *walshii* **sayi** is proposed. *Anoplitis* Kirby, 1837, is a junior synonym of *Chalepus* Thunberg, 1805; this new synonymy is necessary because their types are congeneric. Descriptions of the species are given, together with the complete list of references, and keys to the species and the subspecies are presented. Distributional data and maps are included for each, as are illustrations of the male genitalia. The total length of males is less than that of females, and in *bacchus* and *bicolor* there is a striking sexual dimorphism of total length.

INTRODUCTION

This revision of *Chalepus* Thunberg is the second in a proposed series reviewing the six genera of Chalepini in America north of Mexico. The first, a revision of the genus *Xenochalepus* Weise, 1910, will appear in the Coleopterists' Bulletin (Butte, 1968), and the measurements used here are described in the first revision.

The genus *Chalepus* is represented in North America by five species: *C. walshii* (Crotch); *C. bellula* (Chapuis); *C. hebalus* Sanderson; *C. bicolor* (Olivier); *C. bacchus* (Newman). A new subspecies *Chalepus walshii* **sayi** is proposed in this paper. This genus closely resembles *Odontota* in general appearance; the regularly rounded apices of elytra, its sutural angle, and the structure of the genitalia. However, these two genera are easily separated by the following sets of characters in which those for *Chalepus* are given first and those for *Odontota* second: Form elongate, sides parallel; form oblong, sides gradually but slightly dilated from base to apex. Clypeal apex feebly arcuate, base angulate; clypeal apex more arcuate, base subangulate. Frontal carina feebly developed and usually cristate; frontal carina strongly developed and usually cristulate. Elytra with ten rows of punctures; elytra with ten and one-half rows of punctures.

Anoplitis Kirby, 1837, is monobasic, with *Hispa bicolor* Olivier as its type. This species is congeneric with *Hispa sanguinicollis* L., 1771, the designated genotype of *Chalepus* Thunberg, 1805. *Anoplitis* is therefore a junior synonym of *Chalepus*.

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[1] From a dissertation submitted in partial fulfillment of the requirements for the Ph.D. degree at the Catholic University of America, Washington, D. C.

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This work was carried out under the direction of Dr. Ross H. Arnett, Jr., formerly Professor of Biology, Catholic University of America, to whom the writer is indebted for guidance, constant encouragement, and aid throughout this study. My sincere thanks to Doctors Lee D. Miller and Robert A. Davidson, of the Catholic University, Biology Department for reading the manuscript.

I wish also to express appreciation to the authorities and individuals of the following institutions for the loan of specimens for this study. The letters in parentheses indicate the abbreviations used for these institutions throughout this work. American Museum of Natural History, (AMNH), Dr. J. G. Rozen and Mrs. P. Vaurie; Forest Entomology Labratory, (FEL), Dr. B. A. Sugden; California Academy of Science, (CAS), Mr. H. B. Leech; Canada National Collection, (CNC), Dr. W. J. Brown; Chicago Natural History Museum, (CNHM), Dr. R. L. Wenzel; Cornell University, (CU), Dr. L. L. Pechuman; Museum of Comparative Zoology, (MCZ), Dr. J. F. Lawrence; University of California at Berkeley, (UCB), Dr. Ray F. Smith; University of Kansas, (UKL), Dr. G. W. Byers; University of North Carolina, (UNC), Dr. D. A. Young, Jr.; United States National Museum, (USNM), Mr. O. L. Cartwright, Mr. G. Vogt and Dr. R. E. White. Many of the data on biology reported here are from the unpublished notes in the late H. S. Barber's file. They are acknowledged in the text where they occur.

Genus *CHALEPUS* Thunberg

Chalepus Thunberg, 1805:282; Baly, 1885:48; Weise, 1905:63; Blatchley, 1910:1226; Weise, 1911(a):23; 1911(b):28, 35, 36; Uhmann, 1936:613, 623, 624; 1937:467; 1947:125; Monrós and Viana, 1947:193, 213, 214; Uhmann, 1957:83; 1964:417; Arnett, 1963:915, 940.

Anoplitis Kirby, 1837:227. (NEW SYNONYMY.)

TYPE SPECIES OF GENUS. *Chalepus sanguinicollis* (Linnaeus), 1771:530, fixed as the type species by Weise, 1905:63.

DIAGNOSTIC FEATURES OF GENUS. Form elongate, narrow, sides parallel. Clypeal surface usually finely punctate or coarsely granularly tuberculate with long white hairs. Each elytron predominantly ten striate at base.

DESCRIPTION OF GENUS. Length from 4.8 to 7.6 mm.; females are generally larger than the males.

HEAD slightly wider than length; vertex sulcate or micro-punctate. Frontal carina feebly developed, elongate or diamond-shaped, extending between the antennae and joins clypeal base. Antennal basal segment incrassate. Clypeus large and usually longer than broad; triangularly elevated; apex feebly arcuate; base angulate and lies close to antennal base; surface usually finely punctate or coarsely granularly tuberculate with long white hairs. Labrum prominent, broader than length, apical margin arcuate. Mandibles considerably longer than its width, partly or completely covered by labrum; size and shape of apices

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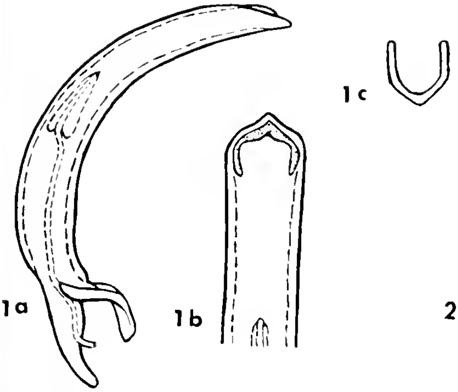
FIGS. 1–5. Drawings of the genitalia of the species and subspecies of *Chalepus*. Similar letters designate corresponding parts in the different species and subspecies: a, lateral or slightly dorso-lateral view of the aedeagus and tegmen; b, dorsal or dorsocaudal view of aedeagus; c, dorsal or dorsocaudal view of speculum gastrale. Figs. 1a, b, c, *C. walshii*; figs. 2a, b, c, *C. walshii* **sayi**; figs. 3a, b, c, *C. bicolor*; figs. 4a, b, c, *C. bacchus*; figs. 5a, b, c, *C. bellula*.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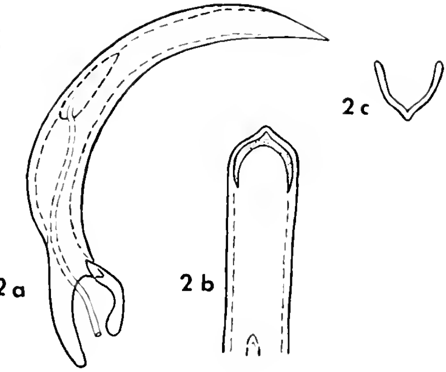
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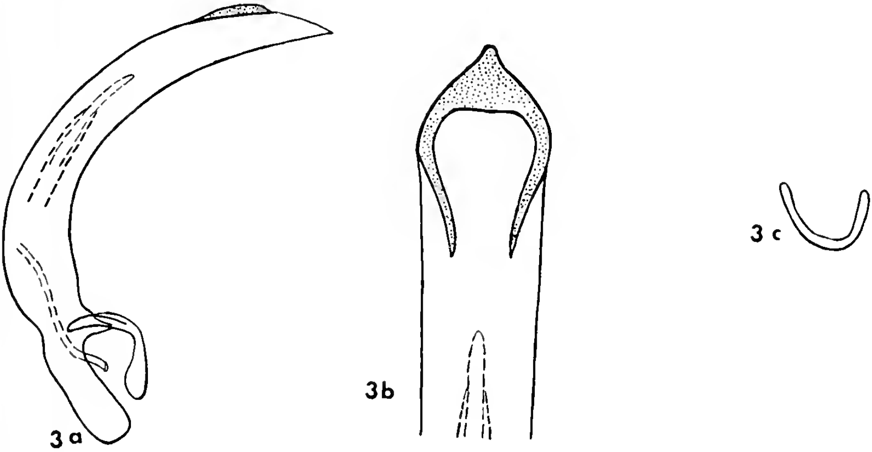
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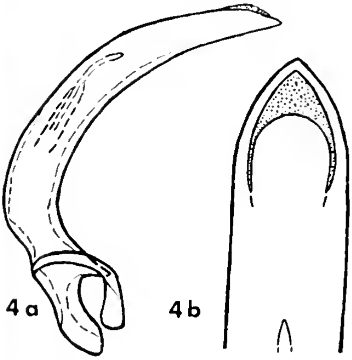
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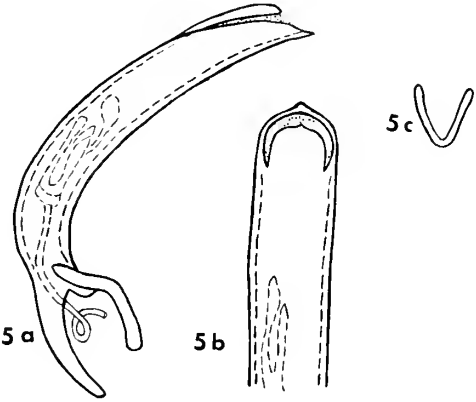
5a
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5c

varies; outer margin of each mandible rather broadly and evenly arcuate. PRONOTUM transverse; lateral margins obtusely angulo-subrotundate at middle; dorsum transversely convex, slightly depressed posteriorly with ante-scutellar transverse ridge. ELYTRA subelongate; parallel, slightly constricted on sides; apices of elytra more regularly rounded, and finely serrulate. Each elytron with ten rows of punctures at base and apex. Abdomen sparsely, irregularly, micro-punctate; fifth visible sternum apically truncate.

MALE GENITALIA. Aedeagus moderately sclerotized. Basal foramen small, slightly larger than one-sixth of length of aedeagus; anterodorsal wall of foramen from feebly to strongly convex. Median lobe tapering distally to acute or subacute point. Apical orifice small, U-shaped. Apical hood varies in shape. Strut keeled dorsally. Flagellum stout, usually broad at base and narrowing towards apex; its basal end away from foramen. Spiculum varies in shape.

DISTRIBUTION. The members of this genus as here recognized are distributed in the eastern, central, and southern parts of the United States (Figs. 6 and 7).

KEY TO THE SPECIES OF *CHALEPUS* OF NORTH AMERICA

1. Elytra not costate .... *walshii* (Crotch)
Elytra costate 2
2(1). Elytra entirely black 3
Elytra with yellow or red patches, ground color black 4
3(2). Elytral striae five to eight, reduced at middle to three rows of punctures .... *bicolor* (Olivier)
Elytral striae five to eight, reduced at middle to two rows of punctures .... *bacchus* (Newman)
4(2). Elytral striae five to eight, reduced at the middle to two rows of punctures; each femur yellow at basal half .... *bellula* (Chapuis)
Elytral striae five to eight, reduced at middle to three rows of punctures; each femur entirely blue-black .... *hebalus* Sanderson

1. *Chalepus walshii* (Crotch, 1873)
(Figs. 1a, b, c; and Fig. 6)

Odontota walshii Crotch, 1873:81. (Holotype cannot be located.)

TYPE LOCALITY. Illinois.

Chalepus walshii (Crotch), Weise, 1911(a):25; 1911(b):37; Uhmann, 1936:629; Leng, 1920:303; Uhmann, 1947:125; Wilcox, 1954:471, 472.

DIAGNOSTIC FEATURES. This species may be easily separated from other species of this genus by the absence of elytral costae.

DESCRIPTION OF SPECIES. MALE. Massachusetts, Suffolk Co., Brookline, 1920. F. C. Bowditch, (MCZ).

The total length 5.5 mm.; width 2.0 mm.

HEAD length width ratio, .714; vertex micro-punctate. Frontal carina diamond-shaped. Antennae 1.7 mm. in length; basal segment subconic; 2nd cylindrical, shorter than 1st; 3rd about 1.7 times longer than 2nd or 4th; segments 3–5 obconic, coarsely, irregularly sulcate and carinate; 6th segment one-half the 5th. Clypeus transverse, surface micro-rugose. Mandibles robust, partly covered by labium; bidentate. Eye width wider than the width of clypeus and equal to the width of interocular distance. PRONOTUM length 0.9 mm.; width

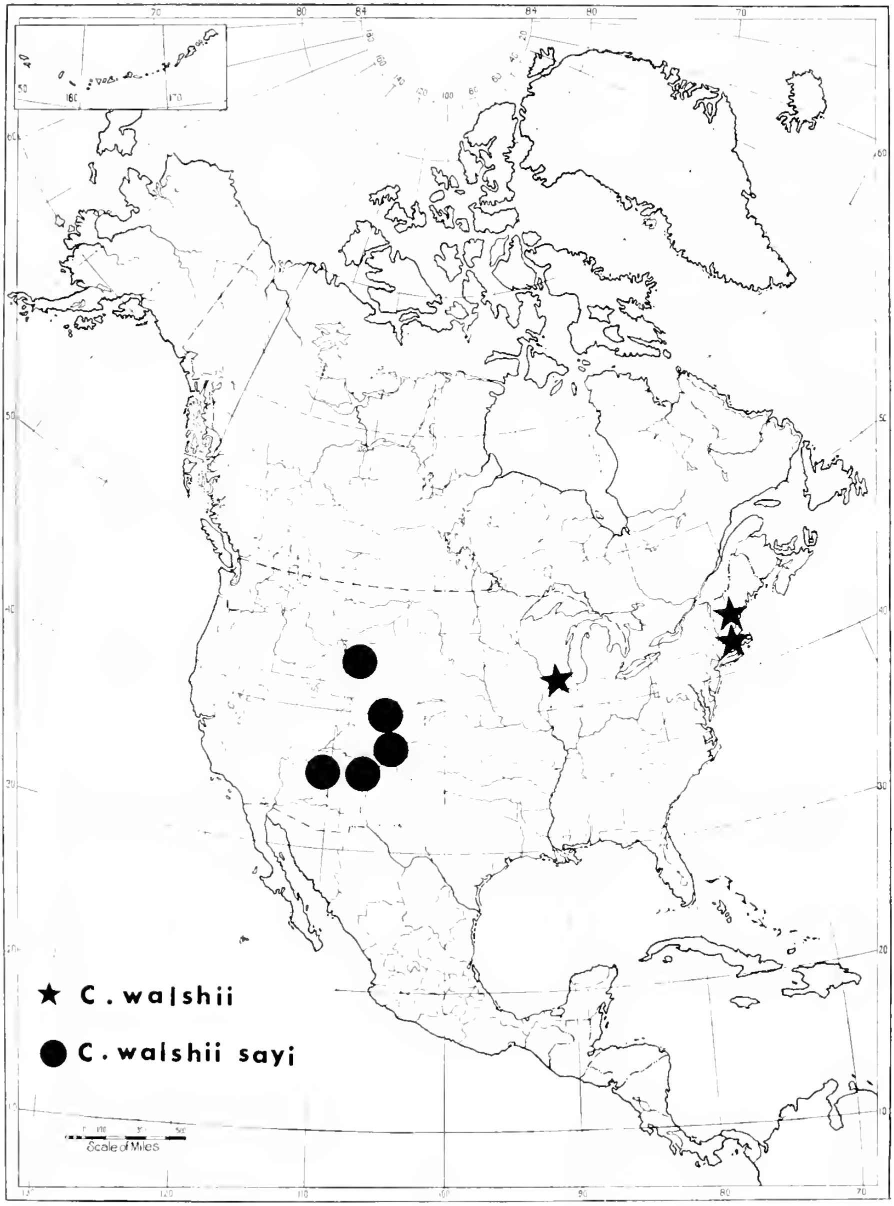

FIG. 6. Distribution of the subspecies of *C. walshii*.

2.6 mm.; widest at center; lateral margins distinctly angulate at middle, narrowing towards apex and obliquely more so towards base; dorsum coarsely foveo-punctate; interstices subcristate, shining. Medial line well-defined at base, evanescenting towards apex. Legs normal, apex of last tarsal segment deeply cleft at the base of claws. ELYTRA length 4.1 mm.; width 2.0 mm.; each elytron with ten uniform rows of deep punctures, extending from base to apex. Elytra not costate, only 8th interstice feebly carinate; 2nd interstice smooth, broad and not elevated.

COLOR. Pronotum bright red; prosternal epimeron partly red; elytra, venter and legs entirely black.

MALE GENITALIA. Aedeagus moderately sclerotized and showing considerable curvature from below (Fig. 1a). Basal foramen very small, equal to one-sixth the length of aedeagus; antero-dorsally strongly convex and running into a depression at one-fifth from base. Apical hood large and broad towards apex (Fig. 1b). Length of flagellum equal to one-seventh the length of aedeagus. Spiculum U-shaped (Fig. 1c), symmetrical.

FEMALE. Indistinguishable from male except by dissection.

BIOLOGY. Unknown.

LARVAE. Unknown.

VARIATION. The size variations are as follows: total length 5.7–6.3 mm.; elytral length 4.1–5.1 mm.; elytral width 2.0–2.4 mm. Males and females do not show sexual dimorphism of total length.

Pronotum bright red, but in some specimens it is bright orange-yellow. Mesoepisternum and mesosternal epimeron black, but in some specimens it is fulvo-aeneous.

DISTRIBUTION. The distribution of *Chalepus walshii* is indicated in Fig. 6. This species is known from Massachusetts, New Hampshire, Michigan, and Illinois. It has been collected from middle of May to late August, mostly in May and June.

SPECIMENS EXAMINED. 51: NEW HAMPSHIRE: Rockingham Co., Hampton, 1933, 2, S. A. Shaw, Wickham Coll'n., (USNM). MASSACHUSETTS: Middlesex Co., Ashland, June 26, 1928, 4, (CU); July 13, 1926, 3, C. A. Frost, (CAS); Hopkinton, June 1, 1913, 1; Natick, May 30, 1941, 2, C. A. Frost, (CAS); Ayer, July 27, 1939, 2, H. R. Dodge, (CNHM); Arlington, June 4, 1924, 1, P. J. Darlington, (MCZ). Suffolk Co., Framingham, May 19, 1907, 1, (CAS); July 27, 1946, 2, C. A. Frost, (CU); Brookline, 1920, 7, F. C. Bowditch, (MCZ). Worcester Co., Southboro, May 22, 1932, 4, (CAS); May 30, 1924, 3, (CU); 3, (USNM); June 17, 1923, 3, C. A. Frost, (AMNH); Springfield, June 23, 1913, 1, C. Dimmock, (USNM). Norfolk Co., Wellesley, June 8, 1913, 3, Bolster, (MCZ). County undet., Sherbern, June 8, 1929, 1, C. A. Frost, (CNHM); June 6–12, 1915, 3, May 20, 1934, 1, C. A. Frost, (CAS); August 27, 1933, 1, C. A. Frost, (USNM). County undet., W. Roxbury, June 6, 1, Bolster, (MCZ). MICHIGAN: Midland Co., May 26, 1935, 1, R. R. Dreisbach, (USNM). ILLINOIS. No further data: 1. Liebeck coll'n., (MCZ).

KEY TO THE SUBSPECIES OF *CHALEPUS WALSHII* OF NORTH AMERICA

Elytra entirely black .. *Walshii walshii* (Crotch)
Elytra entirely blue *walshii* **sayi** new subspecies

2. *Chalepus walshii* **sayi**, new subspecies

(Figs. 2a, b, c, and Fig. 6)

Hispa collaris Say, 1823:433-434. (Holotype cannot be located.)

TYPE LOCALITY. Arkansas.

Odontota collaris (Say), Horn, 1883:295.

Chalepus collaris (Say), Blatchley, 1910:1226.

DIAGNOSTIC FEATURES. This subspecies resembles *Chalepus walshii* in size, but may be separated from the latter by the presence of shiny blue elytra.

DESCRIPTION OF SUBSPECIES. MALE. Colorado, El Paso Co., Colo. Spr., June 15–30, 1898, H. F. Wickham, (USNM), alt. 6,000–7,000 ft.

Length 5.8 mm.; width 2.0 mm.; HEAD length/width ratio, .625; vertex sparsely micro-punctate. Frontal carina diamond-shaped, antennae 1.8 mm. in length; basal segment rotulate; 2nd shorter than 1st; 3rd about 1.4 times longer than 2nd or 4th; segments 1–5 slightly obconic, coarsely, irregularly sulcate and carinate. Clypeus transverse, surface micro-rugose. Mandibles robust, slightly covered by labium; bidentate. Eye width smaller than the width of clypeus and equal to the width of inter-ocular distance. PRONOTUM length 0.9 mm.; width 2.4 mm.; widest at center; lateral margins angulate at middle, narrowing towards apex and obliquely more so towards base; dorsum coarsely foveo-punctate; interstices subcristate, shining. Medial line well-defined with shallow longitudinal groove. Legs normal, apex of last tarsal segment deeply cleft at the base of claws. ELYTRA length 4.5 mm.; width 2.0 mm.; each elytron with ten uniform rows of deep punctures, extending from base to apex. Elytra not costate, only 8th interstice feebly carinate; 2nd interstice smooth, broad and not elevated.

COLOR. Pronotum bright red; prosternal epimeron partly red; elytra shiny blue; venter and legs entirely black.

MALE GENITALIA. Aedeagus moderately sclerotized and showing considerable curvature from below (Fig. 2a). Basal foramen very small, equal to one-sixth the length of aedeagus; antero-dorsally strongly convex and running into a depression at one-fifth from base. Apical hood large, its sides gradually tapering into an obtuse point (Fig. 2b). Flagellum length slightly less than one-seventh the length of aedeagus. Spiculum closely V-shaped (Fig. 2c); symmetrical; slightly emarginate at base.

FEMALE. Indistinguishable from male except by dissection.

BIOLOGY. Unknown.

LARVAE. Unknown.

VARIATION AND DISCUSSION. The size variations are as follows: total length 5.8–6.0 mm.; elytral length 4.5–4.7 mm.; elytral width 2.0–2.4 mm. Male and females do not show sexual dimorphism of total length.

This subspecies is different from the nominate *walshii walshii* (Crotch) in geographical distribution, color of the elytra, and male genitalia. The western subspecies *C. walshii* **sayi** shows mountain top distribution (alt. 6,000–6,600 ft.), while *walshii* which is the eastern species, is not so located, and the ranges are separated by the prairies. Further differences between **sayi** and *walshii* are used as follows. Those for **sayi** are given first and those for *walshii* are second. Elytra metallic blue; elytra black. Basal foramen wall narrow postero-dorsally; basal foramen wall wide postero-dorsally. Flagellum length long and narrow at base; flagellum length short and wide at base. Apical hood narrow towards apex; apical hood broad towards apex. Spiculum more V-shaped and emarginate at base; spiculum U-shaped and not emarginate at base.

NOMENCLATURAL NOTES. *Chalepus walshii* (Crotch, 1873), the type locality is from Illinois. The elytra are black in contrast to the metallic blue displayed by several samples from Colorado. The latter are *Hispa collaris* Say, 1823, but this name is preoccupied by Schönherr, 1817, and cannot be here maintained. Say's type locality was Arkansas near the Rocky Mountains, for *collaris* Say (not Schönherr) for which the new substitute name **sayi** is now proposed. This blue western form may thus be known as *Chalepus walshii* **sayi**.

DISTRIBUTION. The distribution of *Chalepus walshii* **sayi** is indicated in Fig. 6. This species is known from Colorado, western Nebraska, New Mexico, and Arizona. It has been collected from late May to early September, mostly in June.

SPECIMENS EXAMINED (42). NEBRASKA: Sioux Co., Monroe Canyon, June 19, 1911, 1, F. H. Shoemaker (CAS). COLORADO: El Paso Co., Manitou, June 17–20, 1926, 18, E. C. Van Dyke (CAS); Colorado Springs, June 15–30, 1896, 3, H. F. Wickham (USNM); June 1918, 1, M. C. Van Duzee (CAS); N. Cheyenne Cyn., June 27, 1926, 2, Van Dyke, (CAS); July 14, 1924, 1, Liebeck (MCZ); Boulder Co.: Jim Creek, near Boulder, June 21, 1923, 1, (AMNH); Huerfano Co.: La Veta, 1, F. C. Bowditch (MCZ); County undet.: Big Tompsankirr, August 7, Liebeck (MCZ); County undet.: Animas, June 26, alt. 6,600 ft., 2, (AMNH). NEW MEXICO: Valencia Co.: Pinos Altos Mts., Grants, August 28, 1951, 1, E. L. Kessel (CAS); Sandoval Co.: Jemez Mts., May 24, 1, Jno. Woodgate, (CAS); No further data, 1, F. H. Snow (UKL). ARIZONA: Coconino Co., Oak Creek Cyn., July, 2, F. H. Snow, alt. 6,000 ft. (UKL); No further data, Sept. 8, 1943, 1, W. W. Jones, (USNM); August 1902, 1, F. H. Shoemaker (UKL).

5. *Chalepus bicolor* (Olivier, 1792)

Figs. 5a, b, c and Fig. 7

Hispa bicolor Olivier, 1792:94; 1808:774.
(Location of type: Museum National d'Histoire Naturelle, Paris.)
TYPE LOCALITY: Georgia.

Chalepus rufipennis Thunberg, 1805:282; Illiger, 1806:248; Weise, 1911(a):29; 1911(b):42; Uhmann, 1964:417. (Synonymized.) (Location of type: Museum of Uppsala, Sweden.)
TYPE LOCALITY: Patria vacat.

Odontota rubicunda Suffrian, 1868:229; Gundlach, 1891:390; Weise, 1911(a):28; 1911(b):38; Uhmann, 1964:417. (Synonymized.) (Location of type: Museum of Halle, Germany.)
TYPE LOCALITY: Cardenas, Cuba.

Anoplitis bicolor (Olivier): Kirby, 1837:227.

Odontota bicolor (Olivier): Crotch, 1873:80–81; Horn, 1883:295–296; Chittenden, 1902:67.

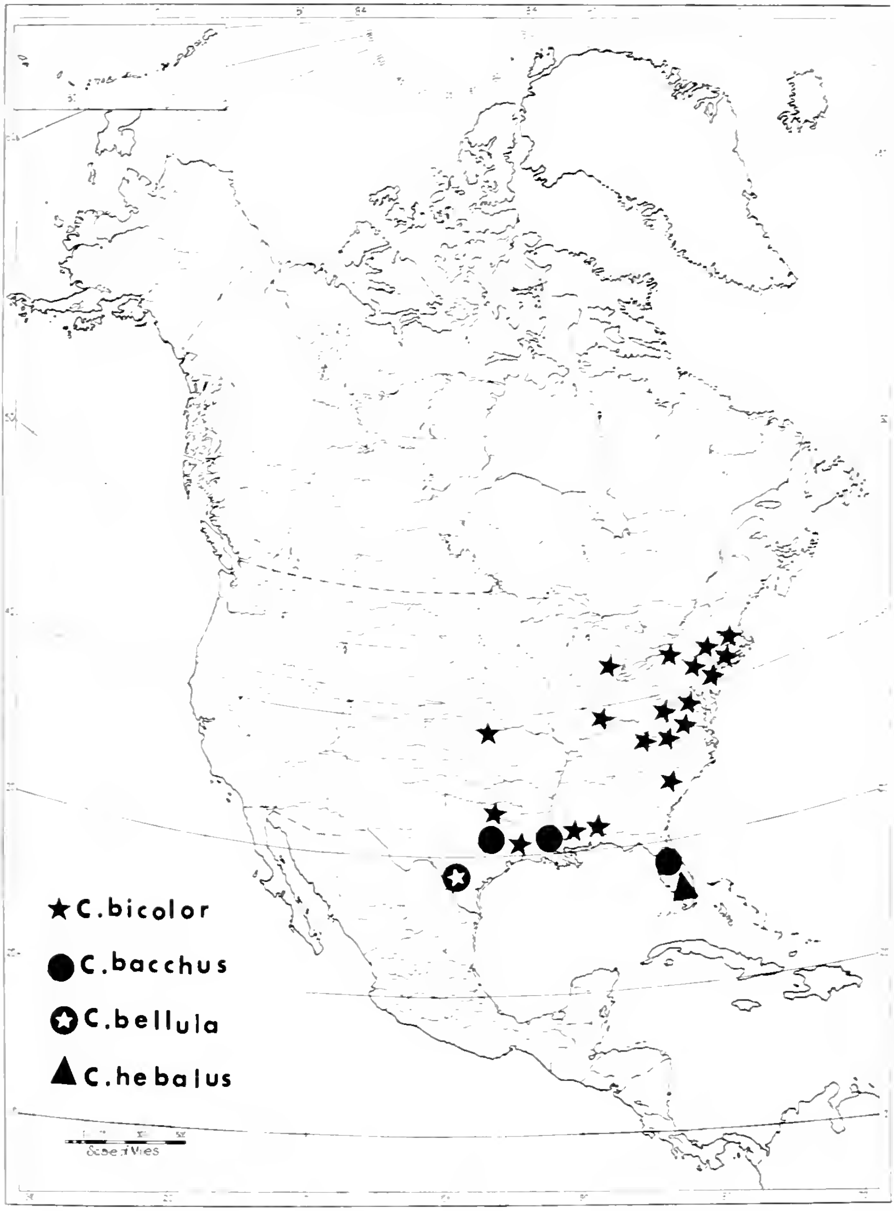

FIG. 7. Distribution of the remaining species of *Chalepus*: *bicolor, bacchus, bellula, hebalus*.

Chalepus bicolor (Olivier), Blatchley, 1910:1226; Weise, 1911(a):24; 1911(b): 37; Frost, 1924:464; Needham, Frost and Tothill, 1928:199; Uhmann, 1936: 614, 625; Maulik, 1937:136; Uhmann, 1957:85.

DIAGNOSTIC FEATURES. This species bears a deceptive resemblance to *C. bacchus*, and may be confused with it in collections. Superficially it differs by the pronotum spotted with black; femora red at base, and elytral striae 5–8 reduced at middle to three rows of punctures.

DESCRIPTION OF SPECIES. MALE. South Carolina, Horry Co., Myrtle Beach, April 23, 1919, E. R. Kalmbach, (USNM).

Length 6.3 mm.; width 2.1 mm. HEAD length/width ratio, .875; vertex and front impressed in the medial line with a deep longitudinal groove sulci close to eyes long and deep; a transverse impression on vertex, near hind margin of eyes feebly present. Longitudinal sulcus on dorso-lateral side of neck perceptible. Antennae 2.1 mm. in length; 2nd segment cylindrical, wider than its length and shorter than 3rd; rotula between 1st and 2nd segment prominently present; 3rd obconic, about one-third longer than 4th; segments 4–6 subconic; segments 3–6 coarsely irregularly sulcate containing decumbent scale-like hairs. Clypeus longer than broad; surface tuberculate. Mandibles prominent, unidentate; cutting edges broad and sharp. Eye width smaller than the width of clypeus and wider than dorsal inter-ocular distance. PRONOTUM length 1.2 mm.; width 2.0 mm.; broader at base; lateral margins angulate at middle, narrowing towards apex and obliquely more so towards base, bisinuate; dorsum deeply foveo-punctate; interstices suberistate, sparsely alutaceous. Medial line with well-defined shallow longitudinal groove. Legs normal; apex of last tarsal segment feebly sulcate at the base of claws. ELYTRA length 5.0 mm.; width 2.1 mm.; each elytron with ten rows of deep punctures at base and apex, and nine rows at middle portions; striae 5–8 reduced at middle to three rows of punctures; 2nd, 4th and 8th interspaces strongly costate; suture also slightly thickened; basal and apical portion of the 6th interspace elevated; 2nd and 4th interspaces smooth, 6th and 8th microscopically tuberculate.

COLOR. Pronotum bright red, often spotted with black; scutellum, venter and basal half of each femora bright red; elytra black.

MALE GENITALIA. Aedeagus moderately sclerotized and showing greater curvature from below (Fig. 3a). Basal foramen larger than one-sixth of length of aedeagus; antero-dorsally depressed, postero-dorsally rectate and running into a depression at one-fifth from base. Apex acute. Apical orifice large and as shown in Fig. 3b. Apical hood large with broad, truncate posterior end. Flagellum length equal to one-third the length of aedeagus. Spiculum as shown in Fig. 3c asymmetrical.

FEMALE. The total length of females is longer than that of males.

BIOLOGY. "This species has been reared by the late Mr. Bridwell near Washington from the mining leaves of *Panicum clandestinum* L." data from H. S. Barber, Unpublished. Chittenden (1902) reared it from *Panicum nitidum* Lam. = (*P. macrocarpon* Le Cont). Blatchley, 1910, mentioned that it is scarce in distribution and taken by sweeping roadside herbage.

LARVAE. Unknown.

VARIATION. The size variations are as follows: total length: males 6.3–6.7 mm.; females 7.3–7.6 mm.; elytral length: male 5.0–5.2 mm.; females 5.5–6.0 mm.; elytral width: males 2.1–2.3 mm.; females 2.4–2.5 mm. The total length of the males studied is considerably less than the length of the females, and thus shows striking sexual dimorphism of total length.

The black spots on the pronotum vary in size, ranging from completely absent to large areas leaving only traces of the red ground color around the edges, as viewed dorsally. When these spots are absent, the femora is red at the base.

C. bicolor is the monobasic genotype of *Anoplitis* Kirby, 1837 which name is misapplied in recent literature to a very different group of species.

DISTRIBUTION. The distribution of *Chalepus bicolor* is indicated in Fig. 7. This species is known from Massachusetts southward to Texas and westward to Kansas. It has been collected from middle of May to late September, mostly in June and July.

SPECIMENS EXAMINED. 86: MASSACHUSETTS: Middlesex Co., Framingham, Aug. 10, 1947, 2, (MCZ), 2, C. A. Frost, (CAS). Hampshire Co., Ware, June 26, 1947, 1, C. A. Frost, (MCZ). NEW YORK: Orange Co., Ft. Montgomery, Sept. 16, 1923, 1, F. M. Schott, (CU); June 24, 1947, 1, F. M. Schott, (AMNH); Bear Mt., Aug. 16, 1925, 1, F. M. Schott, (CU). Niagara Co., Suffern, 1, (AMNH). Bronx Co., Yonkers, June 16, 1935, 1, H. Dietrich, (CU). CONNECTICUT: New Haven Co., New Haven, Aug. 20, 1934, 1, R. H. Beamer, (UKL). Co. undet., Corn Wall, July 27, 1924, 2, Chamberlain, (MCZ). PENNSYLVANIA: Bucks Co., New Hope, May 14, 1949, 1, M. A. Cazier, (AMNH). Co. undet., Glenolden, 3, Geo. M. Greene, (USNM). NEW JERSEY: Atlantic Co., Buena, June 8, 1, Liebeck, (MCZ). Bergen Co., Hillsdale, June 29, 1924, 2, Quirsfeld, (MCZ); Norwood, May 26, 1941, 1, Schott, (AMNH). Middlesex Co., Jamesburg, Sept. 26, 1910, 2, (AMNH). Camden Co., Clementon, May 5, 1897, 1, Geo. M. Greene, (USNM). Sussex Co., Hopatcong, 1, Chas. Palm, (AMNH). Ocean Co., Lakehurst, August 17, 1918, 1, J. C. Pallister, (AMNH). Passaic Co., Paterson, May 31, 1, J. A. Grossbeck, (AMNH); Greenwood Lk., June 3, 1917, 1, F. M. Schott, (CU). Atlantic Co., DaCosta, May 4, 1, Liebeck, (MCZ). No further data: 1, F. A. Eddy, (MCZ). MARYLAND: Anne Arundel Co., Odenton, June 2, 1918, 1, H. Dietrich, (CU). Baltimore, June 30, 4, F. E. Blaisdell, (CAS). Co. undet., Ct. Falls, May 17, 1916, 1, Shoemaker, (CU). Plummers Island, May 25, 1918, 1, Van Dyke, (CAS). DISTRICT OF COLUMBIA: No further data: 1, F. E. Blaisdell, (CAS); 1, (USNM). VIRGINIA: Alexandria Co., Alexandria, June 19, 1916, 1, Shoemaker, (CU). Fairfax Co., Sept. 21, 1911, 1, L. B. Woodruff, (AMNH). Nelson Co., June 19, 1914, 2, W. Robinson, (USNM). Stafford Co., Fredericksburg, June 27, 1900, 2, W. D. Richardson, (USNM); 1, Van Dyke, (CAS). Co. undet., Roslyn, 7, Chittenden, (USNM). Co. undet., Glencarlyn, June, 1923, 2, Quirsfeld, (CU). Co. undet., Mathias Pt., May 22, 2, Liebeck, (MCZ). Co. undet., Great Falls, May 12, 1; Falls Church, Sept. 18, 1, Banks, (MCZ). WEST VIRGINIA: Greenbrier Co., White Sulphur, July, 3, A. Fenyes Coll'n., (CAS). NORTH CAROLINA: Buncombe Co., Black Mts., June 4, 1904, 2, (AMNH). Cherokee Co., Murphy, 1, (CAS). SOUTH CAROLINA: Florence Co., Florence, Aug. 19, 1929, 1, O. L. Cartwright, (USNM). Horry Co., Myrtle Beach, April 22, 1919, 1, E. R. Kalmback, (USNM). ALABAMA: Mobile Co., Mobile, May 27, 1908, 3, H. P. Loding, (CAS). MISSISSIPPI: George Co., Lucedale, June 7, 1931, 1, H. Dietrich, (CU). ARKANSAS: No further data: 1, F. A. Eddy, (MCZ). TEXAS: Cooke Co., Gainsville, June 4, 1923, 1, E. E. Russell, (USNM). Victoria Co., Victoria, May 18, 1907, 1, J. D. Mitchell, (USNM). No further data: 1, C. V. Riley, (USNM). KANSAS: Douglas Co., 1, F. H. Snow, (UKL). INDIANA: Clark Co., May 12, 1908, 1, F. Psota and A. B. Wolcott, (CNHM). Co. undet., Hessville, Sept. 5, 1909, 3, F. Psota and A. B. Wolcott; July 29, 1912, 2, E. Liljeblad, (CNHM). Co. undet., Pine, April 25, 1911, 1, Jeblad, (CZ). MICHIGAN: Wayne Co., 1895, 1, E. B. Chope, (CNHM).

4. *Chalepus bacchus* (Newman, 1841)
(Figs. 4a, b and Fig. 7)

Hispa bacchus Newman, 1841:76. (Location of types in both British Museum and in Hope Museum of Oxford, England.)

TYPE LOCALITY. St. Johns Bluff near Jacksonville, Florida.

Chalepus bacchus (Newman), Weise, 1911(a):24; Uhmann, 1957:85.

DIAGNOSTIC FEATURES. This species bears a deceptive resemblance to *C. bicolor*, and may be confused with it in collections. Superficially it differs by the pronotum entirely red; elytral striae five to eight reduced at middle to two rows of punctures.

DESCRIPTION OF SPECIES. MALE. Florida, Seminole Co., March 15, 1927, F. M. Uhier, (USNM).

Length 5.3 mm.; width 1.7 mm. HEAD length width ratio, .857; vertex and front impressed in the medial line with a deep longitudinal groove; sulci close to eyes long and shallow; longitudinal sulci on dorso-lateral side of neck perceptible. Frontal carina diamond-shaped. Antennae 2.1 mm. in length; 2nd segment cylindrical, wider than its length and shorter than 3rd; rotula between 1st and 2nd segment feebly present; 3rd obconic, about 1.2 times longer than 4th; segments 2–6 coarsely irregularly sulcate containing decumbent scale-like hairs. Clypeus longer than broad; surface tuberculate. Mandibles prominent, unidentate; apices obtuse. Eye width equal to the width of clypeus and wider than inter-ocular distance. PRONOTUM length .7 mm.; width 1.4 mm.; broader at base; lateral margins angulate at middle, narrowing toward apex and obliquely more so toward base, bisinuate; dorsum coarsely deeply foveo-punctate; interstices cristate. Medial line well-defined with shallow longitudinal groove. Legs normal; apex of last tarsal segment feebly sulcate at the base of claws. ELYTRA length 4.0 mm.; width 1.7 mm.; each elytron with ten rows of deep punctures at base and apex, and eight rows at middle portion; striae 5–8 reduced at middle to two rows of punctures; 2nd, 4th and 8th interspaces strongly costate; suture also slightly thickened; basal and apical portion of 6th interspace elevated, apical part of carina little more distinct than the basal part of carina.

COLOR. Pronotum, scutellum and venter bright red. Elytra and legs black; very rarely femora rufescent at base.

MALE GENITALIA. Aedeagus moderately sclerotized and showing greater curvature from below (Fig. 4a). Basal foramen smaller than one-sixth of length of aedeagus; antero-dorsally more depressed; postero-dorsally perceivable concave and running into a depression at one-fourth from base. Apex acute. Apical orifice large. Apical hood large with lunulet posterior end. Flagellum apex curved; its length equal to one-fourth the length of aedeagus.

FEMALE. The total length of females is longer than the males.

BIOLOGY. The late H. S. Barber has "swept several numbers from the 'everglades' grasses about Paradise Key, now called the Royal Palm State Park in February-March, 1919." . . . data from H. S. Barber, unpublished.

LARVAE. Unknown.

VARIATION AND DISCUSSION. The size variations are as follows: total length: males 4.8–5.3 mm.; females 6.6–6.8 mm.; elytral length: males 3.8–4.0 mm.; females 5.0–5.3 mm.; elytral width: males 1.7–1.9 mm.; females 2.1–2.2 mm.

The total length of males studied is considerably less than the length of females, and thus shows striking sexual dimorphism of total length.

The pronotal interstices cristate and not alutaceous, in some specimens it is subcristate and sparsely alutaceous. Pronotum bright red, in some specimens it is bright orange-yellow. The pronotal medial line varies from well-defined to ill-defined. In some specimens the mesoepisternum is black.

This species is usually cited as a synonym of *C. bicolor* (Oliv.) and in the collections it gives a false impression of variability. Specimens from Alabama to Texas display some intermediate combination of characters or inconstancy which cannot be understood from the insufficient samples representing this part of the habitat, but *C. bicolor* and *C. bacchus* appear to be distinguishable by the following characters. The characters of *C. bicolor* are given first and those of *C. bacchus* are given second. Pronotum bright red, often spotted with black; pronotum entirely bright red. Femora red at the base; femora entirely black. Elytral striae 5 to 8 reduced at middle to 3 rows of punctures; elytral striae 5 to 8 reduced at middle to 2 rows of punctures. Aedeago-parameres short; aedeago-parameres very long. Basal foramen larger than one-sixth of length of aedeagus; basal foramen smaller than one-sixth of length of aedeagus.

DISTRIBUTION. The distribution of *Chalepus bacchus* is indicated in Fig. 7. This species is known from Florida to Eastern Texas. It has been collected from early February to middle of August, mostly in July and August.

SPECIMENS EXAMINED. 151: FLORIDA: Pinellas Co., Tarpon Springs, April 18, 1943, 11, B. Malkin, (CNHM); Dunedin, Feb. 9, 1922, 6, E. W. Mank, (CU); Largo, July 18, 1947, 2, F. H. Chermock, (CAS). Collier Co., Everglades Oasis, Aug. 11, 1930, 3, J. Nottingham, (UKL). Alachua Co., Gainesville, July 17, 1934, 1, M. E. Griffith, (UKL). Sarasota Co., Venice, Aug. 11, 1930, 2, J. Nottingham, (UKL). Johna Co., St. Augstne, 1, (UKL); 5, Liebeck, (MCZ). Orange Co., Winter Park, March 20, 1929, 3, John George Gehring, (MCZ). Dade Co., Homestead, June, 1929, 2, Darlington, (MCZ). Okeechobee Co., Okeechobee, June 16, 1929, 8, Darlington, (MCZ). Manatee Co., Oneco, March 26, 1954, 24, G. E. Ball, (CU). Highlands Co., Archbold B. Sta. Lk. Placid, April 8, 1961, 11, A. and H. Dietrich, (CU). Putname Co., Welaka, May 18, 1961, 3, A. and H. Dietrich, (CU); Crescent City, April, 1908, 1, Van Duzee, (CAS), 8, Hubbard and Schwarz, (USNM); Pompana, Feb. 29, 2, (USNM). Palm Beach Co., Palm Beach, March 29, 1923, 3, F. C. Fletcher, (CU); W. Palm Beach, Feb. 5, 1944, 1, (USNM). Osceola Co., Kissimmee, 2, Chas. Palm, (AMNH). Duval Co., Jackson V., 2, Mrs. A. T. Slosson, (AMNH). Hendry Co., LaBelle, April 21, 1921, 1, J. N. Knull, (CAS). Glades Co., Moore Haven, April 17, 1921, 1, J. N. Knull, (CAS). Seminole Co., Sanford, March 1–6, 1927, 1, F. M. Uhler, (USNM). Co. undet., Yankeetown, July 17, 1934, 1, P. McKinstry, (UKL). Co. undet., Childs, Aug 6, 1930, 1, R. H. Beamer, (UKL). Co. undet., Enterprise, 3, Hubbard and Schwarz, (USNM). Co. undet., Palrndale, May 7, 1961, 1, A. and H. Dietrich, (CU). Co. undet., Bisc Bay, 2, Mrs. A. T. Slosson, (AMNH). Co. undet., Paradise Key, April 10, 1921, 1, J. N. Knull, (CAS); March 1, 1919, 4, H. Barber; 2, Schwarz and Barber, (USNM). No further data: 8, F. A. Eddy, (MCZ); 5, (USNM). GEORGIA: Co. undet., Okefenokee Swamp, July 30, 1934, 2, J. D. Beamer, (UKL); July 25, 1939, 3, D. E. Hardy, (UKL); Aug. 3, 1934, 2, P. A. McKinstry, (UKL). No further data: 2, (UKL). ALABAMA: Co. undet., Oak Grove, June 17, 5, H. Soltau, (USNM). LOUISIANA: Natchitoches Co., Natchitoches, Aug. 10, 1928, 1, J. G. Shaw, (UKL). TEXAS: Leon Co., S. W. Oakwood, April 12, 1963, 2, W. J. Gertsch and W. Ivie, (AMNH). Co. undet., Handley, April 27, 1905, 1, J. C. Crawford, (USNM). No further data: 1, Liebeck, (MCZ).

5. *Chalepus bellula* (Chapuis, 1877)
(Figs. 5a, b, c and Fig. 7)

Odontota bellula Chapuis, 1877:11.

(Location of type: Musee Royal de l'Afrique Centrale, Brussels, Belgium.)

TYPE LOCALITY. Mexico.

Odontota tricolor Chapuis, 1877:11; Baly, 1885:68, (Synonymized).

(Location of type: Musee Royal de l'Afrique Centrale, Brussels, Belgium.)

TYPE LOCALITY. Mexico.

Chalepus bellulus (Chapuis), Baly, 1886:121; Champion, 1894:237; Weise, 1911(a):24; 1911(b):36; Uhmann, 1936:614, 624; Sanderson, 1951:160; Uhmann, 1957:84; 1964:417.

DIAGNOSTIC FEATURES. This species resembles *C. hebalus* in size and color, but may be separated from the latter by the following characters:

Elytral striae 5 to 8 reduced at middle to two rows of punctures; each femur yellow at basal half; pronotum entirely orange-yellow; venter entirely reddish.

DESCRIPTION OF SPECIES. MALE. Texas, Cameron Co., Brownsville, in Palm forest, Dec. 29, 1945, R. H. Beamer, (UKL).

Length 6.5 mm.; width 2.0 mm. HEAD length/width ratio, .875; vertex and front impressed in the medial line with a deep longitudinal groove; sulci close to eyes short and deep. Antennae 2.2 mm. in length; 2nd segment cylindrical; 1st and 2nd segments short, subequal; segments 3–6 obconic; 3rd segment one-third longer than 2nd; 4th slightly shorter than 3rd. Clypeus longer than broad; surface tuberculate. Mandibles entirely covered by labrum. Eye width equal to the width of clypeus and wider than dorsal inter-ocular distance. PRONOTUM length 1.2 mm.; width 1.7 mm.; widest at base; lateral margins obtusely angulo-subrotundate at middle, nearly parallel on basal one-fourth then obliquely narrowing towards apex; dorsum coarsely and deeply foveo-punctate; interstices subcristate and alutaceous. Medial line ill-defined. Middle tibia of male with a small subapical tooth; apex of last tarsal segment feebly sulcate at the base of claws. ELYTRA length 4.9 mm.; width 2.0 mm.; elytral apex rather strongly serrulate than the sides; each elytron with ten rows of deep punctures at base and apex and eight rows at middle; striae 5–8 reduced at middle to 2 rows of punctures; 2nd, 4th, and 8th interspaces smooth and strongly costate, suture also thickened; basal and apical portion of the 6th interspace also elevated.

COLOR. Pronotum and venter orange-yellow; elytra with apical third blue-black, the black area extending narrowly along suture to scutellum, extending more widely along lateral margin of elytron, and a little enlarged on humerus, basal discal area of elytra with a broad longitudinal yellow strip which is evanescent posteriorly. Legs black except the basal half of each femur and each coxa orange-yellow. The medio-apical portion of 5th visible sternite infuscate.

MALE GENITALIA. Aedeagus moderately sclerotized and showing more curvature from below (Fig. 5a). Basal foramen smaller than one-fifth of length of aedeagus; antero-dorsally convex and running into a depression at one-fourth from base. Apex distinctly angulate. Apical hood (Fig. 5b) broad toward posterior end. Strut long, not close to foramen. Flagellum stout and irregular; its approximate length equal to one-fifth the length of aedeagus. Spiculum V-shaped (Fig. 5c).

FEMALE. The 5th visible sternum has an irregular patch of setae on either side of the central elevation, whereas in the male it is hardly perceptible.

BIOLOGY. Unknown.

LARVAE. Unknown.

VARIATION. The size variations are as follows: total length: 6.5–7.2 mm.; elytral length 4.9–5.5 mm.; elytral width: 2.0–2.2 mm. Males and females do not show sexual dimorphism of total length.

The elytral interstices are densely alutaceous and in some specimens it is sparsely alutaceous.

DISTRIBUTION. The distribution of *Chalepus bellula* is indicated in Fig 7, and it is known from Texas.

SPECIMENS EXAMINED. 4: 2 males; 2 females. TEXAS: Cameron Co., Brownsville, in Palm forest, Dec. 29, 1945, 1 male, 1 female, R. H. Beamer, (UKL); March 24, 1936, 1 male, P. A. Gliok, (USNM). No further data: 1 female, (USNM).

6. *Chalepus hebalus* Sanderson, 1951[2]

Chalepus hebalus Sanderson, 1951:160; Uhmann, 1957:87.

(Location of type: Illinois Natural History Survey.)

TYPE LOCALITY. Homestead, Florida.

DIAGNOSTIC FEATURES. This species resembles *C. bellulus* in size and color, but may be separated from the latter by the following characteristics:

Elytral striae 5 to 8 reduced at middle to three rows of punctures; leg entirely blue-black; pronotum entirely red, anterior margin above dusky; venter black, except pro- and meso-sternum.

DESCRIPTION OF SPECIES. MALE. Length, 7.0 mm.; width, 2.0 mm. HEAD vertex with a deep median longitudinal groove and a shallower ocular groove on upper margin of each eye; head between eyes very finely granulate; area very narrow between antennal bases, sharply carinate. Antennal 3rd segment very slightly longer than 4th, 6th slightly shorter than 5th. PRONOTUM width about one-fourth greater than extreme median length, the sides on basal three-fifths parallel then converging anteriorly and constricted, then straight to apex. Dorsum coarsely and deeply punctured, the punctures a little larger in median area; interstices cristate. ELYTRA with ten rows of deep punctures at base and apex and nine rows at middle; striae 5 to 8 reduced at middle to 3 rows of punctures; 2nd, 4th, and 8th interspaces carinate; 3rd carina a little sharper than 1st and 2nd carinae; side margin of elytron serrate, the spines in the apical region varying in length from one-half to equal the width of the elytral flange.

COLOR. Head black. Pronotum entirely red, anterior margin above dusky. Mesosternum red, its sides piceous. Elytra entirely shining red in basal region; apical region of elytron blue-black. Legs entirely blue-black. Venter black, except pro- and meso-sternum.

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[2] Dr. Sanderson has informed me that "I have ready to go to press a paper on Chrysomelids which will include the synonymy of my *Chalepus hebalus* with the West Indies *sanguinicollis* L."

MALE GENITALIA. Apex subtruncate.

FEMALE. Unknown.

BIOLOGY. Unknown.

LARVAE. Unknown.

DISTRIBUTION. The distribution of *Chalepus hebalus* is indicated in Fig. 7, and it is known from Florida.

SPECIMENS EXAMINED. Nil.

I have not seen any material on either of the above-mentioned species. Therefore, for the present I am retaining *C. hebalus* as a valid name until the opportunity to study the material is presented. The description of *hebalus* is taken from the literature.

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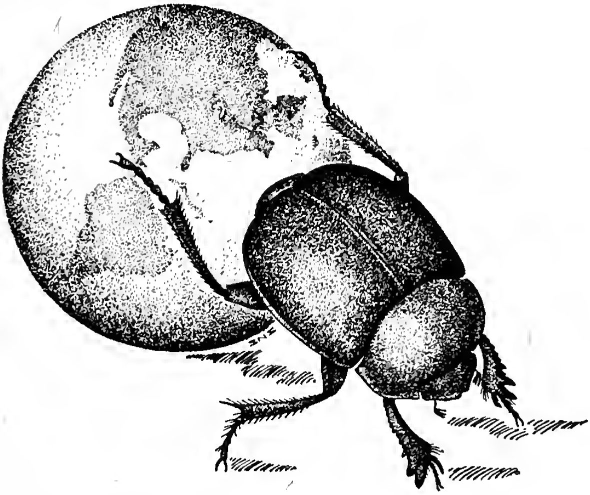
Journal
of the
New York Entomological Society



Devoted to Entomology in General

The New York Entomological Society
Incorporating The Brooklyn Entomological Society
Incorporated May 21, 1968

The New York Entomological Society
Organized June 29, 1892—Incorporated February 25, 1893
Reincorporated February 17, 1943

The Brooklyn Entomological Society
Founded in 1872—Incorporated in 1885
Reincorporated February 10, 1936

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P.M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 79th St. & Central Park W., New York, N. Y. 10024.

Annual dues for Active Members, $4.00; including subscription to the Journal, $9.00.

Members of the Society will please remit their annual dues, payable in January, to the Treasurer.

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Mailed November 1, 1968

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Journal of the New York Entomological Society

VOLUME LXXVI NOVEMBER 1, 1968 No. 3

CONSOLIDATION ISSUE

CONTENTS

Announcement of Consolidation

The President and the Trustees of the New York Entomological Society are pleased to announce the consolidation of the Brooklyn Entomological Society with the New York Society. The official name of the Society is now The New York Entomological Society, Incorporating The Brooklyn Entomological Society, Inc., and the effective date of the consolidation is May 21, 1968.

In recognition of this event the first two articles in this issue of the **Journal** are histories of the New York and the Brooklyn Societies. These accounts record various circumstances over the years and particularly in the last few, which have brought the two Societies together. During the Spring of 1966 the memberships gave their approval, and the necessary paperwork was started through the various New York State agencies.

An important consideration in the consolidation was the preservation of the illustrious publication tradition of the Brooklyn Society. Thus, **Entomologica Americana** will resume publication later this year or early next under the editorship of Dr. James Slater of the University of Connecticut, and the **Journal of the New York Entomological Society** will continue as in the past. The new Society will have two complementary outlets for all publications, **Entomologica Americana** for longer papers and the **Journal** for shorter ones. The **Bulletin of the Brooklyn Entomological Society** ceased publication with volume **60**, 1965. Complete stocks of back issues of all of these publications, including such important works as Boving and Craighead's *An Illustrated Synopsis of the Principal Larval Forms of the Order Coleoptera* and Torre-Bueno's **Glossary of Entomology** with the Tulloch **Supplement** have been taken over by the consolidated Society.

It is our hope that this consolidation will much better serve the entomological community.

Editor's Note: The first three articles in this issue were initiated by Dr. Lucy W. Clausen, the immediate Past Editor of the **Journal**, and now the Chairman of the Publication Committee. The first two deal with the histories of the New York and the Brooklyn Societies, and they are written by eminently qualified persons. Dr. Elsie B. Klots, author of the history of the New York Society, is a long time member of the Society, a recognized entomologist, and an author of books on insects. Dr. Edwin Way Teale, author of the history of the Brooklyn Society, has been a member of both Societies for many years, and he is the well-known natural history writer. The pictures, which are arranged between these two articles, have been selected from the files of the New York Society and those of Dr. Teale with a view to recalling a few days gone-by. All are not of equal quality as pictures, but they are certainly of equal historical importance, and most have never been previously printed. The third article, concerned with the Junior Society, describes an important New York Society activity which has been reported many times in the *Proceedings of the Society*, but which has never been featured in the **Journal**. Miss Alice Gray, the author of this article, is a staff member of the Department of Entomology of the American Museum and, also, a long time member of the Society. Her extensive knowledge of entomology coupled with her warm and friendly personality, and her interest in young people makes her the ideal adviser for this group.

A History of The New York Entomological Society

ELSIE B. KLOTS

In the late winter and early spring of 1892 a small group of men, drawn together by their common interest in beetles, talked at length about forming an entomological society or club. Twice they met at the home of the fur-manufacturer, Mr. Gustav Beyer, at 511 East 117th St., New York City, for the purpose of taking such a step, but when a vote was finally taken no quorum could be obtained. Undoubtedly they recalled the fate of another organization, similar to the one they now considered, that had been started in 1880 but had lasted only two years;[1] and there were those who preferred to continue meeting informally as they had. The Beyer home was a popular place for their gatherings and the hospitality of their host and Mrs. Beyer was described as unbounded.[2] The guests could stroll in the garden while admiring the cactus collection, gather in the basement dining room, or settle down in the back parlor where the insect cabinets were installed. There they would discuss their collecting experiences, show their specimens, and share in the bounty of their host as he divided the many series of duplicates his cabinets contained.

But on June 29, 1892, five entomologists meeting at the home of Mr. Charles Palm, 172 East 64th St., did formally "resolve to form an association to be hereafter known as The New York Entomological Society." These men, beside Charles Palm, were: William Beutenmueller, Ottomar Dietz, Charles Tunison and Franz Rabe. Palm was elected Chairman, *protem,* and Beutenmueller, Sec. *protem,* to hold office until the following January when the first Annual Business Meeting would be held. A Constitution of ten Articles was proposed. Following this, B. Neumoegen, Gustav Beyer and Mrs. Annie Trumbull Slosson were nominated for active membership; and 28 individuals were nominated for corresponding membership, of whom 4 were from Canada, 2 from England, 2 from Australia, and one from Germany. They then adjourned for the summer.

When the group reconvened on Sept. 7 the active membership doubled in number. Meetings followed, two a month; a Committee on a Seal was appointed, as well as a Committee on Admissions, for new members were being proposed at each meeting. On Oct. 5 the first bill was presented: $6.25 for postal cards.

The meetings that first fall were held at the German-American School, 309 West 46th St. and at the homes of Messrs. Neumoegen and Palm. It was at the latter where Mrs. Slosson made her first appearance. She tells of it in her paper given at the 25th Anniversary Dinner:[3]

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[1] For an account of this organization read Harry B. Weiss's interesting article *The New York Club and "Papilio"* in the Jour. N.Y. Ent. Soc., **55:** 119–136, 1948.

[2] *Vide* obituary, *Gustav Beyer* by Charles W. Leng, Jour. N.Y. Ent. Soc., **32:** 165–166, 1924.

[3] Jour. N.Y. Ent. Soc., **26:** 134–137, 1918.

"My brother-in-law's old Arab butler escorted me that evening, calling for me later to see me home. I shall never forget the sensation produced by my unexpected entrance into that scientific meeting. Through the smoke of pipes and over mugs of some beverage which foamed in the gas-light in a sudsy sort of way, I saw startled, embarrassed faces. . . The host himself, good Mr. Palm, seemed somewhat embarrassed. After seating me in the most comfortable chair unoccupied, he hastened away to order coffee for me as more appropriate and fitting drink for a feminine throat."

If her fellow members were, for a moment, abashed at having elected a woman to membership and fearful of what effect her presence might have upon their jovial meetings, they soon came to be grateful for her support and cooperation. She presented many papers before the society and contributed frequent notes on collecting and on specimens. In the years to come she was to be one of their valued financial backers, contributing generously to the support of the Journal and providing material for their fund-raising auctions.

In January 1893 the first slate of officers was elected: George W. J. Angell, Pres., R. Ottolengui, V. Pres., C. F. Groth, Treas., Charles Tunison, Rec. Sec., and Wm. Beutenmueller, Cor. Sec. The following month, Feb. 25, 1893, a Certificate of Incorporation was granted the Society. Those named in it were: Berthold Neumoegen, Charles Palm, Gustav Beyer and Rodrigues Ottolengui, all of N.Y.; and George W. J. Angell of Conn. The incorporation was for a term of 50 years and the Society, under the direction of five trustees, was to have as its "particular business and objective the advancement of the Science of Entomology in all its branches." On Feb. 17, 1943 this Certificate of Incorporation was officially extended, *in perpetuity*. The new document was signed by Wm. P. Comstock, President and Annette Bacon, Recording Secretary. Cyril dos Passos was the Attorney.

It was in the first year, 1893, that the custom of a yearly auction was started. The first was held at the home of B. Neumoegen, 40 Exchange Place. 100 specimens of Coleoptera and Lepidoptera were sold. By 1896 these auctions were so well established and organized that a preliminary list of material to be sold was printed and circulated. The profits of the sale that year were $77.35. Mrs. Slosson writes:[3] ". . . The sight of mature, often elderly, men shouting bids excitedly, like brokers on the stock exchange, for the purchase of bugs, instead of bonds, seemed very funny, not to say absurd," and she found it advisable to explain the situation to a bewildered representative of the press who was present. She recorded that a *Sphinx canadensis* sold for $5.00 although the agent for the buyer had been authorized to go as high as $12; an *Anchocelis digitalis,* for $2.45; but that a *Plusia vaccinii* brought only 50 cents, and *P. nappa* and *P. viridisigma,* 60 cents each.

In 1894 a membership list was published in a neatly bound folder. It contained the names of 54 Active Members and 70 Corresponding Members.

In 1896 the Society held two public lectures for which tickets were sold. The first was by Lyman Best on *Insect Mimicry*; and the second, by E. G. Love, entitled *A Study of Insects and Their Transformation.* The profits from the lectures, as well as from the auctions, went into the publication fund. It was in 1896 also that the Society sent a formal resolution to the Postmaster General requesting him to instruct the American Delegate to the next International Postal Congress to vote for an amendment admitting specimens of natural history to the mail at the same rate as samples of merchandise, rather than at the burdensome and excessive letter rate.

Three anniversary meetings have been held: a twenty-fifth, a fiftieth, and one to honor those who have been members over fifty years. The first of these, preceded by a dinner, was held at the Hotel Colonial on June 7, 1918, to commemorate the 25th anniversary of the Incorporation of the Society. Many visitors were present, including representatives of the N.Y. Academy of Sciences and the Brooklyn Entomological Society. Letters were read from E. A. Schwarz, the only Honorary Member; from the Entomological Society of Washington, the Entomological Society of Canada and from many Corresponding and past members. Interesting reminiscences were presented by Mrs. Annie T. Slosson, Charles Leng, Charles Drury, Henry Bird, Henry Skinner, Roderigues Ottolengui and A. C. Weeks. E. E. Smith, President of the New York Academy of Sciences, spoke on *The Importance of Insects in Relation to Disease*; and R. P. Dow, with his usual eclat, prophesied on the future of the Society.

A 50th anniversary meeting was held Dec. 1, 1942. Twelve of the 26 past presidents were in attendance. Pictures and documents depicting the early days, reminiscences by Christian Groth (1892)[4] and Henry Bird (1905) and remarks by Edwin Way Teale (1938) and Wm. P. Comstock (1899) highlighted the evening.

On Jan. 21, 1964, under the sponsorship of Bernard Heineman (1925), scrolls honoring membership of over 50 years, were presented to Dr. E. R. P. Janvrin (1902) of N.Y. City, and W. T. M. Forbes (1910) of Cambridge, Mass.; and *in absentia* to Alexander Petrunkevitch (1908) of New Haven, Conn., and Chris. Olsen (1908) of Nyack, N.Y.

Two Photographic Exhibits have been held. The first, in 1949 was scheduled to be held in the Foyer of the Roosevelt Hall of the Museum from May 15 to May 23 but because of its popularity was held over until June 5. Arranged by a committee of three: Lucy W. Clausen, Chairman, Roman Vishniac and James Forbes, it included photographs and paintings. There were 10 exhibitors. The second, in 1950, in the 77th Street Foyer of the Museum, consisted of photographs, research equipment, paintings, charts, drawings, insect origami, and a display of books written by society members. In addition it

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[4] Date in parentheses indicates the year the individual first joined the society.

included a large 5-panel display from the National Institute of Health at Bethesda, Md., on the Rickettsialpox, a newly recognized mite-borne disease.

Since 1894, when the Society was the recipient of a donation from the family of George D. Bradford who died of typhoid fever a few months after becoming Secretary of the Society, it has received many gifts. The most sizable of these was the $10,000 legacy from Lewis B. Woodruff in 1925. Others, though smaller, have been equally cherished, especially since they often were given in honor of individuals or in recognition of special anniversaries.

On Jan. 7, 1958 the Society resolved to sponsor a Junior Division having its own constitution and officers but to be under the direction of an Active Member of the Society and under the general supervision of the Field Committee. This came about because of the dedicated work being done by Alice Gray who for some years had been giving of her energies, her time and her talents to young people interested in insects. Miss Gray continues to serve as its inspired director.

Over the years a number of Honorary Members have been elected. At the present time Mrs. SuZan Noguchi Swain and Harry B. Weiss are the only ones. Among those now deceased are: Nathan Banks, Ernest L. Bell, T. D. A. Cockerell, Wm. T. Davis, L. O. Howard, J. McDunnough, A. L. Melander, J. G. Needham, Herbert Osborn, Alexander Petrunkevitch, E. A. Schwarz, Robert E. Snodgrass and Frank E. Watson. Wm. T. Davis was also named Honorary President.

Presidents of the Society have been:

Charles Palm (1892, 1897)
G. W. G. Angell (1893)
Wm. Beutenmueller (1894, 1900, 1901)
J. L. Zabriskie (1895, 1896)
E. G. Love (1898, 1899)
C. F. Groth (1902, 1903)
C. H. Roberts (1904–1906)
Charles W. Leng (1907–1911)
Raymond C. Osburn (1912–1915)
Harry G. Barber (1916, 1917)
Lewis B. Woodruff (1918–1920)
John D. Sherman Jr. (1921, 1922)
Harry B. Weiss (1923, 1924, 1942)
Frank E. Lutz (1925, 1926)
Henry Bird (1927, 1928)
Wm. T. Davis (1929, 1930)
Andrew J. Mutchler (1931, 1932)
Ernest L. Bell (1933)
A. L. Melander (1934)
Herbert F. Schwarz (1935)
Herbert Ruckes (1936)
C. H. Curran (1937)
William M. Moore (1938)
Herman T. Spieth (1939)
Alexander B. Klots (1940)
Max Kisliuk (1941)
William P. Comstock (1943)
Edwin Way Teale (1944)
George S. Becker (1945)
Stanley W. Bromley (1946)
Harold R. Hagen (1947, 1948)
Theodore C. Schneirla (1949)
James Forbes (1950)
Albro T. Gaul (1951, 1952)
Lucy W. Clausen (1953, 1954)

Roman Vishniac (1955, 1956)
Asher Treat (1957, 1958)
Nicholas Shoumatoff (1959, 1960)
John B. Schmitt (1961, 1962)
Bernard Heineman (1963)
Jerome G. Rozen (1964, 1965)
Richard C. Frederickson (1966, 1967)
David C. Miller (1968–

TYPE OF MEETING

At first, meetings were held on the first and third Wednesday of each month, except July and August. The September meetings were dropped in 1898. By 1894 the present custom of meeting on Tuesdays had begun. On several occasions when attendance has been small and speakers hard to get, the suggestion has been made that meetings be held only once a month. One of these occasions arose when the Society was barely out of its infancy. R. P. Dow, speaking at the 25th Anniversary Dinner and commenting on this recurring phenomenon, said:[5] "At first the private collection of each member was his ultimate aim. This is not motive enough to fortify bare existence of a society. It must have some chosen aim, some joint, useful purpose." He believed that it was the decision to build up a society collection that transformed it and its interests. In any event the meetings have continued to be bimonthly. In 1916, by which time the gatherings had become more formal than at first, W. T. M. Forbes suggested Saturday round table discussions, concentrating on Lepidoptera and Coleoptera on alternate weeks. These continued, John Pallister recalls, until the late twenties.

The first account in the minutes of any entomological discussion is that of Oct. 26, 1892 (probably the evening of Mrs. Slosson's first appearance). Mrs. Slosson described her summer's collecting in the White Mts. and exhibited the types of *Phragmatobia assimilans* var. *franconia* which she had captured at midnight on snow-covered ground, and of *Dasylophia puntagorda* and *Ceruroides slossonii.* Mr. Angell described a method of sifting for Coleoptera in mosses and ant nests; Meitzen exhibited a series of Cicindellidae; Shaeffer showed beetles from Staten Island, including a fine pair of *Myas cyanescens*; and Seibert showed beetles from Snake Hill, N.J.

Dr. Edmund R. P. Janvrin, who joined the Society when he was a freshman at Princeton in 1902, recalls that during the busy years of his medical studies and of graduate work in Munich he was unable to attend meetings but when he resumed participation in 1912–13 the meetings ". . . were very informal, the members sitting around a couple of long, green-covered tables; and usually several members would bring boxes of rare or interesting specimens."[6] In those days, he says, Wm. T. Davis was ". . . the best known and best liked member. He lived on Staten Island and came over regularly to meetings, often with his friend Charles W. Leng. . . He was a typical old-fashioned naturalist, being in-

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[5] Copy of speech in archives of New York Entomological Society.

[6] In letter to Elsie B. Klots, March 1967.

terested in birds, reptiles, and amphibians, and in botany, as well as insects. He was most genial and pleasant and a thoroughly well-informed person." Other members who stand out in Dr. Janvrin's mind are: Dr. Lutz, the curator of the Entomology Department of the Museum; Charles W. Leng ". . . who always seemed to know what he was talking about. . ."; Andrew J. Mutchler, the ". . . beetle man. . ." of the Museum who always had time to help a beginner or an amateur; C. Shaeffer, from Brooklyn, ". . . who collected Chrysomelidae very energetically and always used to say, after an unusually large catch: 'When I collect, I collect.'!"; George Angell ". . . the specialist in Lucanidae, who always wore a green eye-shade and, in reporting an unsuccessful collecting trip would say: 'The beetles are still in the wood'!"; and later on, Howard Notman ". . . a fine violinist, who often gave dissertations on ground beetles."

The minutes of the meetings indicate that had one been in attendance all through the years one would have heard most of the outstanding entomologists of the country speak. One would also have seen and heard men (and women) talking with enthusiasm and near-affection about their specimens or the observations they had made in the field. I wish I might have been there that night in 1896 when Mr. Johnson exhibited a piece of stone which he had found over an ant nest and which had been bored through by the ants who used the hole as one of the entrances to the nest; and when the Rev. Mr. Zabriskie showed leaves of hazel rolled into a ball by a weevil, commenting that it was always the 4th leaf from the tip. I wish I might have heard R. P. Dow, in 1898, when he spoke on *Nomenclature—A Little of its Poetry* and discussed Linnaeus's and Schrank's and Westerman's derivation of generic names from classical Greek mythology. "True the Colias seeks the mud-puddle but it is better far to see in every mud-puddle the Pierian Spring than to mistake the spring for some mud-puddle." And to have heard him again in 1916 when his paper was entitled *Insect Progeny of Adam's First Wife.* I wish I might have been there when Charles Leng and William Morton Wheeler discussed Jordan's Law; when the first lantern slides made by the new Lumiere color process were shown; when both W. G. Holland and W. T. M. Forbes were present and both in good voice; or when J. C. Bequaert told of Geo. Franck's experience collecting Tabanidae from a tame cow, explaining that it was essential to have a really tame cow, as he sadly learned after a narrow escape in Africa. And I'm glad I *was* there on that memorable occasion when President Asher Treat had to employ all of his expertise in gracious diplomacy to cope with the author of a new version of the theory of spontaneous generation. This, probably, was the only time anyone was ever denied membership in the Society.

During the nineteen thirties and early forties speakers were so often startled by the steady click of knitting needles and the ominous waving of an ear trumpet that it became customary to explain to them, before the meeting, that the occupants of the front row were the faithful wives of some of our elder members and that they were an accepted and beloved part of our meetings.

In the early days "eatables" were mentioned in the minutes as an important part of the prevailing good fellowship. These were sometimes served before the meeting, as early as six o'clock, and sometimes after the meeting. I can recall an occasion in 1939 when James G. Needham of Cornell was speaking, when the presence of a keg of beer in the anteroom caused considerable coming and going during the lecture. For several years annual dinner meetings were held. Museum restrictions, requiring the services of a designated caterer whenever food is served, have now limited the social, or "eatables," phase of the meetings.

Field trips were an important part of society activities in the early days. The minutes are full of reports on the collecting done and the places visited; and the files contain many old pictures showing the members in derby hats, high starched collars, and long leggings, beating the bushes, peering at the sod or lolling in ease at a picnic lunch. The custom of having field trips continued to be of importance but with the increased urbanization of the last few decades they were reduced to one a year, often becoming more of a family picnic affair. Several of these were held at Chris Olsen's home in Nyack, N.Y.; other memorable ones were at Edwin Way Teale's in Baldwin, L.I., at Lake Mahopac, at Alpine, N.J., Boonton, N.J., the Wild Flower Preserve in Greenwich, Conn., and at the Westmoreland Sanctuary at Bedford, N.Y. None at all have been held since 1960.

THE JOURNAL

It was at the sixth meeting, on Nov. 16, 1892, that the young society discussed at length the already contemplated publication. A committee was chosen: Messrs. Angell, Neumoegen, Beutenmueller and Ottolengui. At the following meeting this committee reported favorably on the project and asked that $500 be raised to support the first year of publication; $370 was subscribed immediately.

Volume I of the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY came out in 1893. Part 1, which appeared in March, opened with a paper by Annie Trumbull Slosson on *Common vs. Proper Names*. This was followed by nine other papers of a more scientific nature, one of which, *Notes on Some North American Moths* by Charles Palm, had an exquisite color plate. Part 1 closed with *Local Entomological Notes* by Wm. T. Davis and an invitation to all to contribute notes of local interest.

By the time Volumes III and IV were out the Society had established an exchange system in order to build up their library, and by 1904 was exchanging with 30 other publications including 17 foreign ones.

In 1912 a complete set of the Journal was presented to the Library of Congress. In 1946 an *Author and General Subject Index to Vols. 1–50* was published under the editorship of Harry B. Weiss.

Vol. LXX (1962) of the Journal was designated the Herbert F. Schwarz Memorial Volume to honor the memory of a member who had served the Society in many capacities for 35 years and who had been a devoted friend and benefactor.

The policy of the Journal has been, for the most part, to publish articles of comparatively short length. A few, however, have been of such length that their publication has been serialized; among these were: *Life Histories of the New York Slug Caterpillars* by Harrison Dyar, which came out in 20 parts; and *A Catalogue of the Lycaenidae of the New World* by Wm. P. Comstock and Irving Huntington, which came out in 14.

Members who have had more than 50 papers published in the Journal are: C. P. Alexander, and Charles W. Leng; those with more than 100: Harrison Dyar, Wm. T. Davis, and Harry B. Weiss. Many have had more than 25.

The Journal has appeared without interruption, although not without delayed schedules. In 1968 Volume LXXVI will be completed. The editors have been: Wm. Beutenmueller 1893–1903; Harrison Dyar, 1904–1907; Wm. M. Wheeler, 1908–1912; a Publication Committee, Charles Shaeffer, Chairman, 1913–1915; Charles Shaeffer, 1916–1919; Howard Notman, 1920–1923; Harry B. Weiss, 1924–1949; Frank A. Soraci, 1950–1959; Wm. S. Creighton, 1960–1961; Lucy Clausen, 1961–1967; and James Forbes, 1968– .

The members of the Society consider that maintaining a Journal of high excellence is one of their chief responsibilities and is proud to have had such a distinguished group of editors during its 75 years of publication.

Affiliations

The little group of coleopterists who first met at Mr. Beyer's home maintained, from the very beginning, a friendly and cooperative relationship not only with other entomological groups but with all local scientific organizations.

From the earliest days the Agassiz Club and the Linnaean Society were invited to participate in their field trips. Newspaper clippings and pictures in the files show that field trips were often taken with the Newark Society; and in June of 1895 we find the Society accepting an invitation to a Fourth of July Excursion in company with the Brooklyn, the Newark and the Philadelphia Societies.

The Brooklyn Entomological Society has been closely allied in interests and in ties of friendship and common membership. Frequently formal invitations were exchanged assuring the members of each group that their attendance at the meetings of the other would be warmly welcomed. In 1903 the New York Society voted to turn over two pages of each issue of the Journal for printing the proceedings of the Brooklyn Society; and in 1904 published a membership list composed of members of the two societies.

When less than six months old, on Dec. 21, 1892, the Society received an invitation (". . . through Mrs. Slosson's intercession with the late Morris K. Jessup")[7] to hold their meetings in the Museum Library.

Although they did meet there twice that winter, they did not do so regularly until the following year and even then continued to hold occasional meetings in the homes of members where the hospitality was more lavish. These home meetings continued well into the new century. In September 1908 a new meeting place was announced. This may have been one of the rooms near or along the corridor now occupied by the Mammalogy Department, for in September 1911 we are told that they were forced to change their meeting place from the "balcony room" to Dr. Lutz's room, owing to the fact that their former meeting place would become the location for the entrance to the new wing. Dr. Janvrin recalls that when he resumed attendance in 1912–13 they were being held in the Tower Room on the third floor of the Museum; and Alexander B. Klots recalls they were still being held in the Tower Room in the early twenties. This room bore on its door the name plate of the Society and housed the Society's collections and library.

For a short while in the mid-thirties the Society met in the duplex room of the education wing but at the present time the meetings are held in Room 129 of the Roosevelt Memorial. Occasionally when an unusually large group is anticipated due to the popularity of a particular speaker or subject, the Society uses a larger room upstairs. All meetings are open to the public. They are announced by postal card to local members, as well as by a notice in the monthly Calendar of the Museum and one in the New York Times on the day of the meeting.

But the relationship with the Museum has been far more than that of a non-paying tenant with a generous landlord. The Society and its members have made many contributions to the Museum's Library and to the Entomology Department. The library and collections which were the center of interest in the early days and which were built up by exchange, by contributions, by memorial gifts and by inheritance, have been given, for the most part, to the Museum. Various of the Society's members have donated or willed outstanding collections to the department. Notable among these have been the collection of Charles Palm, Annie Trumbull Slosson, Wm. Beutenmueller, John Grossbeck, R. Ottolengui, Chris E. Olsen, John D. Sherman, Jr., and R. C. Casselberry. In more recent years the collection of *Papaipema* moths from Henry Bird, of Skippers from Ernest B. Bell, Lycaenid butterflies from E. Irving Huntington, Hymenoptera from Herbert F. Schwarz, Lepidoptera from Alexander B. Klots, and Pentatomid bugs from Herbert Ruckes have been outstanding contributions.

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[7] *History of the New York Entomological Society* by Charles W. Leng. Jour. N.Y. Ent. Soc., **26**: 129–133, 1918.

In 1912 the Society raised $250 ($196 from donations) to buy the Seifert insect collection which they presented to the Museum. In 1928 a gift of $150 was made to the International Congress of Entomology and assistance given in the entertainment of the European guests as they stopped in New York at the Museum, *en route* to Ithaca. For many years an annual contribution was made towards the publication of the ZOOLOGICAL RECORD.

On March 5, 1895 the Society accepted an invitation from the New York Academy of Sciences to send their President and two delegates to convene with similar representatives from six other organizations: The Torrey Botanical Club, The New York Microscopical Society, The Linnaean Society, The American Mathematical Society, The New York Mineralogical Club, and the New York section of The American Chemical Society. From this meeting evolved the Council of the Scientific Alliance of New York. Upon the dissolution of the Alliance in 1907 the New York Academy of Sciences agreed to continue to send its weekly Bulletin to affiliated societies, announcing their meetings without cost to the affiliates, and invited each society to send a delegate to their Executive Council Meetings. Wm. T. Davis served in this capacity until 1944; he was succeeded by Wm. Comstock, Herbert F. Schwarz and Lucy W. Clausen. The practice was discontinued in 1960.

In 1950 The New York Academy of Sciences moved from the Museum to new and palatial quarters. The affiliated societies were offered the continued courtesies of the Academy as well as headquarters and meeting rooms in the new building. Many of them accepted the opportunity to enjoy the conveniences of the new arrangement. The New York Entomological Society, ever mindful of the hospitality offered it in the first year of its existence by the American Museum of Natural History, and tied to the Museum by the memories of a close and happy relationship of over half a century, declined.

Henry Bird, at the 25th Anniversary Dinner in 1918 said:[5] "Of the many things that we as a Society may be proud of and thankful for, one has always stood out with remarkable prominence; it is the relation of the American Museum of Natural History to us as a scientific body. Perhaps an out of town member sees it in a different perspective from those in more immediate touch, perhaps the radiance of the great museum gives us an undue illumination; but this is certain, that with such cooperation, such administrative ideals in the background, we are assured an initiative which must ever be for the best." His words hold true today.

Now, in incorporating the Brooklyn Entomological Society, we are further strengthening another relationship which we have enjoyed throughout our lifetime; and we are confident that the traditions of both societies will continue to flourish in the "radiance" of the American Musuem of Natural History.

Fig. 1. This photograph, from the files of the New York Society, was accompanied by an overlay and a list of the persons indicated below, but there is no designation of the event. The overlay and the names must have been prepared considerably later than when the picture was taken, because all are not named and a penciled notation states "between 1906-1908." However, most, if not all, were members of either or both the New York and the Brooklyn Societies.

1, W. T. Davis; 2, Binsow; 3, Graef; 4, J. B. Smith; 5, Franck; 6, Bischoff; 7, Richter; 8, Wormsbacker; 9, Broadwell; 10, Ottolengui; 11, Love; 12, H. G. Barber; 13, C. W. Leng; 14, Matausch; 15, Reiff; 16, Schaeffer; 17, Zabriskie; 18, Roberts; 19, Angelmann; 20, Kearfott; 21, Brehme; 22, Sleight; 23, Schleckerr; 24, Angell; 25, Kirchner; 26, W. M. Wheeler; 27, Miner; 28, Silvestri.

Fig. 2. Left, Annie Trumbell Slosson, taken 1913. Right, Charles Drury, taken 1914.

Fig. 3. Field meeting at Lakehurst, N.J., July 4, 1910. Left to right, J. Doll; Engelhardt; Bischoff; Kaiser.

Fig. 4. Top left, Charles Schaeffer in his laboratory at the Brooklyn Museum, June 1906; top right, W. S. Wright and L. B. Woodruff at Lakehurst, N.J., May 1917; bottom left, J. Bequaert at Clove Valley, Staten Island, April 1917; bottom right, H. B. Weiss, May 1923.

FIG. 5. Top left, Andrew J. Mutchler; top right, William P. Comstock; bottom left, Frank E. Lutz, bottom right, Alexander B. Klots.

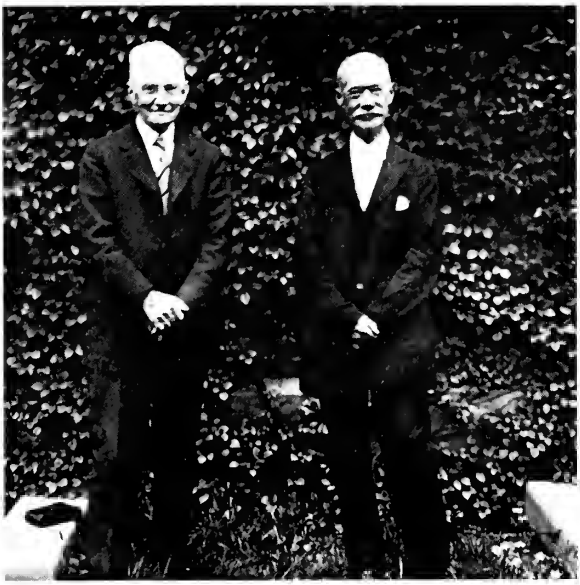

Fig. 6. Top, W. T. Davis collecting in E. W. Teale's "Insect Garden" at Baldwin, N.Y., August 20, 1943 (photo by E. W. Teale). Bottom, Charles W. Leng, left, and W. T. Davis, right, July 1930.

FIG. 7. The New York Society picnic at Chris Olsen's, West Nyack, N.Y., June 8, 1941. Front row, left to right: Bell's granddaughter; Ernest Bell; W. T. Davis; John Sherman; C. H. Curran; Curran's son; back row: Herbert Ruckes and Max Kislick (photo by E. W. Teale).

Fig. 8. Field trip to Lakehurst, N.J. Left to right: O. Buckholz, E. W. Teale, F. T. Naumann (E. W. Teale photo).

A History of The Brooklyn Entomological Society

EDWIN WAY TEALE

The Brooklyn Entomological Society, at the time of its merger with the New York Entomological Society, was within four years of being a century old. It was founded in 1872. Ulysses S. Grant was then President of the United States, the Civil War had ended but seven years before and only thirty-six of the fifty states had been admitted to the Union. The second oldest organization of the kind in the United States and the third oldest in North America, it is antedated only by the American Entomological Society, of Philadelphia, which was founded in 1859 and incorporated in 1862, and the Entomological Society of Ontario which was originally founded in 1863 under the name of the Entomological Society of Canada.

When the Brooklyn Society was founded, it consisted of six members, all amateur collectors. The prime-movers in establishing the organization were Edward L. Graef and Franz G. Schaupp. In later years, Schaupp was referred to, with justice, as the Father of the Brooklyn Entomological Society. An emigrant from Ulm, in southern Germany, he was a huge and jovial man. He weighed about 250 pounds and his large head was crowned by a mass of curly hair. He is described as pleasant, cordial and overflowing with good humor. Well educated, he was fluent in Greek and Latin as well as in German and English. He had arrived in the New World in 1866 aboard the emigrant ship, *William Frothington.*

Although he had had no medical training beyond attending a course of lectures on general anatomy, he crossed the Atlantic as the ship's doctor. In taking an examination for this post, he had been asked a question about cholera morbus. It happened that a few weeks before he had read a book by an authority on this disease, Prof. Pettenghoefer, of Munich. So impressed were the examining physicians by his eloquent presentation of new theories on the subject that they not only approved him for the post but took him out to dinner and before the evening was over were referring to him as their "dear colleague."

It was in Schaupp's room, above Schaeffer's saloon, at 9 Broadway, in the Williamsburg section of Brooklyn, that the first meetings of the new society were held. Later, as the membership grew, the meeting place followed Schaupp to Wright's Business College, where he had found employment teaching languages. Soon after he had settled down in Brooklyn, Schaupp had met another enthusiastic amateur entomologist, Edward L. Graef. The two made field trips together. On one of these occasions they discussed the possibility of organizing a group to include those of similar interests. The result was the Brooklyn society. Schaupp was elected President and Graef treasurer.

When the organization was six years old, in the spring of 1878, it commenced an activity which, over the years, proved of increasing importance. In May of that year, under the editorship of Schaupp, there appeared the first number of the first volume of *The Bulletin of the Brooklyn Entomological Society*. It consisted of eight pages. The subscription price was sixty cents a volume. This was the beginning of the entomological publication that, at the time of its combination with *The Journal of the New York Entomological Society,* was in its sixtieth volume.

As set forth by the Publication Committee in an early issue, the initial aims of the *Bulletin* were three-fold: 1. To provide practical hints to collectors of Coleoptera and Lepidoptera. 2. To furnish synoptic tables of the Coleoptera and Lepidoptera of the United States up to date of publication. 3. To furnish an alphabetical list of scientific terms such as are used in technical descriptions in entomology. From the beginning the publication was oriented toward the interests and needs of the amateur. Among its earliest contributions were articles on such subjects as "Practical Hints on Collecting Coleoptera," "Insect Life on Coney Island," and "Collecting Insects in Winter."

In 1882, Schaupp was joined by John B. Smith as joint editor of the *Bulletin.* In the January issue of that year there appeared "A Check List of the Macro-Lepidoptera of America North of Mexico" which ran to almost thirty pages. The following year, subscribers were provided with an "Explanation of Terms Used in Entomology." It covered thirty-eight pages. Both the society and its publication were flourishing. Active as members of the society during these early years were, besides Schaupp, Graef and Smith: Charles Fuchs, Frederick Tepper, Charles W. Leng, Jacob Doll, Berthold Neumoegen, George Hulst, Archibald C. Weeks, George Franck, A. Luetgens and Charles Duering.

About this time a contribution of considerable importance appeared in the *Bulletin.* It was Schaupp's synoptic table of the Carabidae. Not long afterwards, in 1884, the Father of the society made an ill-starred move to Texas and his association with the organization he had played so important a part in founding came to an end. The last twenty years of his life were spent, much of it in poverty, teaching the children of German ranchers English and collecting insects for sale. In view of his contributions to the Brooklyn society, it is fitting that the emblem of the organization, which for many years appeared on the cover of the *Bulletin,* has as it central figure a tiger beetle named in honor of Schaupp, *Cicindela schauppi.*

With his departure, the editorship of the *Bulletin* was assumed by John B. Smith and the society moved its meeting quarters from Wright's Business College to the Polytechnic Institute. Smith had joined the Society in his early twenties and soon became one of its most valuable members. At the time he assumed the editorship of the *Bulletin* he was 26. Smith's later career fulfilled his early promise. Through his writings and his work as State Entomologist of New Jersey he became widely known among American scientists. His *Glossary of Entomology and Insects of New Jersey* remained in constant demand for many years. After his death in 1912, when his contributions on entomology were tabulated, it was found they totaled 546 titles, all the product of slightly more than thirty years of intensive labor.

The modern historian who delves into the early records of such a society as this finds his work complicated by the variety of spellings in which proper names appear. Many Teutonic names, for example, were being Anglicized. Franck appears also as Frank. Smith, according to Torre-Bueno, was originally Schmidt. Yet when his father, cabinetmaker and ardent collector of insects, designed a superior type of insect box, it was marketed and is known to this day, not as the Smith or Schmidt box but as the Schmitt box. Incidentally, the first company to put this box on the market, the American Entomological Company, an organization which played an important role in the early days by supplying collectors with materials, was an offshoot of the Brooklyn society. It was founded by members who regularly attended the meetings. Eventually this pioneer entomological supply house was purchased by Ward's Natural History Establishment, of Rochester, New York.

From the beginning, meetings of the Brooklyn Entomological Society were held once a month, originally on Saturday evenings, later on Tuesday evenings. They soon began to attract distinguished visitors. One, according to the minutes of the gathering on September 25, 1884, was William G. Holland, author of *The Butterfly Book* and *The Moth Book*. He reported on the insect mortality near Pittsburgh where gas wells burned all night, illuminating the countryside for miles around. On one occasion he counted more than 100 male *Saturnia io* moths in the circle of scorched insects surrounding such a well. Observations in the field, such as this, formed an important part of the meetings of the Brooklyn society throughout its history.

Of special interest in the annals of the society is the year 1885. It was then that the organization became incorporated under the laws of the state of New York. The six members who signed the certificate of incorporation were: Edward L. Graef, George D. Hulst, John B. Smith, Berthold Neumoegen, Christoper H. Roberts and Charles W. Leng. In 1936, when the society was reincorporated, one of the signers was Leng, who had placed his name on the original document more than half a century before. Other signers were William T. Davis, Ernest Shoemaker, Carl George Siepmann and George P. Engelhardt.

During the spring of 1885, the concluding number of Volume VII of the *Bulletin* ended with the following announcement:

"Notice to readers. With this number the Bulletin of the Brooklyn Entomological Society ceases to exists. . . The unanimous expression of the desirability of a union of Entomological journals into one paper which might call to it the support of all those interested in Entomology, led to negotiations between the representatives of the 'Bulletin' and 'Papilio' resulting in an arrangement for the issuing of a new publication for which the name 'Entomologica Americana' was decided upon. The new journal will be published by the Brooklyn Entomological Society."

Papilio, edited by Henry Edwards, was the journal of the New York Entomological Club. This organization, antedating the New York Entomological Society, remained in existence only a few years. John B. Smith assumed the editorship of the combined journals. Primarily, *Entomologica Americana* was intended as a medium of publication for monographic works on American insects, enabling entomologists to make available to other scientists the results of their studies. The subscription price was set at two dollars a year.

Thus the *Bulletin,* the initial publication of the society, went into eclipse. However its subsequent history belied the statement that it had ceased to exist. It was destined to reappear again, after a lapse of more than a quarter of a century, and to continue publication until its merger with the *Journal of the New York Entomological Society,* at which time it had completed Volume 60. *Entomologica Americana,* at the time its publication was taken over by the New York society, had completed Volume 44.

The new journal, beginning with the issue of April 1885, appeared in monthly numbers. Each volume contained about 240 pages. Through the first six volumes, to the end of 1890, John B. Smith continued as editor. The society, at this period, was in a particularly flourishing condition. Its monthly meetings, held at the Brooklyn Institute, on Washington Street, attracted as many as seventy members and guests.

Then, on September 13, 1890, fire swept through the Institute. It damaged property of the society and robbed it of its meeting place. About the same time, John B. Smith, who had moved to Rutgers University, in New Jersey, was forced to resign as editor. These multiple misfortunes had a disastrous effect upon the organization. Its publication ceased and the society fell into a period of inactivity that lasted for a decade. Like the *Bulletin, Entomologica Americana* was destined to be revived but in its case its reappearance came after a hiatus of thirty-six years.

The year 1900 had almost passed before the society emerged from this period of dormancy. Its revival was largely due to the energy and hospitality of George Franck, manager of the American Entomological Company. On December 6, 1900, nearly 30 persons attended a meeting he called. It was held at 1040 De Kalb Avenue, Franck's home and also the headquarters of the entomological company. With Franck as President, the society began to gain momentum once more. In 1906, it made an important contribution through the publication of John B. Smith's *Glossary, an Explanation of Terms Used in Entomology.* Revised and expanded by J. R. de la Torre-Bueno, it was republished as the *Glossary of Entomology.* It remains today the standard work in this field and it has been maintained steadily in print by the society. When it was last printed, in 1962, Supplement A, by George S. Tulloch, was added.

By 1912, the society was in a flourishing condition once more. At last it had found a stable meeting place at the Brooklyn Museum, on Eastern Parkway which was to remain its home for more than thirty years. In the autumn of 1912, the *Bulletin of the Brooklyn Entomological Society* was revived. Number 1, Volume VIII, New Series, appeared under the editorship of Robert P. Dow. A New York Stock Broker and a promoter of international chess matches, Dow was celebrated among members of the society for his flowing reddish moustache, the eight-foot handle he used on his collecting net, and the fact he once gave his own name to a genus by making an anagram of his initials. His enthusiasm and energy played an important part in reestablishing the society's publication.

"From a slumber lasting twenty-eight years," he wrote in his initial editorial, "The Bulletin of the Brooklyn Entomological Society awakens, not like Rip Van Winkle, to find itself aged and enfeebled, but replete with vigor and strength." The publication welcomed short notes, thereby gaining in variety and interest. One of Dow's editorials, in June, 1915, pointed out that by dumping a couple of bushels of lawn mowings and some watermelon rinds in a corner of his yard one member had produced a fine collecting ground for beetles that had yielded several species hitherto unrecorded for the state. He suggested that amateur entomologists in every state in the Union repeat the experiment and report the results.

From the beginning of the Brooklyn Society, field trips constituted an attractive feature of the organization's activity. Regular group trips for collecting were announced. Members brought picnic lunches and made the affairs all-day outings at such places as Rockaway Beach, Coney Island, Staten Island, Fort Lee and Snake Hill, "in the middle of an extensive swamp" in New Jersey. The eccentricities of certain collectors during these days afield were long remembered. Many years later, J. R. de la Torre-Bueno, while editor of the *Bulletin*, recalled the activities of one such member.

"Our protagonist's performance on one trip to Rockaway Beach," he wrote, "are worth recording. He always carried with him on such trips—and on other occasions also—a genuine pre-Civil War carpetbag or gripsack to hold his takings. In its recesses lay hidden from a scoffing world the usual assortment of collecting bottles for killing insects and other oddments for collecting, and always a lunch of sorts wrapped in a greasy piece of newspaper which had distinctly seen better days and which also had held other lunches aforetime. Anything of value to an ant was a treasure to him. His collecting started at the end of the elevated railroad line, when he raced through the car picking up and stowing away discarded newspapers.

"Once the sea-beach was reached, the really serious collecting began.

What finds! Champagne and wine corks, fishing net floats, empty bottles, skeletonized sea-horses, sand-fleas, earwigs and beetles under boards and chips, drowned insects of all sorts in windrows on the tideline all enticed our collector. Among the wreckage he found a battered flour barrel. After a careful examination of his trove, said our collector: "The hoops are good," and gathered they were and draped over his neck and shoulders. At the end of the trip, the party arrived eventually at the New York City garbage dump heaps on Barren Island. And here was the crowning point of a well-spent day! Perched on top of a mound of trash was an obsolete pair of pants, all crumpled, rumpled and filthy. These were secured, shaken out and measured for length against himself by the finder. With the remark: "They are as good as those I have on," into the bag they went, more or less neatly folded."

Eccentric a few members were, but serious work was being done by many and a tremendous amount of enthusiasm was elicited for the activities of the Society. Members often traveled long distances to attend the meetings. In the late 1930's, when I joined the Brooklyn Society, members came from Long Island, southern Connecticut, Westchester County and eastern New Jersey as well as from Staten Island, Manhattan, and Brooklyn. Charles W. Leng, the Staten Island coleopterist, who joined the Society at the age of 16 and was its Honorary President from 1922 to the time of his death, on January 24, 1941, at the age of 81, once recalled the difficulties he surmounted in getting home from the early gatherings: "I had to watch the clock for a Roosevelt Street ferryboat that would enable me, by running to Whitehall Street, to catch the last boat for Staten Island, and then walk four and a half miles to my home."

In the first number of the revived *Bulletin,* in 1912, the leading article was entitled: "A New Cicada from Plummer's Island, Maryland." The author, then President of the Society, was William T. Davis, of Staten Island. What Schaupp and John B. Smith had been to the early days of the Brooklyn Society, William T. Davis was to its latter days. Others contributed greatly; but he contributed most. First serving as President from 1912 to 1916, he was reelected in 1920 and continued to serve for a quarter of a century, until the time of his death on January 22, 1945, at the age of 82.

Conciliatory in nature, tactful and reasonable, but unswerving in adherence to what he though was right, his outlook combined the scientific and the philosophic. In presiding at meetings, he often interspersed reflections with scientific matters, such observations as: "It is dangerous to be too specialized. If anything happens to the particular prey you depend upon, you are lost. I would rather be a cockroach and eat everything." Or: "I wouldn't trust Nature out of my sight. She will play a trick on you every chance she gets." Or: "There is no hurry. There is still tomorrow all untouched." Or: "A naturalist must rather be right than President." In the words of Henry B. Weiss, for many years Editor of *The Journal of the New York Entomological*

Society: "No one could know Mr. Davis for any length of time without being impressed by his innate goodness, his quiet, cheerful disposition, and his abiding interest in natural history."

The leading authority on the cicadas of North America, he named and described 105 new species. His type specimens are now in the American Museum of Natural History, in New York City. The oldest fossil cicada ever found was named in honor of William T. Davis. Scientific papers he contributed to numerous publications numbered in the hundreds. From 1893 to 1944, the 52 volumes of *The Journal of the New York Entomological Society* alone carried 132, an average of almost three a year for more than half a century. Although his writing was mainly concerned with entomology, it embraced numerous other branches of the natural sciences as well. For, William T. Davis, in spite of his devotion to the cicadas, belonged to that glorious band of old-time, all-around naturalists whose interest and knowledge ranged over the whole realm of the out-of-doors. His one book, *Days Afield on Staten Island,* reflects this quiet delight in all phases of nature. Those who are interested in this remarkable man will find the facts of his life, as well as much of his wisdom and charm, preserved in Mabel Abbott's *The Life of William T. Davis* (Cornell University Press, 1949).

But to go back, for a moment, to the revived *Bulletin.* In the issue of December 1918, which formed the concluding number of Volume XIII, there appeared this note: "With deep regret we announce that his failing health has compelled our Editor, Mr. R. P. Dow, to give up his labors on this *Bulletin* in order to take a much needed rest. The Editorship will be in my care until further notice." This was signed by J. R. de la Torre-Bueno. Born in Lima, Peru, on October 6, 1871, José R. de la Torre-Bueno had come with his parents to America at the age of 14. As an amateur collector, his specialty was the Hemiptera. At the time Dow was forced to relinquish his editorship and move to California for the sake of his health, Torre-Bueno was acting as advertising manager of the *Bulletin.* It is interesting to note that the "further notice" was long in coming. As another of the outstanding contributors to the welfare of the society, Torre-Bueno continued as Editor of the *Bulletin* for a period of almost thirty years, until his death, in Tucson, Arizona, May 3, 1948.

Under his direction, the publication began using more photographic illustrations. It began running reviews of current entomological books. It even carried a cartoon series, "The Adventures of E. N. Tom Ology in the American Forest of Bad Original Descriptions," with humorous drawings by J. D. Gunder, of Pasadena, California. Torre-Bueno's editorials were lively, to the point, and often written with eloquence. When *Entomological Americana* was revived in 1926, Torre-Bueno also assumed its editorship. He maintained its original aim of providing a place for longer monographs on entomological subjects. When he moved to Tucson, in 1934, he continued carrying on single-handedly the editorship of both publications for fourteen additional years.

The Brooklyn Society, it becomes apparent, had the advantage of continuity in office, of members who, in numerous instances, carried responsibilities vital to the society for extended periods. Both George P. Engelhardt, former head of the Department of Natural History of the Brooklyn Museum, and Rowland R. McElvare, New York banker who began attending meetings of the Society as a boy, held the exacting office of Treasurer for periods of more than a quarter of a century. Engelhardt carried the responsibilities of this office during the depression and McElvare during the difficulties of the war years. Archibald C. Weeks, author of the words of Cornell's famous song, "Far Above Cayuga's Waters," and the Notary Public who signed the original Certificate of Incorporation, acted as the society's Secretary for many years, as did Miss Anna M. Flaherty during a later period in its history. George S. Tulloch not only served as Chairman of the Publications Committee for more than a quarter of a century, thus helping maintain the continuity of the publications, but he assumed the editorship of the *Bulletin* when it was left vacant by the death of J. R. de la Torre-Bueno.

Throughout its long history, *The Bulletin of the Brooklyn Entomological Society* had a half a dozen editors: F. G. Schaupp, John B. Smith, Robert P. Dow, J. R. de la Torre-Bueno, George S. Tulloch, and John F. Hanson. In the case of *Entomologica Americana*, the list is even shorter: John B. Smith, J. R. de la Torre-Bueno, Joseph C. Bequaert, and James A. Slater. The outstanding monograph published in *Entomologica Americana* was Boving and Craighead's, "Synopsis of the Principal Larval Forms of the Coleoptera." Originally published in the early nineteen-thirties, it has become a classic in its field and has had a continuing sale as a cloth-bound separate.

On December 14, 1922, the Brooklyn Entomological Society held its Fiftieth Anniversary Celebration. The feature of the evening was reminiscences of the early days by Charles W. Leng. In 1947, on December 11, the Seventy-Fifth Anniversary was celebrated at the Brooklyn Museum.

At various times throughout its history, the society elected Honorary Members from among the distinguished entomologists of the world. These have included:

E. L. Bouvier.
Joseph C. Bequaert.
Adam G. Boving.
J. H. Comstock.
Samuel Henshaw.
W. G. Holland.
L. O. Howard.
Karl Jordan.
J. McDunnough.
A. S. Packard.
M. N. Rimsky-Korsakov.

The successive Presidents of the Brooklyn Entomological Society and their terms of office have been:

Franz G. Schaupp (1872–1884).
John B. Smith (1884–1890).
George Franck (1900–1912).
William T. Davis (1912–1916).
W. T. Bather (1916–1920).
William T. Davis (1920–1945).
Rowland R. McElvare (1945–1947).
George S. Tulloch (1947–1949).
Edwin Way Teale (1950–1951).
F. T. Naumann (1951–1953).
Edwin Way Teale (1953–1954).
Charles Pomerantz (1954–1957).
Hubert J. Thelen (1957–1960).
Henry Betros (1960–1963).
Edwin J. Newman (1963–1965).
Henry Betros (1965–1967).

Honorary Presidents of the society have been: Edward Louis Graef, Charles W. Leng, J. R. de la Torre-Bueno, and Rowland R. McElvare.

During the latter years of the organization, conditions changed rapidly. The old-time amateur collector, the original backbone of the society, was disappearing. No longer could the group make field trips by subway, finding open fields or deserted beaches at the end of the line. The older members passed away and fewer young enthusiasts appeared to replace them. Then came World War II, curtailing activity and further reducing attendance at meetings. While the finances and publications of the society remained in a sound condition, due to the devoted labor of a few, membership declined. Many members had moved away, beyond reach of the meetings. Unlike the New York Entomological Society, which has met at The American Museum of Natural History from the beginning, the Brooklyn society was plagued throughout its history by the lack of a permanent base where it could hold its meetings and store its publications. When, after the war, it found itself no longer able to use the Brooklyn Museum, it made its last move, to the Brooklyn Engineer's Club, at 117 Remsen Street.

In the nineteen-fifties, the programs became more general, less confined to entomological matters. These programs, covering all phases of natural history and often illustrated with Kodachrome pictures for a time attracted larger audiences. It was decided, in the early nineteen-sixties to hold two semiannual meetings instead of the regular monthly meetings. The long history of the society, as a separate entity, was drawing to a close.

Over the years, the Brooklyn and the New York societies had had many links. Numerous members were active in both organizations. These included Ernest L. Bell, Chris E. Olsen, George T. Engelhardt, Alexander B. Klots, Frank E. Lutz, Herbert Ruckes, Edwin Way Teale, Charles W. Leng and John M. Sherman. The strongest link of all was William T. Davis who, in addition to his long service to the Brooklyn society, was Treasurer of the New York society from 1904 to 1928, President in 1929 and 1930, and Honorary President from 1940 to the time of his death.

It was a logical step for these two neighboring societies to consolidate. This was accomplished on May 21, 1968, when the New York Supreme Court approved the application of the Brooklyn Society to join the New York Society. That decision brought to an end the history of this pioneer organization whose annals form a colorful chapter in the record of American entomology.

The Junior Entomological Society: The Junior Division of the New York Entomological Society

ALICE GRAY, SENIOR ADVISOR

At the annual meeting of January 7, 1958, the New York Entomological Society resolved to sponsor a Junior Division devoted to helping young people further their interest in entomology and allied sciences. The members believed that this could best be accomplished if the Junior Division were organized and administered by the young people themselves as a separate society, subject, however, to the supervision and approval of the parent organization. To this end, an adult member of the New York Entomological Society should attend all meetings of the Junior Division, in the capacity of Senior Advisor. The Juniors should feel free to call upon the membership of the Senior Society for assistance in carrying out their entomological projects, and should render to the Society periodic reports of their activities.

At that time there was already a group of young insect-enthusiasts, chiefly associated with the Natural Science Center of the American Museum of Natural History, meeting unofficially under the direction of Miss Alice Gray, Scientific Assistant in the Department of Entomology at the Museum and a member of the New York Entomological Society. These 12 young people became the Charter Members of the Junior Entomological Society, with Miss Gray as their Senior Advisor; she still occupies the position. The first official meeting was held on Saturday, February 8, 1958 to draw up a constitution and by-laws for the new society and to elect officers for its first year of operation.

Originally based on the regulations governing the parent organization, the by-laws of the Junior Entomological Society have been greatly modified to cover many circumstances arising out of the youth and very active interests of the members. The rules are enforced by the members themselves far more strictly than their Senior-Advisor would consider necessary, and dues are actually higher than those of the sponsoring group. Active membership is limited to 15 people between the ages of 13 and 22 years, and meetings are held on alternate Saturdays throughout the year.

The program of the Junior Division is exceedingly informal and flexible, as it must be if each member is to persue his own individual interests at his own pace. The activities include lectures by invited speakers upon subjects of general interest, workshops for the manufacture of collecting equipment and the mastery of techniques, presentation by members of topics of personal interest, lessons prepared upon request of the members and delivered by Miss Gray or a qualified member, visits to institutions of entomological interest, and field trips to collecting areas within reach of the public transportation system. The climax of each year's activities is the "Big Spring Field Trip" to some place

Junior Society field trip, Spring 1968. Miss Gray is on the left and partially hidden by a bush.

further out in the country. For the last two years this has been an overnight trip so that members might gain experience in the use of lights and other devices for the capture of nocturnal insects. Now the members are thinking of trying for a week or more in an environment as unlike that of the northeastern states as possible. They are devoting much ingenuity and effort to schemes for making such an expedition practical.

Almost all the young people prefer their insects to be living and they become skilled in keeping the more exciting species in captivity. They belong to TIEG, Teen International Entomology Group, a worldwide correspondence club organized by a teen-ager, Miss Colleen Seeley, and now sponsored by the New York State Agricultural Extension Service at Cornell University; they exchange letters and specimens with other junior entomologists all over the world. Lepidoptera, Coleoptera and Hymenoptera are the orders which interest them most.

It is certain that the young members rapidly acquire a respectable fund of entomological knowledge, but they seem to do it almost incidentally. They learn far more from one another and by reading than they do from lessons designed for their benefit. The Senior Advisor is not a teacher, but rather an opener of doors, a smoother of ways, and an enlarger of horizons. Aside from reminding the young people occasionally of the standard of social responsibility appropriate to members of a learned society, her chief function is to offer suggestions when the combined experience of the members fails. If you were to ask the young people why they belong to the Junior Entomological Society, they would probably say that they enjoy the company of other people who share their interest in insects and who do not think they are mildly insane because they would rather spend a holiday digging an ant nest than racing a hot rod. If congenial companionship is all they gain from the society, it is enough. It can keep their interest in entomology alive until they are mature enough to sustain it without moral support.

The Junior Division has not yet been working long enough to show whether or not its influence will encourage the development of professional entomologists, or even of adult amateurs. Of perhaps 50 young people who have been members throughout their high school years, no more than three are majoring in entomology in college and an equal number have "graduated" to membership in the New York Entomological Society as amateurs. But does it greatly matter if the interest in insects proves transitory? Anyone who has learned in his youth to take pleasure in the natural world, to work happily as an individual and harmoniously as a member of a group, and to understand at least a little of the discipline of any science must be better for the experience. No learned society need be ashamed to have used its influence to such an end.

The Male Genitalia of the Genus *Spilomyia* Meigen Tribe Milesiini (Diptera: Syrphidae)[1]

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Received for Publication February 15, 1968

Abstract: The male genitalia of eight species is described: *S. crandalli* Curran, *S. fusca* Loew, *S. hamifera* Loew, *S. interrupta* Williston, *S. kahli* Snow, *S. liturata* Williston, *S. longicornis* Loew and *S. quadrifasciata* Say. A key based on the terminalia is provided for the species studied.

This paper deals with the genitalic study of eight of the eleven known species of the genus *Spilomyia* Meigen. The descriptions of the male terminalia and a key based on the terminalia are furnished for the species studied. Vockeroth (1958) has referred to the distinguishing characters of the styli in *S. foxleei* Vockeroth and *S. citima* Vockeroth. *S. texana* Johnson could not be studied due to the inability to secure the material.

Metcalf's (1921) terminology and method of preparation used for genitalic study has been followed in the present work. The diagrams were drawn with the help of a camera lucida and a stereomicroscope.

I wish to thank Prof. Ray F. Smith, Chairman of the Department of Entomology and Parasitology, University of California, Berkeley, for providing me with facilities for work. I am indebted to Dr. F. R. Cole, Dipterologist, for generous advice, assistance, helpful suggestions, and checking of the manuscript. My thanks are due to Dr. John A. Chemsak, Division of Entomology, Berkeley, for constructive and helpful reading of the paper. The author wishes to express his sincere appreciation and thanks to Dr. Pedro Wygodzinsky, American Museum of Natural History, for the generous loan of several specimens without which this study would not have been possible.

DESCRIPTION OF MALE TERMINALIA

Spilomyia interrupta Williston (Figs. 1, 2 and 3)

The epandrium trough-shaped, about as wide as long with lower and upper corners produced and acute. Style with a broad base and narrow apical lobe, lobe with at most an obscure depression; long fine hairs present along the lateral border up to about three-fourths from base to the apex and fine pubescence on the rest of the surface. Cerci narrow, kidney-shaped.

The penis sheath about as long as the depth of the epandrium. Superior lobe short, broad at base, apically narrow and curved outward; a broad, deep notch present between the basal and apical parts. The rod-shaped sustentacular apodeme projects into the penis-sheath

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[1] Research supported by a Fulbright scholarship for 1967–1968.

and articulates with the chitinous box at its broadened caudal end. The chitinous box M-shaped, with the lateral corners produced and acute and the ejaculatory hood narrow and umbrella-shaped.

Spilomyia hamifera Loew (Figs. 4, 5 and 6)

The epandrium trough-shaped, about as long as wide, the lower corners produced and acute and the upper corners rounded. Stylus about as wide as that of *fusca* with a broad base and broad apical lobe separated by a broad, shallow notch; base about three and a half times broader than the apical lobe; apical lobe with a broad and extremely shallow notch sub-apically, the upper part of the apical lobe more distinct than the lower part; moderately long, fine bristles present along the dorso-lateral border of the stylus and minute pubescence all over. Cerci lobe-like, narrow at base and broad apically.

The penis sheath about as long as the depth of the epandrium. Superior lobe short, broad basally, deep, broadly notched sub-apically; apical part long, narrow, curved and chitinized. Sustentacular apodeme rod-shaped, narrow basally and extremely broad apically. Chitinous box saucer-shaped with the lateral corners produced and acute. Ejculatory hood small and cylindrical.

Spilomyia quadrifasciata Say (Figs. 7, 8 and 9)

The epandrium trough-shaped, about as wide as long with the lower and upper corners produced and acute. Stylus narrower than that of *hamifera,* with a broad base and broad apical lobe separated by a broad, shallow notch; base about three times broader than the apical lobe; apical lobe with a shallow, narrow notch sub-apically, the upper part of the apical lobe slightly broader than the lower part; long, fine bristles present along the dorso-lateral border of the stylus and fine pubescence on the apical part only. Cerci small, nearly kidney-shaped, clothed with long bristles.

The penis sheath about one and a half times longer than the depth of the epandrium. Superior lobe short, narrow basally, broad medially with a shallow, broad notch sub-apically; terminal part small, narrow and curved outward. Sustentacular apodeme rod-shaped, narrow basally and broad apically. Chitinous box horse-shoe shaped. Ejaculatory hood long, cylindrical, the apical margin grooved medially.

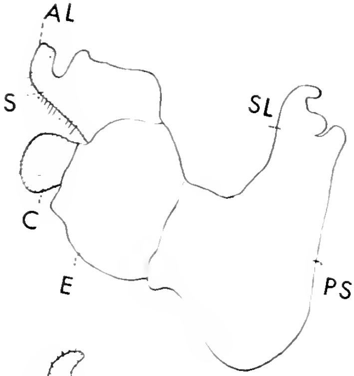
Spilomyia fusca Loew (Figs. 10, 11 and 12)

The epandrium trough-shaped, about as wide as long, the lower corners greatly produced and acute while the upper corners slightly produced and not acute. Stylus much wider than that of *quadrifasciata* with a broad base and broad apical lobe separated by a deep, narrow notch sub-apically, the upper part of the apical lobe longer than the lower part; small pubescence present all over the apical part and along the dorso-lateral border. Cerci pubescent, narrow basally, broad medially and conical apically.

The penis sheath about as long as the depth of the epandrium. Superior lobe long, cylindrical with an extremely narrow notch subapically; apical part long, narrow and curved outwardly. Sustentacular apodeme more or less like that of *hamifera* except that it is less broad apically. Chitinous box semi-oval. Ejaculatory hood cylindrical but narrower than in *hamifera.*

Spilomyia liturata Williston (Figs. 13, 14 and 15)

The epandrium trough-shaped, about as wide as long with the lower corners produced and acute. Stylus about as wide as that of *kahli,* with a broad base and broad apical lobe separated by a broad, shallow notch; base about four times broader than the apical lobe; apical lobe with a shallow, narrow notch sub-apically; with fine, long hairs present along



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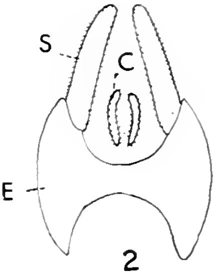

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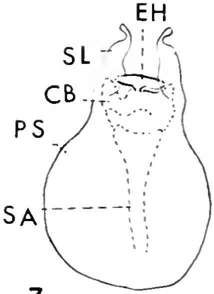

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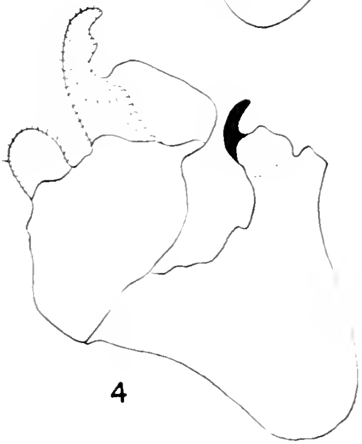

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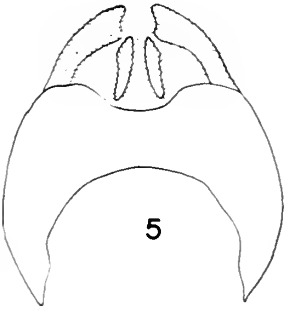

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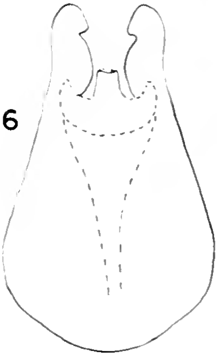

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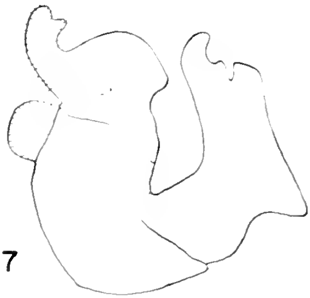

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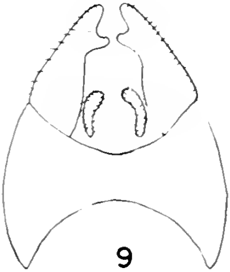

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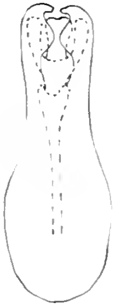

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FIG. 1. Male terminalia of *S. interrupta* Will. (lateral view).
FIG. 2. Epandrium of *S. interrupta* Will. (dorsal view).
FIG. 3. Penis sheath and axial system of *S. interrupta* Will. (ventral view).
FIG. 4. Male terminalia of *S. hamifera* Loew (lateral view).
FIG. 5. Epandrium of *S. hamifera* Loew (dorsal view).
FIG. 6. Penis sheath and axial system of *S. hamifera* Loew (ventral view).
FIG. 7. Male terminalia of *S. quadrifasciata* Say (lateral view).
FIG. 8. Penis sheath and axial system of *S. quadrifasciata* Say (ventral view).
FIG. 9. Epandrium of *S. quadrifasciata* Say (dorsal view).

the outer lateral border of the stylus and minute pubescence all over. Cerci elongated, kidney-shaped with fine long bristles along the borders.

The penis sheath longer than the depth of the epandrium. Superior lobe most distinctly shaped in the entire group, broad at base, apical part also broad and curved, terminating in a conical projection, the sub-apical notch narrow and deep. Sustentacular apodeme similar to that of *kahli,* but the lateral arms narrow and elongated. Chitinous box M-shaped. Ejaculatory hood cylindrical.

Spilomyia kahli Snow (Figs. 16, 17 and 18)

The epandrium trough-shaped, about as wide as long with only the lower corners highly produced and acute. Stylus about as wide as that of *longicornis* with a broad base and extremely narrow apical lobe separated by a broad, shallow notch; base about four times broader than the apical lobe; apical lobe conical terminally and undivided, with long fine bristles along the dorso-lateral border of the stylus and fine pubescence along its outer half only. Cerci somewhat kidney-shaped, basal part slightly broader than the apical region.

The penis sheath slightly longer than the depth of the epandrium. Superior lobe a little wider than long at the basal part with an extremely narrow, deep notch sub-apically; apical part long, cylindrical with a somewhat median groove on the inside. Sustentacular apodeme long, narrow basally, broad apically; median part of the apical border dome-shaped and the lateral borders slightly produced and acute. Chitinous box W-shaped. Ejaculatory hood cylindrical but hroader than that of *fusca*.

Spilomyia crandalli Curran (Figs. 19, 20 and 21)

The epandrium trough-shaped, a little wider than long, the lower corners greatly produced and acute and the upper produced and rounded. Stylus wider than that of *kahli*, with the extremely broad base and broad, apical lobe separated by a deep, wide notch, base about three times broader than the apical lobe; apical lobe with a shallow, broad notch sub-apically, the upper part of the apical lobe long, cylindrical and the lower part only a small protuberance; clothed with long fine bristles along the outer border and medium-sized hairs all over. Cerci small, kidney-shaped with long bristles along the borders.

The penis sheath longer than the depth of the epandrium. Superior lobe broad at base, narrowing toward the apex, apical part curved outward, forming a deep, wide notch with neck area of the basal part. Sustentacular apodeme similar to that of *kahli* except that the median dome-shaped apical part is narrower in *crandalli.* Chitinous box with a small knob-like projection sub-apically. Ejaculatory hood cylindrical with lateral conical projections.

Spilomyia longicornis Loew (Figs. 22, 23 and 24)

The epandrium trough-shaped, a little wider than long with the lower corners produced and acute. Stylus about as wide as that of *interrupta,* with a broad base and narrow apical lobe separated by a shallow, narrow notch sub-apically, the two halves of the apical lobe nearly similar, covered with fine pubescence all over. Cerci pubescent, broad basally and narrow apically.

The penis sheath a little longer than the depth of the epandrium. Superior lobe almost

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Abbreviations: AL, apical lobe of the stylus; C, cerci; CB, chitinous box; E, epandrium; EH, ejaculatory hood; PS, penis sheath; S, stylus; SA, sustentacular apodeme; SL, superior lobe.

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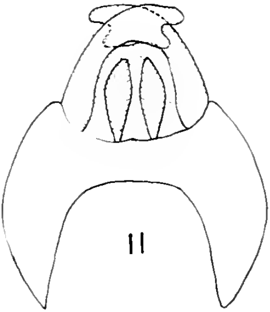

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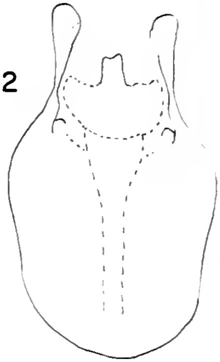

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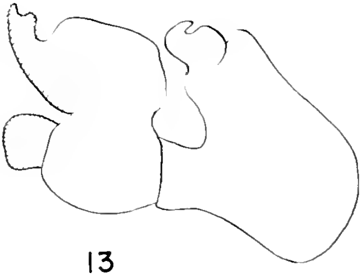

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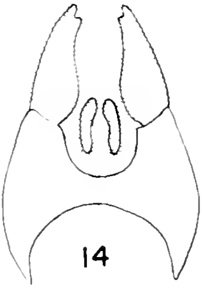

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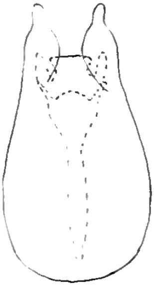

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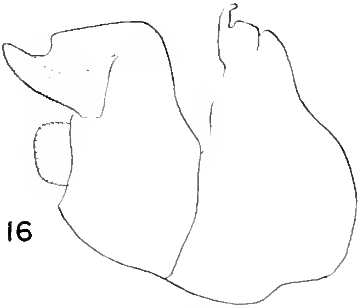

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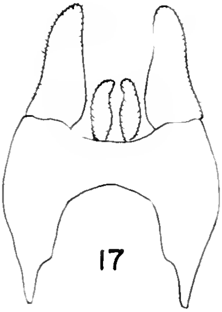

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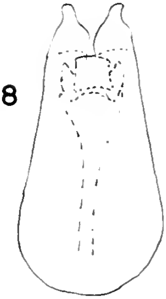

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FIG. 10. Male terminalia of *S. fusca* Loew (lateral view).
FIG. 11. Epandrium of *S. fusca* Loew (dorsal view).
FIG. 12. Penis sheath and axial system of *S. fusca* Loew (ventral view).
FIG. 13. Male terminalia of *S. liturata* Will. (lateral view).
FIG. 14. Epandrium of *S. liturata* Will. (dorsal view).
FIG. 15. Penis sheath and axial system of *S. liturata* Will. (ventral view).
FIG. 16. Male terminalia of *S. kahli* Snow (lateral view).
FIG. 17. Epandrium of *S. kahli* Snow (dorsal view).
FIG. 18. Penis sheath and axial system of *S. kahli* Snow (ventral view).

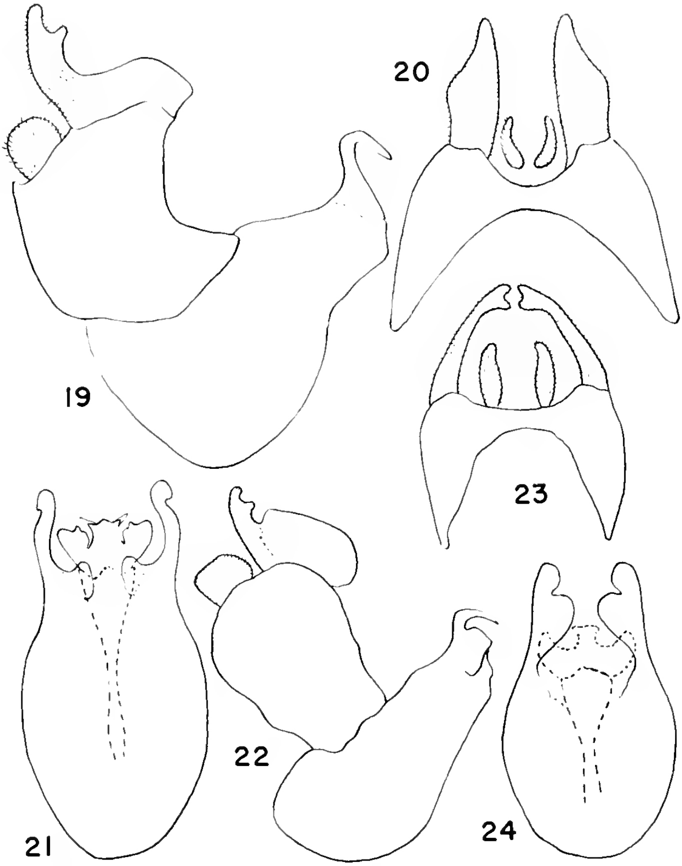

Fig. 19. Male terminalia of *S. crandalli* Curran (lateral view).
Fig. 20. Epandrium of *S. crandalli* Curran (dorsal view).
Fig. 21. Penis sheath and axial system of *S. crandalli* Curran (ventral view).
Fig. 22. Male terminalia of *S. longicornis* Loew (lateral view).
Fig. 23. Epandrium of *S. longicornis* Loew (dorsal view).
Fig. 24. Penis sheath and axial system of *S. longicornis* Loew (ventral view).

similar to that of *fusca* in a lateral view, but the sub-apical notch is deeper and wider in *longicornis*. Sustentacular apodeme like that of *crandalli* except that the median, dome-like apical projection is rather less prominent. Chitinous box kidney-shaped with lateral corners greatly produced and acute. Ejaculatory hood cylindrical, apex capitate.

DISCUSSION OF MALE GENITALIA IN *Spilomyia* Meigen AND GROUPINGS

The bi-lobed stylus and the cylindrical ejaculatory hood are fairly constant features of the genus. The genus can easily be divided into two groups, (i) *interrupta* group and (ii) *liturata* group. The *liturata* group (*S. liturata* Williston, *S. kahli* Snow, *S. crandalli* Curran and *S. longicornis* Loew) is characterized by the sustentacular apodeme's having an apical, median dome-shaped projection, while the *interrupta* group (*S. interrupta* Williston, *S. hamifera* Loew, *S. quadrifasciata* Say and *S. fusca* Loew) lacks it.

(i) The *interrupta* group

The most common species *interrupta* (Fig. 1) can easily be distinguished in the group by the apical lobe of the stylus having at most an obscure depression. The species *quadrifasciata* (Fig. 4) and *hamifera* (Fig. 7) are similar in the structure of the stylus and superior lobe, but distinct in the form of the chitinous box. The species *fusca* (Fig. 12), with long superior lobes, is unique in the group.

(ii) The *liturata* group

The species *kahli* (Fig. 16) is the only one in the genus that bears an undivided apical lobe of the stylus. The species *crandalli* (Figs. 20 and 21) and *longicornis* (Figs. 23 and 24) are related to one another in having the epandrium a little wider than long and the penis sheath longer than the depth of the epandrium. The two can be separated by the structure of the chitinous box, apex of the ejaculatory hood, and the nature of the notch between the basal and apical parts of the stylus. The species *liturata* (Fig. 13) is unique by the form of the superior lobes.

Some intergroup relationships also exist. The species *interrupta* (Fig. 1) of the *interrupta* group resembles *kahli* (Fig. 16) of the *liturata* group in the form of the apical lobe of the stylus. On the other hand, *quadrifasciata* (Fig. 8) of the former group resembles the species of the latter group in the length of the penis sheath.

KEY TO THE SPECIES OF THE GENUS *Spilomyia* Meigen
BASED ON MALE GENITALIA

1. Sustentacular apodeme with an apical, median dome-shaped projection 2
   Sustentacular apodeme without an apical, median dome-shaped projection 5
2. Apical lobe of the stylus not divided (Fig. 16) ... *kahli* Snow
   Apical lobe divided ... 3
3. Sustentacular apodeme with the lateral apical corners highly produced and acute (Fig. 15) ... *liturata* Williston
   Sustentacular apodeme with the apical corners not produced 4
4. Stylus having a broad and deep notch between its basal and apical parts; apical lobe with a broad, shallow notch sub-apically (Fig. 19) . *crandalli* Curran
   Stylus having a narrow and shallow notch between its basal and apical parts; apical lobe with a narrow, shallow notch sub-apically (Fig. 22) . *longicornis* Loew
5. Stylus with a broad base and broad apical lobe; apical lobe divided 6
   Stylus with a broad base and a narrow apical lobe; apical lobe with at most an obscure depression (Fig. 1) *interrupta* Williston
6. Superior lobe long with a deep, narrow notch sub-apically (Fig. 10) . *fusca* Loew

Superior lobe short with a broad notch sub-apically 7

7. Chitinous box horse-shoe shaped and cerci kidney-shaped (Figs. 8 and 9) .... *quadrifasciata* Say

Chitinous box saucer-shaped and cerci elongated, narrow at base and broad apically (Figs. 5 and 6) .... *hamifera* Loew

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Obituary Notice—Theodore C. Schneirla

Regretfully we announce the death of Dr. Theodore C. Schneirla on August 20, 1968. Dr. Schneirla was Curator of the Department of Animal Behavior of the American Museum of Natural History and a member of the New York Entomological Society for many years. He had served as President of the Society for 1949 and had been elected a Trustee for several terms. He was widely known for his studies on Army Ants and made many field trips to various parts of the world in order to observe the different kinds of these unique insects. His research clearly shows how the phasic behavior of these ants is correlated with the development of their large broods. He frequently presented his research at the Society meetings. Dr. Schneirla was a trained Psychologist, and in addition to his ant studies, he also published on mammalian behavior.

Descriptions and Records of South Asiatic Laspeyresiini (Lepidoptera: Tortricidae)

THE LATE NICHOLAS S. OBRAZTSOV[1]

RECEIVED FOR PUBLICATION MARCH 9, 1968

Abstract: **Andrioplecta, Gephyroneura**, and **Rhadinoscolops** are described as new genera; *Laspeyresia* **subpulverula** (Java) and *Grapholitha* (*Euspila*) **harmologa** (Assam, India) are published as new species. The genus *Cimeliomorpha* Diakonoff is redescribed, several new combinations are proposed, and the male genitalia of *Antichlidas holocnista* Meyrick is figured.

Andrioplecta, new genus

Figs. 1–2

TYPE-SPECIES: *Laspeyresia pulverula* Meyrick, 1912.

Head rather roughly short-scaled, a divided tuft between antennae. Antennae in male shortly fasciculate-ciliated, in female with short setae. Labial palpi moderate, rather smooth, ascending; terminal segment large, subconical, exposed. Proboscis rather short. Thorax and legs smooth.

Forewings smooth, broadly triangular; costa gently arched, apex rounded, termen gently convex, tornus broadly rounded; no costal fold in male. Twelve veins, all separate: Sc almost straight, bent at base, R_1 from middle of cell, R_2 about five times as close to R_3 as to R_1; R_2, R_3, and R_4 almost equidistant; R_4 to upper portion of apex, R_5 to termen, approximated to R_4 at origin; upper internal vein from between R_1 and R_2 running to below R_5; lower internal vein to below M_2; M_2 and M_3 subparallel; M_3 approximated to Cu_1 at base and termen; Cu_1 strongly curved, originating at lower angle of discal cell; Cu_2 from two-thirds of discal cell; A_1 well developed at tornus; basal fork of $A_{2\text{-}3}$ about $^1/_3$.

Hindwing as broad as forewing, rotundate-trapezoidal, costa gently arched, more so in male, apex rounded, termen straight in male, more rounded in female; dorsum in male straight externally, thickened and sclerotized internally; cubital pecten present. Seven veins in male, eight in female: Sc almost straight, R and M_1 coincident in male, stalked in female; cell open in both sexes; M_2, M_3 subparallel; M_3 and Cu_1 connate in male, stalked in female; Cu_2 from about two-thirds of cell; A_1, A_2 and A_3 rather well developed.

MALE GENITALIA: Eighth segment with two lateral folds, containing coremata of weak, dilated scales. Tegumen simple, band-like; pedunculi narrow. Valva elongate; outer surface without any specialized scaling, with a scobinate area in neck portion; cucullus elongate-ovate, sacculus narrow, dilated towards base; strong, long setae on inner surface of cucullus; weak setate on sacculus, short at base, longer externad from large basal opening; processus basales short, no pulvinus. Uncus, socii absent. Gnathos weak, rather broad, somewhat angulate caudally; anellus typically olethreutoid; caulis moderate, in lateral aspect widely dilated. Aedeagus tubular, rather long, arcuate; coecum penis widely open, directly connected to membraneous portion of penis; cornuti long, thin, deciduous needles.

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[1] Formerly Research Associate, the American Museum of Natural History, New York. This study has been carried out with a grant of the National Science Foundation. Edited by A. Diakonoff, Leiden, Netherlands, and submitted by Frederick H. Rindge, Amer. Mus. Nat. Hist.

FEMALE GENITALIA: Papillae anales soft, elongate; apophyses posteriores shorter than anteriores. Ostium bursae immediately caudad from postsegmental margin of ventral plate; lamella antevaginalis, a semiannulus, with narrow extensions around ostium bursae; lamella postvaginalis, a weak rounded plate; antrum and ductus bursae fused into a narrow, strongly sclerotized tube; ductus seminalis joined to the point of connection of ductus bursae and cervix bursae; corpus bursae membraneous, ovate, with an indistinct cervix; signa, two short, strong thorns, arising from slightly sclerotized, round patches on surface of corpus bursae. Ventral plate of seventh segment moderately developed.

A monobasic genus, probably a development of *Laspeyresia* Hübner. As to the venation, the new genus approaches *Strophedra* Herrich-Schäffer, but differs from it by having veins M_3 and Cu_1 in the forewing approximated at termen, and in strong sclerotization of the dorsum in the hindwing of the male. Very peculiar is the absence of discocellulars in the hindwing, present in all other Laspeyresiini genera known. The genus also shows some relationship to the Eucosmini, in having the base of M_2 in the hindwing slightly approximated to M_3. The genitalia rather approach those in *Laspeyresia*.

The name of the genus is derived from Greek ἀνδρειος = belonging to man, and πγεκτός = plaited; the gender is feminine.

Andrioplecta pulverula (Meyrick), new combination

Figs. 1–2

Laspeyresia pulverula Meyrick, 1912, p. 876; (in part) 1938, p. 3. Clarke, 1955, p. 265; 1958, p. 452, pl. 225, figs. 2–2c.

? *Enarmonia pulverula*: Diakonoff, 1953, p. 162.

TYPE: Holotype, female (genitalia on slide No. 7371), Khasi Hills, Assam, June, 1906. British Museum.

OTHER SPECIMENS EXAMINED: Two males (genitalia on slides Nos. 6669, 6670), Likiang, China, July, 1934 (H. Höne); one female (genitalia on slide No. 6671), North-Central Province, Ceylon, December, 1904 (J.P.).

The males from Likiang are not quite fresh and look paler than the female holotype. The ocelloid patch of the forewing is also paler, and its longitudinal striation more distinct, consequently. The hindwings lack the white discal area. But the markings of these specimens agree closely with those in the holotype and I regard them as being conspecific.

The Ceylon female hardly differs from the holotype at all. Only its ventral plate is slightly more extended and somewhat differently shaped, but this may be due to individual variation (by analogy with certain other species of Laspeyresiini, as e.g. *Melissopus latiferranus* (Walsingham).

Laspeyresia **subpulverula**, new species

Figs. 18, 20

Laspeyresia pulverula (in part) Meyrick, 1938, (not Meyrick, 1912) p. 3.

? *Enarmonia pulverula*: Diakonoff, 1953, p. 162.

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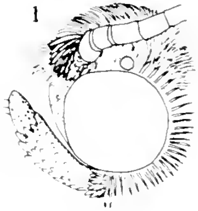

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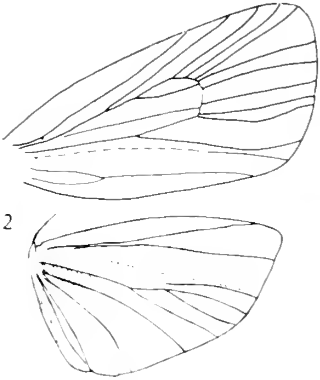

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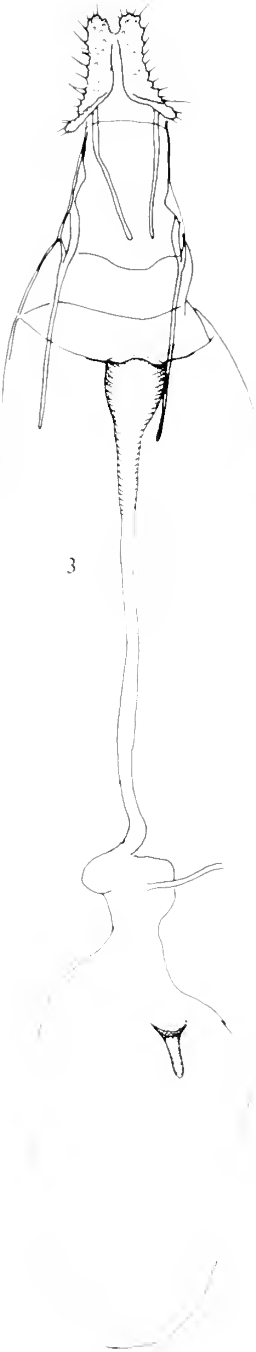

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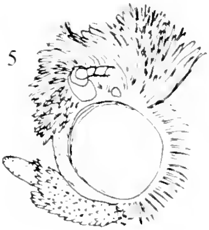

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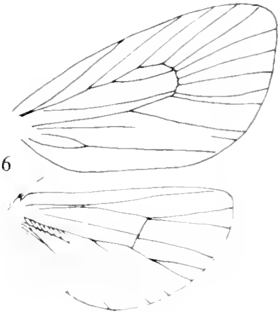

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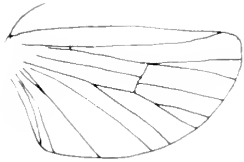

FEMALE: Antennae dark brown, finely brownish ochreous annulated. Head greyish-brown-ochreous. Palpi pale ochreous, tip blackish. (Thorax denuded). Patagia and tegulae black, scales with ochreous tips. Forewings blackish brown with tips of scales ochreous; basal area, ⅓ of wing, separated by a black-brown rather broad line, angulated externad in cell; basal area including close to edge a short oblique blackish supradorsal streak, another similar streak less distinct, close to base of costa, and three large, plumbeous spots: one below costa and two above dorsum; a dull leaden rather large spot on middle of dorsum; four undulate blackish-brown lines, crossing this spot from costa to dorsum and somewhat dilated on dorsum; second of these longest, pale ochreous scales between these lines; a blackish-brown zigzag line from beyond middle of costa, directed first towards termen, then bent at discocellulars and running almost vertically to dorsum, being widely dilated towards tornus and separating median and posterior thirds of wing; beyond this line a large ocelloid patch, extending almost to costa, including many fine blackish-brown longitudinal streaks and two pale ochreous patches, one before another beyond middle of patch; a narrow blackish-brown vertical line within external patch; eleven black-brown costal streaks with pale ochreous interspaces; some of them divided by narrow black-brown lines; two largest interspaces, wedge-shaped, before apex; a straight, oblique, olive brown line, longitudinally divided by black, from the fifth brown costal streak, to middle of termen; a narrow terminal line, black-brown; cilia brownish-grey, with pale ochreous basal line and tips. Underside dark brown with broad whitish touches along cell and dorsum, and costal markings paler than on upper side. Length of forewing, 6.5 mm. Hindwing dark brown, pale ochreous on costa and along discal cell; cilia cream-white slightly greyish apically, with a brown-black basal line.

MALE: Unknown.

FEMALE GENITALIA: Ventral plate subrectangular, caudal margin deeply excavated. Ostium bursae with a subrectangular weakly sclerotized lamella postvaginalis; antrum short, funnel-shaped, placed on excavation of ventral plate. Ductus bursae sclerotized, rather narrow. Corpus bursae elongate, finely punctulate; a large lateral sac, caudally receiving ductus seminalis located in caudolateral part of corpus bursae; two strong, curved, thorn-like signa, dilated at base.

TYPE: Holotype, female (genitalia on slide No. 6672), Lawang, Java, bred October, 1932 (K.). British Museum.

REMARKS: Until the male is discovered, the generic position of the new species is somewhat problematic. It resembles *Andrioplecta pulverula* (Meyrick), but has the discocellulars of hindwing well developed. The genitalia of these two species are quite distinct and in the new species rather similar to those of *Laspeyresia gallicana* (Guenée) and *L. implicatana* (Christoph). Tentatively **subpulverula** may be regarded congeneric with these two species.

Grapholitha (*Euspila*) **harmologa**, new species

Figs. 8, 21

FEMALE: Antenna dark grey-brown, with a fine whitish annulation. Head brown-ochreous. Labial palpi as head, terminal segment darker brown. Thorax brownish-ochreous, dully

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FIGS. 1, 2. **Andrioplecta pulverula** (Meyrick), male. 1. Head. 2. Wing venation.

FIGS. 3–7. **Gephyroneura hemidoxa** (Meyrick). 3. Female genitalia, slide No. 6691 BM. 4. Male genitalia, slide No. 6690 BM, holotype. 5. Head, and, 6, wing venation, female. 7. Wing venation, male.

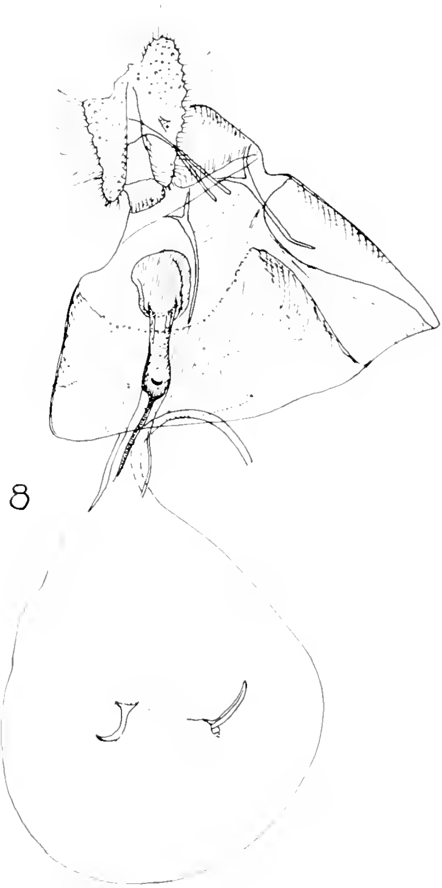


FIG. 8. *Grapholitha* (*Euspila*) **harmologa** new species, female, holotype, slide No. 6661 BM.

iridescent. Forewings bronze-brown, towards base brownish-ochreous; a broad, indistinct, creamy-whitish fasciate patch, posteriorly with slight metallic bluish reflections; it is located slightly before middle of dorsum, crossing wing and faintly divided by an incomplete bronze-brown fascia; a rather larger silvery-bluish spot before ocelloid patch; the latter with a few silvery-bluish scales posteriorly close to termen and with 5–6 black longitudinal streaks, some of them divided in minute dots; 10-12 oblique, rather broad, black costal streaks, separated by white; two oblique, metallic-blue lines, from second and fifth costal streaks respectively, directed towards upper part of termen; cilia whitish, with a brown-black basal line and tips. Underside brown, paler along costa with a violet-green iridescence. Length of forewing: 4.5 mm. Hindwings bronze-brown, sometimes paler than forewings; cilia whitish with a brown-black basal line; underside somewhat smoky brown, more iridescent than forewings.

MALE: Unknown.

FEMALE GENITALIA: Ventral plate large, T-shaped. Ostium bursae located postsegmentally; lamella postvaginalis rotundate-subrectangular, slightly longer than broad, rather indistinctly outlined. Antrum long, tubular, rounded and continued as a narrow cestum to the base of cervix bursae. Corpus bursae rotundate, slightly ovate; two curved, rather long, hook-shaped signa.

TYPE: Holotype, female (genitalia on slide No. 6661), Khasi Hills, Assam, July 1906 (British Museum).

REMARKS: Meyrick identified this specimen as *bigeminata* Meyrick, but it differs from the latter in having a single edge to the dorsal patch of the forewings. This patch is less distinct in the new species and more extended towards the costa. From *dissias* Meyrick the new species differs by a more anteriorly shifted dorsal patch, and by a single edge to it which runs more vertically.

Gephyroneura, new genus

Figs. 3–7

TYPE-SPECIES: *Laspeyresia hemidoxa* Meyrick, 1907.

Laspeyresia (part): Meyrick, 1907, p. 145. Clarke, 1955, p. 156; 1958, p. 440, pl. 219, figs. 3–3a. Okano, 1959, p. 259. Obraztsov, 1959, p. 193.

Enarmonia (part): Diakonoff, 1953, p. 161. Issiki, 1957, p. 57.

Antennae in male somewhat thickened, gently serrated, finely short-ciliated; in female simple, densely and obliquely ciliated. Head roughly scaled. Palpi ascending, second segment rather smooth, terminal well exposed, obtuse, rather large and thick. Proboscis moderate. Thorax smooth.

Forewings broadly triangular, costa arched, apex rounded, termen convex, tornus broadly rounded; no costal fold in male. 12 veins, all separate: Sc rather straight; R_1 from middle of discal cell; R_2 closer to R_3 than to R_1; R_3 almost equidistant from R_2 and R_4, widely remote from them; R_4 and R_5 at least three times as close to each other as R_4 and R_3; R_4 to costa, R_5 to termen; upper internal vein of discal cell from between R_2 and R_1, and running to between R_4 and R_5; lower internal vein from before basal fourth of discal cell and running to M_3; M_1 twice as remote from R_5 as the latter from R_4; M_2 slightly closer to M_1 than the latter to R_5; M_2 and M_3 widely remote; M_3 somewhat incurved, at the origin twice as close to Cu_1 as to M_2, at termen about twice as remote from Cu_1 as at origin. Cu_1 from lower angle of discal cell; Cu_2 from ⅔ of lower edge of discal cell; A_1 interrupted in the middle portion; basal fork of A_{2+3} about one-third as long as entire vein.

Hindwings semiovate, narrower than forewings; costa gently undulate; apex rotundate; termen strongly convex, forming a common arch with external portion of dorsum; internal portion of dorsum convex, in male with a tubular lobe; cubitus with pecten. Eight veins: Sc flatly undulate, in basal third connected with discal cell by a short transverse vein. R and M_1 connate, both to termen; M_2 widely separated, parallel to M_3; latter and Cu_1 stalked from lower angle of cell; Cu_2 from ⅔ of lower edge of cell, all anal veins well developed, A_2 furcate at base.

MALE GENITALIA: Postsegmental membrane of segment 8 with lateral hair-clusters. Uncus papilliform, bilamellate; socii large, membraneous, fused with membraneous scaphium, each with the caudal margin bearing strong short setae directed upwards; gnathos narrow, weak and band-shaped; tegumen broad; pedunculi narrow. Valva elongate, slightly narrowed

[illegible] *[illegible]* Meyrick. [illegible] Wing venation, male. 10. Head. [illegible] male lectotype, slide No. 7411. 11. Female genitalia, paralectotype, slide [illegible] Signum of the same specimen.

[illegible] posteriorly; costa moderately undulate; sacculus thickened at base, then [illegible] an angular excision before middle of lower edge of valva, flattened outwardly [illegible] dense setae along upper edge of sacculus; cucullus not [illegible] with fine hairs and a series of stronger setae parallel to lower edge of valva; [illegible] basally long and narrow. Anellus irregularly hexagonal at base, with a central [illegible] a flat girdle encircling the base of aedeagus, and con[illegible] plate on both sides of the hole. Aedeagus short, tubular; a few [illegible]

FEMALE GENITALIA: Ovipositor conical. Papillae anales weak, rather narrow, elongate; apophyses posteriores longer than these papillae; but shorter than apophyses anteriores. Ostium bursae intersegmental; antrum slightly sclerotized, reverse-bottle-shaped; ductus bursae narrow and rather long; cervix bulbose. Corpus bursae elongate, with a neck near cervix; signum, a single strong thorn located caudally.

REMARKS: The systematic position of the new genus is somewhat obscure. The presence of the socii and the rudimentary basal opening of the valva indicate some relationship with *Pseudophiaris* Obraztsov and *Eucosmomorpha* Obraztsov. The new genus also resembles one of these genera by the tubular thickening of the dorsal margin of the hindwing, but differs from both by many other characters. Especially peculiar is the presence of a short transverse vein between Sc and cell. Among the Laspeyresiini this feature is only known in the genus *Selania* Stephens, but the exact position of the transverse vein in that genus is quite different.

The name of the genus is derived from Greek *γέψυρα* = a bridge, and *νεῦρον* = a vein.

Gephyroneura hemidoxa (Meyrick), new combination
Figs. 3–7

Laspeyresia hemidoxa Meyrick, 1907, p. 145. Clarke, 1955, p. 156; 1958, p. 440, pl. 219, fig. 3, 3a. Okano, 1959, p. 259, pl. 174, fig. 15. Obraztsov, 1959, p. 193.

Enarmonia hemidoxa: Diakonoff, 1953, p. 161. Issiki, 1957, p. 57, pl. 8, fig. 253.

TYPES: Lectotype, male (genitalia on slide No. 7375), Khasi Hills, Assam, September, 1906. Lectoparatypes, one male and one female (genitalia on slides Nos. 6690 and 6691, respectively), same data. British Museum.

Cimeliomorpha Diakonoff
Figs. 9–13

TYPE-SPECIES: *Copromorpha cymbalora* Meyrick, 1907.

Cimeliomorpha Diakonoff, 1966, p. 50, fig. 1.

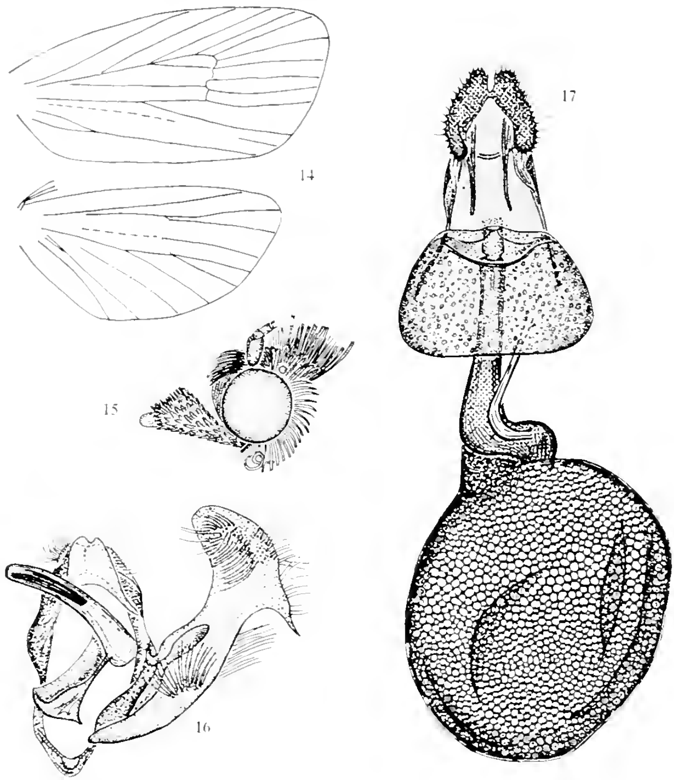
Copromorpha (part): Meyrick, 1907, p. 152. Clarke, 1955, p. 110.

Laspeyresia (part): Fletcher, 1920, p. 52, note. Meyrick, 1937, p. 99; 1939, p. 52. Clarke, 1958, p. 435, pl. 216, figs. 1, 1a.

Enarmonia: Diakonoff, 1949, p. 137.

Antenna in male shortly ciliated, with setae longer than cilia; in female setose. Ocellus caudad of scapus, in male more remote from it. Labial palpus rather short, ascending; second segment widely dilated apically; terminal segment moderate, exposed. Proboscis developed. Thorax smooth. Second abdominal segment in both sexes with a small, rather sclerotized pocket on each side of presegmental margin.

Forewing rather broad, subtriangular, with groups of raised, metallic scales; costa gently arched; apex rotundate; termen between veins R$_5$ and Cu$_1$ straight, almost vertical; tornus



Figs. 14–17. **Rhadinoscolops koenigianus** (Fabr.). 14. Wing venation, male. 15. Head, male. 16. Genitalia, male (slide No 6335, BM). 17. Genitalia, female (slide No. 6360 BM).

broadly rotundate; dorsum very gently curved, almost straight. No costal fold in male. 12 veins, all separate: Sc slightly incurved; R_1 from about middle of discal cell; R_2 closer to R_3 than to R_1; R_4 at origin closer to R_5 than to R_3; R_4 running to costa, R_5 to termen; M_1 closer to R_5 than to M_2; upper internal vein originating between R_2 and R_3 and ending at R_4; lower internal vein ending between M_2 and M_3; Cu_1 from lower angle of discal cell, remote from M_3; Cu_2 originating behind middle and before last third of discal cell; basal fork of A_{2+3} about two-fifths.

Hindwing rotundate-subtrapezoidal, about as broad as forewing; costa gently undulate; apex broadly rounded; termen convex; dorsum rather flat or as gently incurved in external portion as in internal and rotundate-angulate between these two portions. 8 veins: Sc slightly incurved; R and M_1 widely separated; M_2 parallel to M_3; latter vein and Cu_1 connate, originating from lower angle of cell; Cu_2 from about three-fourths of cell; A_1, A_2, and A_3 well developed; A_2 with a short basal fork; A_3 with a strong pecten in male; cubitus with a weak pecten in both sexes.

MALE GENITALIA: Tegumen simple, band-like; no uncus; pedunculi dilated in middle; socii weak, rather large, flexible, turning easily out together with anal tube; gnathos shaped as a narrow half-ring. Valva dilated in basal half; sacculus broad, indistinctly separated, reaching over middle of valva, and roundly projected externally; upper edge of sacculus with long hairs extended over most of surface of large basal opening of valva; a rather broad neck connecting cucullus with basal portion of valva; cucullus obliquely elongate, tapering downwards, and bearing an anal thorn; processus basalis not separated from costa and not protruding beyond interior margin of valva. Anellus with a rather small basal plate; caulis long and board, in middle strengthened longitudinally by a sclerotized strip ending with a fork clasping around the base of aedeagus. Aedeagus tubular, rather moderate; coecum penis broadly rotundate; a cuneus of numerous, very short, fine pins. FEMALE GENITALIA: Papillae anales soft, elongate, rather narrow; apophyses posteriores slightly longer than papillae anales, but shorter than apophyses anteriores. Ostium bursae located at caudal margin of a very large, rotundate ventral plate, and separated from it by a narrow, belt-like lamella antevaginalis; antrum weakly sclerotized, caudally with a short, projected angle on each side of ostium bursae, dorsally with an unpaired, longitudinal colliculum, protruding beyond caudal margin of lamella antevaginalis. Ductus bursae rather long, not differentiated from cervix bursae; corpus bursae membranous, elongate; signum shaped as a round punctulate area with dots more densely accumulated in its middle.

REMARKS: In the shape of the male genitalia this genus resembles *Pseudophiaris* Obraztsov and *Eucosmomorpha* Obraztsov, but differs from these genera in the processus basalis closely attached to the costa of the valva and in the cornuti replaced by a cuneus of numerous, minute pins. Also in other morphological characters the three genera are quite distinct from each other. The venation of the forewing differs in the position of the upper internal vein of the discal cell. The veins R and M_1 of the hindwing are widely separated from each other, and might be compared to these veins in the genus *Dichrorampha* Guenée. A large, rotundate ventral plate of the female of *Cimeliomorpha* also has some similarity with that in the last mentioned genus, but the remaining characters do not show any close relationship of these two genera. A punctulate signum, like that of *Cimeliomorpha* is unique in the tribe Laspeyresiini, perhaps showing a transition towards Olethreutini. The absence of any specialized spine-cluster upon the valva and its general shape, however, speak against this. Provisionally *Cimeliomorpha* Diakonoff might be placed near *Pseudophiaris* and *Eucosmomorpha*.

Cimeliomorpha cymbalora (Meyrick)

Figs. 9–13

Copromorpha cymbalora Meyrick, 1907, p. 152. Clarke, 1955, p. 110.

Laspeyresia cymbalora: Fletcher, 1920, p. 52, note. Meyrick, 1937, p. 99; 1939, p. 52. Clarke, 1958, p. 435, pl. 216, figs. 1, 1a.

Enarmonia novarana (part): Diakonoff, 1949, p. 137.

TYPES: Lectotype (genitalia on slide No. 7411), Khasi Hills, Assam, July, 1906. In the Brit. Museum; selected by Clarke, 1958. Paralectotypes. Two females (genitalia, slide No. 6686), same data. Also in the Brit. Museum.

OTHER MATERIAL STUDIED: One male (genitalia on slide No. 6687), Momeit,

18

Upper Burma, 2000 feet, June, 1890 (Doherty, Wals. Coll. no. 41873). In the Brit. Museum.

REMARKS: Diakonoff considered *C. symbalora* as being a junior synonym of *Grapholitha novarana* Felder & Rogenhofer, and he probably was right in this. However, I cannot agree with him, until the material from the Nicobar Islands, the original locality of the type specimen of *G. novarana* are compared with the known specimens of *cymbalora,* and with the damaged type specimen of *novarana* in the Vienna Museum.

Rhadinoscolops, new genus

Figs. 14–17

TYPE-SPECIES: *Pyralis koenigiana* Fabricius, 1775.

Pyralis (in part): Fabricius, 1775, p. 653; 1781, p. 286; 1787, p. 237; 1794, p. 279.

Hemerosia (not Stephens): Pryer, 1877, p. 235.

Coptoloma (not Lederer): Swinhoe and Cotes, 1889, p. 699.

Eucelis (not Hübner): Walsingham, 1900, p. 571.

Laspeyresia (in part): Meyrick, 1911, p. 292. Fletcher, 1914, p. 450; 1920, p. 62. Meyrick, 1929, p. 721. Ezaki, 1932, p. 1467. Meyrick, 1935, p. 64. Obraztsov, 1959, p. 193. Okano, 1959, p. 259.

Eucosma (in part): Diakonoff, 1941, p. 405.

Enarmonia (in part): Diakonoff, 1948, p. 348; 1949, p. 138; 1953, p. 161. Issiki, 1957, p. 57.

Head roughly scaled. Antenna somewhat thickened, with short cilia and fine setae. Labial palpus moderate, porrect; second segment dilated apically; terminal segment exposed, blunt, thickened. Proboscis developed. Thorax smooth. Hind tibia of male with long scales dorsally; in female smooth.

Forewing rather broad, a little dilated externad; costa arched; apex rotundate; termen gently convex; tornus broadly rounded; dorsum almost straight, strongly arched at base. No costal fold in male. 12 veins, all separate: Sc gently sinuate; R_1 from before middle of discal cell; R_2 at origin slightly closer to R_3 than to R_1; R_4 about twice as close to R_5 as to R_3; R_4 running to costa, R_5 to lower portion of apex; upper internal vein of discal cell from base of vein R_2, or slightly before or behind it, and running to M_1; lower internal vein ending slightly above M_3; M_2, M_3, and Cu_1 almost equally remote from each other at origin; M_2 and M_3 slightly approximated at termen; Cu_1 originating at lower angle of discal cell, and reaching termen widely remote from tornus; Cu_2 from two-thirds of discal cell; A_1 merely distinguishable tornally; basal fork of A_{2+3} about one-third as long as entire vein.

Hindwing subovate, narrower than forewing; costa gently arched; apex broadly rotundate; termen flat or forming a common arch with tornus and external portion of dorsum; inner portion of dorsum oblique, in male with a long brush. 8 veins: Sc almost straight; R and

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FIG. 18. Female genitalia of the holotype of *Laspeyresia* **subpulverula**, new species (figured by W. Bergmans, Leiden Museum).

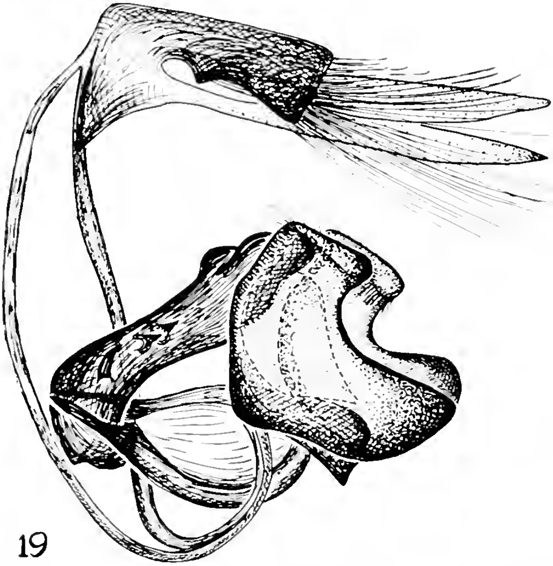

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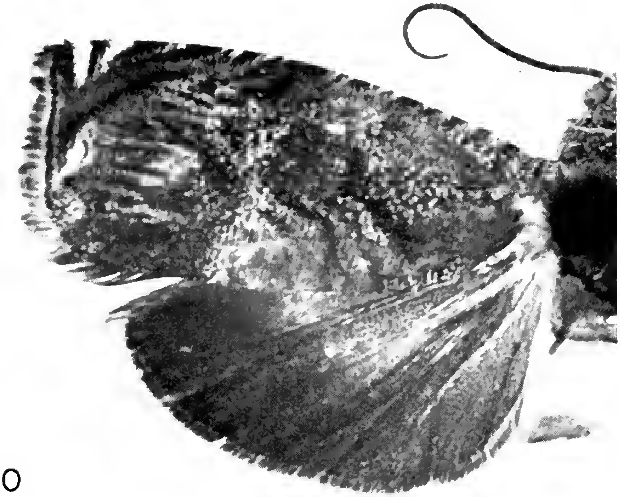
Fig. 19. Male genitalia of the holotype of *Antichlidas holocnista* Meyrick.

M_1 closely approximated in basal third, then diverging; R running to apex, M_1 to termen; M_2 and M_3 parallel; M_3 and Cu_1 connate at lower angle of discal cell; Cu_2 from slightly before last fourth of discal cell; A_1 rather weak; A_2 with basal fork; A_3 normal. Cubitus with a small pecten.

MALE GENITALIA: Tegumen with a slightly sinuate top; pedunculi moderately broad, slightly dilated at middle; no uncus; socii shaped as weak, haired lateral wrappers near top of tegumen; gnathos broad, weak, slightly protruding beyond tegumen. Valva elongate; costa slightly incurved before cucullus; sacculus broad with external tip not defined and merely indicated by a group of hairs; cucullus with a high, rather narrowly rotundate top and lower angle produced as a long, tapering, acute pollex; processus basalis with a free apex bent upwardly; basal opening narrow, reaching middle of valva. Anellus broad and high. Aedeagus moderately thick and long, slightly curved; coecum penis short, broadly rounded; cornuti shaped as long, strong needles.

FEMALE GENITALIA: Papillae anales soft, elongate, somewhat reniform; apophyses posteriores longer than papillae anales, but shorter than apophyses anteriores. Ostium bursae located at caudal margin of lamella postvaginalis; lamella antevaginalis not present. Ventral plate large, rotundate, concave caudally. Ductus bursae rather long, straight, with caudal portion forming a separated, cylindrical antrum; corpus bursae rotundate with surface reticulated; no signum; cervix bursae very short and broad, bent towards ductus bursae, and receiving ductus seminalis laterally.

REMARKS: The new genus differs from *Ostheldericlla* Obraztsov by the presence of a small cubital pecten, absent in the latter genus but has in common a pollex of the valva (absent in most Laspeyresiini) and the socii well developed. From the latter genus **Rhadinoscolops** can also be distinguished by the ab-



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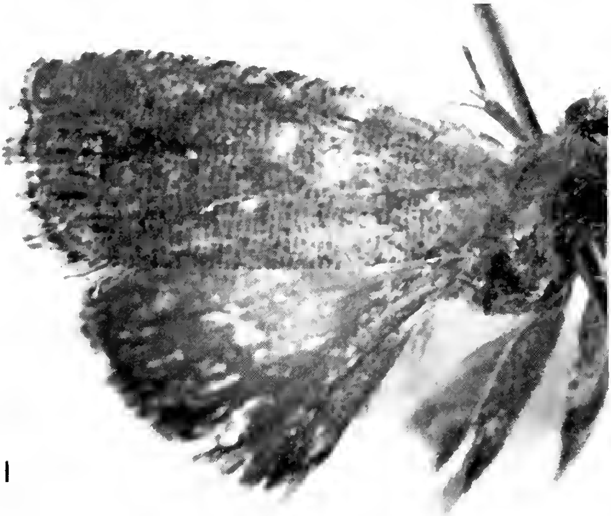

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FIGS. 20, 21. Adults. *Laspeyresia* **subpulverula**, new species, holotype, female. 21. *Grapholitha* (*Euspila*) **harmologa**, new species, holotype, female.

sence of a pulvinus and a dissimilar shape of the cucullus. All of the known Laspeyresiine genera with a pollex (*Diamphidia* Obraztsov, *Cirriphora* Obraztsov, *Selania* Stephens, *Eucosmomorpha* Obraztsov, *Pseudophiaris* Obraztsov, *Enarmonia* Hübner, some *Pammene* species) have a larger cubital pecten in the hindwing, and in all of them, except *Cirriphora,* the forewing veins M_2

and M_3 are not approximated at termen. There are, in addition, many other characters distinguishing **Rhadinoscolops** from the above genera. The name of this new genus is of masculine gender, and is derived from the Greek ῥαδινός, tapering, and σκόλοψ, a thorn.

Rhadinoscolops koenigianus (Fabricius), new combination

Figs. 14–17

Pyralis koenigiana Fabricius, 1775, p. 653; 1781, p. 286.

Pyralis koenigana Fabricius, 1787, p. 237; 1794, p. 279.

Hemerosia aurantiana Pryer, 1877, p. 235, pl. 4, fig. 12.

Coptoloma aurantiana: Swinhoe and Cotes, 1889, p. 699.

Eucelis vulnerata Walsingham, 1900, p. 571.

Laspeyresia aurantiana: Meyrick, 1911, p. 292; 1929, p. 721; 1935, p. 64.

Laspeyreasia koenigiana: Fletcher, 1914, p. 450, fig. 328; 1920, p. 62. Ezaki, 1932, p. 1467, text fig., pl. 11.

Eucosma koenigiana: Diakonoff, 1941, p. 405.

Enarmonia koenigiana: Diakonoff, 1948, p. 348; 1953, p. 161.

Enarmonia koenigana: Diakonoff, 1949, p. 138. Issiki, 1957, p. 57, pl. 8, fig. 254.

Laspeyresia koenigiana: Obraztsov, 1959, p. 193. Okano, 1959, p. 259, pl. 174, fig. 16.

SPECIMENS EXAMINED: One male (genitalia on slide No. 6335), Kobe, Japan, September 22, 1929 (J. E. A. Lewis); one female (genitalia on slide No. 6360), Tainan, Formosa, June 11, 1904 (A. E. Wileman); both specimens preserved in the British Museum (Natural History). One male, Karachi, Pakistan (Swinhoe); preserved in the American Museum of Natural History.

REMARKS: This species is distributed from China, Japan and India to New Guinea and Australia. Guesquière (1940) reports it also from the Congo, but this record is somewhat doubtful. That author has placed **R. koenigianus** in the genus *Anthozela* Meyrick, probably after the examination of the specimens from the Congo. In case this statement is confirmed by a re-examination of the mentioned Congolese specimens, they should be recognized as being not conspecific with the present species, because genus *Anthozela* is characterized by the presence of a thoracic crest, and a cubital pecten and by the absence of the vein Cu_1 in the hindwing.

Antichlidas Meyrick, 1931[1]

Fig. 19

TYPE-SPECIES (MONOTYPY): *Antichlidas holocnista* Meyrick, 1931.

Antichlidas Meyrick, 1931, p. 8.

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[1] No further notes by Dr. Obraztsov on this genus have been found. But his elaborate figure of the puzzling male genitalia of the unique holotype specimen in the British Museum is worth reproducing—*Ed.*

A. holocnista Meyrick

Fig. 19

A. holocnista Meyrick, 1931, p. 8. Clarke, 1958, p. 296, pl. 147, fig. 1–1d (wing, head neuration, ♂ genitalia).—Distribution: China (Kwanhsien).

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A New Publication for Lepidopterists

Lt. Col. Charles F. Cowan, F.R.E.S. has kindly sent me a copy of a new publication, **Annotationes Rhopalocerologicae**, which he proposes publishing from time to time. It is designed to be a tribute to one of the last publications of the late Arthur Francis Hemming, **Annotationes Lepidopterologicae** (vols. 1–5, 1960–1964), and as a supplement and a correction to Hemming's posthumous work, "*The Generic Names of the Butterflies and Their Type-Species*," recently published by the British Museum (Natural History) as Supplement 9 of the **Bulletin of the British Museum Natural History (Entomology)**. This 20-page work of Cowan's is a necessity for those wishing to keep up to date on the generic nomenclature of the butterflies. Copies may be obtained from the author at Little Gaddesden House, Berkhamsted, Herts., England, and postpaid for 12 shillings and six pence (approx. $1.50).

Cyril F. dos Passos
Mendham, New Jersey

Note on the Distribution of Northeastern Woodland Pieridae

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Abstract: Known distributions of three northeastern woodland Pieridae argue against the occurrence of *Pieris napi oleracea* Harris in southern New Jersey.

Dos Passos (1966) records *Pieris napi oleracea* Harris (= *P. narina oleracera* (*sie*)) from the vicinity of Springdale, Sussex Co., N.J., the first modern record of the species from that State. He implies that this record somehow validates or adds credence to 19th-century records from Paterson, Passaic Co. (John A. Grossbeck) and Camden, Camden Co. (John P. R. Carney), quoted by Smith (1910) and assigned by Comstock (1940) to *P. virginiensis* Edwards. Shapiro (1966) dismissed the Camden record as very dubious for either species. The Grossbeck specimen from Paterson in the American Museum of Natural History is *P. virginiensis*.

The accompanying map (Fig. 1) shows the known distributions of *P. napi oleraeea*, *P. virginiensis*, and *Anthocharis midea* Hübner by counties in Pennsylvania, New York, and New Jersey, drawn from various sources. The Paterson record is shown as *P. virginiensis,* and the Camden record has been omitted. As noted by Hovanitz (1963) and Mather (1964), *P. virginiensis* occurs south of *P. napi oleracea,* the two species occupying essentially similar habitats in the Transition and Canadian Life Zones, respectively. A comparable niche appears to be filled in the Upper Austral Zone (Atlantic Costal Plain and lowland Piedmont) by *Anthoeharis midea,* which like the other species is a woodland-Crucifer feeder, and like *P. virginiensis* is univoltine, flying in early spring.

The Sussex Co., N.J. record of *P. napi oleracea* is far to the south of prior records, but the species is probably very locally distributed in pockets of Canadian Zone not only in northwestern New Jersey but in the Catskills and the Poconos. *P. virginiensis* occurs widely in the Appalachian and Allegheny Plateau regions of Pennsylvania and New York (the St. Lawrence Co. record is questionable), but apparently there are few definite records from New Jersey. It should occur in the Appalachian highlands of the northwestern part of the State. The convergence of the Appalachians, the Catskill-Pocono Plateau, and the Coastal Plain in the northern New Jersey area should bring the three species into their closest proximity and provide the opportunity for investigating their ecological relations and the genetic relationship between the two *Pieris*.

The relevance of the Sussex Co. *napi* to the Camden record is, however, another matter. Neither *P. napi oleracea* nor *P. virginiensis* is recorded any-

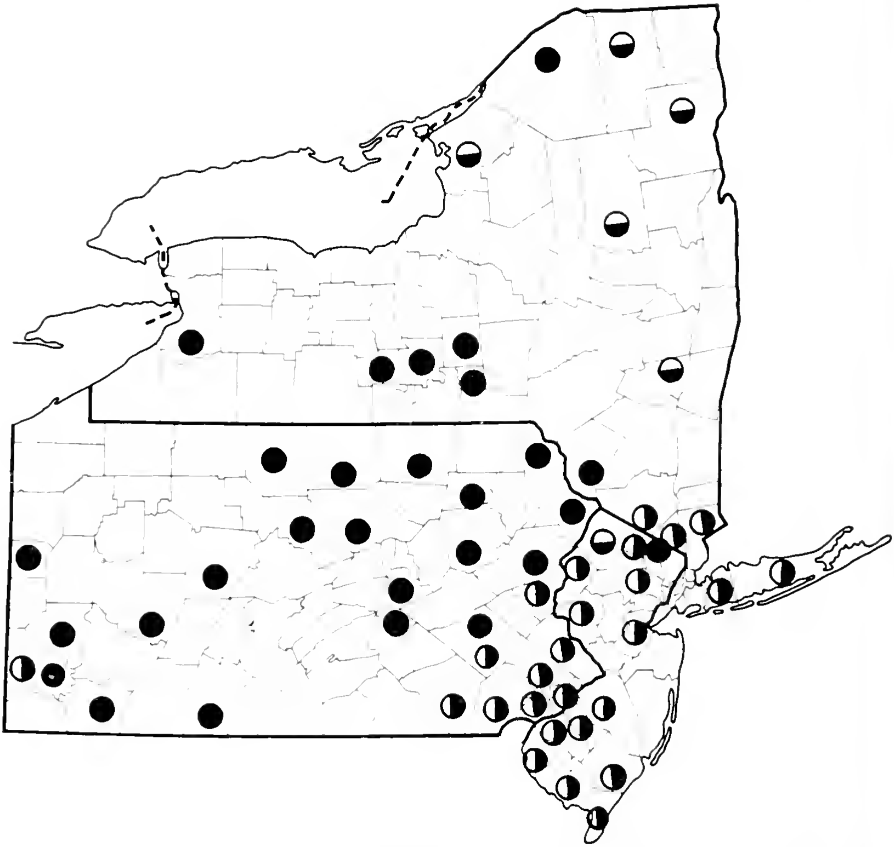

Fig. 1. Distributions of *Pieris napi oleracea* (◒), *Pieris virginiensis* (●), and *Anthocharis midea* (◑) in New York, New Jersey, and Pennsylvania.

where on the Atlantic Coastal Plain, with the exception of Carney's record. Smith probably did not see Carney's specimen, as, referring to other Carney records, he suggests the need to check determinations. Smith notes that the spring form of *P. rapae* Linnaeus has been confused with *P. napi oleracea.*

Except for accidental introduction, the only way for *P. napi oleracea* to occur near Camden would seem to be as a Pine Barrens resident. It is possible that *napi,* along with other northern species, might have a Pine Barrens population, but three generations of collectors, working the area much more assiduously than Sussex Co. has been worked, have failed to find it. The occurrence of *A. midea* in the Barrens (Shapiro, 1968), moreover, militates against the presence of *P. napi oleracea.* The dos Passos record, while constituting a significant range extension for *P. napi* in eastern North America, has no bearing on the interpretation of a record from the Upper Austral Zone.

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A Review of the Nesting Behaviors of the Nearctic Species of *Crabro*, Including Observations on *C. advenus* and *C. latipes* (Hymenoptera: Sphecidae)

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Abstract: Information associated with the nesting behaviors of 10 species of *Crabro* is reviewed. An additional prey record for *C. latipes* is given. Observations on the nesting behavior of *C. advenus*, particularly nest structure and contents, are detailed.

Females of *C. advenus* nested in sand and provisioned their cells with adult flies of the families Otitidae, Anthomyiidae, Muscidae, Calliphoridae, and Sarcophagidae. Two unfinished nests contained 5 and 16 cells. The cells, in clusters of 3–7, were constructed near the horizontal burrows. From 2 to 6 prey, usually of mixed species, were stored in a cell. A wasp's egg was laid on the innermost, but usually not the largest, fly in the cell, across the ventral side of the neck.

The genus *Crabro* includes about 70 species in the Nearctic and Palaearctic regions. In the United States, the genus is a common, though often inconspicuous, element of the digger wasp fauna. According to Krombein (*In* Muesebeck, *et al.*, 1951) the genus contains four subgenera in the United States and Canada: *Paranothyreus* (7 species), *Norumbega* (1 species), *Crabro s. str.* (13 species), and *Synothyreopus* (18 species); plus one species of an unknown subgenus, *C. knoxensis* (Mickel). There are differing opinions regarding these subgeneric separations (see Fox, 1895; Ashmead, 1899; Kohl, 1915; Pate, 1947). The structural characters used in separating these subgenera are relatively subtle, especially in the female.

Little is known about the nesting behaviors of the Holarctic species of *Crabro*. Hamm and Richards (1926) summarized aspects of the biologies of a few Palaearctic species. Their treatment included mostly prey records. Iwata (1942) included species of *Crabro* in his review of the nesting habits of solitary wasps. Rau and Rau (1918) and Evans (1960, 1964) attempted to detail the behavioral components of some Nearctic species.

Species of *Crabro* usually nest in the soil and provision their nest cells with adult Diptera. The nest entrance is left open during provisioning trips. En-

Acknowledgments: The authors are deeply indebted to K. V. Krombein, Smithsonian Institution, for identifying the wasps; and to his associates, R. J. Gagne, K. V. Knutson, and G. Steyskal, for determining the prey flies. (The various stages of the wasps, including adults, and prey specimens from our study have been deposited in the collection of the United States National Museum and bear ethology note no. labels CR–1 and CR–2.) We are also grateful to H. E. Evans, Museum of Comparative Zoology, for allowing us to borrow specimens of *Crabro* pinned with prey.

trances to active nests in flat soil are surrounded by noticeable tumuli. Captured flies are brought to the nest in flight. They are held by the wasp head forward and ventral side up. A wasp with prey usually plunges into an entrance without stopping. According to Hamm and Richards (1926) a fly is held by the wasp's hind tibial spurs during entry into the nest. In many species the flies are temporarily stored at the end of the burrow. This storage area may be enlarged. A cell is constructed after a number of flies accumulate. The flies are then removed from the storage area and placed in the rearing cell.

The nest includes a relatively long, often branched burrow. Several to many cells are constructed near each branch. The first cell of a branch is built farthest from the entrance. Later cells are constructed progressively closer to the entrance. When fully provisioned, a cell contains a few to many, thoroughly paralyzed or dead flies. Most flies are placed in the cells head inward and ventral side up. Certain species of *Crabro* prefer particular families of flies and thus exhibit a degree of prey "specificity." Looking at the genus as a whole, however, a variety of families of flies are utilized. An egg is deposited by the wasp on a single fly in each cell. This prey is often the first one taken into the cell and is usually placed farthest inward, against the back end. The egg is attached to the ventral side of the neck of the fly and extends across the prosternum obliquely and posteriorly. The behavior of the immature stages has been discussed by Hamm and Richards (1926). The larvae of three Nearctic species have been described in detail by Evans (1957, 1959).

A review of the nesting behaviors of the Nearctic species of *Crabro* is presented below, along with our own observations on *C. advenus* and *C. latipes*. The arrangement of the subgenera here does not reflect phylogeny. The species in each subgenus are treated alphabetically following Krombein (*In* Muesebeck, *et al.*, 1951).

Crabro (*Paranothyreus*) *cingulatus* (Packard)

C. cingulatus was studied in Missouri by Rau and Rau (1918) who found females nesting in a 12-foot-high sand bank near the edge of a small lake. Some nest entrances were concealed beneath projecting ledges of sand. A nest was constructed with the mandibles and legs. Several females were each seen carrying a fly beneath the body (probably in flight), and "darting" directly into a burrow "without stopping at the entrance. . . ." The burrows, when excavated, were found to be 12–44 cm long and of various shapes. They were "one-eighth inch" in diameter, enlarging at the entrances to "one-quarter inch." From 2 to 8 oval cells, each "one-fourth by one-half inch," were found near, but not connected "directly" to, a burrow. A fully provisioned cell contained from 11 to 20 flies. In one cell with 14 prey the individuals were "piled up like cord-wood, one atop the other," the heads facing "in the same direction." The flies, all dead, were identified as the ephydrid *Paralimna appendiculata* Loew (= P. *punctipennis* [Wied.]). Accumulated flies and a female wasp were occasionally found at the unenlarged end of the open burrow. Rau and Rau (1918) did not know whether a wasp filled a burrow after the provisioning was completed, then constructed another, or closed only the cell, after provisioning, extended "the burrow to form another, and so on." The positions of the cells they found indicated the latter behavior.

Crabro (*Paranothyreus*) *rufibasis* (Banks)

Krombein (1964) observed a female of *C. rufibasis* entering a nest in an "almost vertical face" of a sand pit on the Archbold Biological Station property near Lake Placid, Florida. The burrow, 6 mm in diameter, entered the cliff horizontally for a short distance, then plunged vertically, ending blindly 54.5 cm from the entrance. He did not find any cells connected with the burrow.

Crabro (*Norumbega*) *argus* (Packard)

Evans (1960) observed females of *C. argus* nesting in "considerable numbers" in a sand bank in Ithaca, New York. Individual females appeared to make successive nests in series, "spending only a few days with each." The nests entered the sand bank in areas where the slope was from 20° to 80° to the horizon. The mandibles and legs were used in constructing a burrow and removing the loose sand. Completion of one burrow required more than five hours. A nest entrance was left open during provisioning trips. A female carried a captured fly in flight, holding it tightly beneath her body. She made characteristic side to side undulations, especially when approaching the nesting area, then plunged rapidly into the burrow, probably holding the fly with the middle pair of legs. Flies were temporarily stored in the burrow, usually at the end. A cell was built only after a number of flies accumulated. The flies were then removed from the burrow and placed in the cell.

A completed burrow, 3 mm in diameter, entered the sand perpendicularly and continued in a rather straight line. This main burrow branched into side burrows which terminated in cells, 18–35 cm from the entrance. Each cell was about 6 × 9 mm. Evans (1960) found from 1 to 5 cells per completed nest. There was a "tendency" for the cells to be constructed "progressively back toward the entrance" and separated by 2–4 cm. A fully provisioned cell contained from 10 to 19 flies, the number being inversely proportional to the sizes of the flies. Most flies were placed in a cell ventral side up, but a few were on their sides or dorsal side up. A wasp's egg, about 2.3 mm long, was attached to the fly which was placed farthest inward in the cell. It was laid "with its anterior end pressed against the ventro-posterior part of the fly's head, the remainder of the egg extending free." The species of flies, sometimes well-mixed in the cells, belonged to the following families (with genera in parentheses): Dolichopodidae (*Argyra*, *Dolichopus*, *Hercostomus*, *Liancalus*, *Pelastoneurus*), Ephydridae (*Parydra*), and Anthomyiidae (*Lispe*).

Hartman (1905) observed *C. argus* preying on a species of *Dolichopus* (Dolichopodidae). A female carried her prey in flight and plunged into an open entrance without stopping. Dow (1930) recorded *C. argus* preying on the dolichopodid *Rhaphium vanduzeei* Curran. A female of *C. argus* in the Museum of Comparative Zoology collection is pinned with a *Tachytrechus angustipennis* Loew (Dolichopodidae).

Crabro (*Crabro*) *cribrellifer* (Packard)

Krombein (*In* Muesebeck, *et al.*, 1951) recorded *C. cribrellifer* preying on *Ommatius tibialis* Say (Asilidae). Three females of *C. cribrellifer* in the Museum of Comparative Zoology collection are each pinned with the asilid *Tolmerus novaescotiae* (Macquart).

Crabro (*Crabro*) *discretus* Fox

C. discretus was listed as preying on *Pollenia rudis* (F.) (Calliphoridae) by Krombein (*In* Muesebeck, *et al.*, 1951). Krombein (1958a) captured a female of *C. discretus* in West Virginia with a large, male tachinid, *Achaetoneura* sp., possibly *aletiae* Riley.

Crabro (*Crabro*) *juniatae* Krombein

Krombein (1958b) recorded *C. juniatae* preying on the anthomyiid *Hylemya cilicrura* (Rond.).

Crabro (*Crabro*) *latipes* Smith

C. latipes was listed as preying on *Musca domestica* L. (Muscidae) by Krombein (*In* Muesebeck, *et al.*, 1951; 1955). One of us (F.E.K.) collected a female of *C. latipes* (CR–2) on 4 October 1967 on a sand cliff near Auburn, New York, with her prey, *Musca autumnalis* DeGeer (Muscidae). The wasp, weighing 29 mg, was transporting the fly (weight, 30 mg) in flight.

Crabro (*Crabro*) *monticola* (Packard)

Evans (1960) observed females of *C. monticola* nesting in flat sand in Connecticut. Each nest entrance (apparently left open during provisioning trips) was surrounded by a prominent rim of soil about 2 cm high and 10 cm in diameter. Evans (1960) excavated two nests, one containing 15 cells, the other, 11 cells. Cells in the first nest were uncovered 25 to 45 cm from the entrance and varied in depth from 7.5 to 17.5 cm beneath the surface. Cells in the second nest varied in depth from 11 to 20 cm beneath the surface. The long burrow of the first nest did not penetrate the soil vertically, but coursed beneath the surface almost horizontally. After several cells had been made near a burrow and the area "used up," a second "major branch" was built in a different direction, more or less horizontally, and a number of cells constructed therefrom. On the basis of the stages of development of the wasps in the cells, Evans (1960) concluded that *C. monticola* "builds its cells progressively back toward the entrance. . ." off one branch, before constructing another branch. During provisioning, the most recent branch was left open, contained flies at the end, and was probably used as a storage chamber. Older branches were filled with sand and the cells sealed off. The "broadly elliptical" cells were each about 8 × 17 mm. They were unearthed in nearly horizontal positions beneath the surface and some were as close together as 2 cm. A fully provisioned cell contained 3–5, apparently dead flies, mostly "tightly-packed" in the cells and in ventral side up positions. The last fly in the cell was sometimes placed ventral side down. An egg was laid on the first fly put in a cell. It was attached by one end "to the middle of the back of the head, the remainder . . . extending laterad between the eyes and the prothorax ventrally." The flies, with one exception, were male tabanids (*Tabanus lasiophthalmus* Macq., *Chrysops celer* O. S.) or therevids (*Thereva* sp.). Flies collected from females of *C. monticola* in Maine by Dr. and Mrs. Henry Dietrich and recorded by Evans (1960) also proved to be male tabanids [*Stonemyia tranquilla* (O. S.), *Tabanus microcephalus* O. S.]. Evans (1960) believed that the hunting behavior of *C. monticola* is such that male tabanids are encountered more often than any other flies.

Pechuman (1963) observed females of *C. monticola* in Ontario provisioning with the tabanids *Stonemyia tranquilla* (O. S.) and *Chrysops venus* Philip. Five of 6 prey taken from the wasps proved to be males. The four nests Pechuman (1963) studied were open in the morning but closed in the afternoon, during which there was no sign of any wasp activity. The nests were scattered in an area of two square feet in a "lightly traveled" gravel road. A wasp with a paralyzed fly flew slowly, "probably due to the weight of the prey." Females carrying individuals of *S. tranquilla* flew more slowly than one with *C. venus*, probably because of the larger sizes of these flies. Upon being disturbed, a wasp immediately released her prey and flew away.

Crabro (Synothyreopus) advenus Smith

C. advenus was observed by Evans (1960) nesting in bare hard clay-loam in his garden near Ithaca, New York. A nest entrance, surrounded by a small rim of soil, was left open during provisioning trips. One female was observed bringing flies at intervals of a few to several minutes, each time remaining inside the nest for "30 seconds to two minutes." She flew very swiftly, "then plunged headlong into the burrow." A fly was held ventral side up against the ventral side of her abdomen and grasped with the middle pair of legs. This wasp was observed final closing her nest six days later. The mandibles and probably legs were used, as well as the tip of the abdomen for tamping the soil in the burrow. Evans (1960) excavated the nest and found a branched burrow. Four cells were uncovered near each of the branches, or a total of 8 cells, varying in depth from 6 to 12 cm beneath the surface (Another, presumably finished nest contained only 2 widely separated cells). Near each branch, the female had prepared cells farthest from the entrance first, and those nearest the entrance later. She apparently sealed off the first branch with soil before constructing the second. A fully provisioned cell, about 7 × 14 mm, was packed tightly with 4–7, apparently dead flies, which were placed mostly ventral side up. The last fly in a cell was often dorsal side up. The wasp always laid her egg on the first fly put in the cell. This individual lay ventral side up near the back end. The wasp's egg, about 2 mm long, was glued by one end to the "back of the head ventrally. . . ." The other end extended "obliquely backward over the venter of the thorax."

C. advenus preyed on a mixture of species and families of flies, although a few cells contained only individuals of *Fannia scalaris* (Fabr.) (Muscidae). Other species recorded as prey of this wasp by Evans (1960) included *Chrysopilus proximus* (Wlk.) (Rhagionidae), *Chrysops univittata* Macq. (Tabanidae), an unidentified otitid, *Pollenia rudis* (Fabr.) (Calliphoridae), and *Opelousia obscura* Tns. (Sarcophagidae).

Patton (1897) found *C. advenus* in Connecticut preying on *Sarcophaga* sp. (Sarcophagidae), *Musca domestica* L. (Muscidae), and *Belvosia unifasciata* Desv. (Tachinidae). The wasps nested beneath shade trees, the nest entrances forming "small hillocks." Patton (1897) noted that the number of individuals of this species was much reduced during rainy summers.

Our observations, presented below, do not confirm this.

A female of *C. advenus* in the collection of the Museum of Comparative Zoology is pinned with a calliphorid, *Phormia regina* (Mg.).

Our studies of *C. advenus* were made in a sand pit (Fig. 1) near the north end of Owasco Lake, 1 mile south of Auburn, New York. A second growth stand of mixed hardwoods bordered the southern half of the pit, while the northern half was bounded by a cemetery. Females nested in the center (Nest 1) and near the southern periphery of the pit (Nest 2). The sand was rather loose on the surface but hard-packed underneath. Initiation of burrow construction

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FIG. 1. Sand pit near Auburn, New York, in which females of *Crabro (Synothyreopus) advenus* nested.

FIG. 2. Entrance to Nest 1 of *Crabro (Synothyreopus) advenus*, with surrounding tumulus.

FIG. 3. Exposed burrow of Nest 1 of *Crabro (Synothyreopus) advenus*, as seen from side, showing enlarged storage chamber containing flies.

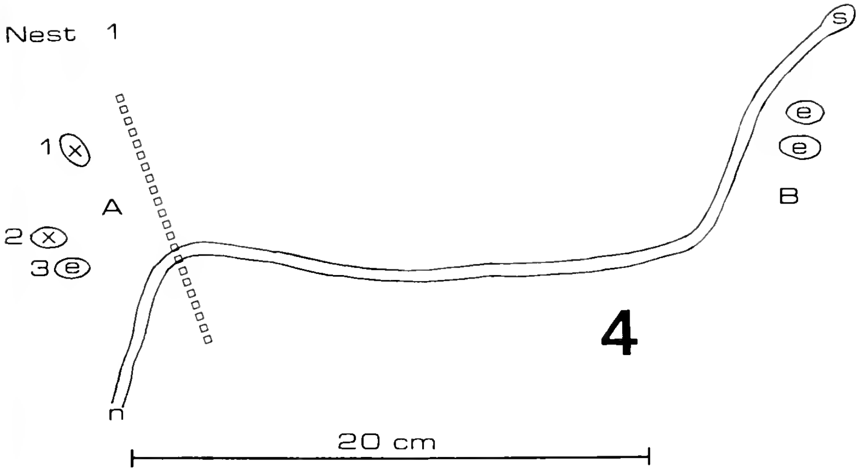
1

2

was not seen. After many entries of short duration with flies, during which time the nest entrance was left open, a female entered her burrow and remained below for longer than an hour. It was probably during this time that a new cell was added to a nest. An entrance was first closed with damp sand from inside. Later, a female shoved this sand out of the burrow with the end of the abdomen and continued to bring up additional loads of sand from below.

Provisioning females were observed on 15 and 16 September 1967. The height of this activity was between 1000 and 1130 hours at air temperatures of 19°–23° C. During this time the sand surface temperatures at Nest 2 varied from 22° to 24° C. Female B (Nest 2; CR–1) took 15 to 90 (Mean, 25, $N = 6$) minutes for a provisioning trip. Upon returning to her nest she flew slowly as if heavily burdened by the weight of the fly. By artificially covering her entrance we were able to induce her to land momentarily on the tumulus. She clasped the fly against her venter, ventral side up and head forward, holding it with the middle pair of legs. Other pairs of legs are probably also used during transport. The provisioning wasp plunged into the burrow four times without stopping. Twice, however, she released the fly just outside the entrance, entered the nest, turned around inside, reappeared head first, 6–8 seconds later, and pulled in the prey by its face (exact details of the grasp were not ascertained). Female B reappeared in her entrance head first nearly 1 minute after taking in a prey. Such an interval can probably be attributed to the relatively long distance inside the nest to which she had to proceed with the fly. Female B always exited in flight without reorienting to the surroundings, unless she was disturbed.

Nest 1 (Female A; CR–1) had a tumulus 7.5 cm long, 5 cm wide, and 2.5 cm high. The entrance, 6 mm in diameter, was located in the center (Fig. 2). The burrow penetrated the sand at an angle of about 40° to the surface for 4 cm, then sloped at an angle of about 20° for 2 cm. It curved abruptly to the right and went rather straight for 18 cm (Figs. 3, 4), at depths of 6 to 10 cm beneath the surface. The tunnel then bent to the left for 6 cm, slightly to the right for an additional 5 cm, and ended in an enlargement, 9 cm beneath the surface (s, Fig. 4). The total length of the burrow from entrance to enlargement was about 35 cm. Three cells, each containing prey covered with water droplets, were exposed to the left of the burrow near the first bend (Cluster A, Fig. 4). Cell 1 was located 5 cm from the burrow, cell 2, 4 cm, and cell 3, 2.5 cm. An egg was placed on one of the flies in cell 3; however, no egg was found in cells 1 or 2. These eggs had probably perished due to an excess of moisture in the cells, while the egg in cell 3, being more recent, had probably not yet reached a critical moisture level. If our interpretation is correct, cells built first in a series are farther from the entrance than cells built later. Two additional cells, less than 1 cm apart, were uncovered near the far end of the burrow, each on the right, about 1 cm from the burrow wall (Cluster B; Fig.



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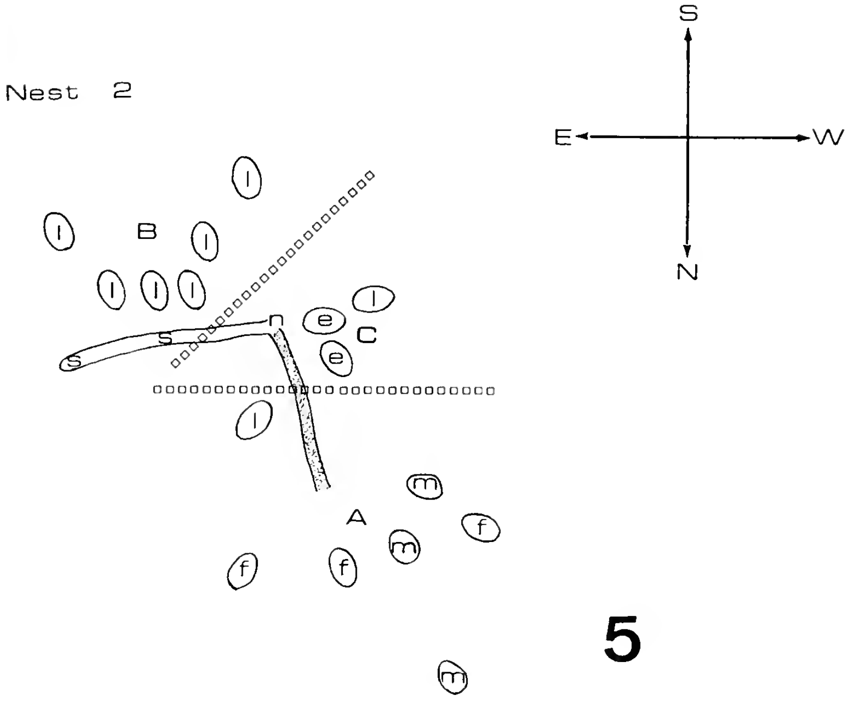

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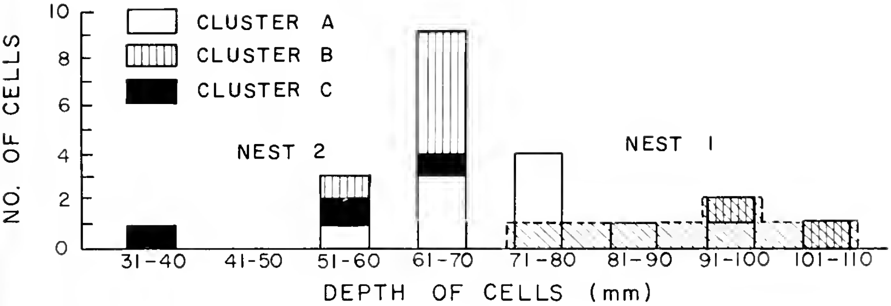
Figs. 4, 5. Structure of Nests 1 and 2 of *Crabro* (*Synothyreopus*) *advenus*, as seen from above. Clusters of cells are indicated by A, B, or C, and separated by dotted lines; e indicates cell containing egg, l, larva, m, small cocoon (probably male wasp), f, large cocoon (probably female wasp), x, contents moist (water droplets) with no egg, larva, or cocoon. Storage areas are indicated by s and nest entrances by n. Burrows filled with sand are stippled. The scale below Nest 1 refers to both nests.

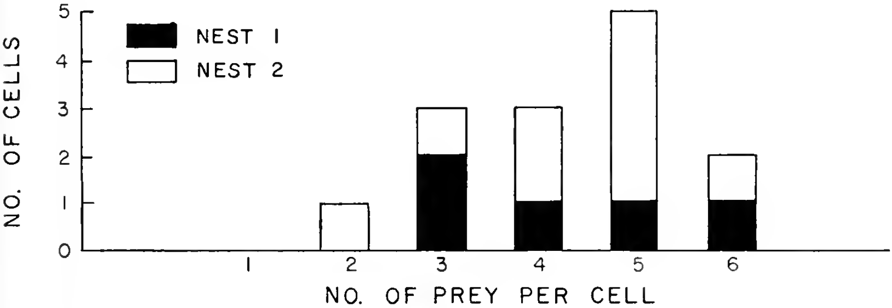
4). Both cells were stocked with flies with one individual in each bearing a wasp egg. None of the flies in either cell were covered with water droplets, suggesting that these cells were provisioned (and built) more recently than those in Cluster A. Six paralyzed or dead flies were found in the enlarged end of the burrow. Whether this enlargement would have been used subsequently as a cell or was serving only as a storage chamber is unknown. Using the chamber as a rearing cell would not lend support to our earlier statement that cells built first in a series are farther from the entrance than cells built later. Cells in Cluster A were separated from those in Cluster B by 27–28 cm.

Nest 2 had a recent pile of damp sand, 2.5 cm in diameter and 1.5 cm high, atop an old tumulus, 7 cm in diameter and 2 cm high. The entrance, 5 mm in diameter, was located in the center of the recent deposit. This nest had two burrows, one open and one closed with sand, both leading away from the entrance (Fig. 5). Six cells, each containing a wasp cocoon, and one cell with a mature wasp larva (weight, 60 mg) were located near the closed burrow, 3–15 cm north of the entrance (Cluster A). The contents of the cocoons were arbitrarily sexed by weighing. Three males weighed 88, 102, and 112 mg; three females, 145, 157, and 188 mg. Cluster A represented the oldest part of the nest, as judged by the stages of development of wasps in the cells. Six other cells, each containing a juvenile or nearly mature wasp larva (weights, 17–54 mg), were uncovered 3–8 cm southeast of the entrance (Cluster B). This cluster represented the second oldest part of the nest. Three cells, one containing a recently hatched wasp larva (weight, 4 mg) and two with prey and wasp eggs, were exposed 1–3 cm west of the entrance (Cluster C). Cluster C represented the most recent portion of the nest, probably that to which the wasp would have added new cells. Two flies were found at the end of the nearly straight, open burrow, 8 cm east of the entrance and 6 cm beneath the surface; another fly, in the same burrow, was found 4.5 cm east of the entrance (s, Fig. 5). In each cluster, with few exceptions, the first cells made and provisioned were farther from the entrance than cells made and provisioned later, as indicated by the stages of development of the wasps in the cells and the weights of the larvae.

Neither Nest 1 nor Nest 2 was complete. Nest 1 contained only 5 cells, Nest 2, 16 cells. The cells were slanted upward in the sand, the front end being slightly deeper than the back. In many other digger wasps the cells slant downward, the back end being deeper than the front. Cells in Nest 1 averaged 7.6 (6–9, N = 5) × 12.8 (11–15, N = 5) mm in size; in Nest 2, 7.0 (6–9, N = 16) × 13.3 (11–19, N = 16) mm. Cells in Nest 1 were noticeably deeper than cells in Nest 2, probably because Nest 1 was situated in more loose sand (Fig. 6). In both nests cells belonging to a cluster were more nearly equivalent in depth than cells from different clusters.

Females of *C. advenus* preyed exclusively on adult flies. Female A stored





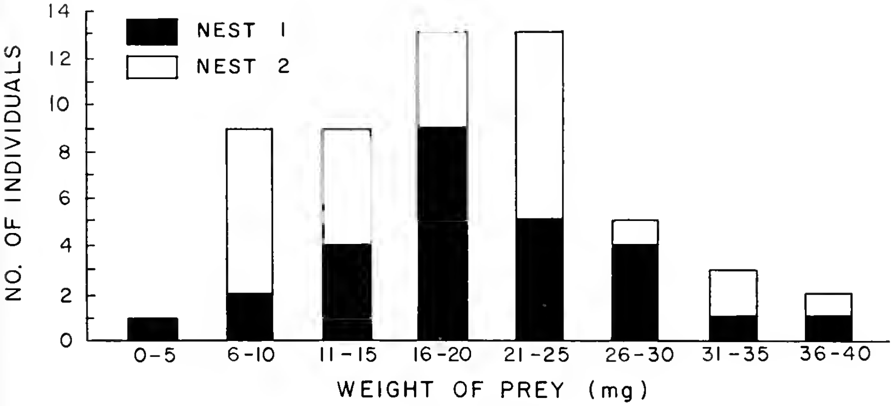


Fig. 6 (TOP). Depth of cells in Nests 1 and 2 of *Crabro* (*Synothyreopus*) *advenus*. Nest 1 is indicated by hatch marks.

Fig. 7 (MIDDLE). Number of prey per fully provisioned cell in Nests 1 and 2 of *Crabro* (*Synothyreopus*) *advenus*.

Fig. 8. (BOTTOM). Weights of prey individuals in Nests 1 and 2 of *Crabro* (*Synothyreopus*) *advenus*.

TABLE I
SPECIES OF PREY OF *CRABRO ADVENUS*

Family and species of prey	Number of individuals Nest 1	Nest 2
Otitidae		
Euxesta notata (Wied.)	1	—
Callopistromyia annulipes (Macq.)	1	—
Anthomyiidae		
Pegomya finitima Stein	1	—
Undetermined species	—	1
Muscidae		
Musca assimilis (Fallen)	1	—
Musca autumnalis DeGeer	1	—
Coenosia tigrina (Fabr.)	—	8
Fannia scalaris (Fabr.)	—	1
Undetermined species	—	1
Calliphoridae		
Pollenia rudis (Fabr.)	6	27
Phaenicia sericata (Mg.)	1	—
Undetermined species	—	7
Sarcophagidae		
Sarcophaga scoparia Pand	12	—
Senotainia sp.	1	—

species of Otitidae, Anthomyiidae, Muscidae, Calliphoridae, and Sarcophagidae, whereas female B stored species of Muscidae, Calliphoridae, and Anthomyiidae (Table I). The species of flies were usually mixed in the cells. At least two species of prey were found in the storage chamber and in 4 of 5 cells in Nest 1, as well as in 7 of 11 cells in Nest 2. Cell 4 in Nest 1 contained 6 flies belonging to four different species. On the other hand, females A and B were either somewhat selective of the species of flies they captured, or, the number of species in their hunting "ranges" was limited. Twelve of 25 flies stored by female A proved to be the sarcophagid *Sarcophaga scoparia* Pand. Individuals of this species were found in each cell and the storage chamber in Nest 1. Twenty-seven of 45 identifiable flies stored by female B were the calliphorid *Pollenia rudis* (Fabr.). This species was stored in 12 of the 16 cells and the storage chamber in Nest 2.

The number of flies stored per fully provisioned cell varied from 3 to 6

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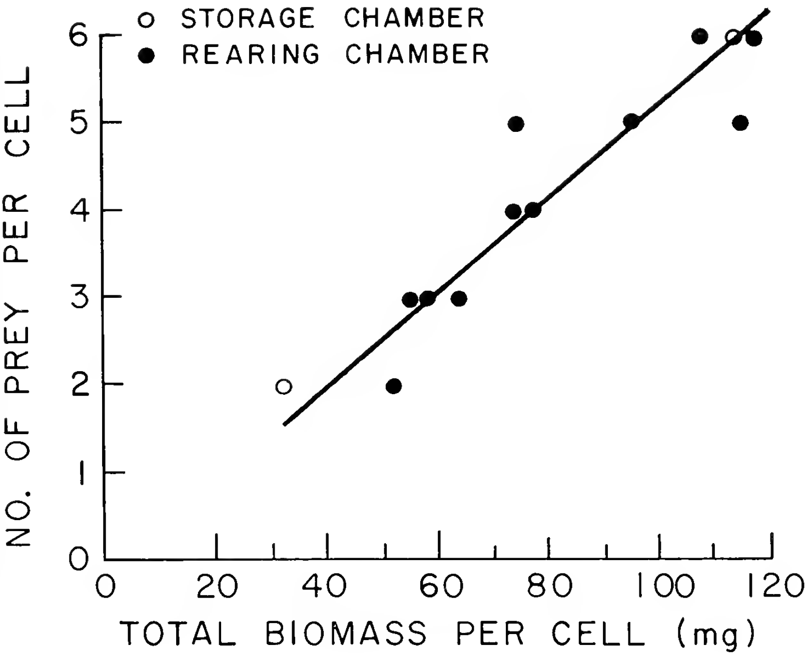
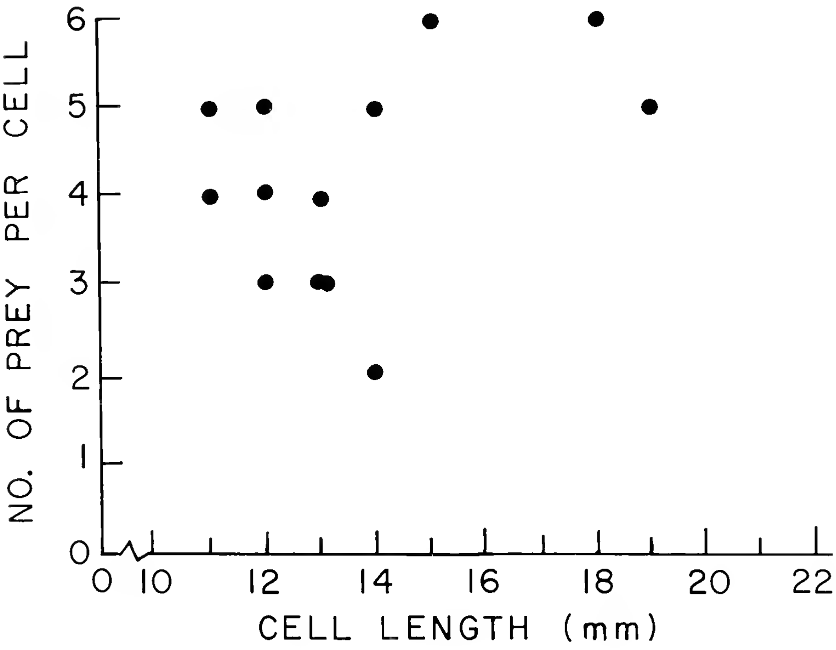
FIG. 9 (TOP). Total biomass of prey per cell plotted against number of prey per cell in *Crabro* (*Synothyreopus*) *advenus*.

FIG. 10 (BOTTOM). Cell length (as an indicator of cell size) plotted against number of prey per cell in *Crabro* (*Synothyreopus*) *advenus*.


○ STORAGE CHAMBER
● REARING CHAMBER
NO. OF PREY PER CELL
0
1
2
3
4
5
6
0
20
40
60
80
100
120
TOTAL BIOMASS PER CELL (mg)


NO. OF PREY PER CELL
0
1
2
3
4
5
6
0
10
12
14
16
18
20
22
CELL LENGTH (mm)

(mean, 4.2, N = 5) in Nest 1, and from 2 to 6 (mean, 4.3, N = 9) in Nest 2 (Fig. 7). There was no correlation between the number of prey stored per cell and depth of cell; nor between the number of prey stored per cell and distance of cell from entrance, i.e., its relative position in the cluster.

The weights of the prey individuals ranged from 4 to 36 (mean, 19.6, N = 27) mg in Nest 1, and from 7 to 38 (mean, 18.2, N = 28) mg in Nest 2 (Fig. 8). Female A weighed 29 mg, female B, 23 mg. The total biomass of prey in individual cells in Nest 1 ranged from 55 to 115 (mean, 83.0, N = 5) mg; in individual cells in Nest 2, from 52 to 117 (mean, 78.7, N = 6) mg. Cells with a greater biomass of prey usually contained more flies (Fig. 9). An increase in the number of prey per cell did not accompany an increase in cell size (Fig. 10).

Nineteen flies in Nest 1 and 23 in Nest 2 were placed in the cells or storage chambers head inward and ventral side up. Seven flies in Nest 1 and 4 in Nest 2 were put in the cells on their left or right sides and head inward. Only one individual in each nest was stored head inward and dorsal side up. These two flies were each the uppermost prey in the cell.

The fly on which a wasp laid her egg was always positioned ventral side up, head inward, near the back end of the cell. Such a placement may reduce the amount of parasitism. Only 2 of 9 eggs were laid on the heaviest individual in a cell, 2 on the second heaviest, 3 on the third heaviest, 1 on the fourth heaviest, and 1 on the fifth heaviest (lightest). The mean weight of these prey individuals was 20.3 (14–32, N = 9) mg. We were unable to determine whether these flies were the first, last, or intermediate ones put in the cells.

Eggs of *C. advenus* were white or cream in color, rather elastic, curved, elongate, about 0.5 mm wide, and 2.5 mm long. An egg was attached by its cephalic end to the ventral side of the neck of the fly (Fig. 11). The rest of the egg extended rather obliquely backward across the prosternum and mesopleuron. In Nest 1, 2 of 3 eggs were attached to the left side of the neck of a fly. In Nest 2, 4 of 6 eggs were attached to the right side of the neck of a fly.

Crabro (*Synothyreopus*) *venator* (Rohwer)

C. venator was observed by Evans (1964) nesting in a sloping, sandy stream bank, about 35 km west of Toluca, Mexico. One female was seen carrying flies (probably in flight) into an open burrow. The entrance was surrounded by a tumulus of soil, 5 mm high and 30 mm in diameter. The burrow, 4 mm in diameter, entered the sand nearly vertically for 8 cm, then curved arcuately, ending blindly, 14 cm beneath the surface. The end of the burrow was "packed" with 20 flies, all Muscoidea. Evans (1964) believed that these flies had not yet been placed in a rearing cell. At depths of 10–12 cm, he found 3 cells, each provisioned with flies. The cells were spaced 2–3 cm apart and 2–3 cm from the burrow. Side burrows leading to these cells had been filled with sand. All 3 cells contained maggots, including the most recent one which also contained a wasp egg glued to one of the flies.

From 30 to 36 flies were stored in a fully provisioned cell of *C. venator*. The vast

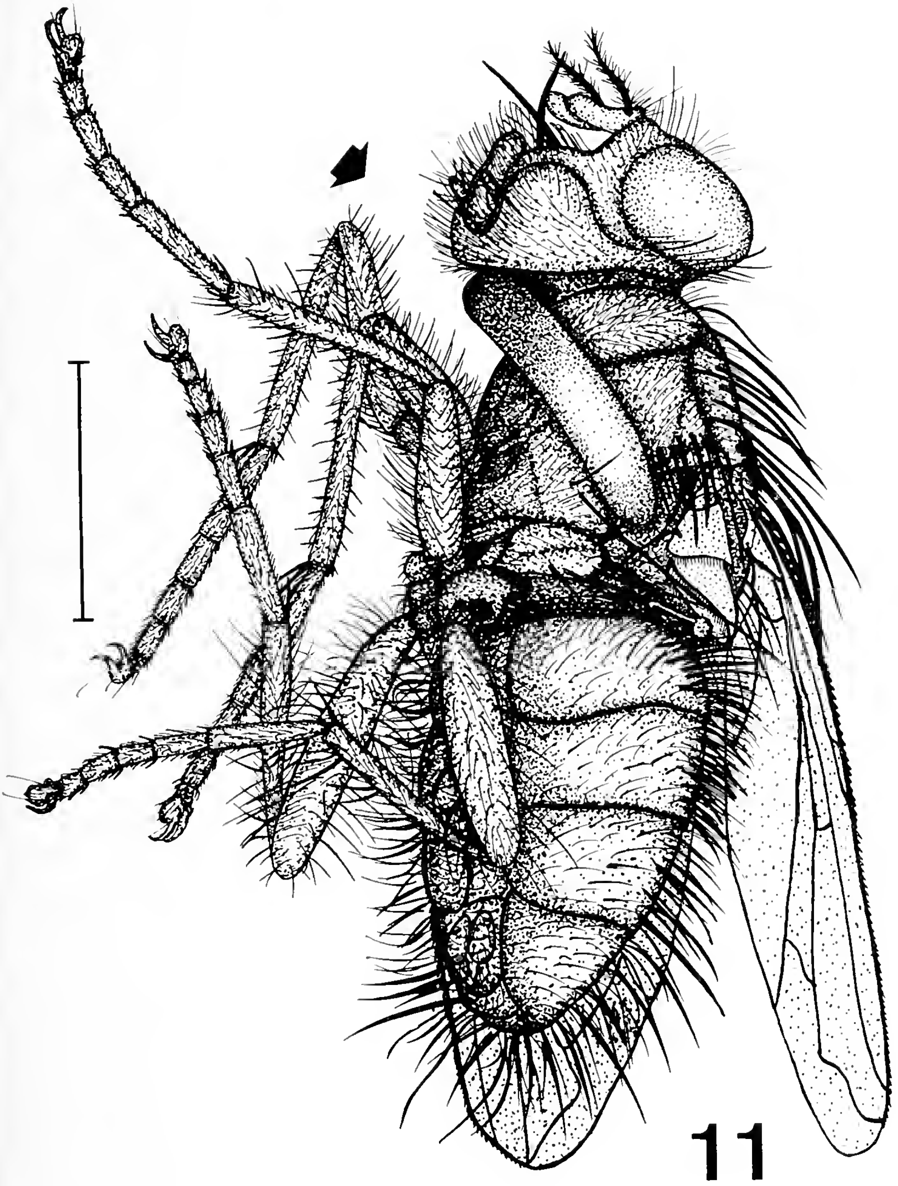


Fig. 11. Egg (arrow) of *Crabro* (*Synothyreopus*) *advenus*, showing attachment to ventral side of neck of prey fly. The right mid leg of the fly is concealed beneath the body. Scale at left equals 2 mm.

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Revision of the African Species of the Termitophilous Tribe Corotocini (Coleoptera: Staphylinidae). I. A New Genus and Species from Ovamboland and Its Zoogeographic Significance[1]

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Abstract: Coatonachthodes ovambolandicus, a new genus and species of termitophilous Staphylinidae (Subfamily Aleocharinae, Tribe Corotocini, Subtribe Corotocina), is described from Ovamboland, South-West Africa associated with *Fulleritermes contractus* (Sjoestedt). This is the first record of a termitophile from the nests of *Fulleritermes*. Its host relationships, its zoogeographic significance, and its remarkable resemblance to termite workers is discussed.

The purpose of this paper is to describe and illustrate a new genus and species of termitophilous Staphylinidae collected by Dr. W. G. H. Coaton in South-West Africa. The genus is of zoogeographic significance and also is of significance in that it is the first termitophile recorded from the termite genus *Fulleritermes* Coaton. The description is offered at this time to validate a name which I have used in a more general discussion of the biology of termitophiles (Kistner 1968, fig. 8).

Genus **Coatonachthodes**, new genus

Closely related to *Spirachthodes* Seevers (1960) from which it is distinguished by the scarce secondary sclerotization of the abdomen, its additional pair of abdominal appendages, and its more reduced prosternum. For comparison of the two genera compare figs. 1 and 2 to fig. 3.

Head capsule generalized, with the eyes bulging which produces a somewhat constricted contour behind the middle. Frontoclypeal suture present. Gula broad at base with the sides converging in front (but not as strongly as in *Spirachthodes*). Submentum and mentum fused. Prementum moderately long. Mouthparts shaped as in *Termitopullus* Reichensperger (most recently illustrated by Pasteels 1967) with the labial palpi very

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Acknowledgments: I wish to thank Dr. W. G. H. Coaton, Plant Protection Research Institute, Pretoria, for sending me the specimen of this new genus, for spending many subsequent hours in the field looking for more specimens, and for the host determination. I wish to thank Mr. V. Branco, Plant Protection Research Institute, Pretoria, for the excellent drawing of **Coatonachthodes.** I also want to thank Mr. David Harwood, Miss Susan Jones, and Mr. R. Gary Malin for assistance with various aspects of this study. Thanks are also extended to Dr. Alfred E. Emerson for reading and commenting on this paper.

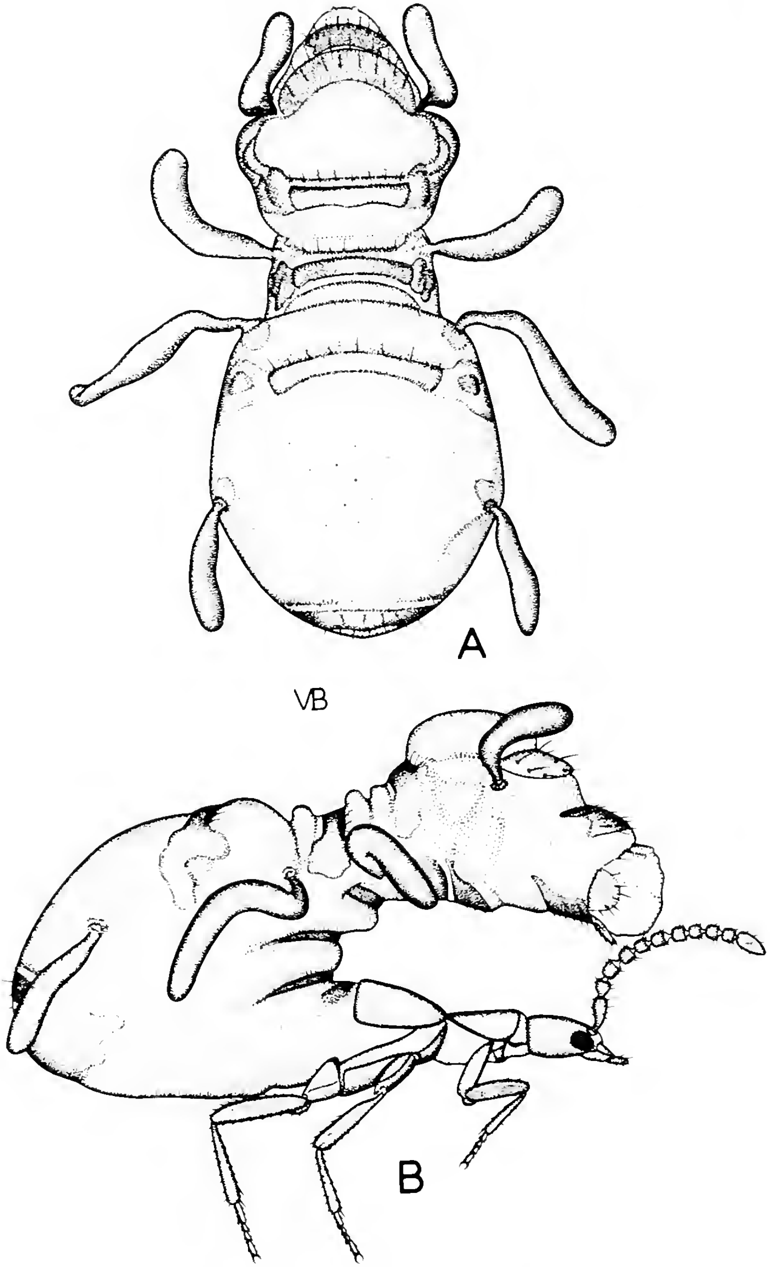

Fig. 1. **Coatonachthodes ovambolandicus** n.sp. A—View from top; B—Lateral view.

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Fig. 2. **Coatonachthodes ovambolandicus** n.sp. A—View from top; B—Lateral View. The drawings bring out some details necessary for taxonomic discrimination, while the photos emphasize other details and actual appearances.


A


B

small and 2-segmented. Maxillae very small but with 4-segmented palpi. Antennae 11-segmented, shaped as in fig. 1.

Prothorax somewhat inflated with moderate expansion of membranous integument between the prothorax and head and between the ventral sclerites. Pronotum generalized with a small hyaline notch in the middle of the anterior border. Prothorax without a V-shaped sclerite behind the procoxae. Prosternum reduced to a very small sclerite. Mesothoracic peritremes entirely membranous. Mesosternum with the mesocoxae widely separated and not set in marginal acetabula. Mesosternal intercoxal process not well-defined exteriorly but the interior shows signs that this would be broad and blunt. Metasternum longer than the mesosternum with the hind coxae triangular in form and set widely apart, articulating on the medial surface with relatively long metasternal processes. Elytra generalized in form; wings present but broken off. Legs shaped as in figs. 1 and 2; with no unusual features. Tarsal formula 4-4-4, with the protarsal segments approximately equal in length. Basal tarsal segments of the meso- and metalegs longer, about equal to the following 2 segments collectively in length.

The abdomen is greatly modified and recurved permanently over the back, (figs. 1 and 2). Since this results in the ventral surface (and the sternites) of the abdomen being on top and the posterior tip of the abdomen being anterior, even anterior to the head, certain descriptive difficulties are encountered. I will ahere to the morphological rather than the functional orientation. Physogastry develops by the expansion of the membranous integument and then the development of secondary sclerotization within the membrane. This view is reinforced by the presence of sternites which are relatively normal in shape and the presence of tergites which have the spiracles in their normal positions at the edges. It is also reinforced by Seevers' (1960) description of the one partially developed form of *Spirachthodes*. The tergites, however, are modified from their normal shape and size in the recurving process so whatever postimaginal growth takes place must occur rather quickly after the eclosion of the adult. Tergites II–IX present, all greatly modified in shape except for the segment IX complex; general appearance from the side as in figs. 1 and 2. Sternite III near the point of curvature of the abdomen with a small amount of secondary sclerotization present at the lateral edges which extends somewhat anteriorly, reinforcing the abdominal curvature. First abdominal appendages arise from the membrane between sternite III and IV. Sternites IV, V, and VI have small amounts of secondary sclerotization at the lateral edges as shown in figs. 1 and 2. Second abdominal appendages arise between IV and V. Third abdominal appendages arise between sternites V and VI. Fourth abdominal appendages arise at the lateral borders of sternite VII. No straps of secondary sclerotization connect the abdominal appendages to the tergites as occur in *Spirachthodes* (see fig. 3). All abdominal appendages with only a hint of sclerotization at the bases only. A clearly defined tergite VIII is present whereas this is not evident in *Spirachthodes*. The membranous expansion of the abdomen takes different forms in different areas of the abdomen; this is most easily observed in the drawings and photographs (figs. 1 and 2).

TYPE SPECIES: **Coatonachthodes ovambolandicus**, new species a description of which follows.

Coatonachthodes ovambolandicus, n.sp.

Figs. 1 and 2

Normal sclerites of the head, thorax, and abdomen light yellowish brown. Secondary sclerotization much lighter. Unsclerotized areas milky white in color with small dark spots of unknown significance irregularly scattered about. Setae sparse and yellowish brown in color, distributed as shown in fig 1.

MEASUREMENTS: Pronotum length, 0.22 mm.; head length, 0.23 mm. Overall length with the abdomen in a recurved position is about 1.8 mm. Number measured, 1.

HOLOTYPE: 1, No. 12563, South-West Africa: Ovamboland, 10 miles ex Elundu-Ondema, 17° 15–29′ S, 16° 45–59′ E, 16 September 1966, Coll. W. G. H. Coaton, No. T-496, ex nest beneath prone log in sandveld. In the National Collection of Insects, Pretoria.

NOTES: The host was determined as *Fulleritermes contractus* (Sjoestedt) by Dr. W. G. H. Coaton and is in the National Isoptera Collection, Pretoria, under accession No. TM 20224.

ZOOGEOGRAPHIC SIGNIFICANCE

Seevers (1957, 1960) showed that the generic group of the subtribe Corotocina which have abdominal appendages most probably evolved first in South America where several species of the genus *Spirachtha* are found with the termite genus, *Constrictotermes*. At first this kind of termitophily was considered to be a New World phenomenon. Then in 1960, Seevers described the genus *Spirachthodes* from Madagascar. If Emerson's (1955) ideas on the origin and dispersion of the Nasutitermitinae are correct (namely that the Nasutitermitinae originated in South America during the Mesozoic and subsequently dispersed to the Old World tropics via an Alaskan land bridge in pre-Tertiary time), then we should expect to find Corotocina with abdominal appendages in areas between South America and Madagascar. **Coatonachthodes** is the first genus of this generic group that has been discovered on the African continent, thus fulfilling Seevers' (1960, p. 826) prediction that additional members of the generic group would be discovered.

Relative Primitiveness of the Members of the Generic Group

All of the genera and species of this generic group are highly modified insects so it is only with difficulty that we can say one genus is more primitive than another. Nearly all abdominal characters are subject to great changes by post-imaginal growth so that these cannot be used reliably. Based on a study of the mouthparts, antennae, and thoracic structure, I would judge *Spirachtha* as the most primitive because of its robust maxillary palpi, its completely sclerotized prosternum, and its long and robust antennae. It is clear that **Coatonachthodes** and *Spirachthodes* are more closely related to each other than to *Spirachtha*. The mouthparts are the same (Seevers' statement that the 4th segments of the maxillary palpi were doubled must have been the result of some artifact or other). Of the 2 genera, I should consider *Spirachthodes* more primitive because of its relatively large and well sclerotized prosternum and also because of the presence of sclerotized (albeit modified) mesothoracic peritremes. This would make **Coatonachthodes** derivative from stock ancestral to and more similar to *Spirachthodes*.

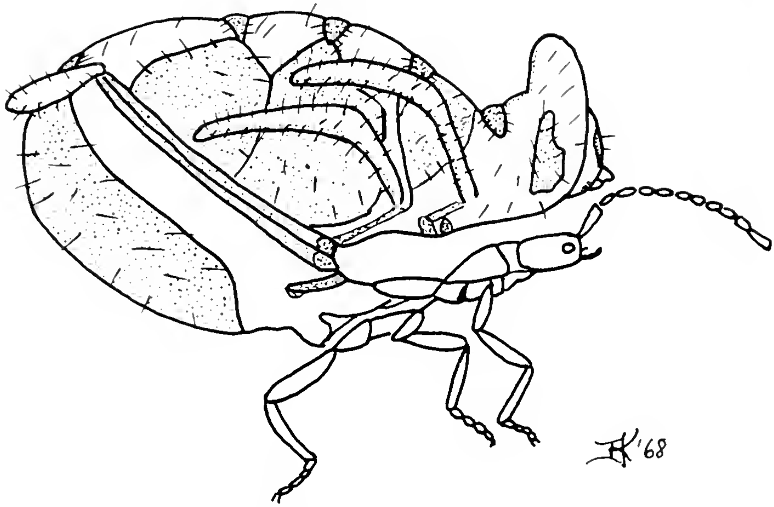

Fig. 3. *Spirachthodes madecassus* Seevers, lateral view, redrawn from a paratype, provided for comparison.

HOST RELATIONSHIPS

Spirachtha, the most primitive genus, is found with 2 species of the genus *Constrictotermes. Spirachthodes* is found with *Nasutitermes kaudernianus* (Sjoestedt) while **Coatonachthodes** is found with *Fulleritermes contractus* (Sjoestedt). According to Sands (1965), *Fulleritermes* is a termite whose soldiers have constricted heads which is most closely related to *Leptomyxotermes* and *Grallatotermes,* both African genera. However, no phyletic line is drawn to *Constrictotermes,* a neotropical genus which was beyond the scope of that paper, but it is obvious from the name that soldiers of this genus also have constricted heads. While it is possible that *Spirachthodes* represents a phylogenetic relict species in the nests of *Nasutitermes,* it is not likely because many *Nasutitermes* nests have been examined on all continents without finding members of this generic group. It is more likely that *Nasutitermes kaudernianus* will be found to belong to some genus, new or existing, related to *Fulleritermes.* Emerson (personal communication) has stated, ". . . there is something peculiar about that species." I will leave it to the termite experts to reexamine the relationships of *Nasutitermes kaudernianus.*

INTEGRATING MECHANISMS

With the work of Pasteels (1966), it is becoming increasingly clear that a principal integrating mechanism of termite-termitophile interspecies association is based upon glandular secretions of the termitophiles. The secretions are licked by the termites and produced in various glands which have evolved as new structures in termitophilous forms. For a review of the previous literature on physogastry, see Kistner's (1968) paper. So far, however, the chemical nature of the glandular exudate has not been determined and no one has made the claim that this is the only mechanism involved in the peaceful coexistence of the phylogenetically unrelated species.

A relatively neglected idea was first enunciated by Trägårdh (1907) in his description of the genus *Termitomimus*. This involved the mimicry of the termites by termitophiles. He enunciated the thesis that the view from the top of *Termitomimus* (the dorsal view would present the recurved abdomen or its ventral surface) presented an appearance which resembled that of the termites. He interpreted the regions of this body as the pseudocaput, pseudothorax, and pseudoabdomen because of the resemblance of the inflated parts of the abdomen to the head, thorax, and abdomen of the termite host respectively. This idea was dropped by other workers rather than disproved due to competing hypotheses of glandular exudates being involved which fit in with the concept of trophallaxis which had a highly vocal proponent in W. M. Wheeler. To be fair it should also be stated that the figures provided by Trägårdh in support of the idea were not of well preserved specimens that would best illustrate the idea and were probably viewed by most workers (including myself until I saw more material) as being somewhat fanciful.

I should like to revive the idea here recognizing that it will be most difficult to test due to the scarcity of specimens in the field. However, someone resident in the area should be able to test it with regard to the genus *Termitomimus* which is sometimes present in large numbers in *Trinervitermes* nests. **Coatonachthodes** presents an unusually faithful image of a worker termite when viewed from the top (see fig. 2A). The photograph reveals this better than the drawing because of the absence of shading. In this case, then the abdominal appendages would resemble the approximate way the termite legs would appear in a normal walking termite worker. The termites cannot see the termitophile but would have to get the image by palpation. It is easy to observe in the field and laboratory that the termites palpate each other much more frequently than they lick each other.

While it will take field observation and experimentation to prove that these forms are really mimics, other forms of possible corroborative evidence might be obtained from preserved termites. Comparing **Coatonachthodes** with *Spirachthodes,* the following predictions can be made about the termite hosts assuming a reasonably faithful copy of the termite phenotype is being presented:

1. *Fulleritermes contractus* (F) should have significantly fewer setae on its thorax and abdomen than *Nasutitermes kaudernianus* (N).
2. The workers of N should have more pointed heads than F.
3. The legs of N should be more setose than the legs of F.

4. The abdomens of N should have harder sclerites and more extensive sclerites than those of F.
5. The clypeus of N should be larger than F.
6. The heads of N should have narrower connections to the thorax than the heads of F.
7. The abdomens of N should be more obtuse at the posterior border than the abdomens of F.

All the predictions are made about workers and without seeing a specimen of either host as I do not have specimens of them available. I will leave it to the termite experts to check on the termites eventually.

If mimicry should prove to be a factor in the colonial integration of the termitophiles, it certainly would not negate evidence about glandular exudates. We might inquire as to the reason termites lick termitophiles. In earlier works it was implicity assumed that the termites got fats or proteins from the secretions. Thus the model of termitophily was that of a mutualistic relationship whereby the termitophiles got food and shelter in exchange for some small amount of food. However, termites also lick each other and to pass small amounts of food around in such a manner would not seem to be of selective advantage to the colony as a whole. If on the other hand the secretions of the termitophiles are eventually shown to be a copy of the secretions of the termites, then we would have a biochemical mimicry reinforced in some instances by morphological mimicry and our conception of termitophily would be more exploitative than mutualistic. This would bring our concepts of termitophily more in line with demonstrated integrative mechanisms involved in myrmecophily.

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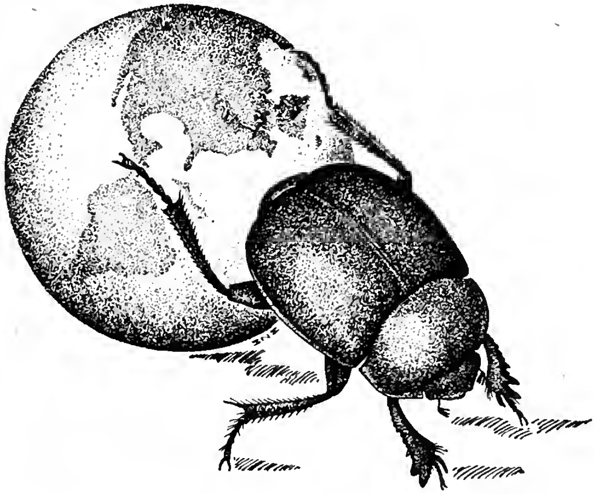

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CONTENTS

Records and Descriptions of Palearctic and South Asiatic Laspeyresiini (Lepidoptera: Tortricidae)

THE LATE NICHOLAS S. OBRAZTSOV[1]

RECEIVED FOR PUBLICATION MARCH 9, 1968

Abstract: Chretienia (with five included species) and **Phanetoprepa** (with three included species) are described as new genera, and *Laspeyresia* **bengalica** (Bengal), *L.* **minuta** (Bengal), and **Phanetoprepa agenjoi** (Spain) are proposed as new species.

Chretienia, new genus

Figs. 1–6

Grapholitha (in part): Zeller, 1847, p. 734. Lederer, 1859, p. 340. Barrett, 1873, p. 148. Ragonot, 1894, p. 218. Rebel, 1901, p. 122. Walsingham, 1903, p. 214. Rebel, 1912, p. 85. Chrétien, 1915, p. 304–307. Rebel, 1924, p. 42.

Grapholitha (*Grapholitha*) (in part): Heinemann, 1863, p. 183.

Grapholitha (*Semasia*) (in part): Wocke, 1871, p. 257.

Laspeyresia (in part): Walsingham, 1903, p. 214. Meyrick, 1916, p. 21; 1920, p. 351. Kennel, 1921, pp. 722, 723. Zerny, 1935, p. 134. Clarke, 1955, p. 37; 1958, p. 431. Obraztsov, 1959, p. 175, 196, 197; 1960, p. 143. Razowski, 1961, p. 647.

Pamene (in part): Caradja, 1916, p. 71.

TYPE-SPECIES: *Grapholitha rhezelana* Chrétien, 1915.

Head roughly scaled, face with a large, flat tuft of large, somewhat iridescent, dense scales. Antenna in male somewhat thickened, with short, appressed ciliations, noticeable chiefly apically; in female less thick, with short setae. Palpus porrect, longer than width of eye; second segment longest, dilated apically; terminal segment exposed, rather short, broad and blunt. Proboscis moderate. Thorax smooth.

Forewing elongate, moderately broad; costa gently curved; apex rounded, somewhat produced, termen slightly concave between R_5 and M_3, tornus broadly rounded, dorsum gently and gradually curved. No costal fold in male. 12 veins, all separate. Sc slightly incurved, R_1 almost from middle of cell, R_2 less than twice as close to R_3 as to R_1; R_3 about four times as close to R_4 as to R_2; R_4 running to costa, R_5 to utmost point of termen; on termen M_3 and Cu_1 slightly more remote from each other than at base; Cu_1 from lower angle of cell, Cu_2 from between middle and last third of cell; fork of A_{2+3} about one-third.

Hindwing subovate, about 1; costa almost straight, apex rounded, not produced, termen oblique, gently convex, tornus broadly rounded. 8 veins: Sc almost straight, M_2 and M_3 apparently subparallel, in fact about twice as remote from each other at termen as at base; M_3 and Cu_1 long-stalked, from between two-thirds and three-fourths of cell; A_2 and A_3 more distinct than A_1; cubitus with pecten.

---

[1] Formerly Research Associate, the American Museum of Natural History, New York. This study has been carried out with a grant of the National Science Foundation. Edited by A. Diakonoff, Leiden, Netherlands, and submitted by Frederick H. Rindge, Amer. Mus. Nat. Hist.

FIGS. 1–5. **Chretienia rhezelana** (Chrétien). 1. Male, wing venation. 2. The same, head, in lateral aspect. 3. In dorsal aspect. 4. Male genitalia (slide No. 6648, Hammam-es-Salahin, Algeria, April 14, 1904). 5. Female genitalia (slide No. 6649, same data, but April 10, 1904).

MALE GENITALIA: Eighth and ninth intersegmental membrane simple, or with one or more large, broad, strongly sclerotized scales, on each side of membrane. Tegumen ribbon-shaped, uncus and socii absent, gnathos membraneous. Valva elongate, moderately broad; cucullus rotundate, hardly separated by a neck from the rest of valva; basal opening of valva large and elongate; external angles of sacculus indistinct or not defined at all; processus basalis short. Aedeagus robust, widely cyclindrical, with a narrow coecum penis;

one strongly sclerotized cornutus, shaped as an elongate, laterally thickened plate, or two or more thick cornuti, connected by a hardly visible membrane.

FEMALE GENITALIA: Papillae anales weak, elongate, slightly dilated caudally. Apophyses posteriores shorter than anteriores, or equally long. Ostium bursae wide, located on caudal edge of ventral plate, or posteriad of it; antrum more or less sclerotized, elongate and rather broad, vase-shaped, dilated caudally and narrowed rostrally. Ductus bursae broad and short; cervix bursae rather indistinct or shifted to the left side, receiving ductus seminalis; ostium wide, generally with thorns, directed inwards, into the bursa copulatrix; corpus bursae more or less pear-shaped, smooth or slightly reticulated; signa, two short thorns or lacking.

REMARKS: The new genus is dedicated to the memory of the French Lepidopterist, P. Chrétien, who was the first to show the distinction of some of its species from those, placed recently in the genera *Laspeyresia* Hübner and *Grapholitha* Treitschke. Chrétien (1915) erroneously regarded also *Selania extinctana* (Chétien) as a member of the present group. He has been misled by the fact that the species of both *Selania* Stephens and *Chretienia* have in common a frontal shield of glassy scales, covering the face, a feature distinguishing these two genera from the other Laspeyresiini. However, *Selania* and *Chretienia* differ from each other in the labial palpi and the venation of the hind wing which was also observed by Chrétien; the important difference of the genital characters, however, remained unknown to him.

Chretienia rhezelana (Chrétien), new combination

Figs. 1–6

Grapholitha rhezelana Chrétien, 1915, p. 304.

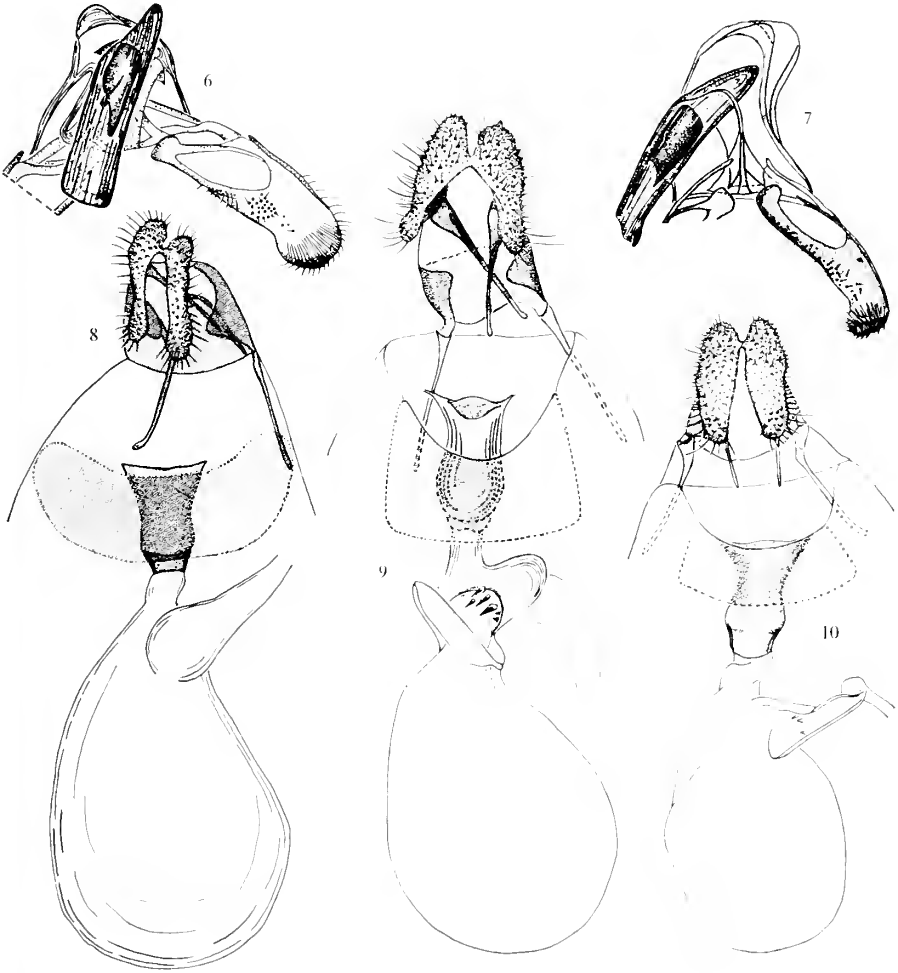
Laspeyresia rhezelana: Obraztsov, 1959, p. 186. Razowski, 1961, p. 674, pl. 87, fig. 8.

Lectotype, male (genitalia on slide No. 3791), "11.7.07, boutons de *Capparis*, Ham. Sal., 6, 6 1." In the Muséum National d'Histoire Naturelle, Paris. Selected and figured by Razowski (1961).

SPECIMENS EXAMINED: Three males and two females (genitalia of two, on slides Nos. 6648♂, and 6649♀), Hammam-es-Salahin, Algeria, April 9–14, 1914 (Walsingham Collection) (Brit. Mus.).

MALE GENITALIA: Valva much broader than in *C. capparidana*; cucullus correspondingly larger, less curved down; setae above ventral edge of valva before cucullus separated from those on the sacculus. Aedeagus not narrowed apicad; cornutus shaped as a broad tapering plate, with a longitudinal fold slightly protruding beyond the oblique edge of plate.

FEMALE GENITALIA: Ostium bursae caudad of and rather remote from the ventral plate; antrum long, pitcher-shaped, widely dilated caudally, narrowed in median part, with sides strongly concave, somewhat rounded and dilated anteriorly less than posteriorly; two narrow girdles in anterior portion of antrum and two lateral colliculi. Ductus bursae slightly longer than in *C. capparidana*. Corpus bursae elongate; dilated portion of ductus seminalis internally with some short thorns pointed towards ostium.



FIGS. 6–10. Genitalia. **Chretienia rhezelana** (Chrétien), male. 7. **C. capparidana** (Zeller), male genitalia (slide No. 6650, Messina, Sicily, July 25 (P. E. Zeller), paralectotype). 8. The same species, female genitalia (slide No. 6651). 9. **C. planifrontana** (Rebel), female genitalia (slide No. V.15, Vienna Museum). 10. **C. capparidana** (Zeller), female genitalia (slide No. 6652), Corfu, April, 1872.

REMARKS: The specimens examined were reared from larvae collected March 5, 1904, on *Capparis spinosi*. The external characters of the adults correspond with the original description of *C. rhezelana*; the male genitalia of a dissected specimen match well the figure of those of the lectotype. It should be emphasized that the aedeagus in that figure is shown in dorsal aspect, for this reason the cornutus appearing somewhat disfigured.

Chretienia decoratana (Chrétien), new combination

Grapholitha decoratana Chrétien, 1915, p. 306.

Pamene decorata sic : Caradja, 1916, p. 71.

Laspeyresia decoratana: Kennel, 1921, p. 723. Obraztsov, 1959, p. 186, 197, fig. 32.

SPECIMENS EXAMINED: One male (genitalia on slide No. M.567), Biskra, Algeria. Zool. Coll. Bavarian State.

REMARKS: This species is known to the present author from a single male specimen. A re-examination of the genitalia slide figured by Obraztsov (1959), has shown that in the aedeagus there are not three separate cornuti but folds of a common, sclerotized plate. The shape of this plate cannot be defined from the examined slide.

Chretienia capparidana (Zeller), new combination

Figs. 7–8, 10, 19–20

Grapholitha capparidana Zeller, 1857, p. 734. Lederer, 1859, p. 340. Barrett, 1873, p. 148. Ragonot, 1894, p. 218. Walsingham, 1903, p. 214. Chrétien, 1915, p. 307. Rebel, 1924, p. 42.

Grapholitha (*Grapholitha*) *leplastriana* (in part): Heinemann, 1863, p. 183.

Grapholitha (*Semasia*) *leplastriana* (in part): Wocke, 1871, p. 257, No. 1163.

Grapholitha leplastriana (in part): Rebel, 1901, p. 122, No. 2196.

Laspeyresia capparidana: Kennel, 1921, p. 722. Obraztsov, 1959, p. 186, fig. 33.

Lectotype, male (Genitalia on slide No. 5680), Messina, Sicily, July 25 (P. E. Zeller) (Brit. Mus.).

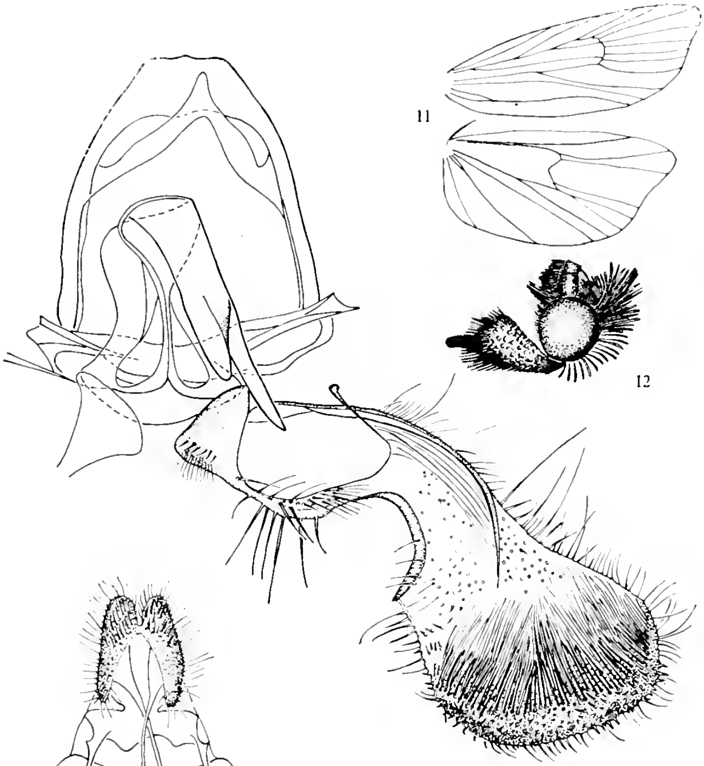
Lectoparatypes, one male (genitalia on slide No. 6650), same data as lectotype; one female (genitalia on slide No. 6651), same data, but August 2, 1847. (Brit. Mus.).

OTHER SPECIMENS EXAMINED: One female (genitalia on slide No. 6652), Corfu, April, 1872 (Walsingham Collection, No. 84612) (Brit. Mus.). One male (genitalia on slide No. M.538), Gravosa, Dalmatia (Zool. Coll. of the Bavarian State).

MALE GENITALIA: Valva moderately broad, cucullus hardly separated, a rounded, slightly dilated distal portion of valva, somewhat downcurved and covered with setae; numerous smaller setae in distal part of sacculus and above ventral edge of valva before cucullus. Aedeagus insignificantly narrowed apicad, with a short, blunt, ventroapical thorn; cornutus, a broad, elongate plate with two acute distal points.

→

Figs. 11–15. Genitalia and head. **Phanetoprepa agenjoi**, new genus and species, male, wing venation. 12. Female, head. 13. Male genitalia (slide No. A.9). 14. Female genitalia (slide No. A.10). 15. **P. strigulatana** (Kennel), female genitalia (slide No. A.13).



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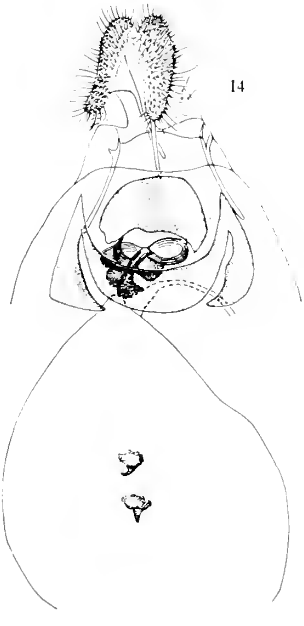

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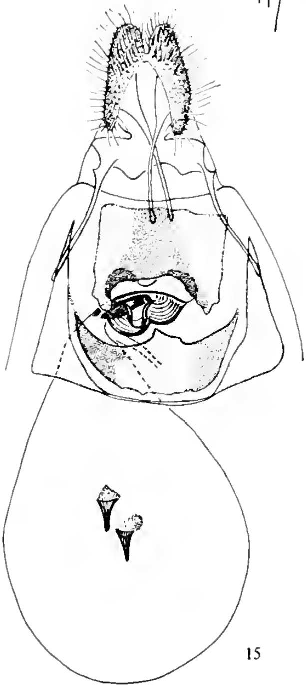

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FEMALE GENITALIA: Ostium bursae wide, just beyond caudal edge of ventral plate; antrum broad caudally, narrower rostrally, slightly incurved at sides; extreme rostral portion of antrum separted like a rather broad girdle with two lateral colliculi. Ductus bursae short, as broad as rostral portion of antrum. Corpus bursae pear-shaped; dilated portion of ductus seminalis without any sculptures, nor a basal fold.

REMARKS: The figure of the male genitalia published by Obraztsov (1959) was made after an unstained and inadequately cleared mount. For this reason only the two distal points of the cornutus, not the entire plate, were shown. The authentic data on the distribution of *C. capparidana* are limited to Sicily, Dalmatia, and Corfu. The records from Bengal were based on misidentification and should be referred to two new species of *Laspeyresia* described below.

Chretienia resedana (Obraztsov), new combination

Laspeyresia resedana Obraztsov, 1959, p. 186, 196, figs. 44, 45; 1960, p. 143, pl. 12, figs. 1, 2.

Chretienia planifrontana (Rebel), new combination

Figs. 9, 21

Grapholitha planifrontana Rebel, 1912, p. 85. Crétien, 1915, p. 307.
Laspeyresia (?) *planifrontana*: Obraztsov, 1959, p. 186.

Lectotype, female (genitalia on slide No. V.15), Heluan /Lower Egypt/, "in Früchten *Farsetia aegyptiaca*, nymph. 17/4 1908, imag. 20/4 1908 (Vienna Mus.). Selected in the present place.

Lectoparatypes, one female (genitalia on slide No. V.16), same data as lectotype, but "imag. 24/4 1908"; one female, same data as lectotype; one female (abdomen missing), same data, but "larva 17/1 1908, cocoon 26/1, nympha 10/2 imago, 6/3 1908"; all three in Vienna Mus.

FEMALE GENITALIA: Ostium bursae at caudal margin of ventral plate; lamella postvaginalis projecting far beyond this margin caudad; antrum subtriangular, narrowed and rounded rostrad, broader than lamella postvaginalis; two lateral colliculi. Ductus bursae short. Corpus bursae pear-shaped, surface granulated; dilated part of ductus seminalis with a large basal fold and some internal thorns, pointing towards ostium.

REMARKS: The female genitalia of the present species are rather similar to those of *L. resedana*, but are of a somewhat larger size. The caudal margin of the lamella postvaginalis is not convex, and the dilated portion of the ductus seminalis is shorter than in *L. resedana*.

Chretienia planifrontana ssp. **lotana** (Chrétien), new combination

Grapholitha lotana Chrétien, 1915, p. 386.
Laspeyresia planifrontana ssp. *lotana*: Zerny, 1935, p. 134.

→

Figs. 16–18. Genitalia of *Laspeyresia*. 16. *L.* **bengalica,** new species, holotype, male. 17. Allotype, female. 18. *L.* **minuta,** new species, holotype, female (figure by W. Bergmans, Leiden Museum).

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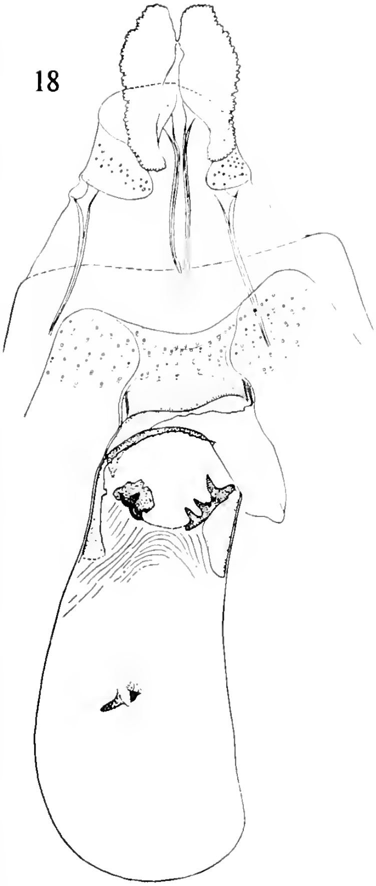

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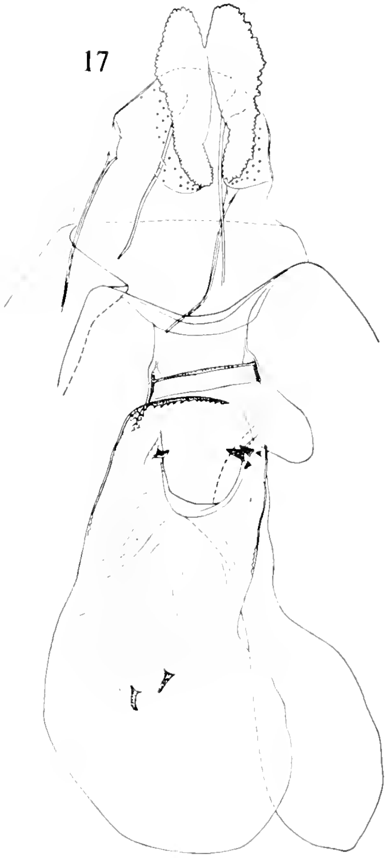

Laspeyresia planifrontana ssp. *lotana*: Obraztsov, 1959, p. 186.

This form has remained unknown to me. Tentatively it is placed as a subspecies of *C. planifrontana*.

Laspeyresia **bengalica**, new species

Figs. 16–17, 25–26

Laspeyresia capparidana Meyrick (nec Zeller), 1920, p. 351.

MALE: Antenna brownish olive. Head concolorous, front smooth, with a slight golden sheen. Palpi whitish, brownish olive apicad, yellowish on the inside; terminal joint brown-black. Thorax grayish olive, tegulae paler. Forewings yellowish brown-olive; a broad elongate whitish spot on dorsum, occupying entire area below cell, narrowed in middle, and reaching from wing base to about two-thirds of wing length; numerous blackish brown, vertical lines crossing this spot; on costa about eight oblique, blackish olive rather long streaks directed outwards; in their interspaces some bluish gray, leaden lines, originating from short, elongate costal spots and directed outwardly; a narrow black elongate streak in external half of cell; oblique, blackish brown streaks directed basad and located above and externad from already mentioned whitish dorsal spot; ocelloid patch large, yellowish-olive, finely gray-striated, including seven black dots, some of them elongate; a bluish-gray leaden line, dilated in middle, and separating ocelloid patch from inside; terminal line black from apex of wing to vein M_1, interrupted there by a grayish yellow spot and continued to tornus as an external, cupreous-brown edge to ocelloid patch; cilia dark brown with a slight cupreous sheen. Length of forewing, 4.5 mm. Hindwings yellowish white in basal half, dark brown outwardly; cilia brownish-white, dark towards the apex of wing, with a dark brown subbasal line.

FEMALE: Similar to male, but much smaller. Length of forewing, 3.5 mm. Cilia of hind wing not darkened at apex.

MALE GENITALIA: Valva with a narrow, slightly convex cucullus; a slight, rather flat concavity of ventral edge before cucullus; the latter rotundate, well separated by this concavity and a slight concavity of costa. Aedeagus rather strong and thick; two strong, long cornuti with obtuse tips, and bases dilated from one side.

FEMALE GENITALIA: Ostium bursae wide, located at caudal edge of ventral plate; antrum slightly narrower than ostium, membraneous, with a sclerotized girdle cephalad; ductus bursae as wide as adjacent portion of antrum, with a blind lateral sac at ostium. This ostium very large, round, with short sclerotized thorns, a single thorn on one side of the ostium, another similar thorn and two smaller, at the opposite side; a narrow, serrate, sclerotized plate forming caudal edge of ostium. Corpus bursae widely tubular, dilated rostrad; two thin acute thorn-shaped signa, each with a dilated and slightly sclerotized round base.

TYPES: Holotype, male (genitalia on slide No. 6657), Pusa, Bengal, February 21, 1910 (T. B. Fletcher); same allotype, female (genitalia on slide No. 6658), same data but February 23, 1910. Both specimens deposited in the British Museum (Natural History).

REMARKS: Meyrick (1920) misidentified this species for *Laspeyresia capparidana* (Zeller). However, it is larger, darker coloured and with a long dorsal spot, occupying the entire area below the discal cell of the forewings. The genitalia of the two species are distinct in the shape of the valvae, number and shape of

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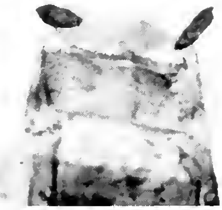

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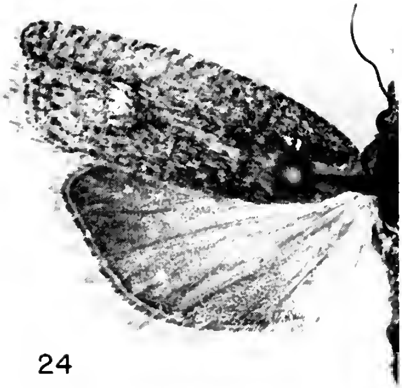

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Figs. 19–24. Adults. 19. **Chretienia capparidana** (Zeller), lectotype, male. 20. The same species, abdominal pouches. 21. **C. planifrontana** (Rebel), lectotype, female. 22. **Phanetoprepa strigulatana** (Kennel), female, Jándula, Jaén, IV.1933 (F. Escalera, Coll. Agenjo). 23. **P. agenjoi**, new species, holotype, male. 24. The same species, allotype, female.

cornuti, in the males, and in the width of the sclerotized girdles around the antrum, and the sculpture around the ostium, in the females.

Laspeyresia **minuta,** new species

Figs. 18, 27

Laspeyresia capparidana: Meyrick (nec Zeller), 1920, p. 351.

FEMALE: Antennae yellowish brown. Head olive-brown; frons smooth, with a strong golden sheen. Palpi ochreous, terminal joint brown. Thorax olive-brown, with a golden sheen; Tegulae with gray tips. Forewings pale ochreous, densely and finely striated with dark brown transverse undulate lines; base of wing with a blackish brown dorsal spot, continued obliquely outward and reaching discal cell; in middle of dorsum a whitish ochreous oblique streak, divided lengthwise towards apex by a blackish-brown line, and reaching end of cell; on both sides of upper part of this streak a blackish brown line, and a third line closing streak from the side of cell; area between this streak and tornus dark brown, finely transversely striated by pale ochreous; ocellus high, yellowish, with fine blackish lines from costa to dorsum, and two short black streaks along veins; a third, obliterate, similar streak between two mentioned streaks, more distinct on left wing; inner border of ocellus whitish, outer yellowish; eight black costal dots with yellow interspaces; fourth and sixth prolonged as blackish lines toward inner and outer border of ocellus, respectively; each of these edged externally by bluish violet plumbeous lines; terminal line fine, black; cilia dark brown, with a slight silky sheen. Length of forewing 3 mm. Hind wings brown, paler at extreme base; cilia gray, with a blackish basal line; along termen a very fine yellowish line.

MALE, unknown.

FEMALE GENITALIA: Ostium bursae wide, located at caudal edge of ventral plate; antrum slightly narrower than ostium, membraneous, with a sclerotized girdle rostrad; ductus bursae as wide as the adjacent portion of antrum, with a slight lateral dilatation over ostium. This ostium very large, round, with well developed almost equal thorns, three at one side of ostium, two at the opposite side; a narrow serrate sclerotized plate forming caudal edge of ostium. Corpus bursae widely tubular, rounded rostrad; two small, somewhat blunt thorn-shaped signa, with round, slightly sclerotized bases.

TYPE: Holotype, female (genitalia on slide No. 6660), Pusa, Bengal, bred September, 1919 (T. B. Fletcher); deposited in the British Museum (Natural History).

REMARKS: The present new species has been confounded by Meyrick (1920) with *Laspeyresia capparidana* (Zeller) with which it has nothing in common. The present species is as well externally as in the genitalia similar to *L. aeologramma* Meyrick, which, however, differs in having the thorns around the ostium arranged in three groups, each of two thorns.

Laspeyresia aeologramma Meyrick

Laspeyresia aeologramma Meyrick, 1916, p. 21. Clarke, 1955, p. 37; 1958, p. 431, pl. 214, figs. 2–2c.

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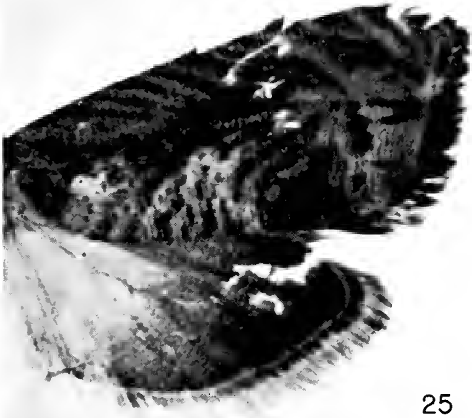
FIGS. 25–27. Adults. 25. *Laspeyresia* **bengalica,** new species, holotype, male. 26. The same species, allotype, female. 27. *L.* **minuta,** new species, holotype, female.



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TYPE: Holotype. female (genitalia on slide No. 7393 J.F.G.C.), Minbu, Lower Burma. August. 1915 (T. B. Fletcher) (Brit. Mus.).

The present species forms together with *L.* **bengalica** and **minuta,** described above, a group of species with the genitalia resembling those of the species of *Chretienia*, new genus. The male genitalia, known as yet only in *L.* **bengalica,** however, differ from *Chretienia* by the cucullus being somewhat more dilated and missing the specialized scales caudad from the eighth abdominal segment. The female genitalia differ from those in *Chretienia* species by a much shorter and wider antrum and the wide and very short ductus bursae, bearing a lateral sac or a dilatation caudad from the ostium. Moreover, typical of the *aeologramma* group is the presence of strong thorns around the ostium, and two thorn-shaped signa in the median portion of the corpus bursae. Signa are lacking in *Chretienia*, while the thorns in the ductus seminalis are located not around the ostium but in the dilated portion of the ductus seminalis itself.

Phanetoprepa, new genus

Figs. 11–14, 23, 24

TYPE-SPECIES: **Phanetoprepa agenjoi**, new species.

Grapholitha (in part): Kennel, 1899, p. 41. Rebel, 1901, p. 121.

Semasia (in part): Kennel, 1916, p. 515.

Epiblema (in part): Lucas, 1942, p. 125. Razowski, 1961, p. 677.

Head roughly scaled. Antennae slightly serrate in the two sexes; ciliations dense, under 1. Palpus porrect, longer than width of eye, second segment triangular, distally dilated by scales, terminal segment blunt, exposed, moderately long. Ocellus present. Proboscis developed. Thorax smooth.

Forewing elongate, moderately broad, gently curved or almost straight, apex broadly rounded, slightly produced, termen moderately oblique, straight or slightly concave. No costal fold in male. Sc gently incurved, R_1 distinctly from before middle of cell, R_2 as far from R_1 as the latter from wing base; R_3 twice as far from R_2 as from R_4; veins R_3 to M_1 almost equidistant, R_4 to extreme end of costa, R_5 to just below apex; upper internal vein from between R_1 and R_2 to R_5; lower internal vein from towards base to M_3; M_2 and Cu_1 almost equidistant from M_3; M_3 slightly curved, in its middle more distant from M_2 than at its base and end; Cu_1 curved, from angle of cell; Cu_2 from between middle and posterior third of cell; A_1 rather well developed; A_{2+3} furcate over i/4.

Hind wing subtrapezoidal, over 1; apex rounded. Sc gently incurved, R and M_1 separate, in basal third approximated, then diverging; M_2 close to M_3 and almost parallel; M_3 and Cu_1 stalked, from angle; Cu_2 from slightly beyond ⅔ of cell; all anal veins developed, A_2 with a basal fork. Cubitus pectinated.

MALE GENITALIA: Tegumen simple, moderately broad, with a flat top; uncus and socii absent; gnathos band-shaped, membraneous, somewhat produced and tapering caudally. Valva elongate, bent with a distinct neck slightly before middle; costa arcuate in basal half, then incurved; cucullus broad, irregularly rounded; sacculus narrow, convex in basal portion, much narrower externally, ending with a sharp point, slightly protruding beyond edge of valva; basal opening large; processus basalis moderate, tip bulbose. Anellus rather high, broader and convex ventrally, concave laterally. Aedeagus moderately longer than anellus, narrow and bifurcate distally, end with one blunt and another longer, narrower sharp process; no cornuti.

FEMALE GENITALIA: Papillae anales weak, elongate; apophyses posteriores longer than anteriores. Ventral plate of seventh sternite sclerotized, a transverse crescent middle part with caudal angles more or less connected with subtriangular lateral parts; lamella postvaginalis broad, with lateral angles directed rostrad. Ostium bursae wide, partly covered by lamella postvaginalis, antrum irregularly shaped, strongly sclerotized and with complicate sculptures; no separate ductus bursae. Corpus bursae more or less pear-shaped, narrower caudally, without cervix; ductus seminalis to extreme caudal part of bursa copulatrix; two conical, straight or somewhat curved signa.

REMARKS: Closely related to *Laspeyresia* Hübner and *Grapholitha* Treitschke. The male genitalia resemble those of the species of *succedana* group of the genus *Laspeyresia* and the female genitalia are rather similar to those of some species of *Grapholitha*. The position of vein M_2 in the hindwing, however, is quite different from both. Moreover, the complicated sculptures of the antrum are unique in the entire tribe Laspeyresiini. Three species are attributed to this new genus. Previously two of them were treated as members of the tribe Eucosmini; one species is new.

Phanetoprepa agenjoi, new species
Figs. 11–14, 23–24

Head and palpus smoke-gray, terminal segment of palpus black. Thorax and abdomen smoke-gray. Forewing concolorous with thorax, but actually striated by numerous fine, alternately olive-gray and pale gray, dull violet glittering lines, originating from dark costal streaks and their whitish interspaces, respectively; ocellus vertical, rather narrow, with three to five slightly elongate, black dots located one over another; inner and outer emarginations of ocellus silvery violet, duller in female; terminal line fine, black; cilia gray, paler at base. Length of forewing: male, 10 mm, female, 8 mm. Hind wing gray-brown; cilia white with a fine, gray-brown basal line.

MALE GENITALIA, as described for the genus.

FEMALE GENITALIA: Ventral plate of seventh sternite with caudolateral angles of crescent central portion connected with lateral pieces; lamella postvaginalis rounded caudally, with two acute angles. Antrum slightly curved, with a longitudinal, tubular sclerotization, followed caudally by lateral swellings and semicircles at the cephalic margin of ostium bursae. Two curved rather short signa.

Holotype, male (genitalia on slide No. A.9), Cercedilla, Province Madrid, Spain, 1481 m, July, 10, 1957 (R. Agenjo). Allotype, female (genitalia on slide No. A.13), Estepar, Province Burgos, Spain, 810 m, June 15–30 (R. Agenjo). In the collection of Mr. R. Agenjo, Madrid.

REMARKS: The new species differs from *hartigi* Lucas in having distinct colour and markings of the forewing. It is rather similar to *P. strigana* Kennel, but the latter has no violet glittering of the forewing and the silvery emargination of the ocellus is less developed. The genitalia in all the three species are distinct.

Phanetoprepa strigulatana (Kennel), new combination

Fig. 22

Grapholitha strigulatana Kennel, 1899, p. 41, pl. 1, fig. 40. Rebel, 1901, p. 121, no. 2167.

Semasia strigulatana: Kennel, 1916, p. 515, pl. 20, fig. 4.

SPECIMENS EXAMINED: Two females (genitalia of one on slide No. A.101), Jándula, Province Jaén, Spain, April, 1933 (F. Escalera). In the collection of Mr. R. Agenjo, Madrid.

DISTRIBUTION: South France, East Pyrenees; Spain; Portugal; Northwest Africa.

Phanetoprepa hartigi (Lucas), new combination

Epiblema hartigi Lucas, 1942, p. 125. Razowski, 1961, p. 677, pl. 92, fig. 26 (female genitalia).

DISTRIBUTION: East Pyrenees.

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BOOK REVIEW

Curculionidae Subfamily Apioninae of North and Central America with Reviews of the World Genera of Apioninae and World Subgenera of *Apion* Herbst **(Coleoptera).** David G. Kissinger. Taxonomic Publications, South Lancaster, Mass. 01561, 1968, 559 pp. Lithographed; paper bound. $20.00.

This is a monumental study, and about one half of the book comprises the author's remarkable illustrations. Most of them are enlarged photographs (15 or more on a page) of these tiny weevils which are less than 3 mm. long. The illustrations show either the entire beetle or restricted parts, such as the head, beak, elytra, and even parts as small as the antennae and the genitalia. The details of the vestiture and punctation are beautifully brought out. Line drawings of anatomical details, various graphs, and more than 20 distributional maps of the species in the United States and Central America are included. There is an index of host and associated plants as well as a general index. Even the size of the book is large, 8½ by 11 inches.

The text is chiefly a revision of the large genus *Apion* in North and Central America (about 300 species divided into 13 subgenera and various species groups), but also reviews the Apioninae of the world (nearly 1500 species distributed in 26 genera) with keys to the genera. The 36 subgenera of *Apion* of the world are briefly diagnosed and illustrated.

Utilizing genitalic and other structures not employed previously, Kissinger has redefined the subfamily to include two tribes, Ithycerini and Nanophyini, which were formerly considered as subfamilies of the Curculionidae. He has an excellent discussion of the structures and characters used, and their importance in this taxonomically difficult group.

The author's methods are thorough, he characterizes all categories (tribes, subtribes, genera, species groups, etc.), and he gives complete citations of types and the literature for species and genera. At the end of the book he lists the higher categories in the world fauna and all the species in North and Central America and some additional notes on the subfamily. This will be the "bible" of the Apioninae for some time to come.

Patricia Vaurie
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Notes on and Descriptions of *Aphelia, Clepsis* and *Choristoneura* Species (Lepidoptera: Tortricidae)

THE LATE NICHOLAS S. OBRAZTSOV[1]

RECEIVED FOR PUBLICATION MARCH 9, 1968

Abstract: Six species of Palearctic *Aphelia* are redescribed. The following new species are proposed: *Aphelia* **galilaeica**, *A.* **ineffecta**, *Choristoneura* **ferrugininotata**, *Clepsis* **vittata**, *C.* **effigies.** Two new combinations in *Choristoneura* are given.

Aphelia accuratana (Kennel)

Figs. 1–2, 15–18

Tortrix praeclarana (non Kennel, 1899), Kennel, 1919, p. 93.
Djakonovia scutellana Obraztsov, 1943, p. 73, fig. 1. Syn. nov.
Aphelia (*Djakonovia*) *scutellana*: Obraztsov, 1955, p. 212; 1957, p. 314.
Tortrix continentana Rebel, 1916, p. 189. Syn. nov.
Tortrix continentana ilienis Rebel, 1916, p. 190. Syn. nov.
Aphelia (*Djakonovia*) *continentana*: Obraztsov, 1955, vol. 98, p. 212.
Aphelia (*Djakonovia*) *continentana* ssp. *iliensis*: Obraztsov, 1955, p. 212.
Tortrix accuratana Kennel: 1901, p. 224; 1910, p. 181, pl. 9, fig. 35.
Aphelia (*Djakonovia?*) *accuratana*: Obraztsov, 1955, p. 212; 1957, p. 314.
Epichorista accuratana: Caradja, 1927, p. 419.

Holotype of *accuratana*: ♂ (slide B.3), Uliassuta, Mongolei, D. 94. Berlin Museum.

Holotype of *iliensis*: ♂ (slide V.1), Asia centr., Ili-Gebiet, Umg. Djarkent, Coll. Wagner. Vienna Museum.

Holotype of *scutellana*: ♂ Of *continentana*: Tannuola, Schawyr, 2500 m, 1914 (Bang-haas). Vienna Museum.

Antenna serrate, pale ferruginous-ochreous; bifasciculate, ciliation 1/1. Labial palpus, head and thorax concolorous. Forewing ochreous, with or without a slightly ferruginous tinge; markings dull gray-ferruginous-brown: an oblique, undulate line, inclined dorso-externad and separating about basal third of forewing; an incomplete, slightly undulate band, start-

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[1] Formerly Research Associate, the American Museum of Natural History, New York. This study has been carried out with a grant of the National Science Foundation. Edited by A. Diakonoff, Leiden, Netherlands, and submitted by Frederick H. Rindge, Amer. Mus. Nat. Hist.

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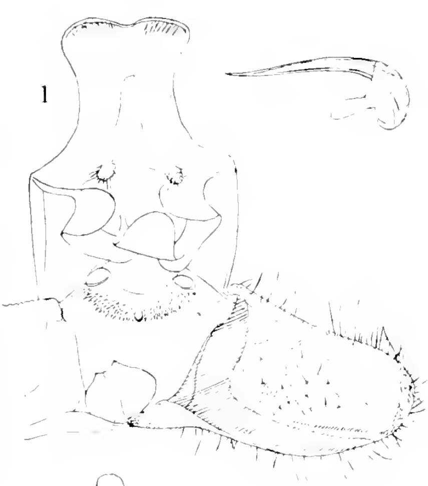
FIGS. 1–7. Genitalia of *Aphelia*. 1. *A. accuratana* (Kennel), male, type, left, aedeagus. 2. *A. continentana iliensis* (Rebel), male, type, left, aedeagus. 3. *A. stigmatana* (Eversmann), male, type, left, aedeagus. 4. The same species, female. 5. The same specimen, bursa copulatrix. 6. *A. imperfectana* (Led.), female, type. 7. The same, holotype, male.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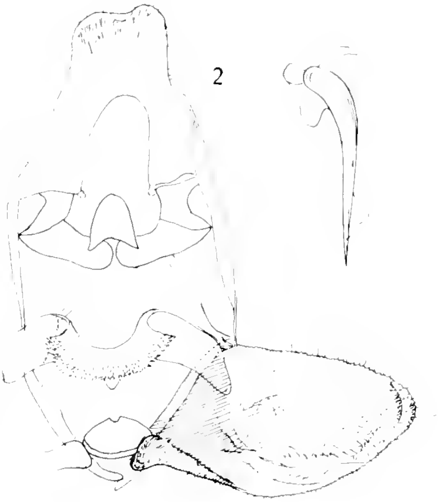
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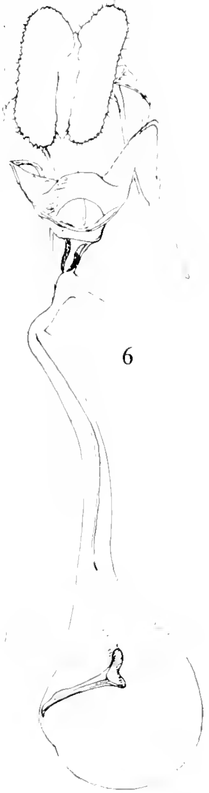
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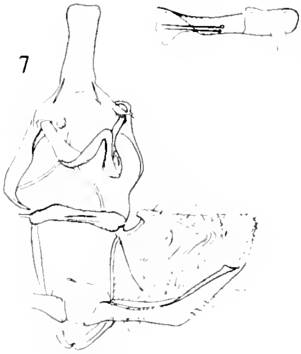
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ing at about middle of costa, directed tornad, crossing end portion of discoidal, and somewhat dilated between veins R_4 and Cu_2; a pretornal spot at dorsum, forming a separated continuation of above mentioned band; a preapical costal spot, tapering apicad, and sometimes including three darker dots; a fine transverse strigulation, especially distinct basally and externally, but not always present; cilia almost concolorous with ground color of wing. Length of forewing: 13–14 mm. Hindwing pale grayish-creamy, slightly more gray dorsobasad; cilia concolorous or slightly paler than ground color, with a faint whitish basal line.

The species is variable and has been described under three different names. The form from Ili province, without a transverse strigulation in the forewings, may probably be separated as a subspecies; but the studied material is not sufficient for this.

Aphelia plagiferana (Rebel)

Antenna brown-ochreous, serrate; bipectinate, ciliation slightly over 1 1. Labial palpus brown on the outside, pale yellow internally. Thorax brown, paler anteriorly; tegulae brown with pale yellow tips. Forewing straw-yellow, finely outlined with brownish-ferruginous along costa, this edge slightly dilated on middle of costa and before apex, thus forming two indistinct costal spots; a large, brown, rotundate spot ventrotornad from end of cell and touching it; cilia concolorous with ground color. Length of forewing 12–13.5 mm. Hindwing pale gray, costa darker; cilia whitish.

The two specimens available are in bad condition. The lectotype consists of the pinned fore part of thorax with head, one fore leg, one middle leg and four wings partly glued together and to the thorax. The lectoparatype consists of four wings joined to a fragment of thorax and a separate head (without antennae and one labial palpus), joined to a piece of thorax with one fore leg. All these parts are pasted to a piece of pinned paper. The lectotype is partly discolored; the forewings of the lectoparatype are better preserved.

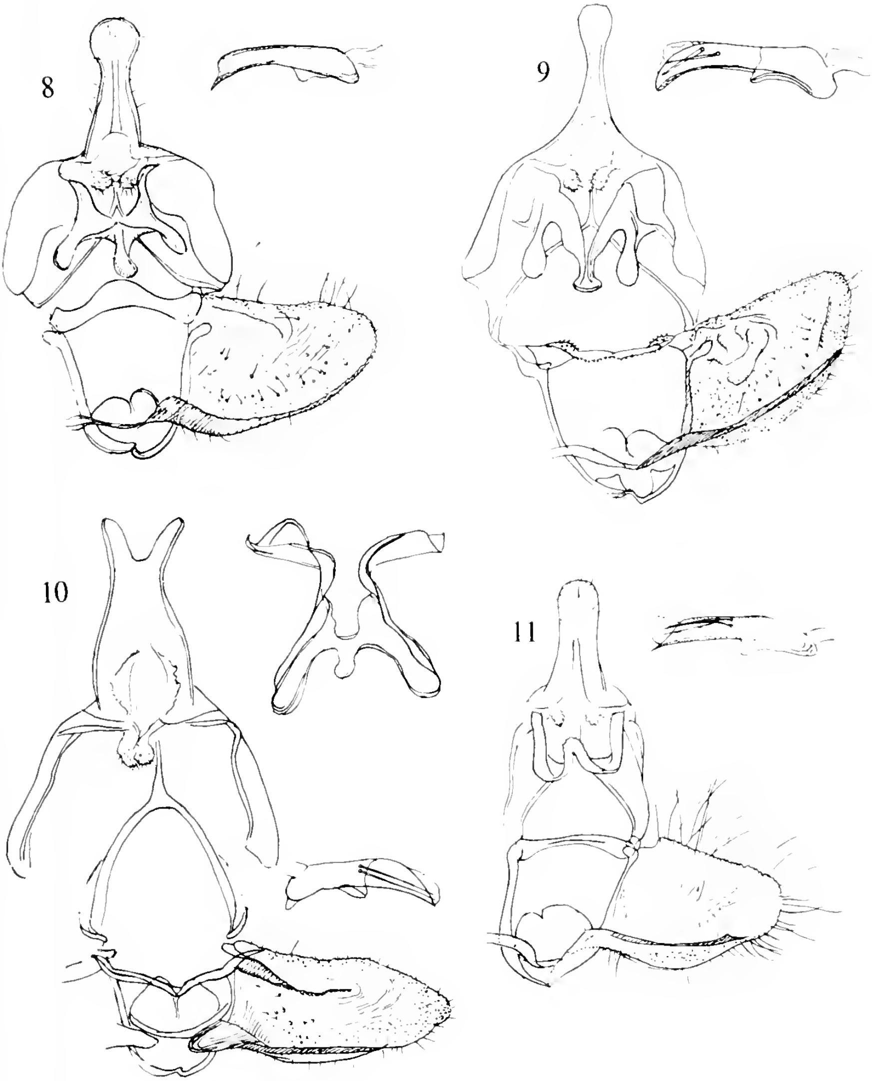
Lectotype: ♂, Ost Tannuola, Schawyz, 2500 m, 1914 (Bang-Haas). Vienna Mus.

Lectoparatype: ♂, same data.

Aphelia phaeana (Rebel)
Fig. 21

Antenna blackish-brown, bipectinate, ciliation slightly over 1. Head and thorax concolorous. Forewing dark gray, with a yellowish silky reflection; cilia slightly paler. Length of forewing: 11 mm. Hindwing concolorous with forewing, but without reflection; cilia paler, with a gray basal line, paler than in the forewing.

The holotype specimen is badly damaged, merely consisting of the four wings and fragments of head, thorax and one leg, all pasted on a piece of corroded paper. The general appearance of the specimen, and the few characters still available for examination speak in favor of attributing the species to *Aphelia*—until more material is found, there cannot be any certainty about the identity and the systematic position of *phaeana*.



Figs. 8–11. Male genitalia of *Aphelia* and *Clepsis*. 8. *A. christophi* Obraztsov, type. 9. *A.* **galilaeica**, new species, holotype. 10. *C.* **effigies**, new species, holotype. 11. *A.* **ineffecta**, new species, male, holotype.

Holotype: ♂, Ost Tannuola, Schawyz, 2500m, 1914 (Bang-Haas). Vienna Mus.

Aphelia stigmatana (Eversmann)

Figs. 3–5

Antenna yellow, with slight ferruginous annulation; in male serrate, with bifasciculate ciliation about 2; in female, simple, with ciliation appressed, under 1, and sparse setae 1. Labial palpus yellow-ferruginous, deeper colored apicad. Head as labial palpi; frons whitish. Tegulae and thorax yellow, becoming more ferruginous towards head. Forewing pale straw-yellow, tinged ferruginous at base of costa and sometimes with a similarly colored spot at the end of cell and in middle of costa; cilia whitish, with a pale grey, faint dividing line. Under side of forewing brown, outlined with yellow on costa, before apex, and along termen. Length of forewing: 12–13 mm. Hindwing pale gray; cilia white, tinged creamy at base.

MALE GENITALIA: Uncus spoon-like, with a narrow stalk and gradually dilated and rounded apically; socii short; gnathos with the median process broad and rounded. Valva moderately long, top broadly rounded, extreme margin slightly inclined, anal angle flatly rounded; sacculus narrow, dilated in anal portion only, reaching to anal angle of valva. Fultura superior rather narrow, spinulate laterally. Aedeagus smooth, slightly curved, with tip acute; many spine-like cornuti over 1/2 (missing in examined slide, but found, as scars, on the vesica, and in the bursa copulatrix of the female).

FEMALE GENITALIA: Lamella antevaginalis stripe-like; lamella postvaginalis with a rounded-angular caudal projection. Antrum rather broad, conical, broader caudally; two large lateral colliculi. Cestum rather broad. Corpus bursae, elongate-ovate; signum with a curved, rather large hood, and an elongate base.

SPECIMENS EXAMINED: 1♂ and 1 ♀ (genitalia on slides 6811 and 6817, respectively), Guberli, ex Christoph Collection. British Museum.

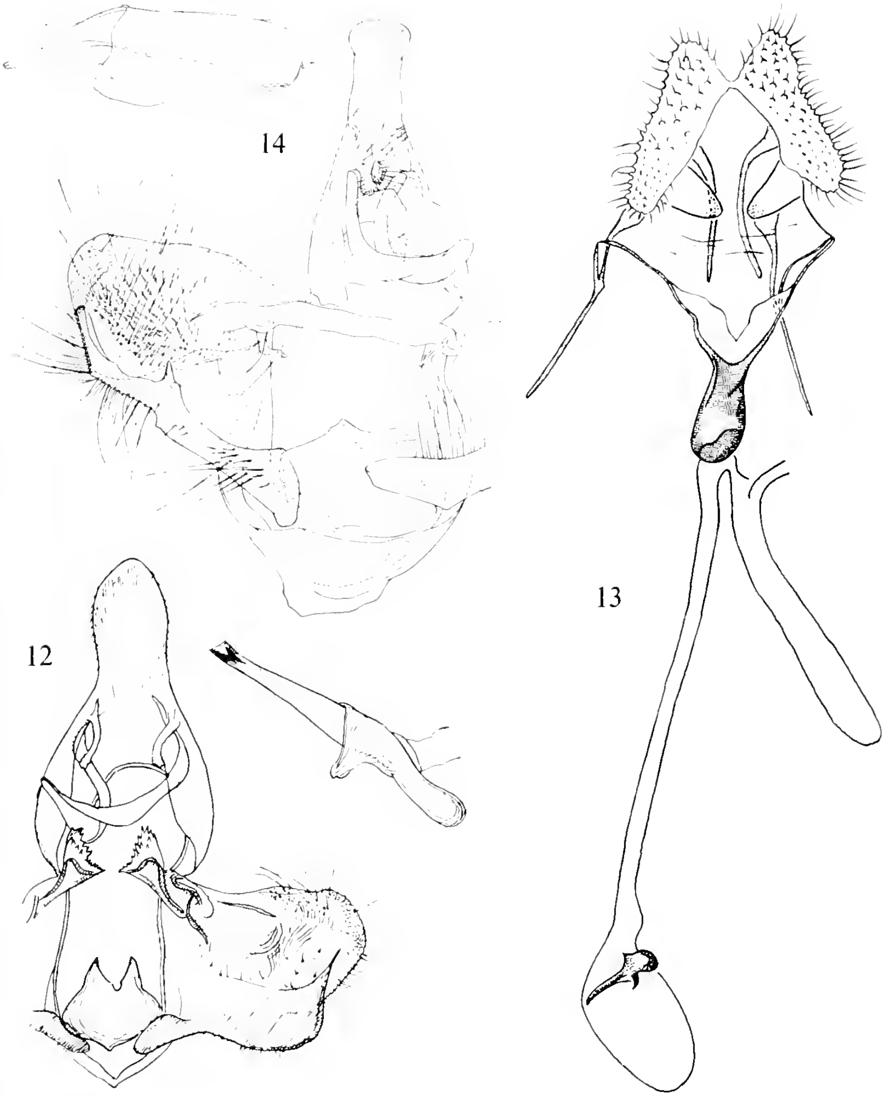
Aphelia **galilaeica,** new species

Figs. 9, 19

MALE: Antenna brownish-yellow, not ringed, underside brown; bifasciculate, ciliation slightly over 1. Labial palpus yellow, the outer side and terminal segment shaded with brown. Head, tegulae and thorax brown-ochreous, with a few occasional whitish scales. Forewing straw-yellow, somewhat more citron-yellow costad, brown at extreme base and slightly ferruginous in basal portion of cell; an oblique, rather broad brownish-ferruginous band running from middle of costa to dorsum just before tornus; its edge rather indistinct, somewhat serrate from inner side and slightly undulate on outer side; a concolorous costal spot in external third of forewing, starting with a darker oblique line, then gradually narrowed and ended shortly before apex of wing; cilia concolorous with ground color and mixed with some citron-yellow scales. Length of forewing 12 mm. Underside of forewing pale brown becoming yellow at costa and dorsum; faint brown spots on costa corresponding with dark markings of upper side. Hindwing greyish-white, suffused with pale greyish-brown. Cilia whitish.

FEMALE: Unknown.

MALE GENITALIA: Uncus spoon-like, with a moderately thick stalk and a rounded apical part; socii short; gnathos with a dilated and rounded median process. Valva moderately long, with a straight costa, a slightly inclined outer margin, and an arcuate rather broad sacculus with a longitudinal marginal rod, extending from the extreme base to the outer



FIGS. 12–14. Genitalia of *Aphelia* **vittata**, new species. 12. Holotype, male. 13. Allotype, female. 14. Genitalia of *Choristoneura* **ferrugininotata**, new species, holotype, male.

margin of valva. **Fultura superior** rather narrow, ends acute, spinulate along its entire length. Aedeagus smooth, slightly down-curved and subacute; cornuti, two spines, less than 1/3.

Holotype. ♂ (slide 6807), Galilee, IV.1886 (Pratt; Leach 60036). British Museum.

Differs from the related species by the distinct oblique brown band of the forewings. The male genitalia are close to those in *stigmatana*, but differ by the shape of valva, the presence of a rod of the sacculus which is remote from the ventral edge of the valva, the more abruptly rotundate top of the uncus, the fultura superior being serrate in the middle, and a less acute top of the aedeagus.

Aphelia **ineffecta,** new species

Figs. 11, 20

MALE: Antenna ochreous with irregular, brownish-ferruginous annulation; serrate; ciliation bifasciculate, slightly longer than 1. Labial palpus brownish-ochreous; terminal segment darker. Head and thorax brownish-ochreous, slightly paler than labial palpus. Forewing straw-yellow; base of costa brown; an indistinct, ferruginous streak from inside of discal cell before its end to tornus; a concolorous streak between veins R_2 and R_3; cilia pale yellow with a straw-yellow dividing line; under surface of forewing brownish-gray, along margins yellow. Length of forewing: 11 mm. Hindwing grayish-white; terminal line darker; cilia white with a gray basal line.

FEMALE: Unknown.

MALE GENITALIA: Uncus spatulate, rounded at tip; socii short; gnathos with middle process obtusely pointed. Valva rotundate-subtriangular; sacculus rather broad, convex at middle, before end with an angulate fold elevated over surface of valva. Fultura superior bar-shaped, slightly curved. Aedeagus smooth, with an acute tip.

Holotype. Male (genitalia on slide 6810), Bescharré, North Lebanon, 1400 m, May 3–10, 1931 (H. Zerny). British Museum.

REMARKS: Similar to *imperfectana* Lederer, and externally not distinguishable from it. Differs in having the tip of the uncus rotundate, the fultura superior narrower and slightly curved, the sacculus of the valva shorter, the external margin of the valva more rotundate, and the acute point of the aedeagus shorter.

Aphelia imperfectana (Lederer)

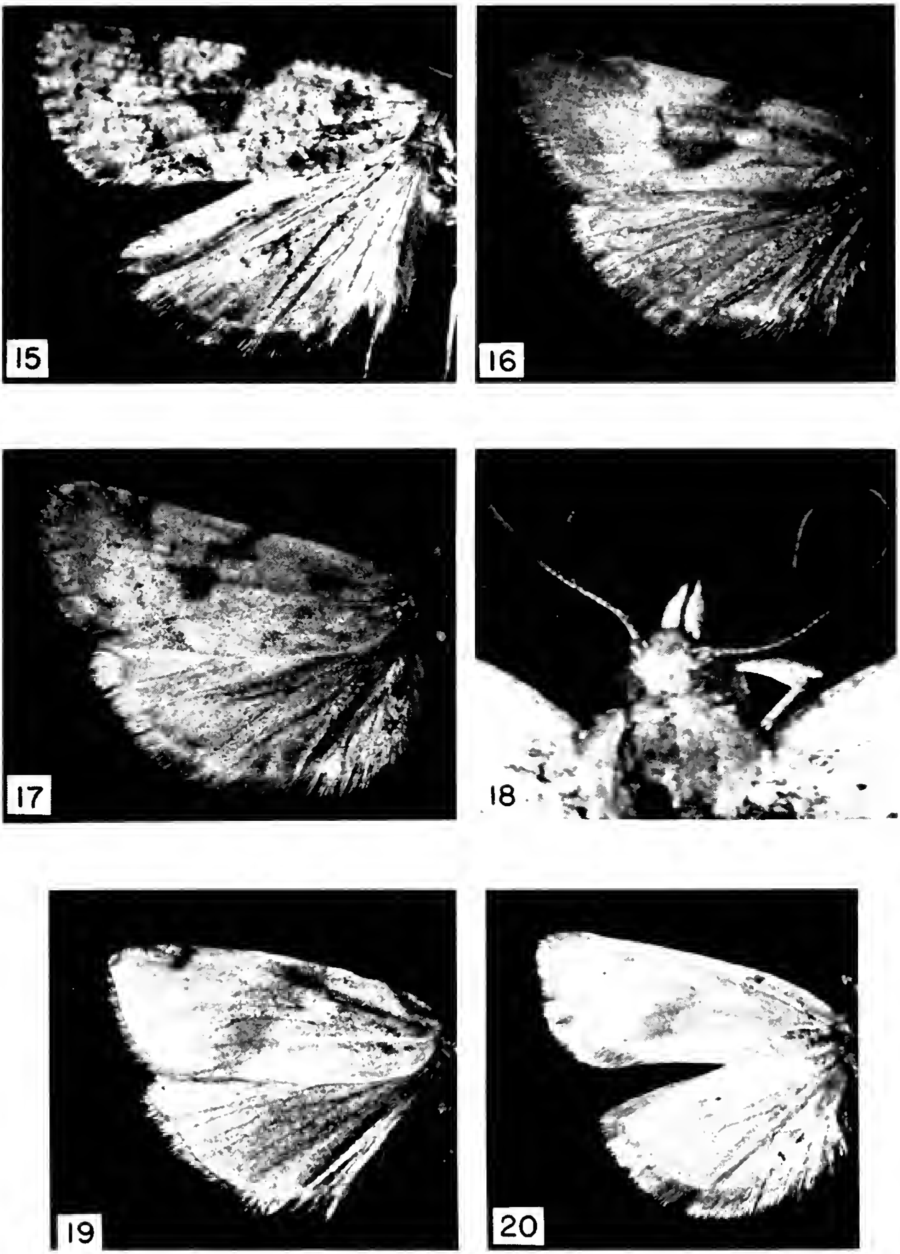
Figs. 6–7

MALE GENITALIA: Uncus spatulate, almost equally broad, with a straight trimmed apex; socii rather short; gnathos with a moderately acute tip. Valva irregularly subtrapezoidal; sacculus rather broad, rotundate, bent, almost reaching external margin of valva, and ending with a tip angularly projected over surface of valva. Fultura superior shaped as a rather broad, at middle slightly narrower bar. Aedeagus smooth, acutely pointed.

FEMALE GENITALIA: Lamella antevaginalis narrow-subtrapezoidal, slightly incurved caudally and straight, lamella postvaginalis with a convex caudal margin. Antrum sub-cylindrical, rounded cephalad, colliculi shaped as two lateral strips. Cestum narrow, not reaching ostium ductus seminalis and cervix bursae. Corpus bursae rotundate; signum with a long, slightly curved hook and an elongate capitulum.

Holotype. Male (genitalia on slide B.5), Beirut, Lebanon; Zoological Museum of Humboldt University, Berlin.

OTHER SPECIMENS EXAMINED: One male (genitalia on slide V.2) and one female (genitalia on slide V.3), Bescharré, North Lebanon, June 3–20, 1931 (H. Zerny). Vienna Museum.



Figs. 15–20. Adults. 15. *Aphelia accuratana* (Kennel), male, holotype. 16. *A. continentana* Rebel, male, holotype. 17. *A. continentana iliensis* Rebel, male, holotype. 18. The same specimen, head. 19. *A.* **galilaeica**, new species, male, holotype. 20. *A.* **ineffecta**, new species, male, holotype.

Aphelia christophi Obraztsov
(= *verbascana* Christoph)
Fig. 8

The original name of this species, *Tortrix verbascana* Christoph (1877), appeared to be homonymous with that of the dubious species *Tortrix verbascana* Schranck (1802), and Obraztsov (1955) proposed the new name *christophi*, consequently. Christoph described the species after a single specimen taken in Sharud, Persia. Therefore, the specimen from his collection, recently deposited in the British Museum and supposedly indicated as "Type," cannot be the holotype, its label reading "Tasch" and in all probability referring to Talysh.

The present author has received from the Zoological Museum of the Humboldt University, Berlin, Germany, a specimen originating from Sharud and identified as *Tortrix verbascana* Christoph. The locality label of this specimen, undoubtedly written by the same hand as most of the specimens in Christoph Collection, reads "Schahrud," but the determination is written in some other hand, and the evidence that this specimen is the holotype, is not complete. The fact that the mentioned specimen originates from the same locality as *verbascana* and is conspecific with this species, gives reason to select it hereby as neotype.

MALE GENITALIA: Uncus rather broad, narrowed before the orbicular tip; socii moderate, rather broad; gnathos with two elongate lateral processes rounded at tips, and a middle process with a slightly dilated rounded tip. Valva widely rotundate-lanceolate; sacculus rather narrow, without free tip. Fultura superior dilated in middle. Aedeagus without any sculpture of the surface.

Obraztsov (1955, 1956) treated *christophi* (= *verbascana*) as a subspecies of *Aphelia paleana* (Hübner), but the differences in the genitalia, especially in the middle process of the gnathos and the aedeagus, the shape of the forewing, and the long ciliation of the male antenna of *christophi* compel me to recognize *christophi* as a separate species.

Neotype, male (genitalia on slide B.4), "Schahrud." Berlin Museum.

OTHER SPECIMEN EXAMINED: Male (genitalia on slide 5310), "Tasch 31.5.71." Berlin Museum.

Choristoneura **ferruginiotata**, new species
Figs. 14, 25

MALE: Antenna pale yellow, fasciculate-ciliated; ciliation about 2, in basal portion of antenna about 1. Undersurface of antenna, palpus, head, and thorax, pale yellow. Forewing without a costal fold, pale yellow, slightly sericeous, with a pale ferruginous suffusion in

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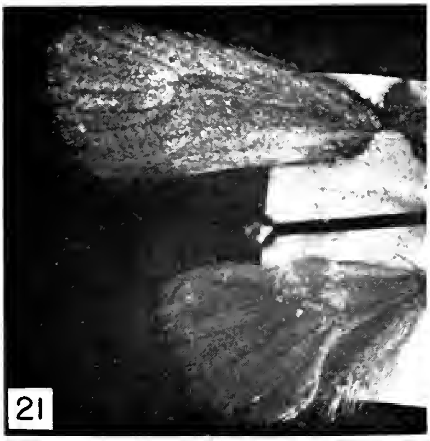
FIGS. 21–25. Adults. 21. *Aphelia phaeana* (Rebel), holotype. 22. *Clepsis* **effigies**, new species, male, holotype. 23. *C.* **vittata**, new species, male, holotype. 24. The same species, female, allotype. 25. *Choristoneura* **ferruginiotata**, new species, male, holotype.



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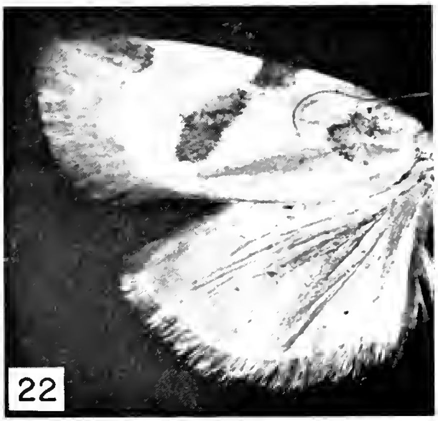

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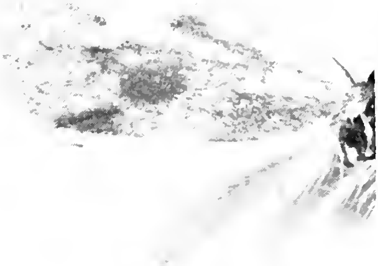

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basal portion and a slight whitish suffusion at middle; an obliterate, ferruginous-ochreous, somewhat undulate band, more distinct and broader in its lower portion, crossing forewing from middle of costa and directed tornad; an obliterate, concolorous, preapical spot on costa; a minute, concolorous, hardly distinguishable dot between preapical spot and band; cilia cream-white, at base yellow. Length of forewing: 12 mm. Hindwing pale grayish cream-white; cilia paler.

FEMALE: Unknown.

MALE GENITALIA: Uncus spatulate, tip gently dilated and rounded. Socii short, slightly pending. Top of middle process of gnathos narrowly rounded. Valva weak, somewhat rotundate, stronger sclerotized in lower basal portion, occupying more than one-third of entire surface of valva; sacculus as long as ventral margin of valva, strongly sclerotized, finely dentate along ventral edge of apical portion, with a strong, dorsal thorn externad of middle, and with an acute tip not separated from surface of valva. Fultura superior, a complete, well sclerotized, straight bar connecting both valvae; fultura inferior trapezoidal, rotundate ventrally. Aedeagus moderately thickened, apically tapering and slightly undulate; sinus penis noticeably sclerotized around most of aedeagus, leaving only its tapering portion uncovered, and fused with a longitudinally prolonged caulis; apparently no cornuti.

Holotype, male (genitalia on slide No. 6808), Kukti, Northwestern Himalayas, 12,000 feet, 1892 (Leach, Walsingham Coll. No. 60516). British Museum. Closely related to *C. griseicoma* Meyrick and *C. neurophaea* Meyrick but differing in the presence of faint ferruginous-ochreous markings in the forewing, the dissimilar dentation of the sacculus, and in the shape of the aedeagus. Superficially it resembles *Aphelia imperfectana* (Lederer).

Clepsis **vittata,** new species

Figs. 12–13, 23–24

Antenna ferruginous-ochreous with yellow annulation, in male slightly serrate at base and tip, bifasciculate ciliation under 1; in female with sparse setae under 1 and short, appressed cilia. Labial palpus 2, brownish ferruginous-ochreous with terminal segment slightly darker. Head concolorous with labial palpus; thorax somewhat paler. Forewing yellow-ochreous with brownish ferruginous markings: an indistinct shadow in basal quarter; a rather broad, well defined fascia, narrow at costa (especially in female) and widened tornad, running from before middle of costa to dorsum slightly before tornus, and in female dark-outlined and with dark striation along veins; external margin of this fascia curved basad before tornus, and slightly serrate in dorsal portion; an oblique preapical streak, in female replaced by a short, narrow streak; some fine, vertical lines between basal shadow and fascia, and externad of latter; terminal line and base of cilia blackish brown; tips of cilia pale yellow. Under surface of forewing brownish ferruginous, in female paler and with indication of middle fascia. Length of forewing: 10 mm. Hindwing pale grayish ochreous; cilia whitish.

MALE GENITALIA: Uncus broad, lanceolate-spatulate; socii narrow, rather long; gnathos with middle process tapering, with a narrow and rotundate tip. Valva broadly subquadrate with a broad, rotundate-subrectangular cucullus; sacculus strong, widened externally, with external angle broadly rotundate; processus basalis strong and broad, ending with an acute lateral tip, and with a high, cucullate and spinulate dorsal portion. Fultura superior narrow, short, membranous; fultura inferior broad, subcordate with upper angles triangular. Aedeagus long, rather slender, widened at middle and gradually narrowed apicad; apex pointed, and accompanied by a dorsolateral spine; coecum penis elongate, connected to a slightly narrower portion of aedeagus; no cornuti detected. Sinus penis clinging to aedeagus; caulis moderately long, rather broad.

FEMALE GENITALIA: Antrum moderately broad, elongate-piriform; lamella postvaginalis deeply and acutely cut out at middle; ductus seminalis discharging directly into portion of ductus bursae covered by antrum; collum of cervix bursae long, without cestum; corpus bursae ovate, rather small; signum large with a narrow, insignificantly curved hook about twice as long as a large, bulbose capitulum.

TYPES: Holotype, male (genitalia on slide 6812), Sarepta; allotype, female (genitalia on slide 6815), Guberli. Christoph Collection, British Museum.
REMARKS: Similar to *praeclarana* Kennel and *fucosana* Kennel, but with the middle fascia of the forewing distinctly narrowed costad and not interrupted vertically. The basal shadow of the forewing is broader than in *praeclarana*. Although the types of the new species originate from two distinct localities, there are no doubts in their conspecificity.

Clepsis **effigies**, new species

Figs. 10, 22

MALE: Antenna pale yellow, fasciculate, ciliation about 1; under surface pale brownish-ferruginous. Labial palpus 2, brownish ochreous, paler on upper edge and under surface. Head ochreous, brownish between antennae. Thorax, patagia, and tegulae straw-yellow. Forewing straw-yellow with brownish markings as follows: an undulate, oblique externad streak from about basal sixth of costa to cubital vein, then turning basad, and halfway not reaching dorsum; a subquadrate spot at about middle of costa, continued as a separated, broad, oblique, slightly curved streak directed tornodorsad and not reaching dorsum; a rather large, elongate-triangular costal spot from about ⅔ of costa to apex; a fine, obliterate line from base of this spot to middle of termen; base and apical portion of costa brownish; cilia straw-yellow at base, paler externad; under surface of forewing yellow, brownish at middle, and whitish at dorsum, with streaks and spots showing from upper surface. Length of forewing: 12 mm. Hindwing pale cream-white suffused with pale brownish-gray, especially along veins; cilia whitish with a pale brownish-yellow dividing line.
FEMALE: Unknown.
MALE GENITALIA: Uncus broad, dilated in basal portion, and ending with a fork; socii moderate, dilated apically; gnathos large with two long and broad lateral processes, and a much shorter middle process, all of them rotundate at tips. Valva elongate, somewhat narrowed and rotundate externally; sacculus rather narrow, tapering apicad; processus basalis subcostal, with interior portion narrow and fused with a curved, bar-shaped fultura superior. Aedeagus smooth, moderately pointed at tip.

Holotype, male (genitalia on slide 6806), Atskhur ("Azkur"), Georgia (Christoph Collection). BM.
REMARKS: Somewhat similar to some specimens of *Aphelia accuratana* (Kennel), but with purer straw-yellow forewing without strigulation, the basal streak turned basad and not reaching dorsum, and the middle fascia consisting of a costal spot and a separate, oblique streak. The male genitalia are rather unique in the genus *Clepsis* Hübner, especially because of a furcate uncus, a trilobate gnathos, and a well developed fultura superior. Perhaps requires a generic separation.

Choristoneura griseicoma (Meyrick), new combination

Tortrix griseicoma Meyrick, 1924, p. 115. Clarke, 1955, p. 150; 1958, p. 240, pl. 120, figs. 1–1b.

Clepsis griseicoma; Obraztsov, 1955, p. 218.

TYPE: Lectotype, male (genitalia on slide 6837, J.F.G.C.), Srinagar, Kashmir, 5200 feet, August 1923 (Fletcher). British Museum.

Choristoneura neurophaea (Meyrick), new combination

Tortrix neurophaea Meyrick, 1932, p. 341. Clarke, 1955, p. 216; 1958, p. 247, pl. 123, figs. 4-4b.

Clepsis neurophaea; Obraztsov, 1955, p. 218.

TYPE: Lectotype, male (genitalia on slide 6834, J.F.G.C.), Killanmarg, Kashmir, 10500 feet, July 1931 (T. B. Fletcher).

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Orientation of Carrion Beetles to Carrion: Random or Non-random?

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Abstract: Carrion-baited ground cans were used to collect carrion beetles in Hutcheson Memorial Forest during the summers of 1961 through 1965. Fingernail polish colors were used to mark the elytra of the carrion beetles utilized in the orientation studies; the release-points of the recaptured individuals were thus identifiable. The rate of return to carrion by *Silpha noveboracensis* from distances of 5 to 75 meters was apparently due to random wandering and not because of orientation to carrion odors. The periphery of odor perception is about 1 meter from carrion when the movement of air is negligible. Carrion beetles were shown clearly to be attracted to carrion. However, the distance of this attraction is much less than what has generally been believed. In this study *S. noveboracensis* was fourteen times more apt to return to carrion than *Nicrophorus* sp. from 5 meters, whereas in a reported New England study these two species were about equally attracted to carrion from the same distance. A much greater overall return of Silphidae in the New England study was reported than is herein observed.

INTRODUCTION

A review of the literature on Silphidae (Coleoptera) gives a distinct impression that the beetles in this family have an extremely keen sense of detecting and locating carrion.

Fabre (1899), when writing about trapping the sexton beetle, observed, "To this carrion, ripened by the sun, the insect will not fail to hasten from the various points of the horizon, so accomplished is he in detecting such a delicacy."

Abbott (1927) said, "The olfactory powers of the Necrophori are certainly remarkable." He also stated, "Normal specimens of *Necrophorus tomentosus* detected meat which was slightly stale and almost certainly placed in situations far from their immediate habitat." In 1937, he spoke of "the ability of the

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adults [of necrophilous Coleoptera] to detect and follow the slightest odor of decaying flesh."

Dethier (1947) said, "The speed with which the insect is able to return to the source of an odor from distances in excess of 15 feet and the high percentage of returns from those liberated at this distance points to the existence of a klino-kinetic mechanism rather than truly random movement."

As recently as 1964 Lanham wrote, "These beetles fly in, apparently from considerable distances, guided by scent."

These studies were originally initiated with the goal of determining the maximum distance from which certain Silphidae would be capable of detecting and travelling to carrion bait. As the work progressed, however, it became increasingly clear that the real question was—Is orientation of carrion beetles to carrion random or is it non-random?

The research was conducted in the William L. Hutcheson Memorial Forest, which is located near East Millstone, Somerset Co., New Jersey. This forest has been relatively undisturbed during the past 260 or more years (Bard, 1952) and is one of the few mature stands of deciduous forest remaining in central New Jersey (Monk, 1957).

METHODS

The beetles were trapped in galvanized, one-gallon cans such as are discarded in large numbers at restaurants and cafeterias. Each can was buried with the open end level with the surface of the soil. To keep out the rain, the open end was covered with a piece of galvanized metal, one foot-square, supported so that there was a clearance of 2 to 4 inches between cover and can (Walker, 1957). This ground can was used in 1963 and 1964. During the summer of 1965 a one-half inch mesh screen cover was fitted to the top of the trapping can (Fig. 1). This served to prevent the loss of carrion, which had been occasionally removed, apparently by carnivorous mammals.

Walker (1957) and Jaques (1915) used fish as bait for the trapping of carrion beetles. Fabre (1899) scattered moles in his orchard for this purpose. Each trap in this study was baited with an uncooked chicken leg ("drum stick"). Chicken legs were used because they were always available, they were suitable attractants of carrion beetles, and they retained some attractant value for 10 or 12 days.

Fingernail polish colors were used to mark the elytra of the carrion beetles. By varying the color of the polish and the location of the markings, it was an easy task to designate the beetles which were to be released at the various points, and thus, to correlate the recaptured individuals with their release-points. A small amount of carbon dioxide from a portable tank was used to temporarily inactivate the beetles in order to mark them.

A total of 460 individuals of the species *Silpha noveboracensis* was marked and released at various distances from the collecting station in 1964. The

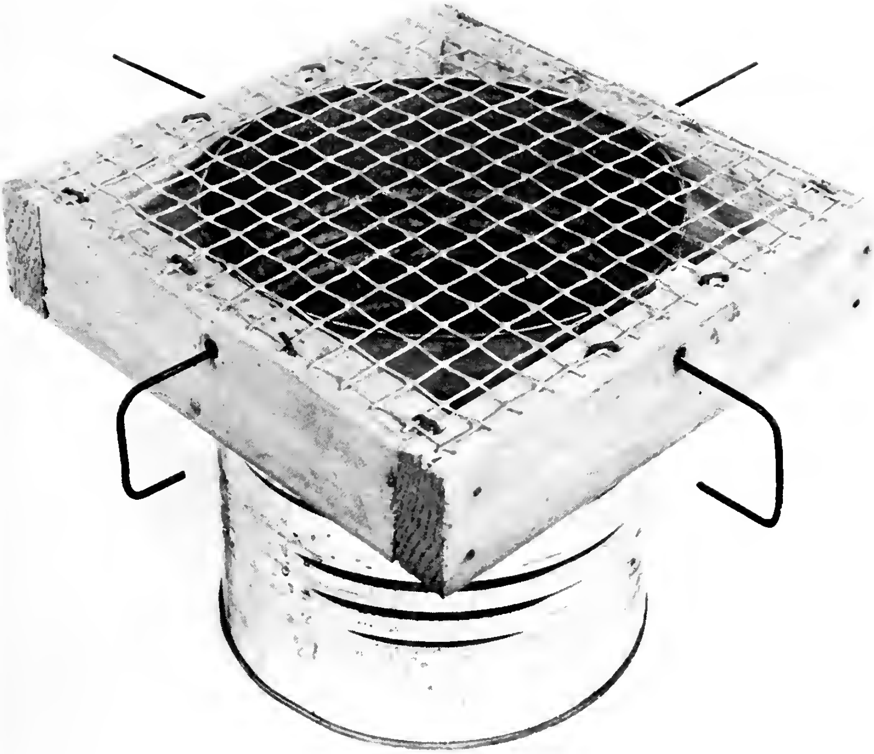

Fig. 1. Ground can with one-half inch wire screen cover to prevent loss of carrion (used in 1965).

station consisted of four ground cans baited with carrion. The individual cans were sunk at points north, east, south and west, each 5.8 meters distant from a central stake. An imaginary circle through the four cans was considered to be the trapping station or trapping circle. Fifty individuals were released east of the trapping circle at distances of 5, 15, 25, 50, 55, 60, 65, and 70 meters, and sixty individuals were released at 75 meters. This furthest release-point was chosen since there had been no return from this distance in a pilot study in 1963 when 76 individuals of this species had been marked and released. Inspection trips to the traps were undertaken every second day from 29 June to 19 July. This arrangement was necessary in order to ensure the capture for marking of a large number of beetles.

During the early part of the summer of 1965 this study was continued. Four new cans were sunk in the ground, similar to the arrangement of the previous year, but each can was situated exactly 5 meters from the central stake.

Twenty marked individuals were released at each 1 meter interval along a line extending from each can to the central stake. The central stake was included as a release-point; there were thus 17 release-points. A total of 80 beetles was released at 1 m, 80 each at 2 m, 3 m, 4 m, and 20 at the central stake. Thus, a total of 340 marked individuals was released. The marking and recapture work was conducted from 29 June to 8 July. Visits were made every second day to the collecting station during the first week and daily during the second week of the study.

During the summers of 1963 and 1964, 205 individuals of the taxon *Nicrophorus* sp. (*N. orbicollis* and *N. tomentosus*) were also marked and released. This taxon was not as abundant as was *Silpha noveboracensis*. As a result, the numbers of individuals released at each release-point were not uniform, and the number of release-points was less. Sixteen individuals were marked and released at 75 m, 30 at 50 m, 65 at 25 m, and 94 at 5 m.

RESULTS

The results of the marking and recapture study when 460 individuals of the species *Silpha noveboracensis* were released are given in Table 1. *S. noveboracensis* showed less than a 2% return from a distance of 75 m and only 28% when released 5 m from carrion. The rate of return from 75 m to 5 m increased linearly as the distance was reduced. These data seemed to suggest that the beetles were not very efficient in so far as orientation to specific carrion odors was concerned. Certainly, odor did not seem very effective in attracting this species at distances of 5 m or more.

Examination of the 1965 data on *Silpha noveboracensis* involving the release of these individuals at close intervals within 5 meters (Figs. 2 and 3) seems to indicate that only at 1 m distance was there a change in response to the carrion bait. At this distance there was a 45%, 50%, 45%, and 55% return at the north, east, south, and west cans respectively for an average return of 48.75%. The results at 2, 3, and 4 meters respectively never exceeded 19%. The mean number of beetles that returned from 2, 3, and 4

Table 1. Mark and recapture study of *Silpha noveboracensis*, 1964

Meters	Number Released	Number Returned	% Return
75	60	1	1.7
70	50	2	4
65	50	1	2
60	50	3	6
55	50	4	8
50	50	5	10
25	50	10	20
15	50	11	22
5	50	14	28

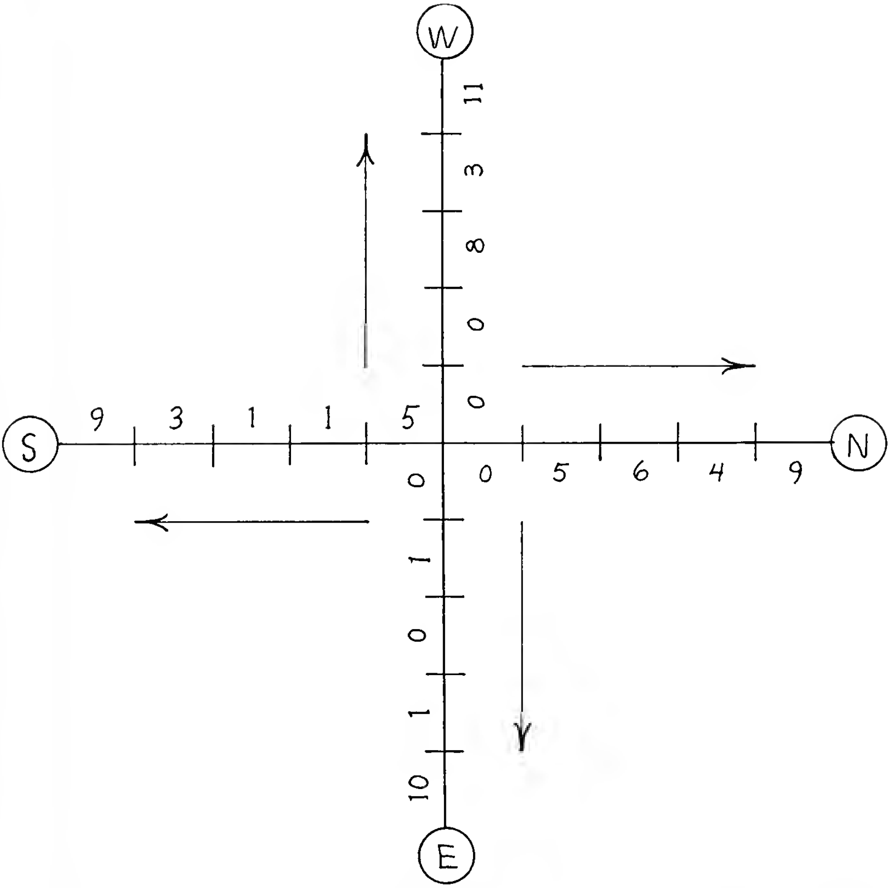

FIG. 2. Recaptures from distances of 1 to 5 meters. A total of 340 individuals of *Silpha noveboracensis* was marked and released for this study.

meters was 11. The number of beetles returning from 1 meter was 39. An average of 39 + 11 = 50 was found. One would thus expect 25 of these beetles to return from 1 m and 25 from the average of 2, 3, and 4 m if one proceeds on the basis of the Null Hypothesis that there is no significant difference in ability to detect carrion at 1 m as compared with 2, 3, and 4 m.

$$X^2 = \frac{(39-25)^2}{25} + \frac{(11-25)^2}{25} = 15.68$$

Since the table of X^2 values shows a value of 3.84, with 1 degree of freedom, at the 5% level of significance, the Null Hypothesis must be rejected and thus, the ability to detect carrion at 1 meter as compared with 2, 3, and 4 meters is significantly higher.

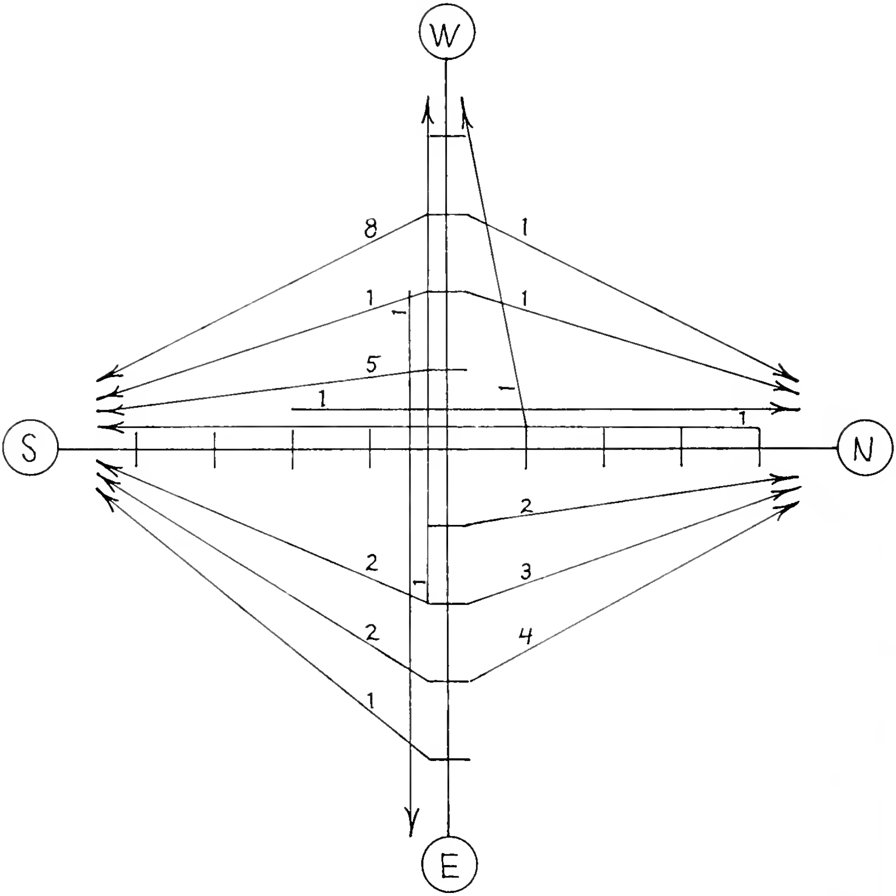

FIG. 3. Recaptures from distances of 5.1 to 9 meters. These results were obtained from the same sample of 340 individuals of *Silpha noveboracensis* mentioned in Fig. 2.

In evaluating these returns, the question arose—was the return random or was positive orientation to carrion involved? One analysis of this question can be made by examining the number of beetles released at 2, 3, and 4 meters that was trapped at the closest cans (from point of release) as compared with the number of beetles released at the same distances that was trapped at the other more distant cans. A total of 33 marked beetles from 240 individuals that had been released at 2, 3, and 4 meters was trapped at the closest cans (Fig. 2). An equal number of marked beetles, from the same 240 individuals, was also taken at the other, more distant cans (Fig. 3). Since the ratio was exactly 1:1 it would seem that this is random return, and not direct orientation, from distances of 2, 3, and 4 meters.

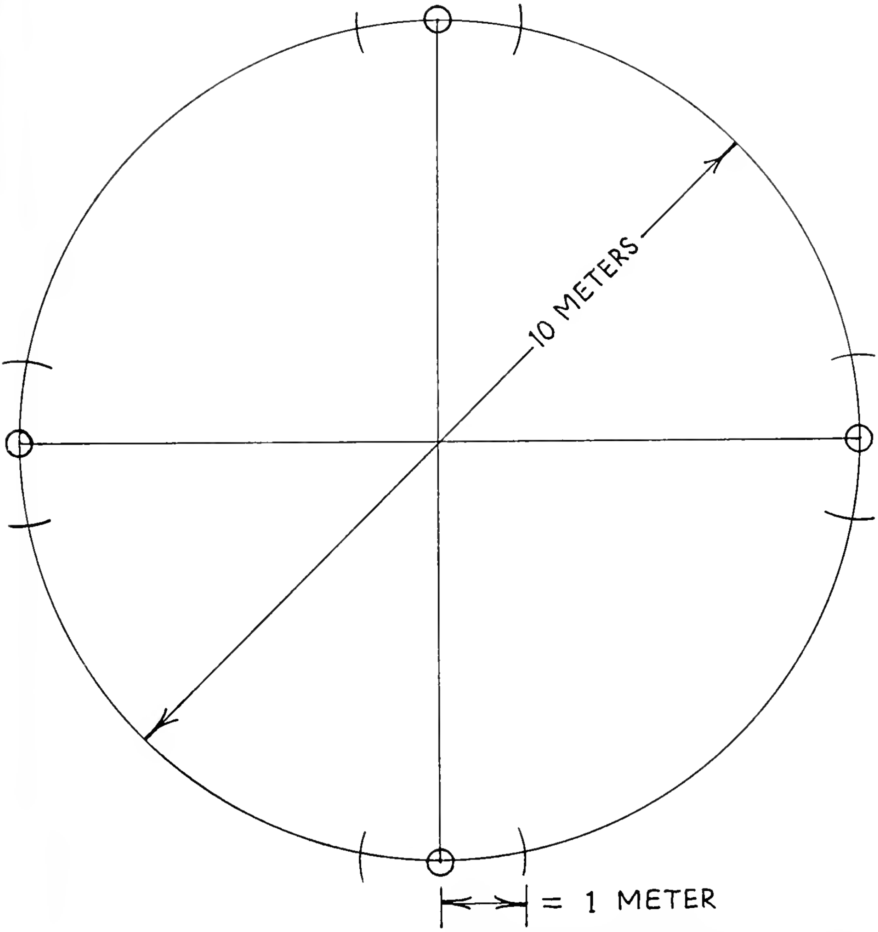

Fig. 4. Determination of that portion of the trapping circle where crossing beetles can come under the influence of carrion odor. $C = \pi D$, $C = 3.14 \times 10$, $C = 31.4$ meters; 2 meters × 4 cans = 8 meters; $\frac{8}{31.4} = 25\%$.

A second approach to the question of random orientation was pursued. Since it is shown that there is a significant difference in ability to detect carrion at 1 meter, a circle can be constructed whose arc goes through the four carrion-baited cans and show that beetles crossing at portions of this arc can detect carrion and be trapped.

To determine that portion of the circle where carrion odor is significant the arcs are marked 1 meter on each side from the center of each of the four cans (Fig. 4). Hence, through 8 meters of the total 31.4 meters (or 25.5%) of the arc, moving carrion beetles can be influenced by carrion odor.

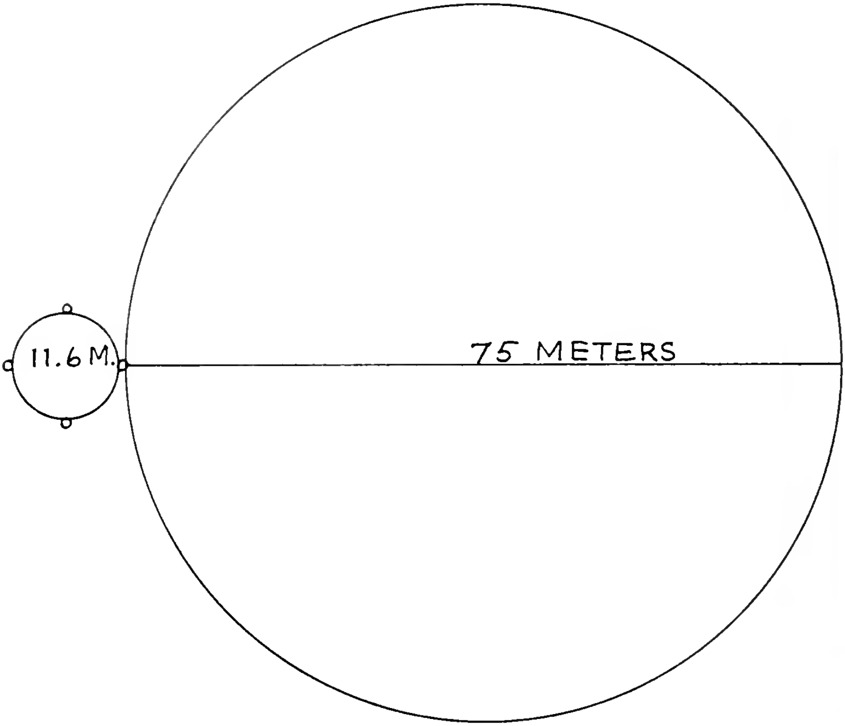

FIG. 5. Determination of the theoretical probability of recapture from 75 meters.
$$\frac{\pi \text{ D (trapping circle)}}{\pi \text{ D (release-point circle)}} \text{ (K)} = \text{P}; \quad \frac{\pi \text{ } 11.6}{\pi \text{ } 75} \text{ (.33)} = \text{P}; \quad .05 = \text{P}.$$

Proceeding on the basis of the Null Hypothesis: If beetles are released within a circle at 2, 3, 4, and 5 meters from carrion-baited cans, they will cross the arc of the circle in a random fashion so that 25.5% of the 260 individuals will cross the circle within 1 meter of any can and be under the influence of carrion odor, whereas 74.5% of the 260 individuals will cross the circle at distances greater than 1 meter from any can and will not be trapped; the computed X^2 was found to be 0.506.

$$X^2 = \frac{(71-66)^2}{66} + \frac{(189-194)^2}{194} = 0.506$$

Since the table of X^2 values shows a value of 3.84, with 1 degree of freedom, at the 5% level of significance, the Null Hypothesis is accepted. This is further evidence that return from 2, 3, 4, and 5 meters is random.

In a paper on movement of Malayan rats Harrison (1958) showed that movement toward a predetermined home range circle was random. He stated that . . . "Since the search is assumed to be random, the rat may be expected

TABLE 2. Actual return compared with theoretical return of 410 individuals of *Silpha noveboracensis.*

Release-point	Actual % Return	Theoretical Probability	±
15 Meters	22.0%	25.8%	+ 3.8%
25 Meters	20.0%	15.4%	- 4.6%
50 Meters	10.0%	7.7%	- 2.3%
55 Meters	8.0%	7.0%	- 1.0%
60 Meters	6.0%	6.4%	+ 0.4%
65 Meters	2.0%	6.0%	+ 4.0%
70 Meters	4.0%	5.4%	+ 1.4%
75 Meters	1.7%	5.0%	+ 3.3%
			± 2.6%

to approach the home circle from any direction, and the important dimension is not the angle subtended by the home range at the point of release (as might be expected) but the circumference of the range compared with the circumference of the circle at that distance from the point of release."

The probability of its discovery is, therefore, π D of home circle / π D of release-point circle. Since the probability of recapture (based on past experience) must be taken into consideration this figure is used as a correction factor (K). We used Harrison's method as evidence to support our hypothesis that the return of *Silpha noveboracensis*, from 5 to 75 meters, in our 1964 study was random return. Our correction factor, based on recapture experience (112/340), was 33.5%.

Figure 5 shows how the probability was derived for the release-point at 75 meters. Since the diameter of the circle at the nearest release-point is less than that of the "trapping circle," the probability of random return was not determined at 5 meters. Probabilities were determined, however, for all other release-points from 15 meters to 75 meters (Table 2).

When the probabilities were plotted against the line showing the actual return, the results were very similar (Fig. 6). The correlation between the theoretical line for random return and the actual line seems to be very good.

The goodness of fit (Dixon & Massey, 1957) of the actual return as it compared with Harrison's theoretical probability for random return was computed using the Chi Square Statistic. The observed figures were derived from the actual return (Table 1) and the expected figures were derived from the theoretical probabilities (Table 2).

$$X^2 = \frac{(11-12.9)^2}{12.9} + \frac{(10-7.7)^2}{7.7} + \frac{(5-3.9)^2}{3.9} + \frac{(4-3.5)^2}{3.5} +$$

$$\frac{(3-3.2)^2}{3.2} + \frac{(1-3)^2}{3} + \frac{(2-2.7)^2}{2.7} + \frac{(1-2.5)^2}{2.5} = 3.73$$

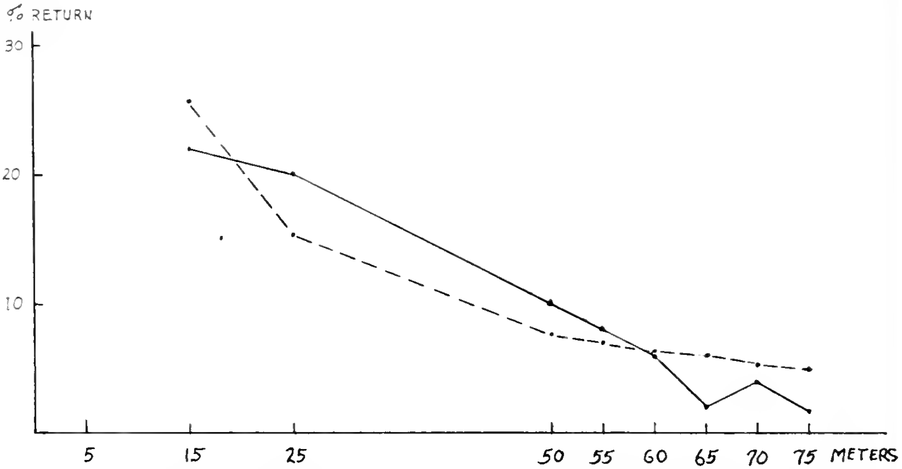

FIG. 6. The solid line shows the actual rate of return from 410 individuals of the species *Silpha noveboracensis*. The dashed-line shows the theoretical line for random return.

Since the computed X^2 is 3.73 and the theoretical X^2, with 7 degrees of freedom at the 5% level of significance, is 14.07, there seems to be a very good fit to Harrison's model for random return. Thus, with 95% probability, the return of *Silpha noveboracensis* to carrion from distances of 5 meters to 75 meters is a random return.

The results of the mark-recapture study of 205 individuals of *Nicrophorus* sp. showed a much lower rate of return than that of *Silpha noveboracensis* (Fig. 7). There was but a 7.1% return from 25 meters in 1963 and a mere 2.1% return from 5 meters in 1964.

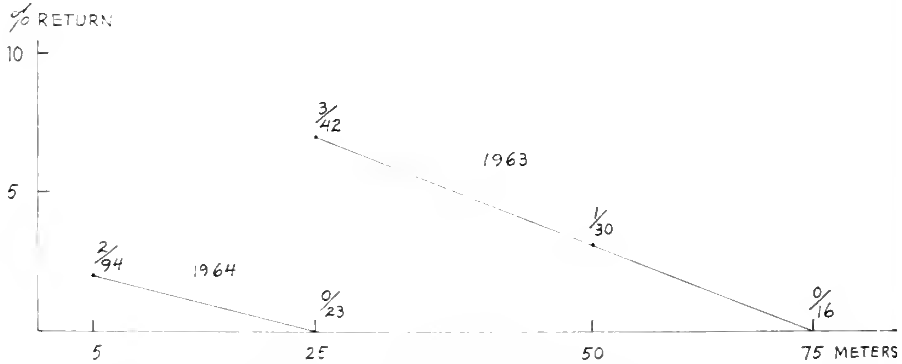

FIG. 7. Individuals of *Nicrophorus* sp. (*N. orbicollis* and *N. tomentosus*) marked and recaptured during 1963 and 1964. The denominator indicates the number marked and released and the numerator indicates the number recaptured.

In general, it seems clear that when wind movement is negligible, as is the case in Hutcheson Memorial Forest (Bruce Wales, graduate student doing research on climatology of Hutcheson Memorial Forest; personal communication), the Silphidae must be very close to carrion in order to detect it.

DISCUSSION

The results of these studies seem to indicate quite clearly that in so far as Silphidae in Hutcheson Memorial Forest are concerned, they are not nearly as efficient in detecting carrion as other populations of Silphidae have been reported to be by other investigators. On the basis of the results obtained in 1964 and 1965, using 800 marked individuals, it seems evident that:

There is a linear relationship in the distance at release and rate of return to carrion by *Silpha noveboracensis* when released at distances from 5 to 75 meters. This is apparently due to random wandering and not because of orientation to carrion odors.

There is a significant increase in ability to return to carrion below 2 meters. The periphery of odor perception seems to be about 1 meter from carrion. It is interesting to note that when working in the forest with carrion beetles, I can detect the presence of carrion at about 25 meters.

The results of the mark-recapture study of *Nicrophorus* sp. were different from the above. The 205 individuals (*N. orbicollis* and *N. tomentosus*) showed a much lower rate of return to carrion. These data seem to indicate random wandering to carrion and possibly a lower rate of activity since both at 25 meters and 5 meters *Nicrophorus* sp. had a much lower rate of return to carrion than *Silpha noveboracensis* (Table 3).

The above results are very different from those obtained by Dethier (1947) in a northern New England conifer forest. I note that the *Nicrophorus* sp. used by Dethier included *N. tomentosus* and *N. vespilloides.* The species *N. tomentosus* was common to both studies.

Two striking observations are evident when comparing these studies:

In the Hutcheson Memorial Forest study, *Silpha noveboracensis* was fourteen times more apt to return to carrion than *Nicrophorus* sp. from 5 meters, whereas in the New England study these two species were about equally attracted to carrion from the same distance.

Table 3. Comparison of orientation results in two different forests.

	New England Conifer Forest (Minimum of 15 Feet)		Hutcheson Memorial Forest (5 meters)	
	number released	percent returned	number released	percent returned
Nicrophorus sp.	70	87.5%	94	2%
S. noveboracensis	20	85.0%	50	28%

In the New England study there was a much greater overall return of Silphidae than that observed in the New Jersey study.

It is possible that this discrepancy is due to the fact that there is very little movement of air in Hutcheson Memorial Forest (Bruce Wales, personal communication). The wind may have played an important part in the high rate of return in Dethier's work. Haskell (1966), in fact, states that . . . "while Dethier (1947) ascribed carcass finding in four species of carrion beetle to a klinokinetic mechanism, his description of the process fits better the idea of odour released anemotaxis."

It is interesting, too, to note that the results that Abbott (1927) obtained relating to the olfactory threshold of the Nicrophori differed so much from those obtained by him in a prior, unpublished study to which he referred. It is possible that different populations of Silphidae develop different patterns of behavior.

One other reason that could possibly explain the high rate of return in Dethier's work is that, for bait, he suspended exposed red squirrel carcasses five feet above the ground. Our carrion-baited can openings, on the other hand, were at the level of the soil surface. It is possible that the surface friction of the soil surface on the air (Geiger, 1965) reduced the movement of air (and odor) directly above the ground which resulted in a lower rate of return in our studies. Since animal carrion normally lies on the ground, it is possible that our results are more realistic.

There is no question but that the carrion-baited cans do attract carrion beetles. In a previous study in Hutcheson Memorial Forest conducted in 1961 and 1963 (Shubeck, 1967), the attraction of carrion bettles to several baits was noted. There was a total of 36 collecting days during that study. Since there were three carrion-baited cans in the trapping circle, a total of 108 can collections were made. A total of 781 Silphidae was collected in these cans. There was thus a 7.2 average for each can collection during the two summers of study. Since each of three replicates in the trapping circle included cans baited with carrion, corn meal, potato, and an empty "control," there were also 108 can collections for corn meal-baited cans, a like number for potato-baited cans, and a like number of collections for empty cans. Not one carrion beetle was ever found in any of these cans. The fact that carrion beetles are attracted to carrion is quite clear. The studies discussed in this paper, however, seem to indicate quite strongly that the distance of this attraction is much less than generally believed.

I intend to continue orientation studies on carrion beetles in Hutcheson Memorial Forest and in other habitats. Experiments will be conducted to (1) demonstrate the nature of the orientation under windy conditions, determining whether it is purely chemotropotactic or if it involves anemotaxis, (2) determine the exact distance, in centimeters, from which the majority of released beetles will return to carrion, and (3) determine the radii of active spaces of decomposition odors in Silphidae in different environments.

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Gynandromorphic *Paleacrita vernata* (Lepidoptera: Geometridae)

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Abstract: Seven specimens of *Paleacrita vernata* Peck, 1795, which have male and female structures combined in single specimens, are described.

A reexamination of *Paleacrita vernata* Peck, 1795 specimens from my collection disclosed seven specimens having both male and female structures. All of these specimens were collected in New Jersey on tree trunks on the dates indicated. Descriptions of these aberrant forms are as follows:

First specimen: Short Hills, March 20, 1945. Abdomen female, antennae male, with short crumpled wings.

Second specimen: Short Hills, March 25, 1950. Abdomen female, antennae male, crumpled primaries only.

Third specimen: Short Hills, March 25, 1950. Abdomen female, antennae male, small stubs of wings.

Fourth specimen: Short Hills, March 28, 1950. Abdomen female, antennae female, wing stubs on left side only, right side normal.

Fifth specimen: Short Hills, April 4, 1950. Abdomen female, antennae female. Primary and secondary on left side fully developed.

Sixth specimen: Short Hills, March 24, 1947. Abdomen female, small wing stub on left and larger crumpled one on right side.

Seventh specimen: Short Hills, March 28, 1950. Abdomen female, antennae male, large wing stubs on both sides.

I am very grateful to Mr. D. C. Ferguson of the Peabody Museum, Yale University, for spending much time analyzing these seven specimens. He dissected the genitalia of the second and fifth specimens, listed above, and found them to have abnormal parts. The genitalia have been retained with the specimens for future study. All seven specimens are now in my collection but will be deposited in the American Museum of Natural History collection.

New Species and Records of Hesperiidae from Mexico (Lepidoptera)

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Abstract: Five new species and seven new records of hesperiids are described from Mexico. The new species, described and illustrated, are *Atrytonopsis* **zweifeli,** *Camptopleura* **oaxaca,** *Decinea* **rindgei,** *Thoon* **wellingi,** and *Urbanus* **hubbellus.** The localities of the new records are given and the previously known localities are included.

Recently I received from the American Museum of Natural History a number of Mexican Hesperiidae for determination. Among these specimens was found five new species and seven new records for Mexico.

In describing the new species where reference is made to the venation of the wings by number, the English system of numbering the veins of each wing from the lowest vein upwards is followed.

Urbanus **hubbellus,** new species

Figs. 1, 2, 15

Male (Upper Side): Primaries dark brown, with some green hair scales near the base. The transverse discal band is made up of four white hyaline spots. The one in space 1b is roundish and situated slightly outward from the spot in space 2. The spot in space 2 is squarish and located just barely outward from the cell spot. The cell spot is broadly columnar, and above this is a broader spot just below the costa. There is a white hyaline spot near the middle of space 3 which is broadly columnar in shape. There are three well defined subapical spots, of the same coloration as the discal spots, in spaces 6, 7, and 8. The two upper ones are approximately the same length, elongated and superimposed, while the lower one is smaller and extends from just under the outer edge of the spot in space 7 outwardly to a little beyond it. The end of the cell and the veins outwardly are slightly darker than the ground color. The fringes are checkered. There is no costal fold present.

Secondaries dark brown, with the cell, the inner two-thirds of the basal area, and along the abdominal fold to the beginning of the tails heavily overscaled with shiny blue hair scales, which become green along the outer edge of this area. The tails are 9 mm long. The fringes above the tails are lightly checkered. The outer margin from the apex to the tail is evenly straight.

Male (Under Side): Primaries pale brown, with the hyaline spots all repeated and of the same white coloration as above. There are scattered whitish scales over the end of the cell beyond the white hyaline spots and towards the outer margin of the wing, and

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[1] The author wishes to thank the National Science Foundation for Research Grant GB-4122 which is making this study of the Hesperiidae of Mexico possible. My thanks also goes to Dr. Frederick H. Rindge, Curator, Department of Entomology, the American Museum of Natural History, for the loan of Mexican specimens from the museum for determination, and for the furnishing of valuable information pertaining to other material. The photographs of the adults used in this article were made by Mr. William L. Skinner, Physics Teacher, Hillcrest High School, Dallas, Texas.


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Figs. 1, 2. *Urbanus* **hubbellus**, new species. Holotype, male, Sinaloa, Sinaloa, Mexico, March–April, 1964 (P. Hubbell; A.M.N.H.).

these group to form an ill-defined white bar at the end of the cell. There is a distinct darker brown band from the costal margin to space 2, outwardly bordering the subapical spots and the spot in space 3, while in space 2 the band is produced inwardly nearly to the base. The inner edge of this dark band is uniformly even but the outer edge is extended slightly along each vein.

Secondaries pale brown, with a slight purplish cast. The subbasal band of dark brown spots is composed of two equal size, squarish spots in space 7; a narrow, white-bordered spot across the cell directly under the space between the two spots in space 7; another somewhat double spot, slightly white bordered below the base of vein 2. There is a dark discal band extending from vein 6 downward where it is white edged at the bottom. The ground color is darker brown over the surface of the tails and extending upward along the outer margin to vein 4, fusing into the discal band except where it is white edged.

Thorax above dark brown, with some blue hair scales present, beneath lighter brown. Abdomen dark brown above heavily overscaled with blue hair scales, beneath lighter brown. Head brown with some intermixed yellowish scales present. Palpi sordid white. There is a whitish band behind and below each eye. Pectus grayish-brown. Legs brown. Antennae, both shaft and club, dark brown above, below lighter with the terminal end of the shaft and club yellowish.

WING MEASUREMENTS: Primaries; base to apex, 20 mm; apex to outer angle, 13 mm; outer angle to base, 13 mm. Secondaries; base to end of vein 3, 12 mm; center of costa to end of tail, 23 mm. Total expanse: 37 mm.

TYPE MATERIAL: Holotype, male, Sinaloa, Sinaloa, Mexico, March–April, 1964, Peter Hubbell, in the American Museum of Natural History, N. Y.

Superficially *U.* **hubbellus** resembles *U. esta* Evans, however there are several ways in which they differ: (1) The cell spot is slightly broader in **hubbellus** than in *esta*; (2) the spot above the cell is broader than the cell spot in **hubbellus,** whereas it is not as broad as the cell spot in *esta*; (3) the subbasal and discal spots and bands on the under side of the secondaries are much larger and more pronounced in *esta* than in **hubbellus;** (4) the marginal area on the under side of the secondaries is darker in **hubbellus** and fuses into the discal band, while this does not occur in *esta*; and (5) the general ground color on the under side of the secondaries is lighter in *esta* than it is in **hubbellus.** The genitalia are not at all like those of *esta* as can be seen in figure 15, plate 3.

Astraptes talthybius (Mabille)

This species was described from a female collected in Brazil and appears to be a rather rare species as yet. Evans records three specimens from the British Museum: 1 ♂, Honduras; 1 ♀, Guatemala; and 1 ♂, Nicaragua. Among the specimens received for determination from the American Museum of

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Figs. 3, 4. *Camptopleura* **oaxaca,** new species. Holotype, male, Soyolapan el Bajo, near Comaltepec, Oaxaca, Mexico, 13 August 1961 (E. C. Welling; A.M.N.H.).

Figs. 5, 6, 7, 8. *Thoon* **wellingi,** new species. 5, 6. Holotype, male, Yetla, near Valle Nacional, Oaxaca, Mexico, 13 September 1961 (E. C. Welling; A.M.N.H.). 7, 8. Allotype, female, same location, 9 September 1961 (E. C. Welling; A.M.N.H.).

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Figs. 9, 10, 11, 12. *Decinea* **rindgei,** new species. 9, 10. Holotype, male, Soyolapan el Bajo, near Comaltepec, Oaxaca, Mexico, 5 August 1961 (E. C. Welling; A.M.N.H.). 11, 12. Allotype, female, Fortin de los Flores, Veracruz, Mexico, 15 August 1967 (H. A. Freeman; H.A F.).

Figs. 13, 14. *Atrytonopsis* **zweifeli,** new species. Holotype, male, 1 mile south Cedritos, Coahuila, Mexico, 23 June 1957 (R. Zweifel; A.M.N.H.).

Natural History was found a female *talthybius* that had been collected at Soyolapan el Bajo, near Comaltepec, Oaxaca, Mexico, 4 August 1961, by E. C. Welling. This is the first record for this species for Mexico.

Potomanaxas unifasciata (Felder)

Described from Colombia, this species has been recorded from Costa Rica, Nicaragua, Colombia, Ecuador (Balzapamba. Paramba. Angamarca), and Peru (El Porvenir) by Evans. There is a female specimen of this species in the American Museum of Natural History from Chiltepec, Oaxaca, Mexico, 23 September 1961, collected by E. C. Welling. This constitutes a new record for Mexico.

Cycloglypha tisias (Godman & Salvin)

The type locality of this species is Costa Rica. Evans records it from the following localities: Costa Rica, Panama, Colombia, Trinidad, Br. Guiana, Fr. Guiana, Eucador (Balzapamba), Peru, Bolivia, Upper Amazona (Iquitos), Maranham, Minas Geraes, and S. Brazil. There is a male specimen of this species in the American Museum of Natural History from Puerto Eligio, near Comaltepec, Oaxaca, Mexico, 30 October 1961, collected by E. C. Welling. This is the first record of this species for Mexico.

Camptopleura **oaxaca,** new species

Figs. 3, 4, 16

Male (Upper Side): Primaries dark brown, with a heavy suffusion of grayish-brown scales from the discal area to the base. There are indistinct submarginal and discal dark markings which are barely discernable. There is a well developed costal fold present. Fringes concolorous with wing.

Secondaries dark brown, with a heavy suffusion of grayish-brown scales from the discal area basad. There are indistinct basal, subbasal, and discal wavy dark lines that are barely discernible due to the heavy over-scaling of lighter gray-brown scales. Fringes concolorous with wing.

Male (Under Side): Primaries light brown, with the slightest indication of marginal and discal markings, and it is slightly lighter in coloration in space 1a.

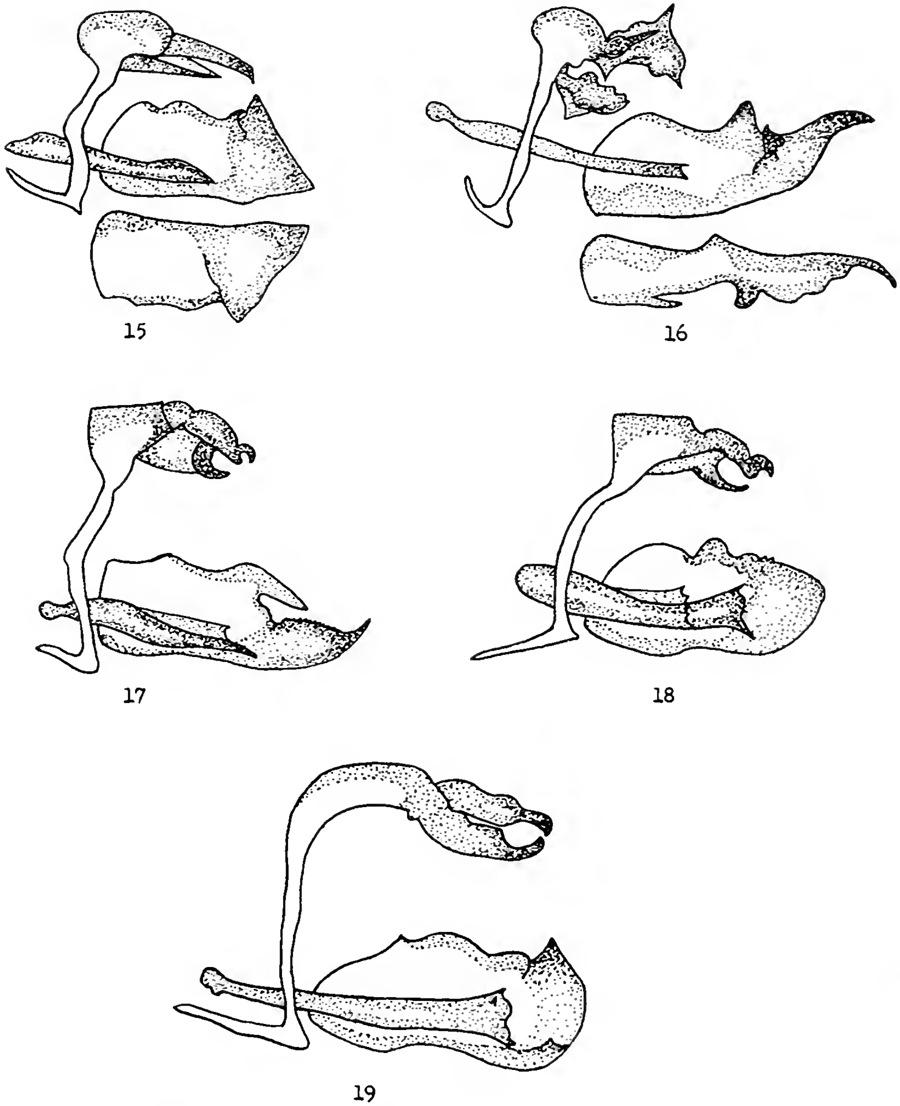
Secondaries uniform light brown, with very faint marginal and discal markings present.

Thorax above dark brown, lighter beneath. Abdomen dark brown above, lighter beneath. Head dark brown. Palpi grayish-brown. Legs brown. Antennae, club and shaft, brown above and below.

WING MEASUREMENTS: Primaries; base to apex, 17 mm; apex to outer angle, 12 mm; outer angle to base, 14 mm. Secondaries; base to end of vein 3, 14 mm; center of costa to anal angle, 12 mm. Total expanse: 35 mm.

TYPE MATERIAL: Holotype, male, Soyolapan el Bajo, near Comaltepec, Oaxaca, Mexico, 13 August 1961, collected by E. C. Welling, is in the American Musuem of Natural History.

The nearest related species to *C.* **oaxaca** is *C. janthinus* (Capronnier) from the Upper Madeira River, Amazonas, Brazil, from which it can be sepa-



Figs. 15–19. Male genitalia. 15. *Urbanus* **hubbellus,** new species, Holotype, Sinaloa, Sinaloa, Mexico, March–April, 1964 (P. Hubbell; A.M.N.H.). 16. *Camptopleura* **oaxaca,** new species, Holotype, Soyolapan el Bajo, near Comaltepec, Oaxaca, Mexico, 13 August 1961 (E. C. Welling; A.M.N.H.). 17. *Thoon* **wellingi,** new species, Holotype, Yetla, near Valle Nacional, Oaxaca, Mexico, 13 September 1961 (E. C. Welling; A.M.N.H.). 18. *Decinea* **rindgei,** new species, Holotype, Soyolapan el Bajo, near Comaltepec, Oaxaca, Mexico, 5 August 1961 (E. C. Welling; A.M.N.H.). 19. *Atrytonopsis* **zweifeli,** new species, Holotype, 1 mile south Cedritos, Coahuila, Mexico, 23 June 1957 (R. Zweifel; A.M.N.H.).

rated by the following characteristics: (1) **Oaxaca** is dark rich brown above, while *janthinus* is black; (2) on the lower surface of the secondaries *janthinus* is dark brown with a purple gloss, while **oaxaca** is light brown with no purple gloss; (3) the average size of the primaries of *janthinus* is 19 mm, while the primary of the type of **oaxaca** is 17 mm; and (4) differences in the genitalia.

This new species differs from the other members of the genus *Camptopleura* by having the palpi and pectus below brown and not white as is found in *theramenes* (Mabille), *auxo* (Moschler), *impressus* (Mabille), and *termon* (Hopffer). There are other differences as can be determined in the above description.

Aecas aecas (Stoll)

There is but a single species in this genus and Evans records it from the following locations: Guatemala, Nicaragua, Colombia, Venezuela, Trinidad, Br. Guiana, Fr. Guiana, Amazons (Tonantins to Para), and S. Brazil (Espirito Santo). Among the specimens determined for the American Museum of Natural History was found 3 ♂♂ of this species that had been collected by E. C. Welling at the following locations: 1 ♂, Chiltepec, near Chiltepec, Oaxaca, Mexico, 20 September 1961; 1 ♂, Yetla, near Valle Nacional, Oaxaca, Mexico, 11 September 1961; and 1 ♂, same location, 13 September 1961. These are the first records of this species from Mexico.

Nastra l'herminieri (Latreille)

This species occurs rather commonly in the United States from the eastern states westward to Texas. So far there have been no accurate records of this species from Mexico. In specimens determined for the American Museum of Natural History was found two examples of this species from the following location: 1 ♀, Colima, Col., Mexico, March 1918; and 1 ♀, same area January 1918 (C. C. Hoffmann). This is another new record for Mexico.

Cymaenes laureolus (Schaus)

This species is not common, however it has a rather wide range. Evans records it from: Costa Rica, Panama, and Ecuador. Dr. Rindge kindly sent me a ♂ from Coatepec, Veracruz, June 10, and 2 ♂♂ from Panama for study, and he stated that there was another ♂ in their collection from Coatepec, Veracruz, and other specimens from Panama. In addition to the two ♂♂ in the American Museum of Natural History from Coatepec, Veracruz, I have two specimens of this species that I collected at the following locations: 1 ♀, Fortin de los Flores, Veracruz, Mexico, 15 August 1967; and 1 ♀, Xicotepec de Juarez, Puebla, Mexico, 16 August 1967. These four specimens appear to be the only known records of this species from Mexico thus establishing another new skipper record for that country.

Thoon **wellingi,** new species

Figs. 5, 6, 7, 8, 17

Male (Upper Side): Primaries dark brown, with no brands present. There are white hyaline spots in spaces 2 and 3, with the one in space 2 narrow and linear, and the one in space 3 rounded. There is a minute white dot in space 6, and a small upper cell spot. There is a semi-hyaline yellow dot in space 1b, directly below the spot in space 2. Fringes are concolorous with the rest of the wing.

Secondaries dark brown, unmarked. Fringes concolorous with rest of the wing.

Male (Under Side): Primaries dark brown, somewhat lighter in space 1b, and also near the apex. All spots reappear and the yellow spot in space 1b is better defined than above. There is a purplish gloss over the apical region.

Secondaries deep chocolate brown with a heavy purple gloss over all but spaces 1a and 1b. There is an evenly curved row of five yellow discal spots and a minute one in the cell.

Thorax dark brown above and below. Abdomen dark brown above, slightly lighter beneath. Head dark brown with some dark green scales present. Palpi mingled light brown and gray. Legs dark brown. Antennae, club and shaft, dark brown above, club yellowish beneath.

WING MEASUREMENTS: Primaries; base to apex, 16 mm; apex to outer angle, 11 mm; outer angle to base, 11 mm. Secondaries; base to end of vein 3, 10 mm; center of costa to anal angle, 12.5 mm. Total expanse: 32 mm.

Female (Upper Side): Primaries dark brown, similar to the male except the spots are all slightly larger and there is a minute dot in space 7. Fringes concolorous with rest of wing.

Secondaries dark brown, with an indistinct curved row of yellowish discal spots. There is a very minute yellowish cell spot. Fringes concolorous with rest of wing.

Female (Under Side): Primaries dark brown, with a broad yellowish-white area in space 1b. There is a heavy purple gloss over all of the upper two-thirds of the wing. All spots reappear, and there is the slightest indication of a tiny lower cell spot below the distinct upper one.

Secondaries dark chocolate brown, with a heavy purple gloss present over all of the wing except spaces 1a and 1b. There is a well-defined, evenly curved, row of 6 yellowish discal spots, and one in the cell.

Thorax dark brown, with some green hair scales present above, below dark brown. Abdomen dark brown, both above and below. Head dark brown, with a few green scales present. Papli mingled light brown and gray. Legs brown. Antennae, shaft brown above and below; club, brown above, lower half yellow below, remainder brown.

WING MEASUREMENTS: Primaries; base to apex, 17 mm; apex to outer angle, 11.5 mm; outer angle to base, 12.5 mm. Secondaries; base to end of vein 3, 12 mm; center of costa to anal angle, 12 mm. Total expanse: 33 mm.

TYPE MATERIAL: Holotype, male, Yetla, near Valle Nacional, Oaxaca, Mexico, 13 September 1961. Allotype, female, same location, 9 September 1961. Both collected by E. C. Welling, and are in the American Museum of Natural History.

The nearest related species to *T.* **wellingi** is *T. aethus* Hayward from which it can be separated by the following characteristics: (1) The ♂ ♂ of *aethus* have two cell spots, while **wellingi** has only a small upper one; (2) on the under surface of the primaries *aethus* has the outer half of spaces 1a and 1b conspicuously white, while this area is less conspicuous in **wellingi** and more yellowish; (3) the purple gloss is heavier in **wellingi** on the under surface of the wings than it is in *aethus*; (4) the discal spots on the under surface of the secondaries are yellowish and much more pronounced in **wellingi** than they are in *aethus* where they are white and vestigial; and (5) the genitalia are quite different.

I take pleasure in naming this new species for Sr. Edwardo C. Welling of Merida, Yucatan, Mexico, who collected the specimens.

Decinea **rindgei**, new species

Figs. 9, 10, 11, 12, 18

Male (Upper Side): Primaries dark brown. There is a large white hyaline spot in space 2, and a smaller one in space 3. There are two apical spots, one in space 6, and another much smaller one in space 7. There is a semi-hyaline, yellowish spot in space 1b. There is no cell spot. Fringes light brown.

Secondaries dark brown, with some slightly lighter hair scales near the base. There is a small white hyaline spot in space 3, and an indistinct small spot in space 2. The fringes are light brown.

Male (Under Side): Primaries chocolate brown, slightly lighter along outer margin and near the apex. There is a broad yellowish area in space 1. All spots reappear.

Secondaries chocolate brown, slightly lighter along the outer margin. There is a white cell spot, and two white discal spots of about equal size, one in space 2 and the other in space 3.

Thorax both above and below dark brown, with a few yellowish hair scales present. Abdomen dark brown both above and below. Head dark brown with a few yellowish scales present. Palpi intermixed yellow and black. Legs brown. Antennae missing.

WING MEASUREMENTS: Primaries; base to apex, 17 mm; apex to outer angle, 11 mm; outer angle to base, 12 mm. Secondaries; base to end of vein 3, 12 mm; center of costa to anal angle, 12 mm. Total expanse: 35 mm.

Female (Upper Side): Primaries dark brown. The spot arrangement and size is very similar to that of the male. Fringes light brown.

Secondaries dark brown. There is the slightest indication of a cell spot. There is a minute white discal spot in space 3. Fringes light brown.

Female (Under Side): Primaries are very similar to the male.

Secondaries dark chocolate brown. There is a clear white cell spot, and a clear white discal spot in space 3.

Thorax, abdomen, head, palpi, and legs same as in the male. Antennae: shaft brown above, yellowish below except the lower one third which is brown; club above yellowish at base remainder black, below yellow except under apiculus where it is brown.

WING MEASUREMENTS: Primaries; base to apex, 18 mm; apex to outer angle, 12 mm; outer angle to base, 14 mm. Secondaries; base to end of vein 3, 13 mm; center of costa to anal angle, 13 mm. Total expanse: 35 mm.

TYPE MATERIAL: Holotype, male, Soyolapan el Bajo, near Comaltepec, Oaxaca, Mexico, 5 August 1961, collected by E. C. Welling, in the American Museum of Natural History. Allotype, female, Fortin de los Flores, Veracruz, Mexico, 15 August 1967, H. A. Freeman collector, in the collection of H. A. Freeman. One female Paratype, Catemaco, Veracruz, Mexico, September 1962, in the collection of Dr. Tarsicio Escalante, Mexico, D. F.

This new species is more closely related to *D. percosius* Godman than to any of the other known species, however it differs in the following ways: (1) **Rindgei** has the ground color on the under side of the secondaries chocolate brown, while in *percosius* this area is lighter brown and overscaled with ochreous scaling; (2) the males of *percosius* rarely have a spot in space 1b on the upper side of the primaries, while this spot is present in **rindgei;** (3) on the lower surface of the primaries *percosius* has a restricted whitish area in space 1, while in **rindgei** this area is much more extensive and is yellowish; and (4) there are basic differences in the genitalia .

I take pleasure in naming this new species for Dr. Frederick H. Rindge, Curator, Department of Entomology, American Museum of Natural History.

Halotus angellus (Ploetz)

This rare species was described from Chiriqui, Panama. Evans recorded it from Costa Rica and Panama. In the American Museum of Natural History there are two males of this species from Rancho Santa Lucia, Sinaloa, Mexico, October 1964, collected by Peter Hubbell. This constitutes another new Hesperiidae record for Mexico.

Atrytonopsis **zweifeli,** new species

Figs. 11, 12, 19

Male (Upper Side): Primaries brown. There is a very narrow indistinct stigma from base vein 3 to mid vein 1, broken at vein 2 and mid space 1b. There is a large discal spot in space 2, which is overlapped by the fused double spots in the cell. In space 3 there is a very narrow elongated spot which curves outward at the lower end. There are three minute apical spots in a straight line in spaces 6, 7, and 8. All spots are white hyaline. Fringes concolorous with rest of wing.

Secondaries brown, unmarked. Fringes white.

Male (Under Side): Primaries brown. All spots reappear and are somewhat better defined than above. There is a yellowish-white area in space 1b beneath the spot in space 2. There is a light overscaling of white scales near the apex.

Secondaries dark brown, lightly overscaled with white scales. There is a dark discal band and a similar subbasal band which contrasts slightly with the dark ground color of the wing. The white fringes extend nearly to the base of the wing along the costal area.

Thorax dark brown above and below. Abdomen dark brown both above and below. Head dark brown, sordid white at base of eyes. Palpi intermixed sordid white and dark gray. Legs brown. Antennae; shaft brown above and below, club black above being somewhat lighter at the base, below lower half yellow and the remainder black, the apiculus is brown.

WING MEASUREMENTS: Primaries; base to apex, 19.5 mm; apex to outer angle, 14 mm; outer angle to base, 13 mm. Secondaries; base to end of vein 3, 13 mm; center of costa to anal angle, 14.5 mm. Total expanse: 38 mm.

TYPE MATERIAL: Holotype, male, 1 mile south Cedritos, Coahuila, Mexico, 23 June 1957, collected by R. Zweifel, in the American Museum of Natural History. One male Paratype, Durango-Villa Union Highway, Rt. 40, Sinaloa, Mexico, 29 April 1966, collected by Peter Hubbell, in the American Museum of Natural History.

The nearest related species to *A.* **zweifeli** is *A. lunus* (Edwards). The following characteristic separate the two species: (1) The ground color of **zweifeli** is slightly darker than *lunus* both above and below; (2) *lunus* has the spot in space 2 situated in the center beneath the spot in space 3 and the fused cell spots, while **zweifeli** has the spot in space 2 situated under the outer half of the cell spots; (3) *lunus* has the spot in space 3 oval and better defined than in **zweifeli** where this spot is very linear and indistinct; (4) the apical spots are much larger in *lunus* than they are in **zweifeli;** (5) the fringes of the secondaries are clearer white in **zweifeli** than they are in *lunus*; and (6) there are differences in the genitalia.

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Food Gathering Behavior of the Ant, *Camponotus noveboracensis* (Fitch) (Hymenoptera: Formicidae)[1]

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Abstract: A study of the food gathering behavior of a single colony of *Camponotus noveboracensis* (Fitch) revealed that its food sources, during the period studied, were the honeydew produced by the membracid, *Vanduzea arquata* (Say), the sap exudate flowing from a wound in the trunk of a common lilac, *Syringa vulgaris*, and the carcasses of dead insects. The behavior of the worker ants in exploiting each of these sources is discussed in detail.

INTRODUCTION

Camponotus noveboracensis (Fitch) is a nearctic ant that can be found from coast to coast across North America, mainly at latitudes between 40° and 48° N (Creighton, 1950). While similar in appearance to *C. herculeanus*, *C. noveboracensis* was recognized as distinct from the former species by Creighton in 1950. Indeed, this ant has a confusing taxonomic history, beginning in 1879 when Forel overlooked Fitch's original description and redescribed the ant as *C. herculeanus* subsp. *ligniperda* var. *pictus*. *C. noveboracensis* has a dark red thorax and petiole and a black head and gaster and can be distinguished from *C. herculeanus* by, among other things, its relatively longer antennal scapes (see Creighton, 1950, for a detailed discussion of the differences between these species). While elements of the biology of *C. noveboracensis* have been discussed by Talbot (1934, 1965), Gregg (1944, 1963), Kannowski (1959), and Sanders (1964), little information has appeared on its feeding behavior. Sanders (1964) did discuss its food sources briefly, and Jones (1929) listed aphid species from which *C. noveboracensis* gathers honeydew excretion. Also, Buckingham (1911) recorded a series of observations on foraging and trophallaxis by this species (as *C. herculeanus pictus*).

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The present investigation provides data on the food gathering behavior of a single colony of *C. noveboracensis.* This colony was observed to have three food sources: (1) the honeydew excretion of the membracid, *Vanduzea arquata* (Say); (2) the sap exudate from a wound in the bark of a common lilac, *Syringa vulgaris*; and (3) the carcasses of dead insects. Each of these sources is discussed in detail.

METHODS

The observational portion of this investigation was carried out in the fall of 1967 from 4 September to 12 November. Observations were made daily and included meteorological data. Regular counts were made of both ants and membracids, and a series of the ants was dissected in the laboratory in order to examine and measure their crops. Head measurements of these ants were made following the method defined by Wilson (1964).

RESULTS AND DISCUSSION

Description of Ant Colony.

The colony investigated was located beneath and probably within the framework of a house in a residential district of Ithaca, New York. While *C. noveboracensis* has been reported from a great variety of habitats, this particular location is somewhat unusual. There are no reports in the literature examined of this ant being a house pest, although closely related species, *C. pennsylvanicus* (DeGeer) and *C. ferrugineus* (Fabricius), do invade such wooden structures (Smith, 1965). *C. noveboracensis* is most often found in "dead wood of standing or prostrate trunks" (W. M. Wheeler, 1910), and has been reported to invade live trees of balsam fir, *Abies balsamea* (L.) (Sanders, 1964). In addition, colonies have been found in the soil alone (Talbot, 1965) and have been twice taken on the grasslands of North Dakota in cow dung (G. C. Wheeler, 1963). This ant has been reported from boreal forests (Sanders, 1964), swamps and marshes (Talbot, 1965), tamarack bogs, fields, forest margins, oak forest, beech-maple forest (Gregg, 1944), pine dunes and black oak forest on sand (Talbot, 1934), aspen forest, ponderosa pine forest, Rocky Mountain Birch grove (Gregg, 1963), pioneer dunes and along the rocky shore of Lake Superior (Gregg, 1946).

Only two foraging trails were observed coming from the colony under study. Both of these trails were permanent and both issued from the same opening beneath a concrete sidewalk adjacent to the house. One trail led to a series of membracid aggregations and the other, running more or less perpendicular to the former, led to a lilac bush. Other foraging trails were searched for but none were found. It is certainly possible that these ants were also foraging beneath the house for various arthropods. A number of individuals would occasionally stray from the trail leading to the lilac and appeared to be engaged in general foraging. This straying behavior is similar to the trail "leakage" phenomenon discussed by Holt (1955) for *Formica rufa* and may account for the discovery of insect carcasses which are carried back to the nest. When the ants' foraging activities finally ceased (30 October) an unsuccessful attempt was made to reach the colony's actual location.

Ant-membracid Commensalism.

The aggregations of the attended membracid, *Vanduzea arquata* (Say), were located on a small common locust tree, *Robinia pseudoacacia* L. This tree was 1.73 m. high and of two parts, each entering the ground separately, but most likely sharing the same root system. The circumference, at ground level, of the main trunk was 5.08 cm. and that of the secondary trunk was 2.54 cm. A Taylor maximum-minimum self-registering thermometer was suspended from the main trunk at a height of 100 cm.

V. arquata is sexually dimorphic and easily sexed in the field. The females are brown with yellowish white markings, while the smaller males are dark brown (almost black) with small whitish markings. This membracid is widely distributed throughout the United States and is abundant in the Cayuga Lake basin. Its biology has been reported on in detail by Funkhouser (1915, 1917) who has described it as being "decidedly gregarious" (1915). Males, females, and nymphs of various instars aggregate into small clusters, usually at the bases of branches. Oviposition occurs at three distinct times during the year: the middle of June, the end of July and in September (Funkhouser, 1915). Funkhouser (1915) reports the following ants attending *V. arquata* in the Ithaca area: *Formica obscuriventris* Mayr, *Formica exsectoides* Forel, *Camponotus pennsylvanicus* (De Geer), *Crematogaster lineolata* (Say), *Prenolepis imparis* (Say).

Because the membracids aggregate at more or less permanent locations, these sites can be permanently tagged and observed. Four clusters were recognized at first, three on the main trunk or its branches at heights of 69 cm., 81 cm., and 124 cm. from the ground and one on the secondary trunk at a height of 76 cm. Individual strays and small clusters of two or three individuals were common but not permanent in location. Three additional clusters were discovered on 4 October. None of these had existed previously. Strays of both membracids and ants were occasionally counted in order to assess the total number of individuals on the tree. Group counts were begun on 9 September and were ended on 10 November and were made approximately every two days.

Figure 1 (the reader is cautioned that the scale of the abscissa is not linear, i.e. equal distances along the abscissa do not represent equal numbers of days) graphs the total numbers of *C. noveboracensis* workers and *V. arquata* males, females, and nymphs counted in the four tagged aggregations at each observation. The number of attending ants is strongly correlated with the number of membracids in each aggregation with a correlation coefficient of .973. This

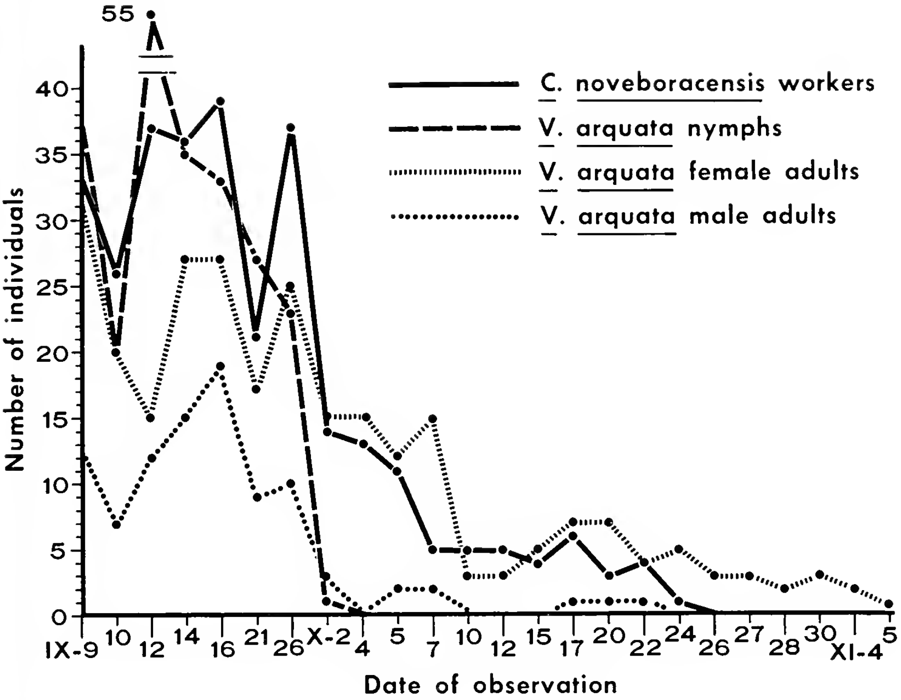
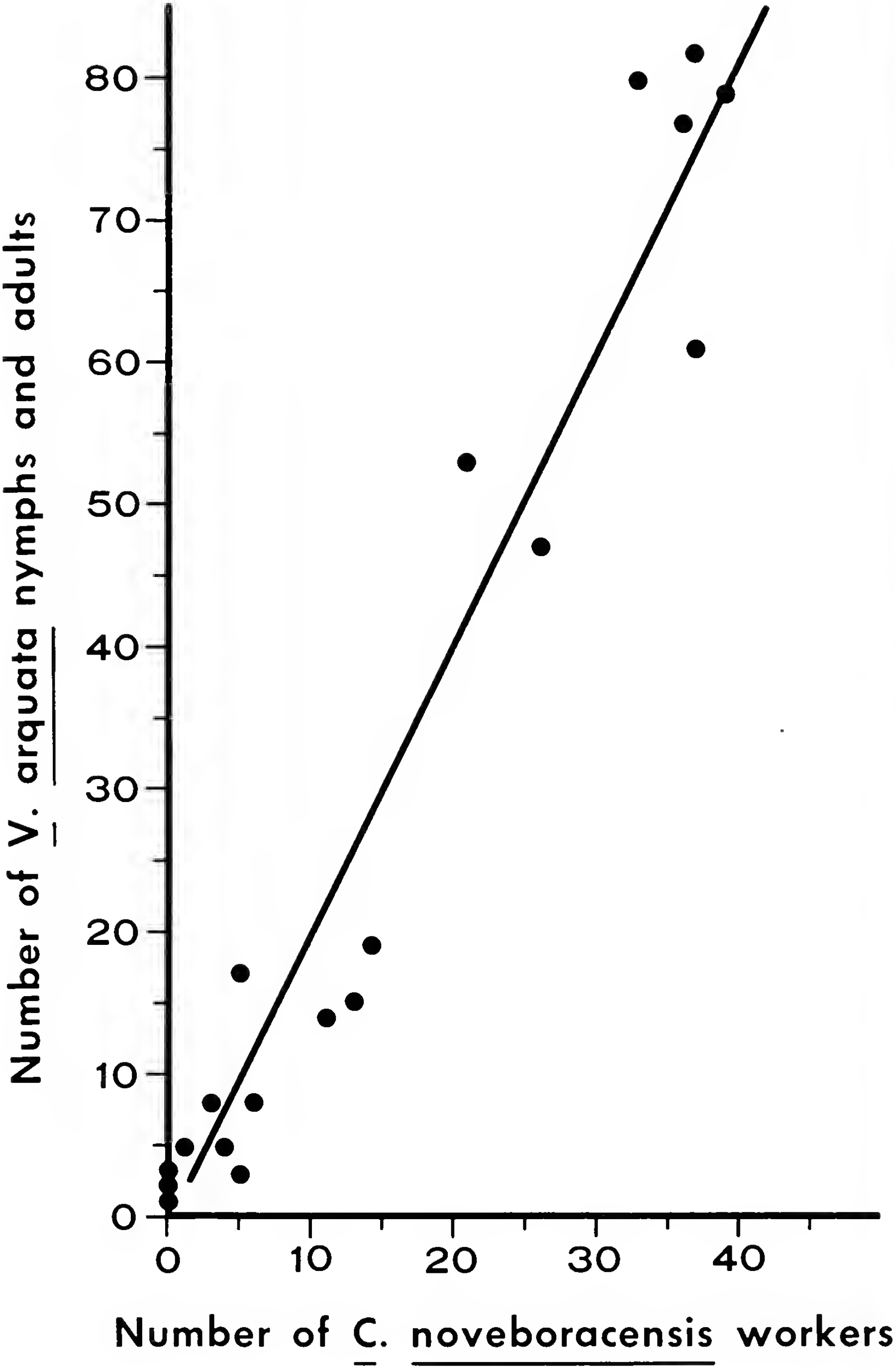


Fig. 1. Total numbers of *C. noveboracensis* workers and *V. arquata* males, females, and nymphs counted in four tagged aggregations. Roman numerals on abscissa indicate the month (the scale of the abscissa is irregular).

correlation is further illustrated by the scatter diagram and regression line in Figure 2. Evidence of this correlation was also seen in other counts made of three additional clusters and in counts made of strays. Andrews (1929), in his investigation of the relationship between *V. arquata* and *Formica exsectoides*, found "no fixed relationship of number between" these two species nor did he report any linear relationship at all between numbers of ants and membracids found together.

As the fall season progressed the total numbers of individuals steadily decreased (Fig. 1). For the ants and female membracids this decrease began after 26 September, for the male membracids after 16 September and for the membracid nymphs after 12 September. On 4 October three other clusters were found, and the formation of these clusters probably accounted for the initial decline in numbers at the original sites, at least for ants and female membracids. On 26 September there were 37 ants and 28 female membracids present in the original four aggregations. On 4 October there were 13 ants and 15 female membracids at these locations, while on that same date in the three new aggregations there were 13 ants and 16 female membracids. The totals of these figures



Number of V. arquata nymphs and adults
0
10
20
30
40
50
60
70
80
Number of C. noveboracensis workers
0
10
20
30
40

for 4 October are close to the totals for 26 September. In each case these figures do not take into account individual strays. The formation of the new clusters cannot account for the changes in numbers of membracid males or nymphs. The total number of males in the original four groups went from 19 individuals on 6 September to 0 on 4 October, while in the three newly formed aggregations, only one male was seen. Between 12 September and 4 October the number of nymphs in the original aggregations went from 55 to 0 individuals. No nymphs were ever seen in the newly formed aggregations, although one was found as a stray on 7 October.

The increases and decreases in numbers of membracid individuals in the groups examined would indicate that they are quite mobile, although Funkhouser (1915) stated that they remained at one location for long periods of time. The males seem especially mobile. They were seen to fly away from and arrive at the locust tree quite regularly. They also appeared more active within the aggregations. The adults are quite prone to hop off the tree if abruptly disturbed by touch or by rapid movement of the branches. This is also recorded by Andrews (1929) and Funkhouser (1915).

The fluctuations in numbers of nymphs are difficult to explain. The nymphs are cryptically colored, and all instars (a total of 5), thus including the very small, can be found within a single aggregation. Both of these factors can lead to counting errors. But the sharp increase from 20 individuals on 10 September to 55 on 12 September is probably not due to counting error. Since the nymphs were never counted on the basis of instar, this addition of 35 individuals may have been from a newly hatched brood, although this does not seem to fit Funkhouser's (1915) oviposition schedule. Even more difficult to explain is the sudden decrease of nymphs from 55 individuals on 12 September to 0 on 4 October. It would not appear from examing adult counts that these nymphs were maturing and moulting into adults, unless these adults migrated immediately. Nor would it seem probable that the nymphs themselves were moving off the tree. The nymphs are far more sedentary and gregarious than the adults. It should be noted that because of these nymphal characteristics, very few stray nymphs were ever found and the counts in the original four aggregations probably are a good estimate of total number of nymphs on the tree. Predation by membracid enemies or by the attendant ants may account for this sudden drop in numbers of nymphs, but such predation was never observed. Andrews (1929) reported that dead or severely injured *V. arquata* individuals are carried off as food by the attendant ant *Formica exsectoides*.

Never at any one point in time did the number of male membracids total more

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FIG. 2. Relationship of total numbers of *C. noveboracensis* workers to total numbers of *V. arquata* nymphs and adults in four tagged aggregations.

than the females (Fig. 1). This is true for the original four aggregations, the three newly formed aggregations and for the smaller groups and strays. This is in direct contradiction to Funkhouser's (1915) observations. He reported that in the fall the males are more numerous than the females, and he regularly observed a ratio of five to one.

During this investigation the temperature ranged from 30°C to –4°C. The last nymph was recorded on 10 October, the last male on 22 October, the last female on 10 November and the last *C. noveboracensis* worker on 28 October. One light snowfall occurred on 8 November. Funkhouser (1915) reported *V. arquata* present to late October.

On 26 October two specimens of the ant *Prenolepis imparis* (Say) were observed on the main trunk of the locust tree. There were only three specimens of *C. noveboracensis* present. Although *P. imparis* was observed foraging on the ground around the locust tree during the entire investigation, it was never seen on the locust while *C. noveboracensis* was present in large numbers. As many as 14 *P. imparis* were observed (28 October) attending the membracids. The last *P. imparis* was seen on 10 November. This increase in activity on the part of *P. imparis* not only corresponds to the decrease in numbers of *C. noveboracensis*, but also to a general lowering in the daily air temperature. Talbot (1943) described *P. imparis* as a cold weather ant and found that this ant reaches its peak of foraging activities at temperatures between 45° and 60°F. At the time 14 *P. imparis* workers were counted, the air temperature was 42°F.

In collecting honeydew from homopterans, ants have been most generally described as stimulating the individual homopterans with stroking movements of their antennae. Wheeler (1910) speaks of this stroking behavior as antennal caresses, and both Funkhouser (1915) and Andrews (1930) described this in particular for ants attending *V. arquata*. Andrews (1930) described in detail the honeydew reflexes of *V. arquata* and the soliciting behavior of *Formica fusca* L. *V. arquata* nymphs produce droplets of honeydew by extending and raising the tip of their abdomen. The adults raise the tip of their abdomen but also rise up on their legs, inclining themselves anteriorly downward. These droplets are produced regardless of whether there are ants in attendance or not. Andrews (1930) reported that honeydew is produced without a detectable external stimulus, although the nymphs can be induced to produce droplets by touching them with forceps, various brushes, or amputated ant antennae. Attendant ants actually touch the membracids with their antennae and palpi. *C. noveboracensis* was observed in this investigation to move rapidly over the membracids touching them or just waving over them with their antennae and palpi. The antennae are generally waved up and down alternately. Andrews (1930) found no indication that *F. fusca* stimulated *V. arquata* to produce honeydew droplets in any precise way, and a similar conclusion was reached in this investigation for *C. noveboracensis*. Droplets are produced by the membracids even in the absence of ants, but the stroking by the ants might conceivably increase the rate of droplet formation.

Both Funkhouser (1915) and Andrews (1930) reported that the nymphs produced more droplets than the adults, and Andrews recorded a female giving a total of 10 drops to attendant ants (*F. fusca*) in a period of 42 minutes. He also recorded one nymph giving 5 drops in 46 minutes, another 4 drops in 50 minutes, and another 5 drops in 35 minutes. His data do not support his conclusion that the nymphs produced droplets more often. The male was not recorded.

The present investigation found the following droplet production rates: on 16 September (24°C) a nymph was found to produce 39 droplets in 23 minutes, with an average time interval between droplets of 36 sec.; the shortest interval was 1 sec. and the longest 3 min. 18 sec.; an adult female was found to produce 35 droplets in 24 minutes with an average time interval between droplets of 43 sec.; the shortest interval was 9 sec. and the longest 1 min. 55 sec.; and on 20 September (26°C) a nymph was found to produce 36 droplets in 19 minutes with an average time interval between droplets of 33 sec.; the shortest interval was 1 sec. and the longest 2 min. 50 sec.; an adult female was found to produce 36 droplets in 25 minutes with an average time interval between droplets of 50 sec., the shortest interval was 15 sec. and the longest 2 min. 34 sec. These figures indicate that the nymphs are producing more droplets than the adult females at the temperatures indicated. But they also suggest that the ants are receiving much more honeydew from the female adult than was indicated by Andrews (1939, 1930) and Funkhouser (1915). Andrews did not mention male droplet production, and it should be noted that in this investigation the males were never observed to give droplets of honeydew to the workers of *C. noveboracensis*. Within the aggregations the males were moving about often, crawling over the more sessile females and were quite easily disturbed. It would appear that the honeydew gathered by the ants comes almost exclusively from the nymphs and female adults. Andrews (1929) noted that the droplets formed by the adults (no reference to sex) were often smeared between the tips of the wings, but this phenomenon was never observed in this study.

Besides actually soliciting and gathering honeydew, three other behavior patterns were noted for the ant workers on the tree. One was a "searching" pattern, in which workers ran out on leaves and leaflets near membracid aggregations, and the others were self-grooming and food transmission or trophallaxis. Both self-grooming and trophallaxis were prevalent in the activities surrounding the membracids. Regurgitative feeding and crop storage are important social functions in the biology of ants (Eisner, 1957), and once food is returned to the nest, food transmission can occur at a rapid rate within the colony (Wilson and Eisner, 1957). All workers on the locust tree appeared to participate in food transmission and all seemed to collect honeydew. Buckingham (1911) observed trophallaxis in this ant and concluded that no single size group of individuals could be the sole regurgitators. All sizes of the workers were involved in food transmission (though Buckingham willingly admitted that the direction of transmission was difficult to determine), although the larger workers did more soliciting for and receiving of food because they did less collecting.

A total of 28 workers returning to the nest from the membracid aggregations captured at random over a period of 14 days (from 11 to 24 September) were dissected in order to examine their crops. Over the same period of time 22 workers going from the nest to the membracids were collected and dissected. The head length and width for each of these workers was measured and the cephalic index (HW / HL × 100) was computed for each. The crops and gasters were arbitrarily classified as belonging to one of four conditions: crop empty, crop partially full, crop full but gaster not distended, and crop full with gaster distended (the crop could be observed only by carefully removing the tergites and sternites of the third and fourth abdominal segments; in lateral view the crop was then measured across its widest point perpendicular to the longitudinal axis of the ant). In the latter two cases the viscera were pushed back by the full crop into the last two visible segments of the gaster. When the gaster was distended the tergites were pulled from one another, as were the sternites, stretching the intersegmental membranes and giving the gaster a translucent quality. The workers going to and from the membracids had a mean head length of 1.67 mm., a mean head width of 1.54 mm., and a mean cephalic index of 91. The significance of these figures will be apparent when they are later compared with those of the ants gathering sap exudate. The mean crop width of those workers going to the membracid aggregations was 0.51 mm., while that of the returning workers was 1.50 mm. Of the 22 workers going to the membracids, five had crops which were partially full, the remaining workers had empty crops. Of those workers returning to the nest, one had an empty crop, four had partially full crops, ten had full crops without the gasters being distended, and thirteen had full crops and distended gasters. Five of the ants returning to the nest were collected at 2300 hours (Eastern Standard Time) on 26 September, and four of the five had full crops. As will be pointed out later, ant activity slows at night, but the collection of honeydew probably continues at a slow rate. Although it would appear that all workers are collecting honeydew, some return to the nest with their crops only partially full. Though this may or may not indicate a partial division in labor in collecting honeydew, it gives no indication of what may be the stimulus for returning to the nest.

Several factors—light, temperature, wind velocity and precipitation—play a role in governing the honeydew soliciting and collecting activities of the ants, either directly, or indirectly by affecting membracid behavior. The individual effects of each of these factors cannot be clearly defined. It is particularly difficult to separate the affects of temperature and light, although it was generally observed that ant and membracid activity decreased at night and with lower temperatures. *C. noveboracensis* attended *V. arquata* 24 hours a day. At night and in conjunction with lower temperatures, the membracids and ants became lethargic and often remained motionless for long periods of time. Andrews (1929) reported also that *Formica exsectoides* attended *V. arquata* overnight and that some ants moved back and forth to the nest. While it is clear that in the fall *C. noveboracensis* is primarily diurnal in its foraging habits, other species of *Camponotus* reach the peak of their foraging behavior at night. Pricer (1908) reported that *C. pennsylvanicus*, a closely related species to *C. noveboracensis*, is most active at night in gathering honeydew from aphids, and Gupta (1963) found that the common black ant of India, *C. compressus* (Fabricius), is negatively phototropic and reaches the peak of its foraging activity at 4 o'clock in the morning. This latter ant, however, is most likely avoiding the intense heat of the tropical day.

Rain was found to inhibit the activities of both *C. noveboracensis* and *V. arquata*. During rain both the membracids and the ants migrated to the undersides of the branches (*V. arquata* is normally found on the upper surfaces). The ants remain still, and no honeydew is collected. Andrews (1929) found a similar reaction on the part of *F. exsectoides* to rain but made no reference to the membracids. Wind was also observed to inhibit activity. Neither the membracids nor the ants could move about easily in strong wind, and both were observed to be blown from the tree under such conditions. Gupta (1963) recorded a similar drop in activity for *C. compressus* during times of increased wind velocity.

The flow of individual worker ants, either to or from the nest, past a particular census point was used as an index to the level of their activity while collecting honeydew. These observations were made during 30 minute units with the air temperature being recorded at the end of each unit. The time interval between each ant (traveling in the same direction) was recorded. The ant trail leading to and from the locust tree was 6 meters long from the point of exit to the bases of the tree. Half of the trail was generally exposed and on the surface of the sidewalk. The other half ran, only semi-exposed, through thick grasses. The flow census point was marked at about midway along the trail. The time that it took to travel the trail distance of 6 meters was recorded for four workers going to the locust tree and four workers returning to the nest. For those going to the tree, the times were 5 min. 18 sec., 6 min. 28 sec., 5 min. 36 sec., and 7 min. 17 sec. for a mean time of 6 min. 10 sec. For workers returning to the nest, the times were 5 min. 35 sec., 5 min. 33 sec., 6 min. 00 sec., and 6 min. 07 sec. for a mean time of 5 min. 49 sec. Workers of *C. noveboracensis* occasionally strayed from the trail and did not follow it with great facility. This was particularly true after rain, when many individuals apparently experienced great difficulty staying on the trail at all. This may indicate that this ant relies heavily on chemical cues in trail following. Workers were occasionally observed removing small stones from the trail.

The peak rates of flow corresponded well with the peaks in population density within the four original ant-membracid aggregations (Fig. 1). These corresponding peaks occurred on 9 September, 12 to 16 September, and 26 September. The flow of workers was never greater than 1.06 per minute, and this occurred at the highest temperature recorded in any of the observational units. Andrews (1929) made some trail counts of *F. exsectoides* going to and from *V. arquata* aggregations, but for several reasons (different time of year, lack of recorded temperatures and time of day information, etc.) his figures cannot be compared to those recorded in this investigation.

Wasps of the genus *Vespula* were frequently seen flying near the ant-membracid aggregations and perhaps were attracted by honeydew deposits on the leaves of the locust tree. None of these wasps was ever seen to land on the tree, although one did touch a branch near one aggregation. The ants became excited but did not attack the wasp, and it quickly flew away. One wasp was held with forceps near an aggregation, and it was attacked by several ants, all of whom made attempts to bite it. Two individual wasps were collected at different times and were identified as *Vespula maculifrons* (Buysson).

The literature on ant-homopteran commensalism is vast. Recent reviews of this relationship have been published by Way (1963) and Sudd (1967). The most intriguing questions arising from studies of this relationship are those concerning the benefits derived by the homopterans and those concerning the evolution of such commensalism. The membracids themselves, when in association with ants, have been examined in less detail than the aphids and coccids, and much remains to be discovered about their role in this relationship.

Gathering of Sap Exudate.

The literature abounds with accounts of ants directly gathering plant sap or juices. These plant liquids may be collected from floral or extrafloral nectaries (Wheeler, 1910) or by biting the stems of succulent plants and collecting the resultant cell sap exudate (Ayre, 1959). Also, ants may gather sap flowing from plant wounds. For example, *Formica rufa* has been observed gathering sap running from the ends of broken birch twigs (Elton, 1932). Such ant and plant liquid relationships can be obligatory or facultative. While there are dramatic examples of obligatory mutualism, for example the relationship between ants of the genus *Pseudomyrmex* and the swollen-thorn acacias, in which, among other things, the ant gathers sweet fluids from foliar nectaries (Janzen, 1966), most of such relationships appear to be facultative. It might be convenient to regard facultative relationships as being either cyclically habitual or opportunistic. A cyclically habitual relationship may be defined as occurring when an ant colony gathers plant liquids at a particular season each year from the same or similar sources as dictated by its habitat. For example, in the spring, all the liquid foods of *Formica subnitens* appear to be obtained from the exudates of the young shoots and buds of *Pinus ponderosa* Laws (in the case studied) (Ayre, 1959). The collecting of sap from plant wounds is described here as being opportunistic. While plant liquids, other than honeydew, may not comprise a very large part of any ant colony's diet (estimated by Sudd, 1965, to be 4.5% for the wood ant, *Formica rufa*), they appear to be of greater importance in the spring of the year than at any other time.

The second of the two foraging trails issuing from the colony of *C. noveboracensis* was discovered on 16 September. It led, in a meandering fashion, to a wound in the trunk of a common lilac, *Syringa vulgaris,* from which the ants were collecting sap. The shortest distance from the trail's point of exit to the base of the lilac was approximately 3.8 meters. About one-fourth of its length was completely concealed beneath a loose assortment of stones and broken pieces of concrete. Most of the remainder of the trail was only semi-exposed as it ran through thick grasses. The lilac was estimated to be about 3 meters high, and the circumference of the trunk at ground level was 12.7 cm. Although the wound in the bark of the tree was about 5 cm. long and ran parallel to the trunk, the sap oozed from only a small area of the wound at its lower margin. This area was 7.6 cm. up the trunk from the ground.

The worker ants gathered in a circle about that portion of the wound from which the sap was issuing, each with its head projecting over the edge of the margin, imbibing the sap. While trophallaxis was an integral part of the overall behavior pattern in gathering honeydew, it was not in gathering sap. Regurgative exchange of food between individual workers was observed only once on the lilac. The ants appeared to come to the wound, imbibe the sap and then return to the nest. There were two exceptions to this general pattern: individuals sometimes appeared to forage in general on the lilac trunk (none were ever seen carrying any prey), and they sometimes appeared to be "defensively" poised near the wound.

Counts of workers collecting sap were made two to seven times each day (when counts were made) for a period of more than two weeks. These counts were made at various times of the day and were aimed at determining the colony's pattern of activity with respect to gathering the sap. The ants were active in this capacity 24 hours a day. The results of the counts are graphed in Figure 3, and two generalizations regarding the graph are possible. Firstly, most population peaks occurred between 1900 and 0100 hours, and most lows

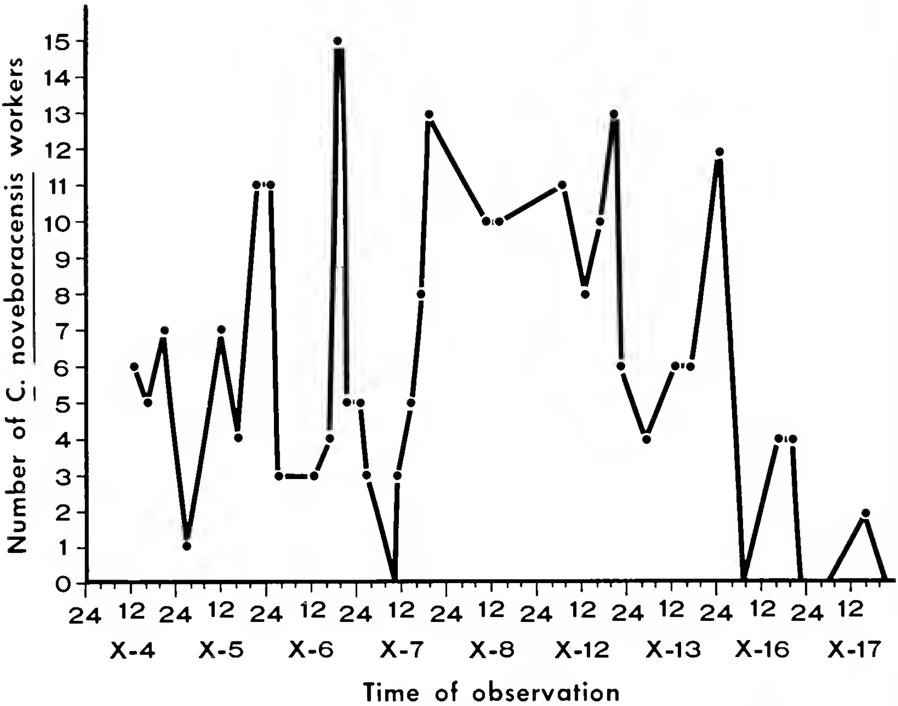
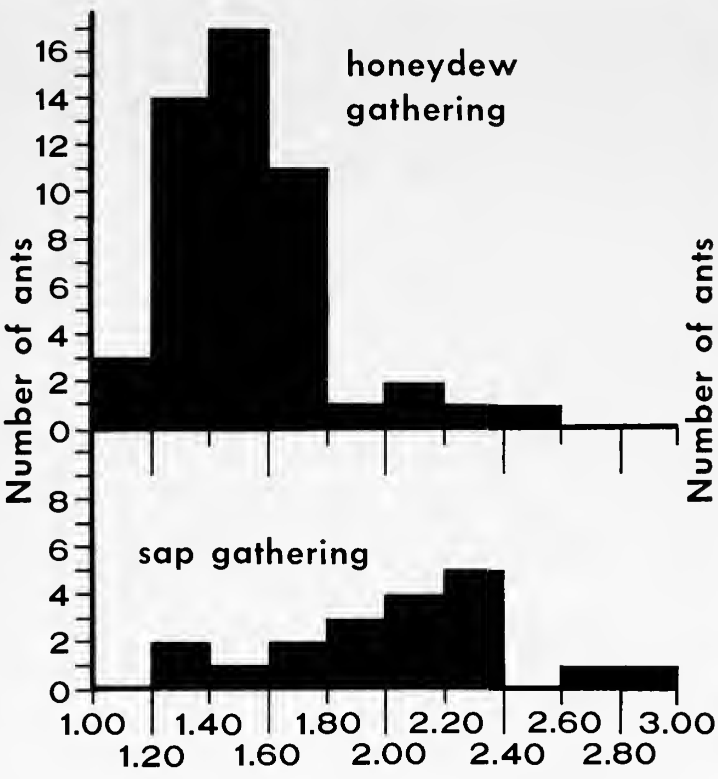


Fig. 3. Daily pattern of sap-gathering activity for workers of *C. noveboracensis.* Upper row of numerals on the abscissa indicates the hour (Eastern Standard Time); lower row indicates the month and day.

occurred around 0800 hours. The second and less substantial generalization is that the overall curve formed during this time period is approximately bell-shaped with most sap collecting activity occurring between 5 and 16 October. Thus the daily activity pattern is different from that involved in gathering honeydew. It is, in essence, crepuscular and nocturnal, while that of honeydew gathering is primarily diurnal. This daily activity pattern may be a reflection of maximum sap flow since, in the vascular plants, the photosynthetically produced sugars are generally stored in the leaves as insoluble starches immediately after being produced during the daylight hours and are translocated down the phloem as sugars at night. The shape of the curve formed over the time period of observations suggests that the sap gathering may have begun only several days prior to the initial observations.

As was the case with honeydew deposits, wasps of the genus *Vespula* were often seen flying about the wound in the lilac. One wasp was seen to land near and inspect the wound. The three ants that were present did not react aggressively toward the wasp. They did, however, remain stiffly poised with



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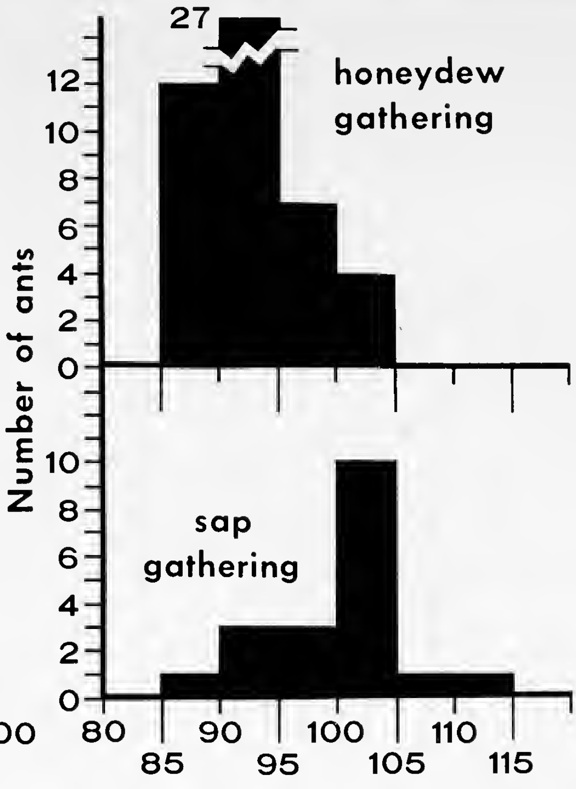

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Figs. 4–5. Frequency distributions of head widths and cephalic indices of *C. noveboracensis* workers gathering honeydew and gathering sap.

their antennae pointed at the wasp. The wasp was aggressive and made several quick moves toward the ants. This wasp was eventually collected and identified as *Vespula maculifrons* (Buysson).

A total of 12 workers returning to the nest from the lilac, and 7 going to the lilac from the nest, were collected at random over a period of 19 days (from 16 September to 4 October) and were dissected in order to examine their crops. The head length and width of each of these workers was measured and the cephalic index was computed for each. The crops and gasters were found to be in any one of the four conditions previously described for the honeydew gathering workers. The workers going to and from the lilac had a mean head length of 2.03 mm., a mean head width of 2.04 mm., and a mean cephalic index of 100. The mean crop width of those workers going to the lilac was 0.54 mm. while that of the returning workers was 1.72 mm. All of the 7 workers going to the lilac had empty crops. Of the 12 returning workers, one had an empty crop, two had partially full crops, six had full crops without the gasters being distended, and three had full crops and distended gasters.

While observing both honeydew and sap gathering activities, it was noted that the workers gathering sap appeared to be larger than those gathering honeydew. The frequency distributions of head widths of both groups of foragers are compared in Figure 4, and the frequency distributions of cephalic indices are seen in Figure 5. Using Student's t test, the head widths of the sap gathering group were found to be significantly larger at the 1% level than those of the honeydew gathering group. A statistical analysis of the cephalic indices, using Wilcoxon's two sample test (Steel and Torrie, 1960), revealed that the indices of these two groups are significantly different also at the 1% level. On the basis of head size and head shape then, it is evident that two different portions of the colony were engaged in the two different foraging tasks.

Studies on the genus *Camponotus* have revealed that the workers of particular species may form a continuous and gradual series from the smallest to the largest or that they may be distinctly bimodal in size distribution. Smith (1942b) found, when plotting head widths against number of individuals in a colony, that *C. noveboracensis* forms a gradual series so that the "classes" of workers are not clearly defined. He also found that the curve formed was distinctly skewed to the left, indicating that minor workers comprise the largest number of individuals in the colony. Buckingham (1911) found similar results for *C. noveboracensis*. For other species Smith (1942b) found that *C. pennsylvanicus* was not completely gradual in distribution but neither was it distinctly bimodal, that *C. santosi* Forel and *C. planatus* Roger were bimodal with connecting media workers, and that *C. inaequalis* Roger was bimodal with no intermediates between the groups. Sanders (1964) found for *C. herculeanus*, in plotting head width against numbers of ants, that a biomodal curve resulted. Buckingham (1911) calculated that the workers of *C.*

americanus formed a continuous, gradual series, and Pricer (1908), using worker body length, reported a gradual series for *C. pennsylvanicus* and *C. ferrugineus*. Wilson (1953) described *Camponotus abdominalis floridanus* (Buckley) as exhibiting partial dimorphism and argued that worker polymorphism should not be defined in terms of frequency, since many truly polymorphic species are apparently unimodal. Buckingham and Pricer both attempted to link worker size differences to specialized work tasks. Buckingham provided little information on foraging, but Pricer found, for *C. pennyslvanicus*, that smaller workers gathered honeydew from aphids. This honeydew was passed on, at the base of the tree where the aphids were located, to the next largest size group which in its turn carried the honeydew to the nest. Pricer indicated that the smallest and largest workers were "house-keepers." Thus it is even clearer that for *C. noveboracensis*, which forms a gradual polymorphic series, there is a foraging specialization on the part of the workers, either based on or coincidental with a difference in size.

Little information could be found in the literature on *Camponotus* plant-juice gathering activities, although it seems to be generally acknowledged that plant juices do form a definite part of the diets of most formicine ants. Pricer (1908) reported that *C. pennsylvanicus* extracted juice from a large stalk of "pie-plant," and Ayyar (1935) observed *C. compressus* to "abstract" vegetable juices from tender shoots, flowers and "sacchariferous" glands.

Gathering Carcasses of Dead Insects.

Workers were often seen foraging in the vicinity of the trail leading to the lilac bush. It was previously suggested that this foraging activity was the result of trail leakage, i.e. workers occasionally or perhaps predictably straying from the trail. Trail leakage would appear to provide these ants with the opportunity of discovering and utilizing new food sources. The area covered by these foragers encompassed approximately 2 square meters. Two workers returning from this area were found carrying the carcasses of dead insects. One was carrying an adult fly of the family Calliphoridae and the other a homopteran adult of the family Fulgoridae.

Workers were also observed returning to the nest with insect carcasses on the trail leading to the membracid aggregations. One was found with the desiccated carcass of a lepidopterous larva and another with the head of a wasp. In the latter case, after a thorough search of the trail, the remainder of the wasp was recovered and identified as *Vespula vulgaris* (L.). The worker ant carrying the wasp head was collected and dissected. Its crop was partially filled with honeydew indicating that it may have been returning from the locust tree when it discovered the dead wasp.

From these observations it is difficult to assess the relative importance of predation versus scavenging as a source of whole proteins in the diet of *C.*

noveboracensis. Sanders (1964) reported one worker of this species carrying a dead spruce budworm larva, *Choristoneura fumiferana* (Clem.), and Green and Sullivan (1950) observed ants which they identified as *Camponotus herculeanus ligniperdus* attacking larvae of the forest tent caterpillar, *Malacosoma disstria* Hbn. In this latter case it can be assumed that they were observing *C. noveboracensis,* since the varietal name was not cited (the name they used is that of a European species). They reported that this ant and *Formica fusca* attacked and carried back to their nests the first to fourth instar larvae. Two types of attacks were noted for both species, one as the result of foraging and the other as the result of attending workers being disturbed when caterpillars crawled among the aphid groups from which the workers were gathering honeydew.

Beyond this, at best, only inferences can be drawn about *C. noveboracensis* and its predation and scavenging habits from observations of the feeding habits of closely related species. Pricer (1908) reported that he had never seen either *C. pennsylvanicus* or *herculeanus* take insects alive, but that they often sucked the "juices" from dead insect carcasses, sometimes carrying the heads of the dead and consumed insects back to the nest. Smith (1942a) reported from laboratory experiments that cannibalism of *C. pennsylvanicus* larvae by attending nurse workers increased when the colony's food supply was reduced. Sanders (1964) observed *C. herculeanus* workers carrying a mosquito and a beetle (Lampyridae) to their nest, and Ayre (1963a) described, from laboratory experiments, the feeding of *C. herculeanus* on housefly larvae, and further reported (1963b) that this species was an effective predator.

CONCLUSIONS

Based on observations made of a single colony of *Camponotus noveboracensis,* the following conclusions are offered regarding the food gathering behavior of this species during the fall season:

1. The major sources of food for the colony are plant liquids, either in the form of homopteran produced honeydew (in this case from the membracid, *Vanduzea arquata*) or sap exudate. This diet is supplemented with proteinaceous materials from the carcasses of dead insects.
2. The number of worker ants gathering honeydew is strongly correlated with the total number of membracids present.
3. Female adults and nymphs of *V. arquata* are *both* an important source of honeydew for the colony, while the males appear unimportant in this respect.
4. Although the number of *C. noveboracensis* workers is correlated with the number of membracids, the ants abandon their honeydew food source prior to the disappearance of the membracids. In the case investigated, the ant *Prenolepis imparis* took the place of *C. noveboracensis* and continued to collect the honeydew.

5. While the benefits of the ant-homopteran commensalism for the ants are obvious, those for the membracid *V. arquata* are not. For each organism, the relationship does not appear to be obligatory.

6. Trophallaxis occurs at different rates between workers gathering honeydew, where food transmission is frequent, and those gathering sap, where it is infrequent.

7. The gathering of honeydew for this ant, in terms of peak rates of activity, follows a diurnal pattern, whereas the collecting of sap is crepuscular and nocturnal.

8. The rate of collection of honeydew by the workers is slowed by lower temperatures, increased wind velocity, and precipitation.

9. Workers collecting sap are significantly larger than those collecting honeydew; thus two different polymorphic segments of the colony may be specialized for two different foraging tasks.

10. While it may be suspected that workers collected some proteinaceous food by predation on other insects, this investigation indicates that most proteinaceous food may be gathered primarily through scavenging.

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The Male Genitalia of Some *Criorhina* Meigen Species from North America (Diptera: Syrphidae)[1]

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RECEIVED FOR PUBLICATION APRIL 22, 1968

Abstract: The male genitalia of eight species of *Criorhina* Meigen (*C. caudata* Curran, *C. kincaidi* Coquillett, *C. luna* Lovett, *C. lupina* (Williston), *C. nigripes* (Williston), *C. nigriventris* Walton, *C. tricolor* Coquillett and *C. verbosa* (Walker)) are described. A key based on terminalia is provided for the species studied.

This study deals with male terminalia of eight species of the genus *Criorhina* Meigen from North America.

Metcalf's (1921) terminology and method of preparation used for terminalia study has been followed in the present work. The diagrams were drawn with the aid of camera lucida under a stereomicroscope.

I wish to thank Prof. Ray F. Smith, Chairman of the Department of Entomology and Parasitology, University of California, Berkeley, for providing me with facilities for work. I am indebted to Dr. F. R. Cole, Dipterologist, for generous advice, assistance, helpful suggestions and checking of the manuscript, and to Dr. John A. Chemsak, Division of Entomology, Berkeley, for constructive and helpful reading of the paper. The author expresses his sincere appreciation and thanks to Dr. Karl V. Krombein, Chairman, Department of Entomology, Smithsonian Institution, for the generous loan of specimens.

DESCRIPTION OF MALE TERMINALIA

Criorhina lupina (Williston) (Figs. 1, 2 and 3)

Epandrium trough-shaped, about as wide as long with lower corners produced and acute. Styles longer than depth of epandrium, almost similar to those of *C. lupina*. Cerci small, pubescent on rest of surface. Cerci narrow, kidney-shaped, pilose.

Penis sheath longer than depth of epandrium. Superior lobes long, narrow basally and broad apically, apical tip black, chitinised, brush-bordered; terminal half flexed over basal region. Chitinous box V-shaped. Ejaculatory hood small, narrow at basal one-fourth and broad apically.

Criorhina tricolor Coquillett (Figs. 4, 5 and 6)

Epandrium trough-shaped, broader than long with lower corners produced and acute. Styles longer than depth of epandrium, almost similar to those of *C. lupina*. Cerci small, kidney-shaped; long pile along lateral borders.

Penis sheath longer than depth of epandrium, narrowed medially. Superior lobes long, broad medially and narrow both basally and apically; apex dark, with fine hairs. Ejaculatory hood broad basally and conical apically.

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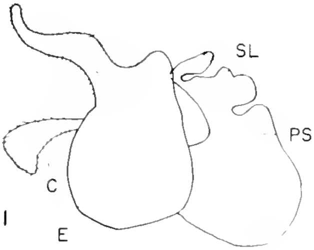
[1] Research supported by a Fulbright scholarship for 1967–1968.



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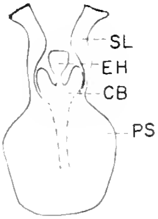

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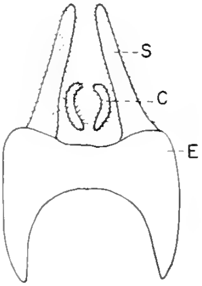

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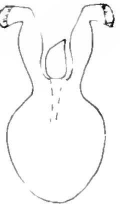

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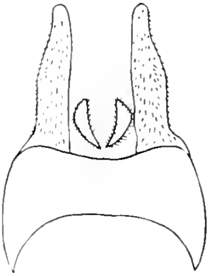

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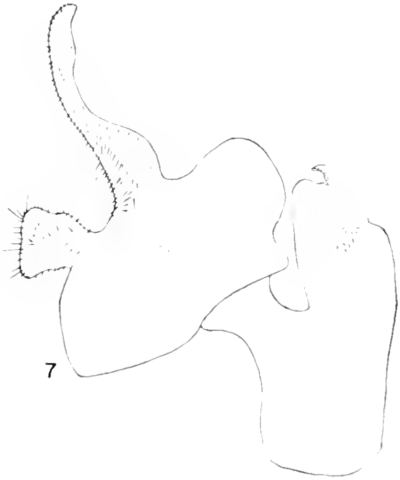

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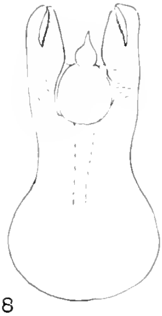

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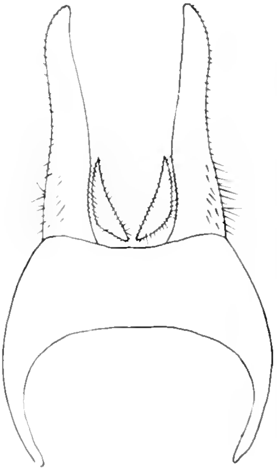

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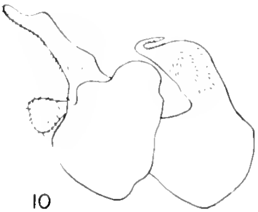

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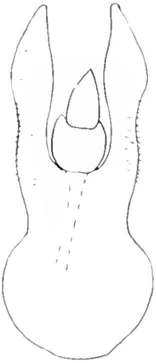

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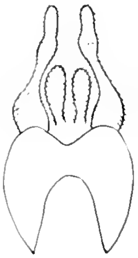

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Criorhina nigriventris Walton (Figs. 7, 8 and 9)

Epandrium trough-shaped, broader than long with lower corners greatly produced and acute. Styles as long as depth of epandrium, broad basally and narrowing apically; long, dense pile along outer border from base to about one-third its length and clothed with medium sized hairs over rest of surface. Cerci somewhat kidney-shaped; pilose.

Penis sheath longer than depth of epandrium. Superior lobes long, narrow basally, broad subapically, apex narrow, conical; a row of setae apically and numerous setae midventrally. Chitinous box oval. Ejaculatory hood flask-shaped.

Criorhina verbosa Walker (Figs. 10, 11 and 12)

Epandrium trough-shaped, about as long as wide, median narrow groove mid-posteriorly with lower corners produced and acute. Styles as long as depth of epandrium broad both basally and sub-apically and narrowing terminally; long pile along outer border at basal half and medium sized over remaining surface. Cerci oval, narrow basally, about half as long as styles; clothed with long bristles.

Penis sheath longer than depth of epandrium. Superior lobes long, similar to *nigripes;* numerous small setae at basal, cylindrical half and circlet of small spines sub-apically. Chitinous box D-shaped. Ejaculatory hood long, dome-shaped.

Criorhina nigripes (Williston) (Figs. 13, 14 and 15)

Epandrium trough-shaped, about as wide as long with lower corners produced and acute. Styles longer than half the depth of epandrium, appearing bi-fid in lateral view; long pile along outer and inner borders. Cerci narrow basally, broad medially and conical apically; pilose.

Penis sheath longer than depth of epandrium. Superior lobes long, basal half narrow, cylindrical, broad medially and narrow apically, terminal part lying curved over sub-apical region; small bristles along outer borders of broadened region and curved apex. Chitinous box horseshoe-shaped. Ejaculatory hood small, conical.

Criorhina luna Lovett (Figs. 16, 17 and 18)

Epandrium trough-shaped, depth about three-fourths width with lower corners produced and acute. Styles two-thirds depth of epandrium, broad, gradually narrowing apically; pile long medially along outer border and short, dense along inner margin. Cerci kidney-shaped, narrow with long hairs.

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Fig. 1. Male genitalia of *Criorhina lupina* (Williston) (lateral view).

Fig. 2. Penis sheath of *Criorhina lupina* (Williston) (ventral view).

Fig. 3. Epandrium of *Criorhina lupina* (Williston) (dorsal view).

Fig. 4. Male genitalia of *Criorhina tricolor* Coquillett (lateral view).

Fig. 5. Penis sheath of *Criorhina tricolor* Coquillett (ventral view).

Fig. 6. Epandrium of *Criorhina tricolor* Coquillett (dorsal view).

Fig. 7. Male genitalia of *Criorhina nigriventris* Walton (lateral view).

Fig. 8. Penis sheath of *Criorhina nigriventris* Walton (ventral view).

Fig. 9. Epandrium of *Criorhina nigriventris* Walton (dorsal view).

Fig. 10. Male genitalia of *Criorhina verbosa* Walker (lateral view).

Fig. 11. Penis sheath of *Criorhina verbosa* Walker (ventral view).

Fig. 12. Epandrium of *Criorhina verbosa* Walker (dorsal view).

Abbreviations: C, cerci; CB, chitinous box; E, epandrium; EH, ejaculatory hood; PS, penis sheath; S, stylus; SL, superior lobes.

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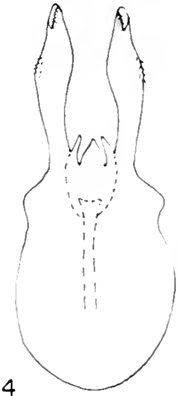

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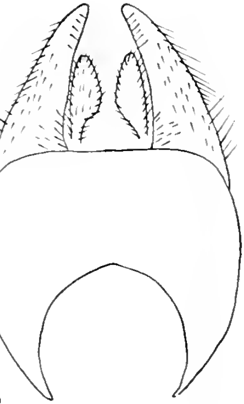

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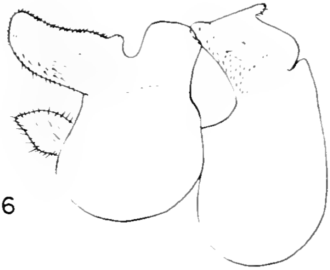

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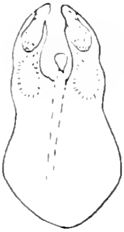

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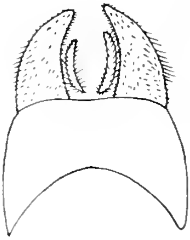

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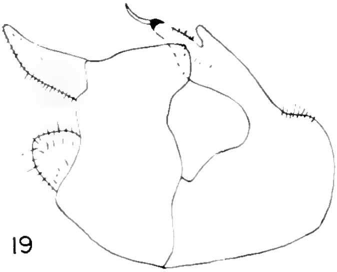

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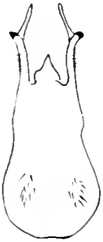

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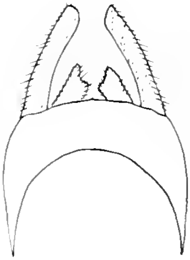

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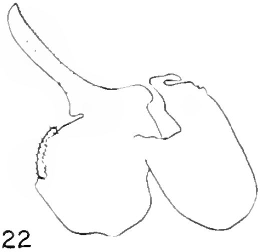

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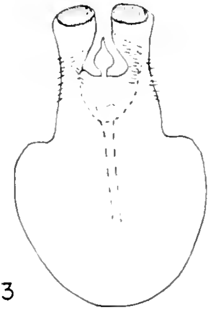

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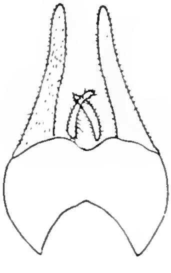

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Penis sheath longer than depth of epandrium. Superior lobes long, about one-third of apical part lying curved over middle part; a circlet of small setae at basal area, some terminally and along outer border at apical part. Ejaculatory hood small, quadrangular.

Criorhina kincaidi Coquillett (Figs. 19, 20 and 21)

Epandrium trough-shaped, depth about three-fourths width with lower corners produced and acute. Styles narrow, tubular, shorter than depth of epandrium; long fine hairs along outer border on about basal three-fourths and fine pubescence over remaining surface. Cerci short, broad with long pile.

Penis sheath longer than depth of epandrium; a patch of long bristles present laterally near base. Superior lobes long, narrow, tubular with a terminal process, black chitinized below process; clothed with medium sized bristles laterally at basal half. Ejaculatory hood short, broad, pointed apically.

Criorhina caudata Curran (Figs. 22, 23 and 24)

Epandrium trough-shaped, about one and one half times wider than long with lower corners produced and acute. Styles narrow, tubular, longer than depth of epandrium; minutely pubescent. Cerci kidney-shaped, narrow, covered with fine long hairs.

Penis sheath longer than depth of epandrium; sharp constriction between bases of superior lobes and basal rim of penis sheath. Superior lobes long; narrow, black, brush-bordered apical part flexed over broad sub-apical region; medium sized hairs present at about middle part. Chitinous box triangular. Ejaculatory hood broad medially, narrow basally and pointed apically.

DISCUSSION OF MALE GENITALIA IN *Criorhina* MEIGEN AND GROUPINGS

Features of the male genitalia which are fairly constant within the genus are the penis sheath longer than depth of epandrium, a construction between bases of superior lobes and basal rim of penis sheath and long superior lobes. The species studied can be divided readily into three groups; the Lupina group, the Verbosa group, and the Kincaidi group.

Lupina group

The group with *C. lupina, C. tricolor* and *C. nigriventris* is characterized by the shape of the styles. *C. lupina* and *C. tricolor* are closely similar in the

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Fig. 13. Male genitalia of *Criorhina nigripes* (Williston) (lateral view).
Fig. 14. Penis sheath of *Criorhina nigripes* (Williston) (ventral view).
Fig. 15. Epandrium of *Criorhina nigripes* (Williston) (dorsal view).
Fig. 16. Male genitalia of *Criorhina luna* Lovett (lateral view).
Fig. 17. Penis sheath of *Criorhina luna* Lovett (ventral view).
Fig. 18. Epandrium of *Criorhina luna* Lovett (dorsal view).
Fig. 19. Male genitalia of *Criorhina kincaidi* Coquillett (lateral view).
Fig. 20. Penis sheath of *Criorhina kincaidi* Coquillett (ventral view).
Fig. 21. Epandrium of *Criorhina kincaidi* Coquillett (dorsal view).
Fig. 22. Male genitalia of *Criorhina caudata* Curran (lateral view).
Fig. 23. Penis sheath of *Criorhina caudata* Curran (ventral view).
Fig. 24. Epandrium of *Criorhina caudata* Curran (dorsal view).

structure of the styles and cerci but distinct in the form of the superior lobes and ejaculatory hood. The species *C. nigriventris* is unique in the group in possessing an oval chitinous box, flask-shaped ejaculatory hood and superior lobes with mid-ventral hairs.

Verbosa group

There is marked variation of various structures in this group. The species *C. verbosa* and *C. nigripes* come closer to one another in the form of the superior lobes, epandrium and penis sheath but differ in the styles, chitinous box and ejaculatory hood. In addition, *C. nigripes* and *C. luna* have similar appearing styles in a dorsal view. *C. luna* is distinct in the group with its circlet of hairs at the basal part of the superior lobes.

Kincaidi group

The two species studied, *C. kincaidi* and *C. caudata*, share only characters of the styles but differ greatly in all other structures of the terminalia.

Key Based on the Male Terminalia for the Species of *Criorhina* Meigen Studied

1.	Penis sheath with patch of bristles near base	*kincaidi* Coq.
	Penis sheath without bristles at basal part	2
2.	Epandrium as wide as long; cerci not kidney-shaped	3
	Epandrium wider than long; cerci kidney-shaped	5
3.	Superior lobes long, broad medially, narrow both basally and apically	4
	Superior lobes long, narrow basally and broad apically	*lupina* (Will.)
4.	Ejaculatory hood dome-shaped	*verbosa* Walker
	Ejaculatory hood conical	*nigripes* (Will.)
5.	Styles shorter than depth of epandrium	*luna* Lovett
	Styles longer than depth of epandrium	6
6.	Superior lobes narrow medially with mid-ventral bristles	7
	Superior lobes broad medially, without bristles	*tricolor* Coq.
7.	Chitinous box triangular	*caudata* Curran
	Chitinous box oval	*nigriventris* Walton

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Additions to the Supplemental List of New Jersey Macrolepidoptera

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RECEIVED FOR PUBLICATION APRIL 22, 1968

Abstract: Twenty-nine additional species, subspecies, and named aberrations with their food plants are here added to the *Supplemental List of Macrolepidoptera of New Jersey* which was published in 1965.

In this report twenty-nine species, subspecies, and named aberrations with their food plants are added to the supplemental list which I published in 1965. This number of additions is remarkable when it is realized that former collecting localities are being lost to the growing urbanization and industrialization occurring in this region. During the last ten years I have observed that the populations of the saturnids and the larger sphingids have been declining. This decline I had attributed to the increased use of insecticides and insecticide spraying. However, I doubt that this is the only reason, because the common, smaller Lepidoptera are as numerous as ever.

Most of the daytime and the nighttime collecting was done around Lakehurst, Lebanon, and Montague. More time than ever had to be spent looking for new places to collect, since the old locations either are being destroyed or are no longer as productive as formerly.

Two species, *Pieris napi oleracea* Harris and *Euptychia mitchellii* French, both mentioned in the lists of Smith and Comstock but considered doubtful by later authors, can now definitely be added to the New Jersey list. *Pieris virginiensis* Edwards, not reported in the state since 1940, will be sought in the northern part of the state where a large stand of its food plant, *Dentaria diphylla* Michaux, has recently been located through the help of botanist friends.

I thank Dr. C. F. dos Passos for a critical reading of this manuscript and Dr. A. E. Brower for the determinations.

BUTTERFLIES (Identifying numbers are from dos Passos, 1964)

HESPERIIDAE

Thymelicus Hübner
  123 *lineola* Ochsenheimer
    form *pallida* Tutt 1896
    Lakehurst, July 1, 4, 1967
    Grasses, *Graminae* spp.

PIERIDAE

Pieris Schrank
  278 *napi oleracea* Harris 1829
    Newton, July 8, 1966 (collected by Mrs. C. F. dos Passos)
    Toothwort, *Dentaria* spp.; rock cress, *Arabis* spp.; hedge mustard, *Sisymbrium officinale*.

LYCAENIDAE

Strymon Hübner

412 *falacer* ab. "heathii" Fletcher 1903
Lakehurst, July 1, 1967 (collected by F. Rutkowski)
Oak, *Quercus* spp.; Hickory, *Carya* spp.

SATYRIDAE

Lethe Hübner

638 *euridice euridice* Johansson 1763
Newton, July 1, 1966 (collected by F. Rutkowski)
Grasses, *Graminae* spp.

Euptychia Hübner

644 *mitchellii* French
Newton, July 6, 8, 12, 1966 and July 14, 1967
Grasses, *Graminae* spp.

MOTHS (Identifying numbers are from McDunnough, 1938)

ARCTIIDAE

ARCTIINAE

Phragmatobia Stephens

1029-1 *lineata* Donahue and Newman 1941
Short Hills, June 23 and July 15, 1966; Lebanon, July 16, 1965 and June 29, 1966
Thoroughwort, *Eupatorium* spp.; probably other low herbs.

Apantesis Walker

1052 *figurata* ab. "lugubris" Hulst 1887
Lakehurst, June 1, 6, 7, 1966
Dandelion, *Taraxicum officinale*; plantain, *Plantago Rugelii.*

PHALAENIDAE

ACRONICTINAE

Acronicta Ochsenheimer

1151 *dactylina* Grote, melanic form, 1824
Lakehurst, June 27, 1967; Lebanon, June 30, 1966
Birch, *Betula* spp.; willow, *Salix* spp.

PHALAENINAE

Rhynchagrotis Smith

1602 *cupida* Grote 1875
Lakehurst, July 20, 1965
Apple, *Malus* spp.; grape, *Vitus* spp.

HADENINAE

Polia Ochsenheimer

1697 *cristifera* Walker 1858
Montague, July 30, August 27, 1966
Birch, *Betula* spp.; blueberry, *Vaccinium* spp.

Xylomiges Guenée

1914 *dolosa* Grote 1880

Lebanon, April 21, May 2, 1965 and April 29, 1966

Poplar, *Populus* spp.

CUCULLINAE

Apharetra Grote

2156-1 *purpurea* McDonnough 1940

Lakehurst, July 20, 1966 and July 26, 28, 1967

Blueberry, *Vaccinium* spp.

AMPHIPYRINAE

Neperigea McDonnough

2636 *costa* Barnes & Benjamin 1923

Lebanon, August 27, 1966

Enargia Hübner

2685 *decolor* Walker 1859

Montague, July 30, 1965 and July 20, 1966

Birch, *Betula* spp.; Poplar, *Populus* spp.

Amolita Grote

2696 *roseola* Smith 1903

Montague, July 30, 1967

ACONTIINAE

Erastria Ochsenheimer

3119 *albidula* Guenée 1852

Newton, July 27, 1966

Acontia Ochsenheimer

3202 *aprica* Hübner 1803

Lebanon, June 8, August 20, 1966 and May 5, Aug. 27, 1967

Hollyhock, *Althea rosea*

PLUSIINAE

Autographa Hübner

3265 *ampla* Walker 1857

Lebanon, June 30, 1965

Juneberry, *Amelanchier* spp.

CATOCALINAE

Catacola Schrank

3334 *maestosa* Hulst 1884

Lebanon, August 28, 1966

Black walnut, *Juglans nigra*

3337 *nebulosa* Edwards 1864

Lebanon, September 24, 1959

Black walnut, *Juglans nigra;* Hickory, *Carya* spp.

3342 *ilia* form obsolete Worthington 1883

Lakehurst, July 18, 1962 and July 23, 1965; Cape May, July 15, 1966

Zale Hübner

–3478 *phalaeocapna* Franclemont 1950 (determined by genitalia)

Lebanon, May 27, 1957

–3494 *metatoides* McDonnough 1943
Montague, June 10, 1967

HYPENINAE

Gabara Walker
3633 *pulverosalis* Walker 1865
Lakehurst, August 14, 1967

Bomolocha Hübner
3690 *palparia* Walker 1861
Montague, July 17, 1965
Oak, *Quercus* spp.

HERMINIINAE

Camptylochila Stephens 1918
3739 *julia* Barnes and McDunnough 1918
Lebanon, July 9, 1966

GEOMETRIDAE

LARENTIINAE

Hydriomena Hübner
4485 *renunciata* Walker 1862
Lebanon, May 19, 1966

Hydrelia Hübner
4597 *albifera* Walker 1866
Lebanon, June 2, 1966

ENNOMINAE

Hyperetis Guenée
5043 *amicaria nepiasaria* Walker 1860
Lebanon, May 19, 1965
Maple, *Acer* spp.; Oak, *Quercus* spp.; willow, *Salix* spp.

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Proceedings of the New York Entomological Society

(Meetings held in Room 319 of the American Museum of Natural History
unless otherwise indicated.)

Meeting of October 3, 1967

Vice-president David Miller presided; 27 members and 29 guests were present. Dr. Miller announced the resignations of Dr. Richard Fredrickson and Mr. Raymond Brush, as the Society's President and Treasurer, respectively; Dr. Fredrickson has taken a position at St. Joseph's College in Philadelphia and Mr. Brush has moved to Florida. Dr. Miller announced the appointment of Doctors Elsie Klots, Kumar Krishna, and Jerome Rozen to the Nominating Committee for the 1968 elections. Dr. Krishna introduced Father Jean Ruelle, of the University of Lovanium, located in Kinshasa, the Congo, where he conducts research on African termites. Father Ruelle showed slides of the University's Campus and of termites and other insects in the University's collection. The following people were proposed for active membership: Dr. Edward Balboni of the Dept. of Biology of Hunter College; Dr. Paul Howse of the Bruce Museum of Greenwich, Conn.; Dr. June Tice of the American Museum; Dr. John Buckett of Davis, California; Mr. Peter Baker of Oaklyn, New Jersey; and Mr. Alfredo Sarachaga of New York City.

PROGRAM. **Wasps as Predators.** Dr. Howard E. Evans, Curator at the Museum of Comparative Zoology, Harvard University, illustrated his talk with slides and motion pictures. (An abstract follows.)

Howard R. Topoff, *Sec.*

WASPS AS PREDATORS

Wasps are nearly all predators, but they are predators of an unusual sort. They take prey not primarily for themselves, but for their offspring, and it follows from this that predatory behavior is limited to the female sex, since the males take no part in the nesting process. Furthermore, nearly all wasps are in some measure host-specific; that is, they take one particular type of arthropod only. In several groups, prey specificity is on the family level, e.g., all Dryinidae take leafhoppers, all Pompilidae spiders. In the true digger wasps, the Sphecidae, specificity is largely on the subfamily or genus level, and prey type often provides a good taxonomic character. For example, all Ampulicinae take cockroaches; but many genera of Nyssoninae take Homoptera, one takes Heteroptera, two take adult Lepidoptera, and several take Diptera. In the higher Nyssoninae, as in a few of the more highly evolved members of other subfamilies, there is a loss of host specificity (in *Microbembex*, for example). As a general rule, wasps which are more primitive structurally and which belong to groups with a long fossil record tend to take more primitive types of insects, indicating that there has been evolution paralleling that of their prey.

Wasps carry the paralyzed prey to their nest in a specific manner, but the mode of prey transport has undergone an evolution independent of that of prey type. Flies, for example, may be carried with the mandibles, with the middle legs, or on the sting; but groups of wasps which utilize a particular type of prey carriage may prey on quite a variety of different things. Mode of prey carriage has evidently been molded by different selection pressures having to do with the attacks of the ubiquitous dipterous parasites of these insects.

Howard E. Evans

Meeting of October 17, 1967

Dr. David Miller presided; 11 members and 8 guests were present. Mr. W. E. McCauley, of the Shell Chemical Co. was introduced. He is in charge of the mixer for the Entomological Society of America meetings which will be held at the Hotel New Yorker, November 27–30. Mr. McCauley asked for volunteers to act as guides to show guests around the first floor exhibits of the American Museum, since the mixer will be held in the Invertebrate Hall. The following people were elected to membership: Dr. Edward Balboni, Dept of Biology, Hunter College; Dr. Paul Howse, Bruce Museum, Greenwich, Conn.; Dr. June Tice, American Museum; Dr. John Buckett, Davis, California; Mr. Peter Baker, Oaklyn, New Jersey; and Mr. Alfredo Sarachaga, New York City.

Mrs. Ophelia Gona of the City University of New York was proposed for student membership.

PROGRAM. **Reproductive Isolating Mechanisms in the Superspecies *Drosophila paulistorum*,** by Dr. Lee Ehrman of the Rockefeller University. (An abstract follows.)

HOWARD R. TOPOFF, *Sec.*

REPRODUCTIVE ISOLATING MECHANISMS IN THE SUPERSPECIES *Drosophila paulistorum*

The sterility of the male hybrids produced by crosses between the races of the superspecies *Drosophila paulistorum* is transmitted in the maternal line only, via the egg cytoplasm. The nature of the causative cytoplasmic factor is still undetermined. It is not independent of chromosomal genes, since it can be suppressed after several generations of backcrosses. The fact that it can be transferred for at least one generation by the injection of homogenates indicates that some sort of symbiont is involved. Heat shocks administered to the carriers of the symbiont interfere with its action in the subsequent generations although such treatments do not "cure" the carriers completely. In nature, however, these sterile male hybrids are not formed because of a primary isolating mechanism perfected between the *Drosophila paulistorum* races: sexual isolation.

Ehrman, L. 1967. Proc. Natl. Acad. Sci., **58:** 195–198.

LEE EHRMAN

November 7, 1967—Election Day—No meeting.

Meeting of November 21, 1967

Dr. David Miller presided: 25 members and 6 guests were present. Miss Anna Flaherty and Mr. John Van Wert, both of the Brooklyn Entomological Society, were introduced. Also introduced as guests were Mr. Bruce Cutler and Dr. Aaron Wasserman. Mrs. Ophelia Gona of the City University of New York was elected to student membership, and Mr. Russel Rahn of Wausau, Wisconsin was proposed for active membership.

PROGRAM. **Moth Mites, Old and New,** by Dr. Asher Treat, formerly of the City University of New York. (An abstract follows.)

HOWARD R. TOPOFF, *Sec.*

MOTH MITES, OLD AND NEW

At least four species of gamasine mites and one tydeid are known so far only from noctuid moths, while mites of more than twenty other species infest these insects among others. Except for the moth ear mite, incidence of infestation is ordinarily low. Most species appear to be merely phoretic upon their noctuid hosts, but a few are truly parasitic and can complete their life cycles without recourse to other food. Behavioral adaptations, especially as regards site selection, characterize the various species, some being tympanicolous, some retropatagial, some submaxillary, and some relatively unrestricted. Little is known about moth mites in general, and observations by collectors, both amateur and professional, are likely to be of interest and value. Specimens may be preserved either dry or in alcohol.

ASHER TREAT

Meeting of December 5, 1967

The meeting was held in Room 129 with Dr. Jerome Rozen presiding in the absence of President Miller; 19 members and 2 guests were present. Mr. Russel Rahn of Wausau, Wisconsin was elected to active membership.

PROGRAM. **Observations on the Anatomy of the Male Ant, *Myrmica rubra*,** by Dr. Winifred Trakimas of Marymount-Manhattan College. (An abstract follows.)

HOWARD R. TOPOFF, *Sec.*

OBSERVATIONS ON THE ANATOMY OF THE MALE ANT, *Myrmica rubra*

This investigation is a reinvestigation and expansion of Janet's studies, and it adds a myrmicine to the growing number of studies investigating phylogenetic relations among the subfamilies of ants.

Specimens gathered from nests were provided by Dr. M. V. Brian of the Nature Conservancy, Wareham, Dorset, England. Ants in two different states of maturity are described, those with large, sperm-filled testes and empty vasa deferentia, and those with depleted testes and the vasa deferentia packed with sperm. These developmental differences of the reproductive systems can be recognized by external differences in the individuals, and they are correlated with the functional condition of the ventriculus of the digestive system. The ventricular epithelium of males with sperm-filled testes consists of tall, columnar-shaped digestive cells, while the epithelium of males with depleted testes shows drastic degeneration. These degenerative changes appear to be part of the normal male cycle and begin before the ants leave the nest for the nuptial flight.

This study indicates a myrmicine pattern in the reproductive organs characterized by a small number of testicular lobes and in the shape and position of the seminal vesicles.

The three pairs of genitalic valves, the ninth and tenth terminal gastric terga, and the ninth sternum are sufficiently different from those of other myrmicines to be considered taxonomic criteria for this species.

The myrmicine subfamily seems more closely related, in the anatomy and histology of its reproductive system and in the anatomy of the genitalic valves and terminal gastric segments, to the ponerine, and in some points, to the formicine sub-family, rather than to the doryline or dolichoderine subfamilies.

WINIFRED TRAKIMAS

Meeting of December 19, 1967

The meeting was held in Room 129, and Dr. David Miller presided; 19 members were present. Dr. Lee Herman of the American Museum was proposed and elected to active membership. It was announced that Miss Ann Young, formerly of the Dept. of Animal Behavior at the Museum, has taken a position in the Dept. of Biology at the University of Georgia.

PROGRAM. **The Origin and Function of Castes in Army Ants: A Developmental Approach,** by Mr. Howard R. Topoff of the City University of New York. (An abstract follows.)

HOWARD R. TOPOFF, *Sec.*

THE ORIGIN AND FUNCTION OF CASTES IN ARMY ANTS: A DEVELOPMENTAL APPROACH

The appreciation of the fact that all individuals in sexually reproducing populations exhibit structural and functional variation has resulted from current, population-oriented, evolutionary studies. In the social Hymenoptera, such variation is embodied in the term "polymorphism" which is defined as the existence within a colony of two or more intrasexual castes, without regard to their genetic or environmental origin.

Developmentally, the best analyses of polymorphic differences have been applied through comparative population studies based upon larval allometric growth, adult allometry, and intra-colonial size-frequency distribution. In this approach, "allometry" refers to differences in proportions as related to changes in absolute magnitude of an entire organism or any of its parts.

For the biologist these population characteristics can be used to understand and describe the biological bases underlying physiological and behavioral integration.

Howard R. Topoff

Meeting of January 2, 1968—The Annual Meeting

The meeting was held in Room 129, and Dr. David Miller presided; 10 members and 2 guests were present. The Report of the Nominating Committee, composed of Dr. Jerome Rozen, Dr. Elsie Klots, and Dr. Kumar Krishna, proposed the following for election to the respective offices for 1968:

President—Dr. David Miller
Vice President—Dr. Lee Herman
Secretary—Mr. Howard Topoff
Assistant Secretary—Dr. June Tice
Treasurer—Mr. Nicholas Shoumatoff
Assistant Treasurer—Mrs. Patricia Vaurie
Trustees (renominated for a second two-year term):
  Dr. Jerome Rozen and Mr. Robert Buckbee
Publication Committee:
  Dr. Lucy Clausen   Dr. Asher Treat
  Dr. Peter Wygodzinsky

There were no further nominations, and the nominated candidates were elected. Mr. Joseph Myerson was proposed for active membership.

PROGRAM. **Mites from Desert to Seashore** by Dr. Richard Fredrickson of St. Joseph's College in Philadelphia. Dr. Fredrickson discussed the incidence and habits of mites in different habitats at various locations.

Howard R. Topoff, *Sec.*

Meeting of January 16, 1968

The meeting was held in Room 129. President David Miller presided; 16 members and 3 guests were present. Miss Alice Gray reported on the activities of the past year for the Junior Entomological Society. She described the Society's past field trips and future guest lecturer program. The Junior Society has a membership of 15, and at present there is a waiting list of six candidates. Dr. Herman introduced Dr. Wang, a post-doctoral fellow working at the American Museum on Psocoptera. Mr. Joseph Myerson was elected to active membership. Dr. David Kistner of Chico State College, Calif., was proposed for active membership and Mr. David Adler of Holliswood, New York was proposed for student membership.

PROGRAM. **Some cases of Unusual Distribution Patterns** by Dr. Richard Blackwelder of Southern Illinois University. The speaker discussed some oddities of geographical distribution as they affect taxonomic thinking, and the genesis and philosophical basis of his recently published book, *TAXONOMY*.

Howard R. Topoff, *Sec.*

Meeting of February 6, 1968

President David Miller presided; 15 members and 4 guests were present. The reports of the Treasurer, Mr. Nicholas Shoumatoff, for 1967 and of the Auditing Committee composed of Mr. Robert Buckbee, Dr. Lucy Clausen, and Dr. Jerome Vanderberg, were submitted and accepted. Dr. David Kistner of Chico State College, Calif., was elected to active membership, and Mr. David Adler was elected to student membership. Dr. Miller announced that the Executive Committee of the Society has appointed Dr. John Schmitt to fill the position on the Publication Committee of Dr. Wygodzinsky, who has resigned.

PROGRAM. **Chemical Communication in Insects** by Dr. George Happ of the Biology Dept. of New York University.

Howard R. Topoff, *Sec.*

Meeting of February 20, 1968

Dr. David Miller presided; 17 members and 5 guests were present. Dr. Forbes announced that the Fordham University Chapter of Sigma XI was sponsoring a symposium on "Human Chromosomes."

PROGRAM. **High Jungle Revisited: A Look at Rancho Grande Today** by Dr. D. Duckworth of the National Museum in Washington, D. C. Dr. Duckworth discussed the research opportunities available at Rancho Grande, as well as aspects of his own work on the Lepidoptera of South America.

Howard R. Topoff, *Sec.*

Meeting of March 5, 1968

President David Miller presided; 13 members and 7 guests were present.

PROGRAM. **The Evolutionary and Taxonomic Significance of Reproduction in the Blattaria** by Dr. Louis Roth of the U. S. Army Natick Laboratories, in Natick, Mass. (An abstract follows.)

Howard R. Topoff, *Sec.*

THE EVOLUTIONARY AND TAXONOMIC SIGNIFICANCE OF REPRODUCTION IN THE BLATTARIA

Oviposition behavior, water changes in the oöthecae, structure of the oötheca and ovarioles tend to support the recent concept that there are 2 phyletic lineages in cockroaches. One, the superfamily Blattoidea, remained oviparous, whereas the second line, Blaberoidea, evolved ovoviviparity and viviparity.

Rotation of the oötheca occurs only in certain subfamilies of Blaberoidea and this was a necessary preadaption for the evolution of viviparity. Turning the oötheca 90° reoriented the egg case so that the long axes of the eggs lay in the plane of the cockroach's width, a position which allowed for the stretching of the uterus by the growing eggs.

The evolution of internal incubation of the eggs necessitated a change from a hard rigid oötheca that was dropped after its formation, to a soft, flexible, reduced egg case which would be retracted internally. Such changes have taken place in the Blaberoidea but not in the Blattoidea.

Studies of the shapes of water uptake curves of the eggs during development suggest that ovoviviparous species may have evolved from a blattellid-like stock that had less than 50% water initially, whereas viviparous species may have come from a blattellid-like stock that had more than 50% water.

The Blaberoidea show a distinct evolutionary trend toward a decrease in the total number of oöcytes per ovariole, as well as a decrease in the number containing yolk at the time of oviposition. A similar trend is not found in the Blattoidea.

Louis Roth

Meeting of March 19, 1968

President David Miller presided; 7 members and one guest were present.

PROGRAM. **Field Studies on Alligator Weed and Related Amaranths, and Their Biotic Suppressants in Southern United States.** Dr. George Vogt of the U. S. Department of Agriculture described his survey of the distribution of Alligator Weed, *Alternanthera philoxeroides*, and related plants in South America, and the selection of a flea beetle of the genus *Agasicles* for introduction into the United States as a biological control agent; this program has been successful. Alligator weed has been resistant to chemical herbicides. His talk was illustrated with color slides.

Howard R. Topoff, *Sec.*

Meeting of April 2, 1968

No regular meeting was held on this date. Members and guests of the Society attended the James Arthur Lecture in the Lecture Hall of the American Museum of Natural History. The speaker was Dr. Kenneth Roeder who lectured on **Three Views of the Nervous System.** The text of his talk will be published in one of the Museum publications.

Howard R. Topoff, *Sec.*

Meeting of April 16, 1968

Dr. David Miller presided: 19 members and 12 guests were present. Miss Kathleen Cunningham of Fordham University was nominated for Student Membership. Dr. Lee Herman discussed plans being made to reactivate the Coleopterists' Society.

PROGRAM. **Hidden World,** a National Geographic Society film which included many fine closeup color shots of insects by various cinematographers.

Howard R. Topoff, *Sec.*

Meeting of May 7, 1968

The meeting was held in Room 129, and President David Miller presided; 19 members and 15 guests were present. Miss Kathleen Cunningham of Fordham University was elected to Student Membership. Dr. George Happ, Department of Biology of New York University, was nominated for Active Membership. The President and Treasurer of the Junior Entomological Society described their plans for a field trip in September to the Archbold Research Station in Florida.

PROGRAM. **A Peephole in Africa.** Dr. John Stamatov showed a color film he had made during a recent trip to Africa. The film included extended sequences of African wildlife including the insect fauna.

Howard R. Topoff, *Sec.*

Meeting of May 21, 1968

The meeting was held in Room 129, and Dr. David Miller presided: 26 members and 16 guests were present. Dr. George Happ was elected to active membership. The following people were proposed for and elected to active membership: Mr. Jerzy Grabowski of West

Caldwell, New Jersey; Mr. Jack Shaff of Wantagh, N. Y.; Mr. Philip Mayer, Jr. of Great Neck, N. Y.; Dr. Leon R. Cahen of New York City; Mr. John Morony, Dept. of Ornithology of the American Museum. Dr. Miller announced that Dr. James Slater of the University of Connecticut will resume the Editorship of **Entomologica Americana**.

PROGRAM. **Simple Close-up Photography of Insects.** Mr. Matthew Cormans of the Dept. of Entomology of the Museum showed color slides including fine habitat shots of insects and explained and answered questions about his methods and equipment.

HOWARD R. TOPOFF, *Sec.*

INDEX TO SCIENTIFIC NAMES OF ANIMALS AND PLANTS

VOLUME LXXVI

Generic names begin with capital letters. New genera, subspecies, and varieties are printed in italics. This index does not include the Additional Records of Spiders from Western Pennsylvania pp. 101–105 and Additions to the Supplemental List of New Jersey Macrolepidoptera pp. 303–306.

ENTOMOLOGICA AMERICANA

The President and the Trustees of the newly consolidated *New York Entomological Society, Incorporating the Brooklyn Entomological Society, Inc.* are happy to announce that the next issue of the ENTOMOLOGICA AMERICANA is now in preparation. It is anticipated that it will be issued during the first half of 1969. Dr. James Slater will continue as Editor.

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