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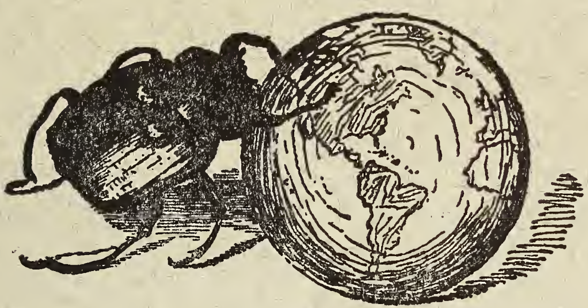

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A SYNOPSIS OF THE CICADIDÆ OF MISSOURI (HOMOPTERA)

By Richard C. Froeschner

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This study was undertaken to clarify the status of Missouri members of the family Cicadidæ so that the state list of insects might be more accurate; to furnish local workers with a convenient means of identifying their Missouri specimens; and to call attention to the possibility of separating at least some of the genera by characters which work with either sex.

In the literature fifteen species have been credited to the state. Of these, three apparently do not belong to the local fauna. *Okanagana rimosa,* which was described in part from "Missouri" as *Cicada rimosa* by Say in 1830, is deleted because Davis (1919) concluded that the specimens were actually taken in one of the Dakotas which were included in the old "Missouri Territory." This species, therefore, cannot be claimed for the local fauna on Say's record. Since it seems to be a more northern form and as we have seen no local specimens, it probably does not belong to the Missouri list.

Although Uhler (1892) listed "*Cicada canicularis* Harris"—now *Tibicen canicularis* (Harris)—for Missouri it apparently does not belong to the state's fauna. We have seen no state specimens and Davis (1930) wrote that this species ranges from "Nova Scotia to Manitoba and the mountains of Colorado and thus seems to have a wide distribution in the north." On the basis of this more northern range and the lack of specimens we are dropping *canicularis* from our list of Missouri insects.

In 1905 Uhler recorded "*Cicada grossa* Fab." from "Southern Missouri." Under this name he is known to have confused at least two of the large species of *Tibicen*, namely *auletes* and *marginalis*. This confusion of forms plus the fact that true *grossa* was described from "Brazil" makes it necessary to exclude this name from our Missouri list.

To the remaining twelve species we add two more names bringing our total of valid forms to fourteen. General recorded distributions indicate that three others are of likely occurrence. Seventeen species are therefore included in this paper.

The author is deeply grateful for additional records from the institutional collections of the University of Missouri (Dr. L. Haseman), the St. Joseph Museum (Dr. R. E. Coy) and the Academy of Science of St. Louis; and from the private cabinets of W. S. Craig, W. R. Enns, H. I. O'Byrne, E. P. Meiners and H. I. Rainwater. Records which the author did not personally collect are indicated by the initials of their collectors as follows: C. F. Adams, C. L. Heink, C. W. Wingo, H. I. O'Byrne, H. I. Rainwater, L. Haseman, R. E. Coy, S. Sparling, T. E. Birkett, W. K. Clark and W. S. Craig. Indebtedness extends further to Dr. M. Cazier of the American Museum of Natural History and to Dr. R. J. O'Connor for generous loans of material of *Tibicen robinsoniana* Davis for study.

Illustrations for this paper are all original by Elsie Herbold Froeschner.

Keys to the Missouri Genera and Species of Cicadidæ

1. Veins M and Cu at base of forewing leaving arculus separately (Fig. B.) 2

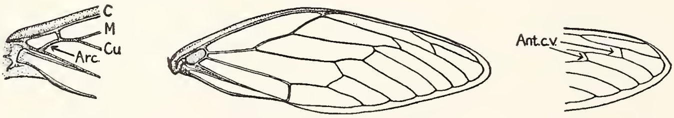

FIG. A FIG. B FIG. C

(key structures)

Fig. A. base of forewing of *Melampsalta calliope*
Fig. B. forewing of *Tibicen linnei*
Fig. C. tip of forewing of *Diceroprocta vitripennis*

Veins M and Cu at base of forewing united for a short distance and leaving the arculus as a single vein (Fig. A.) .... VI. *Melampsalta*

2. (1). Pronotum laterally with prominent longitudinal carina for nearly or quite its entire length; hind collar of pronotum may project laterally 3

Pronotum with sides rounding regularly into dorsal disk, without longitudinal carina laterally; hind collar of pronotum projecting abruptly outwards at sides .... V. *Magicicada*

3. (2). Abdomen translucent; carinate edge of pronotum evanescent anteriorly; longitudinal veins of front wings each with a distinct brown cloud apically .... I. *Cicada*

Abdomen opaque; carinate edge of pronotum reaching anterior margin; longitudinal veins not clouded at apices 4

4. (3). Humeral angle of pronotum not expanded as a prominent, subquadrate lobe; head at least as wide as front margin of pronotum 5

Humeral angle of pronotum produced as a prominent, subquadrate lobe; head not as wide as front margin of pronotum .... IV. *Okanagana*

5. (4). Front wings with anterior two cross veins strongly oblique (about 45°), the front one placed distinctly before the middle of the cell anterior to it (Fig. B.) .... II. *Tibicen*

Front wings with anterior two cross veins more nearly vertical, the front one placed just about at the middle of the cells anterior and posterior to it (Fig. C.) .... III. *Diceroprocta*

I. *Cicada* Linnæus

1. Straw yellow; head, pronotum and mesonotum strongly and intricately marked with black, and usually lightly washed with green; length 20–25 mm. (Fig. 4) .... *hieroglyphica* Say

II. *Tibicen* Latreille

1. Hind collar of pronotum nearly or quite wholly black 2

Hind collar of pronotum almost wholly pale, occasionally blackened anteriorly 3

2. (1). Color fulvous and black; mesonotum fulvous, black occupying central area and irregular lines at margins; abdominal sternites with a wide, polished black median vitta; length 31–34 mm. .... 2. *lyricen* (DeG.)

Color green and black; mesonotum black with narrow pale lines and spots; abdominal sternites without or with only a very narrow black vitta; length 32–36 mm. ..... 3. *chloromera* (Wlk.)

3. (1). Apical third of front wing distinctly infuscated; color, including abdomen, chiefly greenish buff with few black marks on mesonotum; length 30–33 mm. .... 13. *superba* (Fitch)

Apex of front wing not infuscated, except sometimes by a small cloud over each of the anterior two cross veins; abdomen always dark brown to black 4

4. (3). Abdominal segments above with posterior margins or more brown 5

Abdominal segments above not paler on posterior margins, sometimes with pruinose white markings 6

5. (4). Anterior two cross veins covered by distinct brownish clouds; brown of abdominal tergites extensive, not confined to hind margins of segments; length 32–35 mm. .... 12. *resh* (Hald.)

Anterior two cross veins without surrounding brown clouds; brown of abdominal tergites confined to hind margins of segments; length 35–40 mm. .... 6. *marginalis* (Wlk.)

6. (4). Size larger, front wings at least 50 mm. in length. 7

Size smaller, front wings less than 50 mm. long. 8

7. (6). Mesonotum ferruginous, marked with black as follows: elongate spot either side of middle anteriorly, a small spot laterad of these, a spot on each side margin and a large transverse spot posteriorly which has a narrow point extending forward along the middle line; length 38–40 mm. .... 4. *resonans* (Wlk.)

Mesonotum black with lateral margins and anterior inverted V-shaped mark fulvous, latter broadened and extended posteriorly to reach pale cruciform elevation; length 40–42 mm. 5. *auletes* (Germ.)

8. (6). Abdomen without a median row or pruinose white spots above 9

Abdomen with a median row of pruinose white spots above; marks on mesonotum, entire side margins of abdomen and band across pregenital segment white pruinose; length 31–38 mm. 11. *dorsata* (Say)

9. (8). Size small, length of body 23–26 mm; pronotum all green except for triangular black spot on anterior margin; abdomen beneath with hind margins of segments distinctly paler, sometimes covered with dense pruinosity .... 7. *aurifera* (Say)

Size larger, length of body at least 29 mm. 10

10. (9). Costa of forewing obtusely bent near middle (Fig. B); lateral white marks on abdominal tergite I inconspicuous; length 30–33 mm. .... 8. *linnei* (Sm. & Gross.)

Costa of forewing not so bent (Fig. 5) 11

11. (10). Under side of abdomen with broad, parallel-sided black stripe covering middle two-thirds or more of sternites; side margins of under side of abdomen also black; length 32–36 mm. 10. *robinsoniana* Dav.

Under side of abdomen with median stripe obsolete, when present not occupying more than middle third of sternites and conspicuously tapering posteriorly; abdomen beneath not blackened along side margins; length 29–35 mm. 9. *pruinosa* (Say) (Fig. 5)

III. *Diceroprocta* Davis

1. Head with transverse black stripe reaching nearly or quite from eye to eye; membranous part of fore wings entirely (including basal cell) hyaline; length 20–23 mm.
14. *vitripennis* (Say) (Fig. 2)

IV. *Okanagana* Distant

1. Pronotal margin anterior to humeral projection yellowed; underside of abdomen, except sometimes base of first segment and subgenital plate, pale; pale color of mesonotum not forming a broad, continuous stripe either side of middle; length 19–20 mm. ....15. *balli* Davis (Fig. 6)

V. *Magicicada* Davis

1. Head, thorax and abdomen chiefly black; eyes red; legs and most of wing veins orange-red; anterior two cross veins and longitudinal vein between them strongly clouded; length 21–31 mm. ....16. *septendecim* (Linn.) (Fig. 3)
   a). Abdomen conspicuously marked with pale brown, especially ventrally; size larger, 27–31 mm.
   nominal *septendecim* (Linn.)
   Abdomen almost or quite wholly black ventrally; size smaller, 21–25 mm. ....variety *cassinii* (Fish.)

VI. *Melampsalta* Kolenati

1. Straw-yellow, males only with a few dark markings; wings wholly hyaline; length 12–16 mm. ....17. *calliope* (Wlk.) (Fig. 1)

NOTES ON MISSOURI CICADIDÆ

1. *Cicada hieroglyphica* Say. All our records are for the latter half of June. On one occasion this cicada was found very common and singing in midafternoon on the trunks of oak trees in an Ozark woods. In this instance the majority of specimens were less than seven feet up on the trees, with only an occasional one above fifteen feet. Davis (1924) published an interesting note concerning a Missouri specimen: "Lately Mr. A. E. Brower of Willard [Greene County], Missouri, sent me a male *Cicada hieroglyphica* and a *Polistes pallipes* wasp with the following memorandum: 'Heard the cicada feebly crying and found it upon the ground with the enclosed wasp feeding upon it, July 4, 1923.' The head and part of the pronotum of the cicada are gone, evidently eaten by the wasp." A year later (1925) he again listed it for the state. Dent and Scott counties.

2. *Tibicen lyricen* (DeG.). The few Missouri specimens studied were collected between July 13 and August 10 in Atchison, Cape Girardeau (WRE), Greene (HIR), Jackson, Oregon and St. Louis (EPM) (HIO) counties.

3. *Tibicen chloromera* (Wlk). The several specimens collected by the author were found in decidedly moist situations—in willow shrubs along river banks—during July. Boyer and Heinze (1934) reported finding one of these insects in the stomach of a copperhead snake collected in Ste. Genevieve County on August 9. Cape Girardeau (CWW), Carter (EPM), Mississippi (WSC), St. Louis, Stoddard and Vernon counties.

4. *Tibicen resonans* (Wlk.). Since this southern species has been reported for Kansas there is some probability that it may be found in Missouri.

5. *Tibicen auletes* (Germ.). This, the largest cicada to be found in the United States, has been recorded from the state several times. Davis (1915), on the basis of some specimens collected in Wright County during August by M. P. Somes, listed it as *Cicada auletes;* later reports, under the present name, were given by VanDuzee (1917), Lawson (1920) and O'Byrne (1932). The latter wrote of a specimen in St. Louis County being attacked by the wasp *Polistes rubiginosus* Lepeletier on July 19. Studied material had been collected between August 1 and September 7. Boone, Cole (CFA), Crawford, Dade, Oregon (WKC) and St. Louis (HIO) counties.

6. *Tibicen marginalis* (Wlk.). This species was originally described by Thomas Say (1825) from "Missouri" as *Cicada marginata,* but as this name was preoccupied Walker changed it to *marginalis.* Under the generic name *Cicada,* Uhler (1892) recorded it for the state. Using the modern terminology Davis (1925 & 1935) listed it from the state, and with his description of the variety *pronotalis* (1938) he mentioned a few Missouri specimens. Except for a few individuals of the varietal form which were taken in Atchison and St. Louis counties during August, all our material is of the nominal form and was collected between July 27 and October 7. Gasconade, Jackson (HIR), Mississippi (WSC), Pemiscot, Pike (WSC), St. Louis and Taney counties.

7. *Tibicen resh* (Hald.). Davis (1918 & 1930) twice reported *resh* from the state; we have seen no local specimens.

8. *Tibicen aurifera* (Say). "*Cicada aurifera*" was described by Say (1825) with the remark, "Inhabits Missouri." We have seen a single male specimen which had been found dead in the Japanese beetle traps in St. Louis.

9. *Tibicen pruinosa* (Say). This is by far the most common of our cicadas or "locusts" as they are commonly called in the state. The number of individuals found coming to lights at night was most surprising. We have seen these night-flying individuals find their way into ice cream parlors and drug stores where their clumsy whirring flight frequently caused a mild panic among the patrons. Specimen records extended from June 21 to September 27, but we have "song" notes as late as October 11. One specimen from Livingston County has the lateral white pruinose spot of the third abdominal segment prolonged inwardly almost to the middle line of the abdomen. Except for this extended white mark and a narrow brown edge at the middle of the hind margin of the second segment it does not differ appreciably from normal specimens taken at the same locality. Davis (1915) recorded it from "Hollister [Taney County], Mo., (H. H. Knight)" as *Cicada pruinosa;* VanDuzee (1917) and Davis (1923) both gave local listings under the present name, the latter on the basis of a specimen collected in Greene County by A. E. Brower. Atchison, Boone, Buchanan (HIR), Cape Girardeau (CWW), Cole (CFA), DeKalb, Greene, Holt, Jackson (HIR), Livingston (SS), Mississippi (WSC), Nodaway, Pike (WSC), St. Charles and St. Louis counties.

10. *Tibicen robinsoniana* Davis. Although we have collected no material of this species, it belongs to the state's fauna as indicated by the literature records of Davis:—(1923) Hollister [Taney County], VII–22, 1915 (H. H. Knight); (1925) referring to the 1923 record; (1930) Forsyth [Taney County], September 4 (A. E. Brower); and (1932) Missouri. Through the extreme kindness of Dr. R. J. O'Conner, Curator of Science at the Staten Island Institute of Arts and Sciences, we were able to borrow and study the three specimens on which these records were based.

11. *Tibicen linnei* (S. & G.). We have two specimens—both females—which show the decided bend in the costa of the fore wing as figured by Davis (1918) and in the present paper (Fig. B). These had been taken in Boone and Crawford counties on September 10 and 7 respectively. Cuthbert and Cuthbert (1945) reported that a number of nymphs of this species had been eaten by a cat in Adair County on July 8.

12. *Tibicen dorsata* (Say). Beginning with Say's (1825) original locality citation, "Inhabits Missouri," we find a number of literature references to the local occurrence of this species: under the old generic assignment with *Cicada* there are records by Uhler (1892) and Davis (1915), the latter for "Mountain Grove, Wright Co., Mo., Aug. 4, 1902, male," and the same locality for a female in the collection of the Missouri Agricultural Experiment Station; VanDuzee (1917) and Lawson (1920) used the present terminology. At least in some localities in this state the species occurs in great abundance during August. We have collected it most commonly in open grass land and on sparsely weeded fields. Numerous freshly emerged and fully matured adults have been seen clinging to low growth (*Rhus* and *Solidago*) in such localities. An occasional individual has been found in clumps of trees which are often encountered in these prairie habitats. Atchison, Cass and Holt counties.

13. *Tibicen superba* (Fitch). This species has been listed for the neighboring states of Kansas, Oklahoma and Arkansas so we may expect to find it in at least the southwestern part of Missouri.

14. *Diceroprocta vitripennis* (Say). Besides Davis' (1928) listing we have specimen-records that were collected between June 24 and August 30 in Cole (LH), Mississippi (WSC) and St. Louis (PR) counties.

15. *Okanagana balli* Davis. This species is said by Davis to be "common in Iowa and neighboring states as far west as Kansas." We should, therefore, look for it in the northern part of our state.

16. *Magicicada septendecim* (Linn.). The "periodical cicada" has probably excited as much interest in the non-entomological mind as any other species of insect. Even though so widely known, the exact status of the several names involved in treatments of this cicada is still uncertain. The questions involve

the possible specific distinctness of the northern seventeen and southern thirteen year forms, and the exact status of the dwarfed form *cassinii* (which occurs with both the thirteen and seventeen year forms) in relation to the nominal forms.

There are a number of literature references to this species' occurrence within our state, of which a partial list follows: as *Cicada septendecim* by Riley (1869, 1881 & 1885); as *Tibicina septendecim* by VanDuzee (1917), Lawson (1920) and Rau (1922); as *Tibicen septendecim* by Marlatt (1907); as *Tibicina cassinii* (Fisher) by Davis (1919a); and as *Magicicada cassinii* by Davis (1925) from Clark County on October 15, 1919, this being an exceptionally late seasonal record, adults usually having disappeared by midsummer.

In 1915 Dr. L. Haseman published a bulletin entitled, "The Periodical Cicada in Missouri," in which he gave a synoptic report of the species as it was known to occur within the state up to that time. Most of the following distributional data is gleaned from that study. The average period of adult appearance is from late May until late June or early July. Eight broods have been reported for the state, two of which are of doubtful occurrence (Brood XVII and XXX).

Missouri Broods of *M. septendecim*

Brood No.	Distrib. in State	Scheduled Appearances	
		Last	Next
III	northern & western	1946	1963
IV	northern & western	1947	1964
X	all but northwestern third	1936	1953
XVII	western third	1950	1967
	13 Year Races		
XIX	all but northwest corner	1946	1959
XXIII	widely but scattered	1950	1963
XXIV	southeast lowlands	1938	1951
XXX	Cass County only	1944	1957

The Periodical Cicada has been reported for 110 of the 114 counties of the state (all except Nodaway, Platte, Wayne and

Worth counties). The following list of counties and broods reported to have occurred in them is based chiefly on Haseman's 1915 paper with additions from Haseman (1919) and Hyslop (1935), and specimen records enclosed within brackets. Adair XIX, XXIII; Andrew IV [1947 REC]; Atchison IV; Audrain XIX, XXIII; Barry X-Hyslop (1935), XIX, XXIII; Barton IV, XIX; Bates III; Benton XIX; Bollinger XIX, XXIII; Boone [IV-1947-WSC], XIX [1920-U of Mo. & 1933 (TEB)], XXIII; Buchanan III, IV; Butler XIX; Caldwell IV; Callaway XIX, XXIII; Camden X, XIX, XXIII; Cape Girardeau X (Haseman 1919), XIX, XXIII; Carroll IV; Carter X (Haseman 1919), XIX; Cass III, IV, XVII–?, XXX–?; Cedar XIX, XXIII; Chariton X, XIX; Christian XIX, XXIII; Clark III, IV, X, XIX, XXIII; Clay XIX, XXIII; Clinton XXIII; Cole XIX [1946 CFA], XXIII; Cooper XIX, XXIII; Crawford X, XIX, XXIII; Dade X, XIX, XXIII; Dallas XIX, XXIII; Daviess IV; Dekalb IV, XIX; Dent X, XIX, XXIII; Douglas X, XIX, XXIII; Dunklin XIX, XXIII; Franklin X, XIX [1946] [1947-one specimen, probably a straggler?], XXIII; Gentry III; Greene XIX, XXIII; Grundy III, IV, XIX; Harrison III, IV; Henry III, IV, XIX; Hickory X (Haseman 1919), XIX, XXIII; Holt IV; Howard X, XIX, XXIII; Howell X, XIX, XXIII; Iron X, XIX, XXIII; Jackson IV; Jasper XIX, XXIII; Jefferson X, XIX, XXIII [1937]; Johnson III, IV, XXIII; Knox III, X, XIX, XXIII; Laclede XIX; Lafayette III, IV, XXIII; Lawrence XIX, XXIII; Lewis III, XIX; Lincoln XIX, XXIII; Linn X, XIX, XXIII; Livingston III, XIX; McDonald XIX; Macon III, XIX; Madison XIX; Maries X, XIX, XXIII; Marion III, IV, XIX, XXIII; Mercer III, IV, XXIII; Miller 19, XXIII; Mississippi XXIII; Moniteau XIX; Monroe III, XIX; Montgomery XIX, XXIII; Morgan X, XIX, XXIII; New Madrid XXIII; Newton XIX, XXIII; Oregon XIX, XXIII; Ozark XIX, XXIII; Pemiscot XXIII; Perry X (Haseman 1919), XIX, XXIII [1937]; Pettis XIX, XXIII; Phelps XIX, XXIII; Pike (X Hyslop 1935), XIX [1933 WSC], XXIII; Polk X, XIX, XXIII; Pulaski X, XIX, XXIII; Putnam III, X, XIX, XXIII; Ralls III, X, XIX, XXIII; Randolph III, X, XIX; Ray IV; Reynolds XIX, XXIII; Ripley XIX, XXIII;

St. Charles XIX [1946], XXIII; St. Clair III, XIX, XXIII; Ste. Genevieve X, XIX, [XXIII–1937]; St. Francois X, XIX, XXIII; St. Louis XIX [1907 CLH, 1920 EPM, 1933 EPM, 1946], XXIII [1937]; Saline IV, XIX, XXIII; Schuyler III, XIX, XXIII; Scotland III, XIX, XXIII; Scott X, XXIII, XXIV; Shannon X, XIX; Shelby III, XXIII; Stoddard XIX; Stone XIX, XXIII; Sullivan III, XIX, XXIII; Taney X, XIX, XXIII; Texas XIX, XXIII; Vernon IV; Warren XIX, XXIII; Washington X, XIX, XXIII; Wayne XIX; Webster X, XIX, XXIII; Wright XIX, XXIII.

17. *Melampsalta calliope* (Wlk.). *Cicada parvula,* Say's (1825) synonym of this species, was described with the remark, "Inhabits Missouri." Davis (1918) cited this locality and later (1920) listed a specimen collected in Wright County on June 20, 1873. Our material was swept from fields of low weeds and tall prairie grasses between June 24 and July 20. Carter (EPM), Holt (EHF), Jasper and Jefferson counties.

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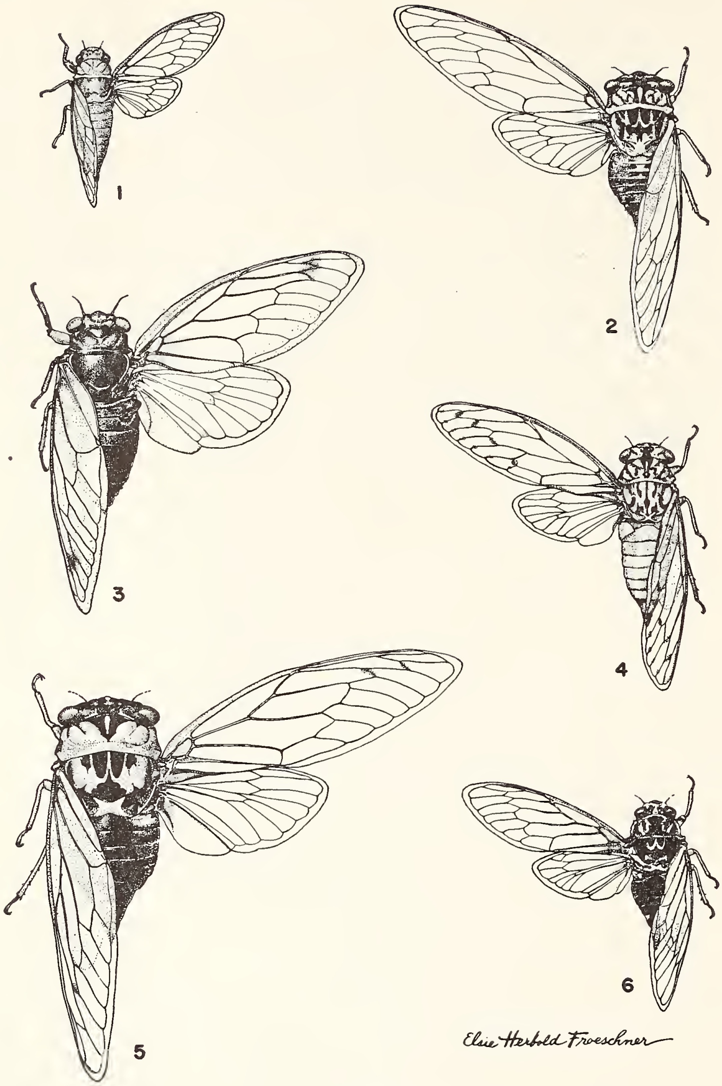

PLATE I

1. *Melampsalta calliope*
2. *Diceroprocta vitripennis*
3. *Magicicada septendecim*
4. *Cicada hieroglyphica*
5. *Tibicen pruinosa*
6. *Okanagana balli*

(All natural size)

ENTOMOLOGISTS OF THE NEW YORK CITY REGION, 1878–82

By Harry B. Weiss

The following list of entomologists of the New York City region, 1878–82, has been compiled from Cassino's "Naturalists' Directory for 1878," Charles W. Leng's "Memories of Fifty Years Ago," (Bull. Brook. Ent. Soc., Feb. 1923), and Harry B. Weiss' paper on "The New York Entomological Club," (Jour. N. Y. Ent. Soc., June, 1948). Such lists are frequently useful in identifying bygone collectors' names on labels and in supplying starting places for biographical research.

Practically all entomologists and collectors in the New York area around 1880, were either coleopterists or lepidopterists. Of the 48 individuals listed, approximately half were collectors and students of the Lepidoptera and the other half were devoted to the Coleoptera. Nearly all had collections of their specialties. And a goodly number brought their liking for entomology from Germany.

Akhurst, John. Brooklyn. Coleoptera, Lepidoptera.

Andrews, W. V. 187 State St., Brooklyn. Coleoptera, Lepidoptera.

Angell, G. J. 64 Elliott Pl., Brooklyn. Lucanidæ, Scarabæidæ.

Angus, James. West Farms, New York City. Catocala, Sphingidæ.

Bridgham, S. New York City. Lepidoptera.

Cramer, W. S. C. P. 227 E. 93rd St., New York City. Lepidoptera.

Crooke, John J. 163 Mulberry St., New York City. Coleoptera, Lepidoptera.

Davis, William T. Staten Island. Entomology.

Doll, Jacob. 74 Graham Ave., Brooklyn. Lepidoptera.

Edwards, Henry. 185 E. 116th St., New York. Lepidoptera.

Eliot, S. L. 439 E. 87th St., New York City. Lepidoptera.

Franck, Geo. 123 W. Houston St., New York City. Lepidoptera.

Fuchs, Carl. 14 Bond St., New York City. Coleoptera.

Gissler, Carl F. 241 North 6th St., Brooklyn. Coleoptera.

Graef, Edw. L. 40 Court St., Brooklyn. Entomology.

Grote, A. R. New Brighton, S. I., N. Y. Lepidoptera.

Hilton, A. P. 331 Hudson St., New York City. Coleoptera.

Hubbell, Mark L. 211 W. 23rd St., New York City. Lepidoptera.

Hulst, George D. Brooklyn. Lepidoptera.

Julich, Wilhelm. 157 W. 32nd St., New York City. Coleoptera.

Koebele, Albert. 419 W. 24th St., New York City.

Leng, Charles W. Brooklyn. Coleoptera.

Linell, Martin L. 97 Bergen St., Brooklyn. Coleoptera.

Luetgens, Augustus. 207 E. 15th St., New York. Coleoptera.

Mead, T. L. 674 Madison Ave., New York City. Lepidoptera.

Merkel, Aug. 13 Broadway, New York City. Coleoptera.

Meyer, Julius E. 61 St. Felix St., Brooklyn. Lepidoptera.

Miller, Frank. 690 Myrtle Ave., Brooklyn. Lepidoptera.

Morton, Henry H. 70 West 12th St., New York City. Entomology.

Neumogen, Berthold. New York City. Lepidoptera of the world.

Nostrand, P. Elbert. Brooklyn. Entomology.

Peck, Geo. W. 226 W. Pearl St., New York City. Lepidoptera.

Pfordte, Otto. Hoboken, N. J. Coleoptera.

Roberts, Chris. H. 156 E. 80th St., New York City. Lepidoptera, Coleoptera.

Sachs, Herman. 96 Bloomfield St., Hoboken, N. J. Lepidoptera, Coleoptera.

Saltzwedel, Henry, M.D. 58 Union Ave., Brooklyn. Coleoptera.

Schaupp, F. G., Prof. 9 Broadway, Brooklyn. Coleoptera.

Schaus, W., Jr. 38 W. 30th St., New York City. Lepidoptera.

Schmelter, H. New York City. Coleoptera.

Schultze, E. 636 Third Ave., New York City. Entomology.

Schuster, Theo. 419 Herkimer St., Brooklyn.

Seifert, Otto. 7th Ave. and 24th St., New York City. Lepidoptera.

Scivenson, J. M. New York City. Scarabæidæ.

Taber, Edmund B. Tribune Office, New York City. Lepidoptera.

Tepper, Fred. New York City. Lepidoptera.

Van Waggenen, G. H. Rye, N. Y. Lepidoptera.

Waters, W. E. 103 Fulton St., New York City. Lepidoptera.

Woodworth, W. Sing Sing, N. Y. Lepidoptera.

THE FLIGHT OF VESPINE WASPS IN RELATION TO STORMY WEATHER

By Albro T. Gaul

Long Island University, Brooklyn, N. Y.

In the course of a series of observations and experiments on the physiology of flight mechanisms of the Vespine wasps, it was noted that flight activities came to a halt upon the onset of rain. During the summer of 1950, it was decided to study the cause of this phenomenon.

A test colony of *Dolichovespula arenaria* F. was established in a laboratory, near a permanently opened window, but away from direct sunlight. Within a foot of this colony was a set of meteorological instruments including a barometer, wet and dry bulb hygrometer, and (in the sunlight)a foot-candle meter. The location of the laboratory in Windsor, Mass. is of such altitude and topography that it lies in the path of many local thunderstorms. Advantage was taken of this fact to record data involving wasp flight in relation to meteorological changes.

It was originally assumed that the wasps had some receptor mechanisms which might warn them of impending bad flying weather. Therefore much attention was placed upon the phenomena just preceding storms. Attempts to relate normal daily flight rates with the small barometric changes preceding rainfall were a failure because there were no changes in the rate of flights. Similarly, all phenomena of the approaching storm (relative humidity, temperature decrease, and light decrease) were impossible of correlation with daily flight rates. It is now apparent that these weather phenomena are inoperative in influencing wasp flight. This is reasonable, because each phenomenon is of common occurrence and is not necessarily associated with approaching precipitation. Further, neither the light nor the temperature reaches a point below the flight thresholds as determined by the author (1).

It might be expected that changes in barometric pressure might be the greatest influencing factor in curtailing flight (if any single factor could be interpreted as an omen of bad weather by the wasps). The greatest barometric change noted upon the approach of a thunderstorm was – 0.23 inches. Since this pressure change is equivalent to an altitude change of about 160 feet, and since it is known that the wasps frequently attain this altitude above ground level in their normal flight, the possibility of such a barometric change causing a change in flight rate can be safely ruled out. This lack of anticipation of approaching storms may serve a useful purpose. There are many days of overcast and impending bad weather, when most meteorological instruments can be interpreted as indicating an approaching storm. On such days, it would impede the efficiency of the colony if all the ergates were to remain within the nest, and no fresh food were to be brought from the field.

The foregoing does not imply that the wasps are unequipped with receptor mechanisms for the various meteorological phenomena discussed. It is known that they are equipped to detect at least some of these weather changes. Newton (3) has shown that the campaniform sensilli of the honey-bee may detect changes in atmospheric pressure. The author has shown (loc. cit.) Vespine sensitivity to light and temperature changes. Moreover, Homann has demonstrated (2) that the ocelli of a number of insects, including *Formica,* are sensitive to very small changes in light intensity. It can thus be concluded that since Vespine wasps have some receptors for the weather phenomena discussed, they cannot, or do not, integrate the various sensory stimuli in such a way as to predict a storm.

As a check, it was decided to duplicate insofar as possible the electrical effects of a thunderstorm. Two, three inch square, sixteen mesh copper wire screens were attached to the cage entrance (one above and one below), so the wasps were forced to fly between the screens. The screens were placed 7 cm. apart. It was then determined that a potential of 100 kilovolts was required to start an arc of this length. Since potentials of this magnitude seldom exist, short of proximity to a direct lightning discharge, a potential of 9.5 kilovolts was placed on the screens. The presence of this charge, regardless of polarity of the screens, induced no apparent restriction in wasp flight. The same negative result was obtained on both clear and rainy days. It is therefore apparent that the dielectric effect of air during an electrical storm has no notable influence upon the activities of the Vespine wasps.

The final attempt to duplicate the effects of an electrical storm was the application of radio frequencies to the copper screens. It is known that the lightning discharges generate an untuned radio frequency wave. The experimental radio frequencies were generated by a crystal controlled Hartley circuit, with assorted frequency doubler and quadrupler output circuits, applied to the screens through co-axial cables. The frequencies used were: 8.3 megacycles, 16.6 mc. and 66.4 mc. The power was constant at 20 watts R.F. Since these experiments had no effect in curtailing the wasp flights, an untuned 10 watt R.F. oscillator was built and employed to activate the screens. There was still no reduction in wasp flights. Each application of these radio frequencies was tried a number of times in all weather.

Both the R.F. and the electrostatic experiments were run for continuous periods of ten minutes. When these were found without effect, momentary applications of these agents were tried, still without effect. In no instance were both agents in simultaneous use. It was concluded that either the wasps could not detect the presence of these agents, or they did not associate them with oncoming storms.

It was noted, during periods of actual precipitation, when flights had come to a halt, that the wasps made sporadic flight attempts at the rate of perhaps one flight every four to six minutes. These flights always concluded with a quick return to the nest, the total round trip seldom exceeding six feet. Thereafter data was analysed with wasp flight related to actual precipitation. While wasps may disregard the warning signals of an approaching storm, it was quickly discovered that they were activated by the falling of actual rain.

As soon as precipitation had begun, the wasps crowded homeward. Outward flights stopped upon the advent of rain at the site of the nest. Observations in the field showed that the wasps would fly homeward when it rained, even though it had not yet begun raining at the nest site. Four or five minutes after the beginning of a rainfall, all flights would come to a stop, indicating that all wasps who could attain the nest had already returned.

Immediately after the end of a short rainstorm there was a rush of six to ten ergates to the nest. These were probably survivors of those who had been beaten down by the rain before reaching home. This was the observed pattern of behavior of three nests during six thunderstorms and one 36 hour rainfall, except that there were no returning stragglers after the 36 hour rainfall.

It appears that the occasional flight of an individual worker during the rain is a sort of test flight to ascertain weather conditions. Upon the cessation of the rain, the first flying worker does not immediately return to the nest, but continues on a normal foraging flight. Therefore this wasp cannot communicate her findings about the improved weather to the nestmates. Immediately after the inauguration of this successful flight, however, the wasps begin streaming out of the nest on their regular duties. Perhaps the failure of the first wasp to reappear is the signal of clement weather. Frequently, the wasps that are resuming their interrupted work are encountered, on leaving the nest, by the returning stragglers. It is significant that the wasps do not resume flight precisely upon the termination of rainfall. There is a time lapse between the end of the rain and the first flight which is within the normal periodicity of the regular test flights.

In conclusion, changes in temperature, relative humidity, barometric pressure, light intensity, electrostatics and radio frequencies (all of which accompany some types of storms) cause no anticipation of bad weather as demonstrated by a change in flight rate among the Vespine wasps. Wasps react to a storm only when they get wet. Some wasps are so unprepared for a storm that they are overtaken and beaten down by the rain. The wasps make regular experimental flights during a storm. These flights are of short duration and distance. The function of these flights is to forage for field products, but the rainfall drives the wasp back into the nest. It has been shown that the wasps are probably equally unable to detect the end of a rainfall.

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METABOLIC CYCLES AND THE FLIGHT OF VESPINE WASPS

By Albro T. Gaul

Long Island University, Brooklyn, N. Y.

It has long been noted by the author that the temperatures of excavated colonies of *Vespula* (s.str.) and the earth immediately around these colonies are higher than those of the air or the earth at some distance from the nest. Since this temperature differential has been attributed to metabolic heat, it was believed that a similar phenomenon must occur among colonies of the arboreal *Dolichovespula* species. In order to determine if this might be true, two colonies of *D. maculata* L. were established near a window of a laboratory in Windsor, Mass. Laboratory thermometers were thrust through the paper envelope of the nest in such fashion that the bulbs of the thermometers were located between layers of brood comb. Check thermometers were placed in the air six inches from the nests.

Within two days the ergates had repaired the damage done to the nest envelope by the penetrating thermometers, and had effectively sealed these instruments into the nests. At this point data were collected.

It is common knowledge that an aggregate of living cells will produce detectable quantities of metabolic heat. That this is true among insects has been shown by Mosebach-Pukowski (2) and others, who noted that gregarious lepidopterous larvæ can raise their own temperature by one or two degrees when they gather. It is accordingly not astonishing that Vespine colonies, comprising numbers of larvæ (with a relatively high metabolic rate due to feeding and growth), pupæ (with a relatively low metabolic rate) and adults of the several castes, all of which are confined within a number of layers of paper envelope (an excellent heat insulator) generate and retain appreciable quantities of metabolic heat.

Air temperatures and internal nest temperatures were noted for a full 24 hour period at regular hourly intervals. Subsequent temperature readings were made for a number of hours at a time, at different periods of day and night. These subsequent readings confirmed the accuracy of the first observations. It was at once realized that absolute readings of temperature were worthless in an understanding of the problem. Variations in air temperature were far greater than differences in nest temperature. Therefore a system of relative temperatures was devised, in which the air temperature at any one reading was subtracted from the nest temperature, giving the temperature differences. It is apparent that the nest temperature would vary with the air temperature, while the difference between the two, if a positive number, would represent heat from metabolic activity.

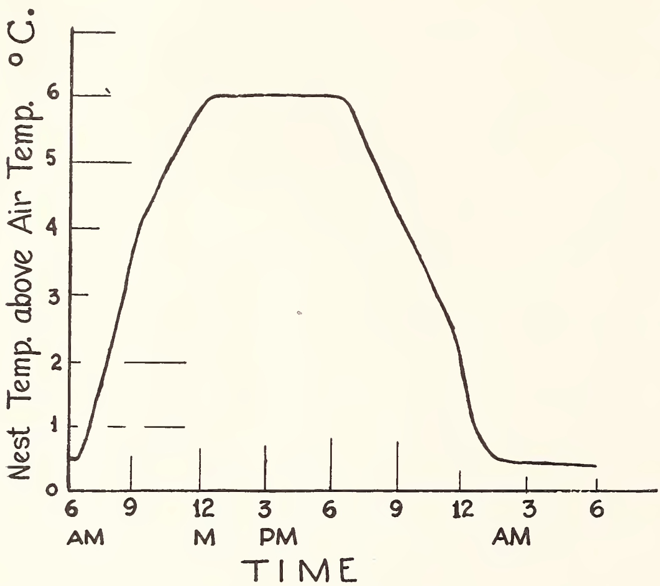

Figure 1. Daily Cycle of Metabolic Temperature Change in a Nest of *Dolichovespula maculata* Linn.

By considering air temperature a constant, and plotting nest temperature difference against time, Figure 1 is the result.

Both colonies of *D. maculata* under observation were of nearly the same size (9 inch diameter) and both had a population of from 65 to 70 ergates, with a probable brood of 90, discounting eggs. The temperature differential curves for the two nests were remarkably similar.

There is a nocturnal constant of 0.5° C. above the surrounding air. This is a fair indication of the normal resting metabolism of the colony. Immediately after the morning flights begin, the temperature differential begins to rise above the 0.5° minimum. The attainment of 6.0° C. above the surrounding air occurs about noon and continues until the colony settles down for the night. This morning increase is probably the result of several factors. When morning flights start, fresh food is brought in by the foragers. Work is performed in the nest as other ergates (brood nurses) distribute food to the larvæ. Work is done by the larvæ in metabolizing the food. Also the absolute temperature is increasing outside from the sun's heat, and may perhaps be increasing the efficiency of Vespine enzymes which would accelerate metabolism.

The relatively slow temperature differential drop at night indicates a more gradual slackening in metabolic activity. This slackening could well be correlated to the more gradual decrease in evening air temperatures, and hence the gradual decrease in enzyme efficiency. Of course, from the moment the light drops below the threshold for flight no more food supplies are imported, and the decrease in temperature difference can in part be accounted for in decrease in food metabolism. It is the author's opinion that both factors are present and interactive both in morning and evening. This cyclical production of heat is perhaps akin to Lammert's cycles of heat production in the hives of the honeybee during winter months.

Total heat production is not represented on the graph, as there are certainly substantial heat losses through the nest envelope, and through wing fanning within the nest. Also much potential colonial heat is lost by the ergates in the field.

It is remarkable that the flight activities as determined by the author (1) correlate so completely with the metabolic rate as determined by heat production. Whereas flight is initiated by certain threshold minima before the wing muscles can function at the proper frequency, the temperature of the colony depends in turn upon the quantity of food brought into the nest by the flight muscles. The increase in the daily temperature differential is nearly simultaneous with the awakening of the colony.

The moment of temperature decline is nearly coincident with the cessation of the day's flight activity.

In conclusion, it can be stated that there is a definite daily metabolic cycle of heat production in the Vespine nest. This metabolic cycle is closely coincident with the daily activity cycle. The heat production is probably dependent upon the importation of food to the nest, and to the influence of the actual heat upon enzyme activity which in turn increases the metabolic rate of the wasps.

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INTERNATIONAL UNION FOR THE STUDY OF SOCIAL INSECTS

At the 1951 meeting of the International Entomological Congress in Amsterdam, it was decided to organize an International Union for the study of social insects. The aims of the union are: (1) to foster the scientific study of problems concerning these insects and (2) to integrate such work in appropriate ways internationally and within the various countries.

Dr. T. C. Schneirla, of the American Museum of Natural History, New York 24, N. Y., has been named Chairman pro tem and Dr. Chas. D. Michener, Dept. of Entomology, University of Kansas, Lawrence, Kansas, is secretary pro tem of the North American section.

It is planned to establish a Bulletin, which would contain news items, lists of current publications and other reports of work in progress, as well as discussions and short articles of interest. A trial number, prepared and financed by the French section will appear shortly.

Entomologists, who would be interested in becoming affiliated with the North American section of the union, are asked to write to either Dr. Michener or Dr. Schneirla, so that they might be informed of further developments, and receive the initial copy of the Bulletin.—F. A. S.

INSECT FECULÆ, II

By Harry B. Weiss and William M. Boyd

This paper is supplementary to the one on the same subject that was published in this Journal in 1950 (vol. 58 (3): 154–168) and includes brief descriptions and illustrations of the fecal discharges of the larvæ of some thirteen additional species of insects. For the material described in this and in the former paper, we are greatly indebted to Robert J. Sim and to Dr. S. W. Frost. For the most part, only feculæ from mature larvæ are described and figured.

In accordance with our plan of referring only to papers on the subject that appeared after Frost's general summary in 1928 under the title "Insect Scatology," attention is called to "Defæcation by a jassid species" by H. H. Storey and R. F. W. Nichols in the Proceedings of the Royal Entomological Society of London, (1937). These authors state that apparently two substances are excreted by *Cicadulina mbila?* Usually clear honey-dew is ejected forcefully. A second method is the defecation of a cloudy fluid thought to be the product of the malpighian tubules. In this case the fluid is transferred to the anterior edge and upper surface of the forewings by the hind tibiæ. After it dries the excrement is scrubbed off the wings vigorously. In the nymphs this cloudy fluid is excreted upon the hind tarsi from which it is spread to the other legs and scrubbed off as it dries.

From our own observations it may be said that various species of adult lace bugs such as *Stephanitis pyrioides* Scott, *Stephanitis rhododendri* Horv., etc., cover their eggs with liquid excrement that hardens into a brownish scab-like, flat crust. When most of the egg is inserted into the leaf tissue, only the egg cap, which is level with the leaf surface, is covered. When only the base of the egg is inserted in the leaf tissue, such as by *Corythuca arcuata* (Say), the remaining part is coated with brownish excrement which soon hardens.

Thomas E. Snyder in his book "Our Enemy the Termite" (Ithaca, 1935), states that "fossil pellets of partly digested, excreted wood of a dry-wood termite (Kalotermes sp.) have been found in the Seminole Pleistocene formation" in Florida. In writing of the food of termites he states that excreta often go through the bodies of several termites before being finally rejected as devoid of further food value; also that certain tropical termites store small potato-like spheres of excreted wood that are supposed to be a reserve food supply. Dry wood termites excrete "impressed pellets of fine digested, excreted wood," the chief element of which is lignin. An analysis of the pellets showed that for the most part only cellulose had been lost and that there remained mostly lignin which could not be digested.

Although it has been stated that the feculæ of insects have a practical value in indicating the presence of insects after they have stopped feeding and have disappeared and although keys have been made for the identification of certain defoliators, we are of the opinion that the use of feculæ in the identification of species has only a very limited and by no means positive value. Size is not a constant character even of mature larval feculæ. Texture is not constant, depending, as it does, upon the character of the food. Shape is fairly constant, but is approximately the same for many species. Color is variable, depending upon the food and upon the bleaching effect of the sun and weather. Furrows and striations appear to have identification value but these are identical for many species and they are subject to changes as the specimens dry. In addition, the undigested food or the waste material, if coarse, frequently does not take some of the minor striations impressed upon it by the internal structure of the rectum. A pellet with a constriction in the middle may or may not be two pellets that failed to separate when voided. All in all, specific constant characters were absent in the sixty-seven different types that were examined. However, it is not denied for example, that orthopterous, lepidopterous and hymenopterous feculæ can usually be readily identified as such. And in the Lepidoptera the excrement of the Papilionidæ is usually easily distinguishable from that of the Sphingidæ, Noctuidæ, Saturnidæ, etc.

LEPIDOPTERA

LIMACODIDÆ

Phobetron pithecium S. & A.

Subglobular, flattened on one end and frequently with a shallow or deep concavity at opposite end, giving many pellets a globular, cup-like appearance. Segmentation absent. No trace of striæ. Outer surface somewhat rough and glistening. Texture fine. Color black. Length, 1.5–2.3 mm. Width, 1.6–2.0 mm. (Figure 1).

TORTRICIDÆ

Archips argyrospila Wlk. May 20.

Roughly elongate or subglobular, the elongate ones usually somewhat constricted at the middle. Segmentation not apparent. Striations absent. Texture fine. Outer surface finely sculptured. Color black becoming ashen with age. Length, 0.6–1.3 mm. Width, 0.4–0.7 mm. (Figure 2).

Archips rosaceana Harr., on apple, May 20.

Similar to that of *Archips argyrospila* WLK.

SPHINGIDÆ

Lapara bombycoides Wlk., on pine.

Cylindrical, truncate at each end. No longitudinal segmentation. Each "pellet" usually divided into subequal segments by two or more shallow, circumferential striæ. Outer surface slightly sculptured with pine needle debris, glistening. Texture coarse. Color, light yellow flecked with brown. Length, 4.0–5.5 mm. Width, 1.8–2.2 mm. (Figure 3).

Pholus satellitia Dru. (pandorus Hbn.), on grape.

Roughly cylindrical tapering gradually from the widest truncate end to the opposite rounded or truncate end. Six-segmented. Longitudinal furrows between segments, deep. Outer surface of each segment with an ill-defined median stria and several transverse striæ that divide the surface into subequal areas. Texture moderately coarse. Color black. Length, 3.0–4.5 mm. Width, 2.5–3.0 mm. (Figure 4).

Pholus achemon Dru., on grape.

Roughly cylindrical, tapering gradually from broadest truncate end to opposite rounded or truncate end. Six-segmented. Longitudinal furrows between segments, deep. Outer surface of each segment with a single ill-defined, median, longitudinal stria. Transverse striæ numerous. Texture moderately coarse. Color, black. Length, 3.5–4.0 mm. Width, 2.5–3.5 mm. (Figure 5).

NOTODONTIDÆ

Datana drezelli Hy. Edw. on witch-hazel. (Old specimens).

Subcylindrical, six-segmented. Usually truncate at one end, bluntly rounded at opposite end. Longitudinal furrows between segments, deep. Texture moderately coarse. Outer surface of each segment without longitudinal or transverse striæ. Absence may be due to age of specimens. Color, dark brown. Length, 2.0–4.0 mm. Width, 1.5–2.0 mm. (Figure 6).

NOCTUIDÆ

Cucullia convexipennis G. & R., on goldenrod.

Subcylindrical, truncate at both ends. Six-segmented. Furrows between segments shallow. Outer surface of each segment without a longitudinal median stria, but with 3 or 4 transverse striæ that break up surface into 4 or 5 segments. Texture not coarse. Color, black. Length, 3.6–4.6 mm. Width, 1.5–2.0 mm. (Figure 7).

Amphipyra pyramidoides Gn., on apple, May 26.

Irregularly subcylindrical. Truncate at one end. Opposite end frequently with shallow concavity. Six-segmented. Segments compressed so as to make segmentation indistinct in cross section. Furrows between segments shallow and irregular. Outer surface of each segment with transverse striations only. Texture fine. Color, black. Length, 0.8–2.0 mm. Width, 0.5–1.2 mm. (Figure 8).

NYMPHALIDÆ

Basilarchia archippus Cram., August 27.

Subcylindrical, truncate at one end and frequently concave at opposite end. No visible segmentation. Striæ absent on outer surface. Texture moderately coarse. Outer surface roughly sculptured. Color, light tan to dark brown. Length, 2.0–2.5 mm. Width, 1.2–1.5 mm. (Figure 9).

HYMENOPTERA

PAMPHILIIDÆ

Acantholyda (Itycorsia) *zappei* Roh., on red pine, October.

Roughly cylindrical, unsegmented ''pellets,'' usually truncate at both ends, but sometimes drawn out somewhat at one end. Surface coarsely sculptured, frequently glistening. Texture coarse; compact masses of short, empty pine needles embedded without design or order. Color, light to dark tan. Length, 3.0–5.0 mm. Width, 0.8–1.8 mm. (Figure 10).

DIPRIONIDÆ

Neodiprion fabricii Leach, on *Pinus rigida*, May 19.

Subrhomboid-shaped, compact, flattened masses of empty pine needles, arranged in more or less diagonal and parallel positions. Texture coarse. Surface rough. Color, green. Length, 1.5–3.0 mm. Width, 0.8–1.2 mm. Thickness, 0.5–0.9 mm. (Figure 11).

Neodiprion abbotti Leach, on white pine, September 15. (Specimens 12 years old.)

Subrhomboid-shaped, compact, flattened masses of empty pine needles, arranged in more or less diagonal and parallel positions. Texture coarse. Surface rough. Color, light brown (light green when fresh). Length, 1.5–2.5 mm. Width, 1.0–1.2 mm. Thickness, 0.5–0.7 mm. (Figure 12).

Neodiprion sertifer Geoff., on red pine, May 23.

Rectangular or rhomboid-shaped, flattened, compact masses of pine needle, alimentary debris, arranged in parallel or parallel-diagonal positions. Texture coarse. Surface roughened. Color, light green flecked with dark green. Length, 1.8–2.3 mm. Width, 0.7–1.2 mm. Thickness, 0.3–0.7 mm. (Figure 13).

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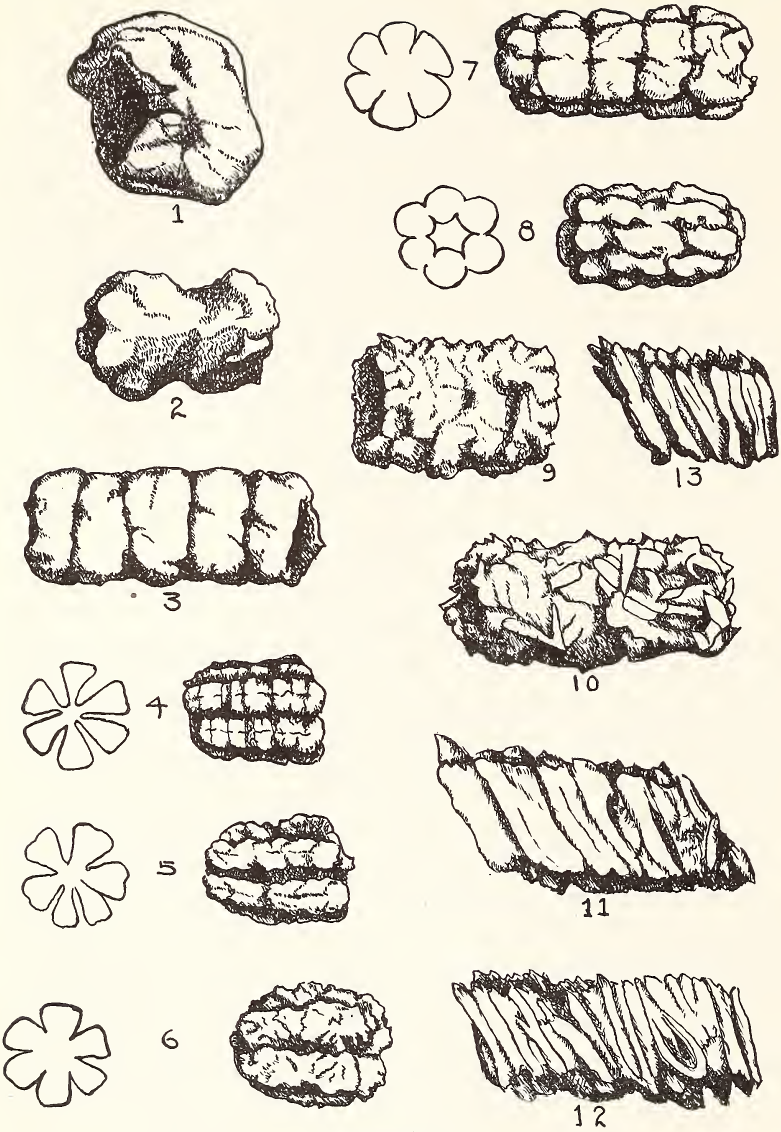

Plate II

Fig. 1. Phobetron pithecium S. & A. Fig. 2. Archips argyrospila Wlk. Fig. 3. Lapara bombycoides Wlk. Fig. 4. Pholus satellitia Dru. Fig. 5. Pholus achemon Dru. Fig. 6. Datana drexelli Hy. Edw. Fig. 7. Cucullia convexipennis G. & R. Fig. 8. Amphipyra pyramidoides Gn. Fig. 9. Basilarchia archippus Cram. Fig. 10. Acantholyda zappei Roh. Fig. 11. Neodiprion fabricii Leach. Fig. 12. Neodiprion abbotti Leach. Fig. 13. Neodiprion sertifer Geoff.

INSECT INHABITANTS OF POLYPORUS BETULINUS[1]

By Edith L. Minch

The fungus, *Polyporus betulinus* (Bull.) Fr., is an abundant shelf fungus on trees of the genus *Betula* in northeastern United States. In its early stages it is very fleshy, but with age and drying gradually becomes woody. It is a wound parasite, according to MacDonald (1937), although it continues to occur on dead standing trees for several years. Individual sporophores persist only one year.

In the vicinity of Albany, New York, this fungus is abundant on the gray birch, *Betula populifolia* Marsh. Specimens used for this study were obtained from a large grove of these trees along Fuller Road, just west of the Albany city limits.

ACKNOWLEDGEMENTS

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METHODS OF PROCEDURE

Collections of fungus were made at two week intervals from September to late May. Each specimen was checked externally as it was secured from the field and then carefully dissected in the laboratory. All adult insects were collected. Larvæ were reared on pieces of fungus in plastic bags, according to the method developed by Minch (1951) for this purpose. Periodic checks yielded larvæ, pupæ, and adults of several insect species.

[1] This is part of a report submitted to the faculty of the New York State College for Teachers at Albany, in partial fulfillment of the requirements for the degree of Master of Arts, in June 1951.

SPECIES OBSERVED

The following list includes all species of insects taken from or on this fungus during the progress of the study. Weiss and West (1920) list nine species of insects occurring in this fungus in New Jersey. Seven of these species were found at Albany. Sixteen other species were also collected from the fungus.

COLEOPTERA

TENEBRIONIDÆ

Diaperis maculata Oliv.
Xylopinus saperdioides Oliv.

OSTOMIDÆ

Thymalus marginicollis Chev.
Tenebroides corticalis Melsh.

CARABIDÆ

Pinacodera platicollis Say.

LAMPYRIDÆ

Lucidota corrusca L.

MELANDRYIDÆ

Penthe obliquata Fab.
Eustrophinus bicolor Fab.

MYCETOPHAGIDÆ

Mycetophagus punctatus Say.
Mycetophagus flexuosus Say.

NITIDULIDÆ

Epurea truncatella Mann.

SILPHIDÆ

Agathidium politum Lec.

STAPHYLINIDÆ

Omalium humerosum Fauv.
Nudobius cephalus Say.
Philonthus blandus Grav.
Staphylinus violaceus Grav.

HEMIPTERA

ARADIDÆ

Aradus similis Say.

LEPIDOPTERA

TINEIDÆ

Tinea granella L.

THYSANOPTERA

PHLÆOTHRIPIDÆ

Hoplothrips major Hood

COLLEMBOLA

ENTOMOBRYIDÆ

Entomobrya corticalis Nicolet

Entomobryoides purpurascens Packard

ISOTOMIDÆ

Isotoma cinerea Nicolet

DIPTERA

SCIARIDÆ

Sciara johannseni End.

DISCUSSION

Of the twenty-three species listed, at least six occur in both adult and immature stages on the fungus. Four others, *Sciara johannseni* and the three species of Collembola, probably spend their entire life cycle there. The other thirteen species appear to be visitors, using the fungus for food, as the Melandryids and Mycetophagids; for shelter, as the Lampyrid; or as a source of animal food, as the Staphylinids. Little is known about the relationships of these to the fungus and its other inhabitants. The following discussion is concerned with the six species which inhabit the fungus in both immature and adult stages.

Thymalus marginicollis—According to Donisthorpe (1931) *Thymalus limbatus* F. is the most characteristic beetle found in *Polyporus betulinus* in England. Similarly, *Thymalus marginicollis* is by far the most abundant resident of this fungus at Albany. Larvæ are found from September, when the new growth begins to reach usable size, until late May. In the field, pupæ are found in early May, and by late May some adults have emerged. Under the warm and humid conditions of the laboratory, pupation and emergence may occur somewhat earlier. Pupation occurs in a simple hollow in the fungus. Weiss (1920) gives the pupation period as ten days, although this is variable, depending on temperature and humidity. Adults continue to feed on the fungus through the summer and early fall. Although no eggs were discovered, it seems likely that they are deposited on the very young growth of fungus in late summer.

Diaperis maculata—This handsome species is abundant on the riddled old fungus in late summer and early fall. At this time they outnumber even *Thymalus marginicollis*. Pupæ, discovered in material taken during July and August, were encased in a hard spherical case within the fungus. The pupal chamber had a small opening at one end where the beetle emerged upon reaching adulthood. The chambers were variable in size, averaging about one-half inch in diameter. The walls of the chamber are manufactured from the fungus itself, either by the larva, or by the fungus in response to some larval secretion.

Xylopinus saperdioides—This large species was found on two occasions. The first, in the larval stage, was found on October 8, 1950. It was kept through the winter in the laboratory and pupated in late March, but died before emerging. It was identified by authorities at the National Museum. A second larva was discovered in May 1951.

Aradus similis—This bug is common on the fungus from early May to October. Both nymphs and adults are present, but there is no evidence that oviposition occurs on the fungus. All nymphal specimens were of approximately the same size as the adults.

Hoplothrips major—This thrips occurs commonly on the fungus throughout the year, except when it becomes frozen in winter. At this time only larvæ of *Thymalus marginicollis* are found. The immature thrips are bright red in color, changing to black when adult. Both stages are present at all times.

Tinea granella—One specimen of this moth was reared from a larva found in the spring of 1950. It emerged as an adult in May. No other specimens have been found.

SUMMARY

Twenty-three species of insects are listed as occurring on or in the shelf fungus, *Polyporus betulinus,* at Albany, New York. Of these, 16 are Coleoptera, 1 Hemiptera, 1 Diptera, 1 Thysanoptera, 3 Collembola, and 1 Lepidoptera. The most common species are two beetles, *Thymalus marginicollis* Chev. (Ostomidæ) and *Diaperis maculata* Oliv. (Tenebrionidæ). A thrips, *Hoplothrips major* Hood, is also common. Other species use the fungus for food, shelter, or as a source of animal food.

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THE MINNEAPOLIS BOOKWORM

The following bit of entomological misinformation was recently discovered in "The British Colonial Printer & Stationer" (London, England) for October 7, 1904. It originated in the "Minneapolis Daily Tribune." The account, which is quoted below is remarkable. It describes a "bookworm" of Scottish extraction, with four horns on its head and "a couple on the tail," being the only one of four or five discovered in America and which may have been a hundred years old. And in addition its sex is noted. It was probably a silverfish, which had nothing to do with the "wormholes" in the book.

"Capture of a Bookworm.—We find the following in the 'Minneapolis Daily Tribune':—Did you ever see a real crawling bookworm? C. D. Raymer, 15 Third street, has a little grey bookworm in a bottle. The animal is a real right specimen with four horns on the head and a couple on the tail. It was captured in the middle of the second stanza of "The True-Born Englishman," by Daniel Defoe, the same being printed in a leather-bound volume printed in London in 1701. The bookworm may have been a hundred years making his way through the pages of Defoe's book, but if slow, he was effective. There are ragged holes through "The True-Born Englishman," a spiral trail through "The Character of Dr. Samuel Annesley," a series of trenches in front of "The Spanish Descent," and the "Danger of the Protestant Religions" is shot full of holes. There is a record of only four or five bookworms having been discovered in America. Raymer prides himself on having the most perfect specimen of the lot. This worm is doubtless of Scotch extraction. It was imported with a lot of books brought here from Scotland by the Rev. Thos. Peebles, still a resident of Minneapolis."—H. B. W.

THE AMERICAN SPECIES OF TRIXOSCELIDÆ*

By Axel Leonard Melander

Rondani (1856) erected the genus *Trixoscelis* for the European *Geomyza obscurella* Fallen, but his citation was overlooked for many years. Frey (1921) proposed the family Trixoscelidæ as differing from the Helomyzidæ in that the fronto-orbits are not shortened but extend to the suture. This family was accepted by Hendel (1928). Hendel was the first (1911) to report the occurrence of *Trixoscelis* in America, although previously species had been described by Coquilett (1902) and Aldrich (1908) under other generic names.

In 1913, I published a synopsis of the seven American species recorded up to that date. Since that time I have found so many new species as to warrant the present study. Although but a single genus (*Trixoscelis*) is found in Europe, with *Psiloplagia* in the Transcaspian region and *Diplogeomyza* and *Allophylopsis* in the Australian region, in America there are four genera. One of these, *Neossos,* is found in the nests of song birds around Washington, D. C., another, *Spilochroa,* occurs in the West Indies and Florida. All the genera are found in the Eastern part of America. Nothing is known of their habits, other than that the species are found in grassy spots, in woodlands, and in the desert. The European species have been written up by Loew (1865) and by Czerny (1903 and 1909) as *Geomyza,* and Collin (1943) has published the British species.

The Trixoscelidæ (emended by Hendel and by Collin to Trichoscelidæ) are differentiated from the other Muscidæ acalypteratæ by the following combination of characters: Antennæ two-jointed, the arista microscopically pubescent; palpi long and narrow, always yellow; two fronto-orbital bristles, the orbits extending to the suture; five dorsocentrals (in Neossos four), one mesopleural, two sternopleural, propleural present, acrostichals variable; wings with subcosta close to first vein, costa broken at end of subcosta and provided with more or less evident spines; anal vein not reaching margin; halteres pale yellow.

* Publication Number 711. The Citrus Experiment Station, University of California, Riverside, California.

Key to the American Genera of Trixoscelidæ.

1. Yellow species with all bristles yellow; back of cheeks equal to or one-half the eye-height. .... *Zagonia* Coquillett.
   Usually blackish in ground-color, the bristles all black; cheeks usually one-half the eye-height or less. .... 2.
2. Mesopleura with a distinct bristle and some adjacent setulæ; two sternopleurals; acrostichals in two or four series; five uniform strong dorsocentrals; anterior fronto-orbital nearer the antennæ. .... 3.
   Mesopleura without bristle or setulæ; only posterior sternopleural developed; acrostichals in six or eight rows; anterior pair of dorsocentrals underdeveloped; fronto-orbitals on posterior half of front. *Neossos* Malloch
3. Cheeks one-eighth the eye-height; wings largely blackened but with many hyaline spots, or hyaline with brownish spots; acrostichals in four rows. .... *Spilochroa* Johnson
   Cheeks one-eighth to two-thirds the eye-height; if wings are more or less clouded the dark marks are longitudinal. .... *Trixoscelis* Rondani

NEOSSUS Malloch

Malloch, 1927, p. 90. Curran, 1934, North Am. Dipt. p. 331 and 372.

Anterior fronto-orbital bent outwardly; eyes large, round; lateral setulæ of thorax abundant; abdomen shining; wings hyaline, costal setulæ not longer than diameter of costa.

Key to the Species of Neossos.

Front nearly square, furnished with scattered setulæ; face shallowly concave; antennæ luteous; thorax fuscous, pleuræ testaceous; legs testaceous. (Md.) .... *marylandica* Malloch
Front narrower than long, bare; the black antennæ sunken; thorax entirely black; legs dark fuscous. (Cal.) .... **californica**. n. sp.

Neossos marylandica Malloch

Malloch, 1927, p. 90.

This species was reared from puparia found in the nests of purple martin, wren, bluebird, crested flycatcher and starling.

Neossos californica, new species

Female.—Length 2 mm. Front rufous below, the orbits becoming black at the bristles and merging with the occiput, face deeply sunken, last antennal joint large and round, the arista black; cheeks one-sixth the eye-height, with a row of six strong setulæ. Thorax wholly black, subshining, the abdomen shining black and with small bristles. Legs fuscous, the front coxæ. Wings hyaline, the veins yellowish, costal setulæ minute and sparse, anterior crossvein at three-fifths the discal cell, posterior crossvein equal to last section of fifth vein.

Holotype: Corona del Mar, California, 16 July 1945.

ZAGONIA Coquillett

Coquillett, 1904, Invert. Pacif. 27. Aldrich, 1910, Can. Ent. XL, 100. Melander, 1913, 297.

Synonym. *Silago,* part. Aldrich, Trans. Am. Ent. Soc. xxxiv. 98 (1908).

The yellow bristles and hairs of the body and legs are the only distinctive characters. The entire insects are yellow, the dark arista and costal setulæ being the only parts not yellow.

KEY TO THE SPECIES OF ZAGONIA.

Cheeks equal to diameter of eye, deeper behind, face receding; last joint of antennæ of female black, of male yellow. (Wash., Ida., Oreg., Calif.) **flava** Coquillett

Cheeks one-half the diameter of the eye, scarcely deeper behind, face nearly vertical; antennæ of both sexes yellow. (Wash.) **flavicornis.** n. sp.

Zagonia flava Coquillett

Coquillett, 1904. Inv. Pacif. 27. Melander, 1913, p. 297. Curran, 1934, No. Am. Dipt. 372, f. 3, 4.

Synonym. *Silago oregona* Aldrich, 1908, p. 99.

Length 3 mm. Front up-heaved above antennæ, the anterior fronto-orbital closer to the posterior than to the lunule, one-half the length of the posterior; a single row of occipitals forming an S-shaped line; face receding; cheeks wide, much deeper behind, equal to diameter of the small horizontal eye; hind metatarsi about as thick as the tibiæ, the following joint more than two-thirds as long as the metatarsus; the black setulæ of the costa longer than the width of the costa.

Eighty-five specimens. Idaho, opposite Grande Ronde River, May. Washington, Wawawai, Almota, Alpowa, Prosser, Dungeness and Mount Vernon, May and June. Oregon, Corvallis, June. California, Riverside, Palm Springs, April and May.

Zagonia flavicornis, new species

Length 2.5 mm. Entirely flavous, the arista except base and the minute costal setulæ alone black. Front not bulbose, the anterior fronto-orbital bristle closer to the frontal suture than to the posterior, face not receding, the cheeks about half the diameter of the rounded eye; a few setulæ near the row of occipital setulæ below. Hind metatarsi slender, twice as long as the following joint. Wings subhyaline, with flavous tinge, veins yellow, anterior crossvein at middle of discal cell, posterior crossvein one-fourth longer than the last section of fifth vein. The dorsal setæ are long and yellow.

Sixteen specimens: Omak, 29 May, 1916, and Pullman, 4 June, 1922, Washington.

SPILOCHROA Williston

Williston, 1907, Jour. N. Y. Ent. Soc. XV, 2. Melander, 1913, t.c. XXI, 284.

Similar to Trixoscelis, but the wings reticulate with hyaline spots on a darkened ground.

KEY TO THE SPECIES OF SPILOCHROA.

Thorax rufous, some marked darker spots at bases of bristles, abdomen marked with gray at base and brown with gray spots apically; wings mostly brown. (Jamaica, Fla.) .... *ornata* Johnson

Thorax blackish, unspotted, abdomen black, dorsum gray separated by a median black line; legs fuscous; wings mostly hyaline. (N. Mex.) *punctipennis* Melander

Spilochroa ornata Johnson

Johnson, 1895, p. 306 (*Heterochroa*). Czerny, 1903, Wien. ent. Ztg. XXII. 97 (*Peratochætus*). Williston, 1908, Manual, 3 ed., p. 297, f. 3, 4. Melander, 1913, p. 288.

Head, antennæ, thorax and legs rufo-testaceous, abdomen spotted with gray on each side of middle line and with smaller lateral spots; wings heavily infumated, marked with numerous white spots.

Jamaica; Drayton's Island, Florida.

Spilochroa punctipennis Melander

Melander, 1913, Psyche, XX, 167.

Upper parts of head blackish, thorax black, pleuræ fuscous, abdomen black, the dorsum cinereous interrupted by a median line; wings more largely hyaline, the dark marks less intense and more confluent than in *ornata*.

New Mexico; Pecos, July 26; Las Vegas Hot Springs, August.

TRIXOSCELIS Rondani

Rondani, 1856, Gen. ital. ordinis dipterorum, 134. Melander, 1913, p. 296. Collin, 1943, p. 235.

Synonym. *Geomyza* Loew, 1865, pp. 14–25. Czerny, 1903, pp. 123–127; 1909, x p. 281.

Synonym. *Parodinia* Coquillett, 1902, p. 186. Malloch, 1913, p. 274.

Synonym. *Siligo,* Aldrich in part, 1908, p. 98.

Two presutural and one postsutural dorsocentrals; antennæ with the last joint round to elliptical; cheeks variable, ranging from one-eighth to one-half the head-weight; wings hyaline or clouded.

TABLE OF THE AMERICAN SPECIES OF TRIXOSCELIS.

1. Wings more or less infumated, at least the costa darkened ..... 2.
   Wings clear, or whitish, costa yellowish, not darker than the middle veins 8
2. Abdomen shining black; antennæ mostly reddish; front legs brown; wings strongly infumated along veins and posterior crossvein. (Manitoba, Wash.) ..... *fumipennis* Melander
   Abdomen more or less pollinose, at most subshining ..... 3.
3. Both crossveins and costa at end of first vein marked with smoky tinge, marginal cell not infumated; notum with brownish tone, pleuræ and abdomen yellowish; legs all yellow; cheeks one-thirds the eye-height. (Ariz., Colo.) ..... **buccata**. n. sp.
   Anterior crossvein not clouded, marginal cell darker then submarginal; cheeks narrower ..... 4.
4. Front legs black; antennæ mostly yellow; markings of wing strong, tips of third and fourth veins darkened, posterior crossvein clouded, equal to last section of fifth vein; thorax dark cinereous, acrostichals in four rows; proboscis black. (Cal.) ..... **signifera**. n. sp.
   Legs yellowish, at most front femora or tarsi darkened; antennæ mostly black including base; proboscis yellowish; pollen of thorax somewhat yellowish in tone ..... 5.
5. Infumation of wing relatively strong along veins and posterior crossvein; tarsi yellowish; posterior crossvein not shorter than last section of fifth vein ..... 6.
   Infumation of wing suffused, posterior crossvein not clouded, shorter than last section of fifth vein; pollen of thorax with yellowish tone, not vittate; pygidium dark testaceous to black; front tarsi of female darkened. (Wash., Calif.) ..... **suffusa**. n. sp.
6. Veins around anterior crossvein pale, posterior crossvein equal to last section of fifth vein, discal cell at end equal to first posterior cell before it; notum pale yellowish gray, with weak brown vittæ on dorso-central rows; pygidium yellow; legs all yellow. (Calif.) **pygochroa**. n. sp.
   All veins blackish except at base, posterior crossvein longer than last section of fifth vein, discal cell at end wider than first posterior cell before it; pygidium darker 7

7. Notum with five brown vittæ; front brown except the gray orbits, costa blackish from base; front femora infuscated. (Calif.) **deserta.** n. sp.
   Notum cinereous, evittate; front anteriorly flavous; base of costa and of veins pale; legs yellow. (Calif.) .... **mohavea.** n. sp.
8. All femora and coxæ black .... 9.
   Coxæ and at least posterior femora largely or wholly yellowish, at least not black .... 10.
9. Abdomen polished black; face all whitish; front tibiæ and tarsi black; acrostichals scattered and sparse. (Calif.) **nitidiventris.** n. sp.
   Abdomen cinereous; middle of face dark; all tibiæ and tarsi yellow; middle rows of achrostichals very distinct. (Calif.) *litorea* Aldrich
10. Front femora more or less black or brown .... 11.
    All legs light yellow, rarely the front femora somewhat darkened .... 15.
11. Thorax vittate with brownish, sometimes very faint; cheeks one-sixth the eye-height .... 12.
    Thorax showing no trace of brown vittæ .... 14.
12. A median vitta in addition to the pair on the dorso-central rows; acrostichals biseriate, weak, prescutellars undeveloped; desert species. (Ariz., Mex., Calif.) .... **triplex.** n. sp.
    Only two vittæ inside the dorsocentral rows; acrostichals in four irregular rows .... 13.
13. Sternopleura shining, upper pleuræ with yellow pollen; abdomen somewhat shining; third and fourth veins slightly converging; last antennal joint distinctly longer than deep, mostly yellow; prescutellar bristles strong. (Ariz.) .... *claripennis* Malloch
    Sternopleura cinereous, upper pleuræ with brown pollen; abdomen cinereous; third and fourth veins distally parallel; last antennal joint round, blackish except lower edge; prescutellars not developed. (Ariz., Utah, Calif.) .... **sagulata.** n. sp.
14. Tarsi slender; last antennal joint circular; male antennæ usually yellow and tibiæ yellow; female with last antennal joint darkened, but lighter below, and front tibiæ and tarsi black; cheeks one-sixth the eye-height; proboscis yellow; acrostichals weak, laterally straggling. (Western North America; Europe) .... *frontalis* Fallen
    Hind metatarsi of male more or less enlarged and darker than the tibiæ, of female slender and concolorous; last antennal joint oval, mostly uniformly blackish; cheeks one-third the eye-height; acrostichals strong, in four rows, the prescutellar pair strong; last section of fifth vein shorter than posterior crossvein. (Wash., Oreg., Calif.) **tumida.** n. sp.
15. Last antennal joint black both inside and out, and rounded; four irregular rows of acrostichals; costa and veins yellow; posterior crossvein twice as long as last section of fifth vein. (Colo., Calif.) *cinerea* Coquillett
    Last antennal joint mostly or all yellow, at least not wholly black .... 16.

16. Abdomen wholly bright yellow, contrasting with the cinereous thorax; two rows of sparse acrostichals; antennæ pale yellow, the last joint round. (Calif.) .... **dimidiata.** n. sp.
Abdomen blackish in ground color, at least not lighter and contrasting with the thorax .... 17.
17. Cheeks about one-eighth the eye-height; last antennal joint round ...... 18.
Cheeks about one-third to one-half the eye-height, increasing behind; some setulæ outside the dorsocentral rows .... 19.
18. Pleuræ and mesonotum gray-black; two rows of acrostichals; one row of occipitals; no setulæ outside the dorsocentral rows. (Calif.) **plebs.** n. sp.
Pleuræ and mesonotum yellowish; about four rows of acrostichals; two or three rows of occipitals. (Wash.) .... **flavida.** n. sp.
19. Pleuræ and mesonotum gray-black; two or three rows of occipitals; last antennal joint round and yellow; two rows of acrostichals. (Colo., Wash., Calif.) .... *nuda* Coquillett.
Pleuræ and mesonotum yellowish; last antennal joint one-half longer than deep, blackish except at extreme base; upper occiput yellowish; mesopleural bristle near middle of mesopleura. (Wash.) **flavens.** n. sp.

Trixoscelis buccata, new species

MALE.—Length 1.9 mm. Light testaceous, front becoming dull luteous except the large ocellar triangle and the orbits; face, cheeks and mouthparts flavous; antennæ luteous, the outer joint marked with a distinct but small brown spot, arista blackish. Thorax heavily pollinose, the pleuræ lighter, four rows of scattered diminutive acrostichals; metanotum testaceous, abdomen appearing light on account of the pollen coating; pygidium large. Legs flavous. Wings narrow, costa beyond first vein and veins beyond base blackish, small clouds about the end of the first vein and the crossveins, posterior crossvein longer than the end of the fifth vein.

FEMALE.—Last antennal joint largely black.

Types: Sabino Canyon, near Tucson, Arizona, May 5, 1942. Eleven paratypes: Colorado; Manitou, June 16, 1940. Arizona; Baboquivari Mts., 27 April, 1947. California, Mojave Desert, Thorn, May 30, 1944; Upper Santa Ana River, San Bernardino County, July 29, 1948.

Trixoscelis cinerea Coquillett

Coquillett, 1902, p. 186 (*Parodinia*). Melander, 1913, p. 296. Aldrich, 1929, Proc. Ent. Soc. Wash. xxxi, p. 34.

Length 2.5 mm. Cheeks about one-half the eye-height or less, deeper behind, eyes higher than wide; outer antennal joint round, entirely black with black arista, basal joint of antennæ yellow; mouthparts yellowish. Thorax cinereous on a black ground, acrostichals sparse, in four irregular rows. Abdomen black, cinereous, subshining. Legs wholly yellow. Wings hyaline, veins yellow.

I have taken the species at four places, all in San Bernardino County, in Southern California. Aldrich called attention that one of the types of *Leria nuda* from Colorado belonged to this species.

Trixoscelis claripennis Malloch

Malloch, 1913, p. 276 (*Parodinia*).

Synonym: *costalis* Coquillet, part, Jour. N. Y. Ent. Soc. X, p. 187 (1902) (*Parodinia*)

Length 2–2.5 mm. Opaque gray; acrostichals in four irregular rows, the prescutellar pair distinct; upper pleuræ with yellowish pollen; abdomen more or less shining; third and fourth veins slightly convergent.

Coquillett (1901) described *Rhicnoessa costalis* from the Galapagos Islands (Proc. Wash. Ac. Sci. III. 378). The next year he transferred the species to *Parodinia* and reported its occurrence at several places in Arizona. Malloch noted that two species were involved, *costalis* with pictured wings, and the Arizona form with hyaline wings, and gave the name *claripennis* to the latter. In 1913 I examined Malloch's type and assigned it to the variable *Trixoscelis frontalis* (Psyche, 1913, p. 169). In this I was in error, for we now realize that there are many species of Trixoscelis. The two faint yellowish vittæ just within the dorsocentral rows and shining lower pleuræ distinguish *claripennis*. I have no specimens that agree with the description.

Trixoscelis deserta, new species

MALE.—Length 2.5 mm. Front wholly fuscous except the whitish orbits, occiput light slaty gray; face and cheeks yellowish white, the cheeks one-sixth the height of the obliquely oval eyes; antennæ blackened, a small yellow spot at base of the black arista; proboscis testaceous, palpi pale yellow. Thorax nearly brown except the gray front and lateral margins, more intense and broadly under the bristles and the sparse acrostichals, scutellum brown the sides narrowly gray; upper pleuræ brown-gray; lower parts more gray, mesopleural bristle at upper three-fourths. Abdomen entirely black in ground color, gray-pollinose, less densely so along the middle. Legs deep flavous, the front femora lightly infuscated. Wings infumated, costa blackened from the humeral crossvein, the marginal cell infumated as also the posterior crossvein and the fifth vein, veins black from base of wing, costal setulæ small.

Holotype: Palm Canyon, Borrego Desert, California, May 2, 1945.

Trixoscelis dimidiata, new species

FEMALE.—Length 3 mm. Front including most of ocellar triangle and vertex wholly luteous, face and cheeks light yellow, eyes nearly round, vertically very slightly higher than wide, cheeks about one-third the eye, deeper behind, upper occiput cinereous yellow, lower occiput yellow; antennæ wholly yellow, the last joint nearly circular, arista brown with base yellow; mouthparts all yellow. Thorax black cinereous; scutellum concolorous or apically yellowish, acrostichals long, sparse, biseriate, pleuræ cinereous with slight yellowish tone. Abdomen wholly bright yellow. Coxæ and legs completely yellow. Wings almost hyaline, veins yellow, costal setulæ strong, anterior crossvein just before middle of discal cell, posterior crossvein slightly longer than last section of fifth vein.

Four specimens: Riverside, May 5, 1935; Morro Bay, July 27, 1940; near Lucia, June 17, 1947, all in California. The strongly yellow abdomen readily distinguishes this species.

Trixoscelis flavens, new species

FEMALE.—Length 3 mm. Head, thorax and legs in general yellowish, the face, cheeks, lower occiput and legs paler. Front distinctly wider than long; cheeks nearly one-half the eye-height; at most two rows of occipital setulæ; antennæ luteous, the third joint blackish except at base of arista, inside fuscous; proboscis and palpi pale yellow. Abdomen blackish; scutellum pale yellow; pleuræ entirely yellow, mesonotal setulæ very small, about four rows of acrostichals. Legs wholly yellow. Wings hyaline with yellowish tinge, veins yellow, anterior crossvein at middle of discal cell, posterior crossvein longer than last section of fifth vein, first posterior cell wider than submarginal cell at anterior crossvein, costal setulæ large and abundant, about seven along costal cell.

Holotype: Lind, Washington, June 11, 1919 (F. W. Carlson).

Trixoscelis flavida, new species.

MALE.—Length 2 mm. Upper occiput to lower corner of eye fusco-testaceous, with three scattered rows of setulæ; front luteous, the anterior fronto-orbital placed well forward on the flavous orbits; cheeks very narrow, about one-eighth the height of the rotund eye; antennæ with outer joint luteous, slightly longer than deep, arista luteous on basal half; palpi and proboscis flavous. Mesonotum and metanotum fusco-testaceous, about four rows of acrostichals; scutellum yellow; pleuræ entirely yellow, mesopleural bristle located at upper angle of mesopleura; abdomen blackish, pygidium small, castaneous, shining. Legs wholly yellow. Wings hyaline, with yellowish tinge, veins yellow, anterior crossvein at middle of discal cell, posterior crossvein equal to last section of fifth vein, costal setulæ small, only two near apex of costal cell.

FEMALE.—Outer side of last antennal joint centrally with a pale fuscous spot leaving the edge yellow.

Type: Mill Creek, Walla Walla, Washington, July 4, 1922.

Allotype: Union Flat, near Pullman, Washington, June 16, 1916. Paratypes: Two males with the type, and another, Pullman, Washington, June 16, 1912; two females, Pullman, Washington, June 16, 1918, and Salem, Oregon, July 4, 1917.

Trixoscelis frontalis Fallen

Fallen, 1823, Agromyz., 7 (*Anthomyza*). Meigen, 1830, Syst. Bes. vi, 111 (*Opomyza*). Macquart, 1835, Suit. II, 581 (*Leptomyza*). Zetterstedt. Dipt. Sc. VII. 2698 (*Anthophilina*). Loew, 1865, p. 22 (*Geomyza*). Becker, 1903, Mitth. Mus. Berl. II. 3, p. 187 (*Geomyza*). Czerny, 1903, p. 125 (*Geomyza*). Melander, 1913 A, p. 296. Collin, 1943, p. 249.

Cheeks about one-fourth the eye-height; last antennal joint circular, yellow in all males and with brownish spot on outside in nearly all females. Thorax black, heavily cinereous, sometimes with slightly yellow tinge, acrostichals fine, sparsely scattered in four rows, rarely the prescutellars stronger. Abdomen laterally cinereous, dorsally subshining in male to dull and cinereous in female. Posterior coxæ and legs yellowish.

This is our commonest species. Although I do not have European specimens for verification the American species seems to be identical with *frontalis,* which occurs throughout Europe. The easiest recognition character is the color of the front legs, the coxæ being quite white, their femora black and the front tibiæ and tarsi ranging from black to brownish yellow. Nearly all the females have the front legs wholly black, and the paler front tibiæ and tarsi are found in about half of the males, the rest of the males having black front legs like the females.

I have mounted some three hundred specimens collected in seventy-one localities in British Columbia, Vancouver Island, Washington, Idaho, Montana, Oregon, California and Arizona.

Trixoscelis fumipennis Melander

Melander, 1913, Psyche XX. p. 168.

Length 2.5 mm. Front reddish-yellow, becoming brown each side of ocellar triangle, face and cheeks whitish, cheeks two-fifths the height of the horizontally elliptical eyes, occipital setulæ coarse; last joint of antennæ oval, dusky except below at base, arista brown; mouthparts yellow. Thorax reddish yellow in ground color with brownish vittæ on dorsocentral and presutural rows, acrostichals in two definite median rows plus some scattered ones. Abdomen shining castaneous. Coxæ yellowish, front legs brownish, posterior legs reddish yellow. Wings with veins and posterior crossvein bordered with brown, marginal cell wholly infumated, costa blackish to base.

The type came from Aweme, Manitoba. I have taken the species at Liberty Lake, near Spokane, Washington, June 26, 1924.

Trixoscelis mohavea, new species

Male.—Length 2.1 mm. Front yellowish, extending on each side of the light testaceous ocellar triangle to the level of the posterior ocelli, orbits whitish; face and cheeks whitish, the latter one-eighth the height of the eye; occiput with three rows of setulæ; antennæ black with a small yellow mark at base of the black arista, larger within; mouthparts yellow. Mesonotum densely covered with pale golden dust, two rows of sparse acrostichals; scutellum and pleuræ concolorous; mesopleural bristle located at one-third. Abdomen black in ground-color, the incisures not differentiated, covered with fine gray pollen. Legs uniformly flavous. Wings subhyaline, lightly marked with clouds in marginal and submarginal cells and along posterior crossvein and fifth vein, veins blackish except at base, costal setulæ short.

Female.—Acrostichals in four sparse rows.

Four specimens: Mojave Desert, California, Piute Butte, May 12, 1944; and Big Rock Wash, May 13, 1944.

Trixoscelis nitidiventris, new species

Female.—Length 2 mm. Lower front luteous, upper two-fifths dark especially on each side of the prominent ocellar triangle, face and cheeks whitish, the cheeks narrow, one-sixth the eye-height, not deeper behind, eyes nearly round, very slightly higher than broad; upper occiput with a few setulæ behind orbital row; antennæ yellow, outer joint slightly infuscated outside, almost circular, arista black; proboscis blackish. Thorax dark cinereous on a black ground, scutellum and pleuræ concolorous, four irregular rows of sparse acrostichals. Abdomen polished black. All coxæ and front legs black, posterior femora blackish, posterior tibiæ and tarsi dark brownish. Wings nearly hyaline, veins and costa clear and brown, anterior crossvein at middle of discal cell, posterior crossvein slightly shorter than last section of fifth vein.

Three specimens: Beaumont, California, April 25, 1944; and Perris, California, May 10, 1945.

By its dark coxæ and femora the species seems close to *litorea*, but lacks the facial marks and abdominal pruinosity of that species. *Litorea* has yellowish tibiæ and tarsi and pale veins.

Trixoscelis nuda Coquillett

Coquillett, 1910, Proc. Ent. Soc. Wash. xii. p. 130 (*Leria*). Aldrich, 1929, Proc. Ent. Soc. Wash. xxxi, p. 34.

Synonym: *prima* Hendel, 1911, p. 43. Melander, 1913, p. 296.

Length 2.5 mm. Eyes round; antennæ yellow, the last joint round, with a small exterior brownish spot, arista brown; proboscis black. Thorax black in ground color, cinereous with slight golden tone, two distinct rows of acrostichals. Abdomen cinereous, not shining. Coxæ and legs wholly yellow, the posterior coxæ sometimes darkened at base. Wings hyaline, veins yellow.

Coquillett described *Leria nuda* from two specimens, one from Claremont, California, and the other from Boulder, Colorado. Aldrich designated the California cotype as the lectotype, because the Colorado specimen belonged to *Parodinia cinerea* Coquillett. In the meantime Hendel had described *Trixoscelis prima*, as the first record of the occurrence of *Trixoscelis* in America. Hendel's *prima* came from Claremont, California, and proved to be Coquillett's *Leria nuda*.

I have mounted nearly two hundred specimens, representing thirty collecting stops in Riverside, San Bernardino, San Diego, Orange and Los Angeles counties, all in Southern California. I have also taken the species at Welton, Arizona, and at Husum, Washington.

Trixoscelis plebs, new species

MALE.—Length 1.9 mm. Cheeks very narrow, one-eighth the eye-height, eyes round; front pale yellow merging into the yellowish cinereous occiput; antennæ wholly pale yellow, the last joint round, with fuscous arista, the base yellow; mouthparts pale yellow. Thorax cinereous, acrostichals sparse and short; pleuræ without setulæ; abdomen cinereous, pygidium subshining. Legs pale flavous, the front femora sometimes darkened along the distal half leaving the knees yellow. Wings hyaline with a yellowish tinge, paler at base, veins yellowish, the costal setulæ very small, anterior crossvein at middle of discal cell; posterior crossvein equal to last section of fifth vein. Knob of halteres white.

Travertine Rock, on the West side of Salton Sea, California, May 2, 1945; two male and three female specimens; Indio, California, same date, one female.

The reduced size of the bristles and the small number of setulæ are distinctive.

Trixoscelis pygochroa, new species

Length 2.3 mm. Anterior half of front and two posterior prongs flavous, orbits whitish, posterior part merging into the yellowish occiput, occipital triangle large; face and cheeks whitish, the cheeks one-fifth the diameter of the round eye, merging into the occiput; antennæ fuscous, the outer joint with a small flavous spot under the base of the fuscous arista, the inner side flavous on almost the basal half; mouthparts pale yellow. Thorax pale flavous, heavily pollinose, two thin light-brown vittæ along the dorsocentral rows; pleuræ slightly darker than the notum, mesopleural bristle at one-third the distance down. Abdomen slightly blackish under the yellow coating, pygidium large, luteous, anteriorly with two thin long terminal appendages. Base of wings whittish, costa blackened from two-thirds the auxiliary cell, marginal cell all blackened, veins firm and blackish except the fourth vein almost to the posterior crossvein.

A pair from Palm Springs, California, November 10, 1944, and April 24, 1944.

Trixoscelis sagulata, new species

Length 2 mm. Lower two-thirds of front luteous, upper third concolorous with upper five-sixth of occiput, face and cheeks dull yellow, the cheeks one-sixth the eye-height; antennæ fuscous, outer joint circular, the lower third flavous, arista blackish; mouthparts dull yellow. Thorax cinereous, marked with two fuscous vittæ just inside the dorsocentral rows, acrostichals sparse and small, in four irregular rows; pleuræ cinereous, the upper half of mesopleura and pteropleura with a vague brown band, mesopleura with scattered setulæ. Abdomen lightly cinereous, the small pygidium shining. Front coxæ whitish, the posterior pairs yellowish, front legs otherwise black, posterior legs sordid yellow. Wings hyaline, with slight yellow tinge, veins thin, dull yellow, anterior crossvein at middle of discal cell, posterior crossvein a little longer than last section of fifth vein, costal setulæ small.

Types: Whitewater Canyon, California, November 11, 1944. Thirteen male and eighteen female paratypes: Utah: Zion Park, April 20, 1935. Arizona: Superior, April 13, 1935; Huachuca Mountains, Miller Canyon, May 3, 1948. California: Salton Beach, November 12, 1945; Borrego Desert, Palm Canyon, November 10, 1945; Morongo, November 26, 1946; Palm Springs, November 20, 1943; Cathedral City, November 22, 1944; Oak Glen, June 19, 1946; La Jolla, December 29, 1934.

Trixoscelis signifera, new species

Female.—Length 2.8 mm. Front half luteous, merging into the blackish occiput, face and cheeks flavous, the cheeks about one-eighth the eye-height; antennæ luteous, the outer side of the last joint fuscous except the upper edge, arista blackish; proboscis reddish on last section. Thorax blackish in ground color, covered with dark cinereous dust, two brown vittæ evident within the dorsocentral rows, acrostichals very sparse, about four rows anteriorly, mesonotal setæ long; pleuræ dark cinereous, the upper part with a brown vitta. Abdomen subshining along middle, concolorous with notum along sides, incisures yellow and set off by rows of strong bristles just before them. Front coxæ flavous, front legs black, with tibiæ less so, posterior legs including the coxæ flavous. Wings with entire costal margin infumated, marginal cell subhyaline up to the end, posterior crossvein clouded, longer than last vein, third, fourth and fifth veins yellowish at base, the third dark only in outer fifth, the fourth on outer half, the fifth on outer third.

Six specimens. Type: Ortega Highway, El Cariso Camp, May 15, 1946. Paratypes: Ortega Highway, San Juan Camp, May 26, 1944; Laguna Beach, March 28, 1935; San Francisco, August 1, 1915; Palo Alto, August 2. All in California.

Rhicnoessa costalis Coquillett (1901: Proc. Wash. Acad. Sci. III. 378) from the Galapagos Islands is similar. It is much smaller, 1.5 mm., has front legs dark brown and the infumation of the wings begins at end of the first vein and does not include the posterior crossvein. See remarks under *claripennis*.

Trixoscelis suffusa, new species

MALE.—Length 1.2–2 mm. Front one-half wider than long to the ocelli, flavous, the ocellar triangle reaching half-way, the orbits pale yellow, occiput cinereous black, with two scattered rows of setulæ; face and cheeks whitish, the cheeks one-fourth the eye-height; antennæ blackish, the outer joint yellowish within on basal half or less and on outer side yellow at upper corner; palpi whitish, proboscis yellow. Mesonotum and scutellum with golden dust, two rows of minute acrostichals; pleuræ yellow. Abdomen testaceous at base becoming blackish apically and covered with fine thin yellow dust; pygidium round, large, rufous, provided with blackish hairs. Legs wholly light flavous. Wings subhyaline, the marginal cell lightly infuscated, veins blackish, discal cell outwardly equal to first posterior cell.

FEMALE.—Front tarsi infuscated.

Twenty-eight specimens. Types: Oak Glen, California, July 2, 1945. Paratypes: Washington: Entiat, July 26, 1919; Goldendale, July 23, 1921. California: Morro Bay, July 27, 1940; Scotland, September 19, 1943; Oak Grove, May 8, 1943; Mountain Home Canyon, May 13, 1947; Barton Flat, June 20, 1945–September 7, 1946; Falls Valley, July 10, 1940; Crestline, July 4, 1942; Victorville, May 22, 1945.

Trixoscelis triplex, new species

Length 2 mm. Body rosaceous, slightly darker on occiput and abdomen, and yellow on face, cheeks and legs. Front luteous, posteriorly merging with the occiput. Antennæ yellow at base, male with last joint wholly yellow within and with a suffused dusky spot on the upper part of the outer side, female with inside of last joint and apical two-thirds of outside blackish, last joint one-third longer than deep, arista blackish to base; cheeks one-sixth the eye-height; palpi and proboscis yellow. Three darker narrow vittæ evident on mesonotum; acrostichal setulæ all very small, thoracic and head bristles long. Legs flavous, the front femora darkened except at base. Wings hyaline, the veins slightly brownish, third and fourth veins slightly closer together than usual, the apical sections of costa proportioned 2: 1, anterior crossvein at about three-fifths the discal cell, posterior crossvein shorter than last section of fifth vein.

Types: Organpipe Cactus National Monument, Arizona, April 18, 1947. Twelve paratypes: Mexico; Sonoyta, April 21, 1947. Arizona: Sabino Canyon, near Tucson, July 5, 1942; Liguerta, April 9, 1937. California: Gordon Wells, Imperial County, April 9, 1947; Palm Canyon, Borrego Desert, May 2, 1945; Palm Springs, April 24, 1944.

Trixoscelis tumida, new species

MALE.—Length 3 mm. Occiput and mesothorax testaceous, abdomen blackish covered with yellowish pollen. Front flavo-testaceous, wider than long, postocellar bristles strong; face and cheeks pale yellow, the cheeks one-third the diameter of the round eyes; antennæ yellow at base, outer joint brownish except at base of inner side; arista fuscous except the paler base; mouthparts flavous. Thorax with long bristles, about four rows of acrostichal setulæ on disk and about three rows outside the dorsocentral rows; scutellum concolorous; mesopleural bristle near middle of mesopleura. Hypopygium fuscous, the valves longer than usual. Legs flavous, the front and hind metatarsi swollen and fuscous, nearly as thick as their tibiæ. Wings hyaline, with yellowish tone, veins yellowish, posterior crossvein longer than last section of fifth vein, anterior crossvein slightly before the middle of the discal cell; knob of halteres whitish.

FEMALE.—Metatarsi not swollen nor darkened.

Types: Lucerne, on Lake Chelan, Washington, July 29, 1919. Twelve male and fifteen female paratypes: Oregon: Mt. Hood, July 29, 1921. California: Green Valley, July 26, 1944; Crestline, July 4, 1942; Barton Flats, July 29, 1942–September 4, 1944; Jenks Lake, June 20, 1945; Big Pines, August 9, 1944; Mojave Desert, Lovejoy, May 10, 1944; Palm Springs, April 2, 1945; Corona del Mar, December 28, 1944.

The California specimens have the occiput quite blackish, the pygidium black and the hind metatarsi less fuscous.

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BOOK NOTICE

Traité de Zoologie, Anatomie, Systématique, Biologie. Edited by Pierre-P. Grassé. Published by Masson et Cie., Paris (6^e). Volume X, *Insectes Supérieurs et Hémiptéroïdes,* published in two parts, 1951. Fascicule I, *Néuroptéroïdes, Mécoptéroïdes, Hyménoptéroïdes* (*Symphytes* et *Térébrants*). Page 1–975, Fig. 1–905, Colored pl. 1–5. Price: 6500 fr. Fascicule II, *Hyménoptéroïdes* (*Aculéates*), *Psocoptéroïdes, Hémiptéroïdes, Thysanoptéroïdes.* Page 976–1948, Fig. 906–1648. Colored pl. 6. Price: 6500 fr.

Certain general features of this outstanding series were discussed in an earlier issue of this Journal (Vol. 58, June, 1950, pages 83–86). In that review, particular attention was given Volume IX, which treats certain of the insect orders. The two parts of Volume X, presently under discussion, complete the systematic treatment of the insects.

The section dealing with the Néuroptéroïdes was written by Lucien Berland and Pierre-P. Grassé. Superorder *Neuropteroidea* (p. 3–4), *Megaloptera* (5–17), *Raphidoidea* (18–22), *Planipennia* (23–69). Under the superorder Mecopteroidea, the order *Mecoptera* (71–124) was written by Pierre-P. Grassé. The *Trichoptera* (125–173) by Raymond Despax. The *Lepidoptera* (175–448) by Jean Bourgogne. The *Diptera* (449–744) and the *Siphonaptera* (745–769) by Eugène Séguy.

The order Hymenoptera, split between the two fascicules, was authored as follows: *Generalities* (771–772) and *Anatomy and Physiology* (773–820), which also contains material on spacial and temporal distribution, were written by Francis Bernard. The sections on *Reproduction* (821–843) and *Larval Form and Metamorphosis* (844–852) were written by Lucien Berland. *Generalities on Social Life* (853–858) by F. Bernard. *Generalities on Systematics* (859–861), Suborder *Symphyta* (861–881) and Suborder *Apocrita* (882–931), *Cynipoidea* and *Ichneumonoidea*) by L. Berland. The rest of the Apocrita (931–975, *Chalcidoidea* and *Serphoidea*) by F. Bernard. The *Aculeata* begins fascicle II. The *Bethyloidea* (976–987) and the *Scoloidea* (987–996) were written by L. Berland. The *Formicoidea* (997–1119) by F. Bernard. The *Pompiloidea* (1120–1126) by L. Berland. The *Vespoidea* (1127–1174) by L. Berland and Pierre-P. Grassé. The *Sphecoidea* (1175–1197) by L. Berland. The

Apoidea (1198–1257) by F. Bernard. The fairly extensive Bibliography covering the Hymenoptera (1258–1276) is a most valuable addition to an unusually fine piece of work.

The order *Strepsiptera* (1277–1299) is the second order treated under the superorder Hyménoptéroïdes. It was written by René Jeannel.

Under the Superorder Pscopteroidea, the *Pscoptera* (1301–1340) was written by André Badonnel. The *Mallophaga* (1341–1364) and the *Anoplura* (1365–1384) by Eugène Séguy.

The Superorder, *Hémiptéroïdes* begins with a section on *Generalities* (1385–1389) written by Raymond Poisson and Paul Pesson. The *Homoptera* (1390–1656, including over 6 pages of bibliography) by Paul Pesson. The *Heteroptera* (1657–1803, including 5 pages of bibliography) by Raymond Poisson.

The single order *Thysanoptera* (1805–1869) included in the superorder Thysanopteroïdes was written by Paul Pesson.

Page 1870 contains the Errata and an Addendum on sex determination in the Hymenoptera. Pages 1871–1940 contain an exhaustive index covering both parts of this volume. Pages 1941–1948 give a detailed table of contents for both fascicules.

As in the previous three volumes examined, the numerous illustrations, which are in part original, are clear and well integrated with the text. The style of the volume is exceptionally lucid in consideration of its varied authorship. The quality of the paper, printing and binding is unusually good.

As in Volume IX, concise bibliographies ending each section are the rule, although the one covering the Hymenoptera is fairly lengthy. Likewise there is a general tendency for morphology to come first in the amount of allotted space under a given section. Classification is typically given considerable space under most sections. Biologies of the various groups are treated with varying degrees of completeness. Some sections, such as the one on Ants, contain a wealth of biological information. In other groups one finds a limited amount of biological information. Often this is a result of our imperfect knowledge of the group in question.

It is unnecessary to do any amount of missionary work in selling entomologists on the value of owning personal copies of the entomological volumes of this outstanding series. Their great value to research workers and teachers alike make their cost seem relatively small.—MERLE W. WING

ON THE COLLECTION OF ANTS MADE BY TITUS ULKE IN THE BLACK HILLS OF SOUTH DAKOTA IN THE EARLY NINETIES

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The history of North American formicology is so little known that the average student is in almost complete ignorance of details pertaining to early collections and collectors, or conditions under which collections were made. This especially applies to a small but important collection made by Titus Ulke in Hill City and vicinity in the Black Hills of South Dakota. The purpose of this article is to make known such facts as are available to the writer.

In 1890 and 1891 Titus Ulke, a mineralogist by profession, was employed by a mining company operating in the vicinity of Hill City. During his leisure time, which was considerable, Ulke collected myrmecophilous beetles for his father, Henry Ulke of Washington, D. C., a distinguished portrait painter by vocation and an eminent coleopterist by avocation. Ulke senior, however, had no connection with the Federal Bureau of Entomology or the Smithsonian Institute, as some individuals possibly think, but he did have a number of friends in these organizations. Among them was Theodore Pergande, who was employed by the Bureau of Entomology to work on miscellaneous insects. Pergande was deeply interested in ants, especially North American forms, and was continually collecting them, receiving specimens from friends and maintaining a private collection in his home. Since North American formicology was still in its infancy, Pergande sent many of his specimens for identification to Mayr, Emery and Forel, the noted European formicologists of that time. It thus came about that Henry Ulke referred to Pergande the ants found by his son, Titus Ulke, in South Dakota. Pergande, in turn, submitted them to Carlo Emery of the University of Bologna, Italy, and they, along with other North American forms assembled by Emery, were treated in his important articles on the ants of our fauna (Beiträge zur Kenntniss der nordamerikanischen Ameisenfauna, Zool. Jahrb., Abt. f. System. 7: 633–

682, 1 plate with 29 figs., 1893 and 8: 257–360, 1 plate with 24 figs., 1895). In these two papers thirty-two forms from Hill City and vicinity are listed, and ten of them are described as new. It was Pergande's habit to divide his series and to retain some specimens of each form for his own collection when he sent material to a specialist. If the ants proved to be new, he labeled his specimens as types, although they were not really types since the authors of the names had not seen them. Such specimens from the Pergande collection can now be found in the Museum of Comparative Zoology, Cambridge, Mass., the National Museum, Washington, D. C., and the American Museum of Natural History, New York City.

Titus Ulke, now in his eighties and living in Washington, D. C., has very kindly prepared for the author a detailed account of his ant collecting at Hill City and vicinity and the conditions under which it was done. His statements read as follows:

"In 1890 and 1891 I lived in Hill City on Spring Creek, Pennington County, South Dakota as assayer to the Harney Peak Tin Company and spent much of my leisure time collecting myrmecophilous beetles and their hosts, the ants, for my father, Henry Ulke of Washington, D. C. These I forwarded to Washington where my father separated the ants from the beetles and turned them over to the government entomologist, Theodore Pergande. He in turn sent them to Dr. Carlo Emery of the University of Bologna, Italy, who named the specimens and described the new species I had discovered, including one in my honor, *Formica ulkei.*

"My collecting ground, lying approximately within a radius of a dozen miles of Hill City, was rather varied in nature, including grassy open parks, wooded hills, and barren rocky slopes. In the open parks grew tall and handsome Western yellow pine (*Pinus ponderosa*) under which the ground was usually covered by thick mats of pine needles or tufts of Buffalo grass (*Boutelonya oligostachys*) and old decaying logs, in and under which the ants liked to nest. The soil was sandy, the land arid, but the climate mostly fine and sunny, light cooling rains falling frequently from 2 to 4 P. M. on warm afternoons.

"About 8 miles south of Hill City arose Harney's Peak, a picturesque peak of nearly 7,300 feet high, the highest mountain in the United States east of the Rockies. It was frequently the goal of my Sunday all-day hikes. Along its lower brushy slopes, clothed with lodge-pole pines and Englemann spruces, I found some interesting ant colonies under slabs of granite or schist. Not far away was the famous Etta Tin Mine, a geologist's paradise. . . .

''The Harney Peak Tin Company's numerous prospects dotted a hilly area some 5 by 12 miles stretching from Hill City to Custer (located about 12 miles south of Hill City) and to Harneys' Peak. . . . In the open fields near the mines were occasionally seen low mounds of granitic sand constructed by the ants but more frequently the ants were under logs, boards and flat stones.''

Holotypes or cotypes of the forms from Hill City and vicinity described by Emery as new should be found in the Emery collection which is now in the Museum of the City of Genoa, Italy. Not all forms recorded by Emery are specifically distinct, some being either intermediate or transitory between two other forms or of subspecific status. Below are listed all the South Dakota ants mentioned by Emery in the two articles referred to above. In each case the first name cited is the name assigned the form by Emery; this is followed in parentheses by the present name as given in Creighton's ''The Ants of North America'' (April 1950), the caste or castes seen by Emery and the locality. The statement, ''One of several localities'' means that the form in question was recorded by Emery from other localities as well as from Hill City and vicinity. ''One of the original localities,'' means that the form was described as new by Emery from specimens coming from a number of localities including Hill City and vicinity. An asterisk preceding the name of a form indicates that Hill City and vicinity is the type locality.

1. *Myrmica rubra* L. subsp. *brevinodis* n. subsp. (*Myrmica brevinodis* Emery)
   ☿ ♀. S. Dakota. One of several localities. 8: 312–313 (1895). According to Emery the Dakota specimens represent a transitory form between *brevinodis* and *sulcinodis.* Type locality of *brevinodis,* Salt Lake, Utah.

2. *Myrmica rubra* L. subsp. *brevinodis* n. subsp. var. *sulcinodoides* n. var. (*Myrmica brevinodis* Emery)
   ☿. S. Dakota. One of the original localities. 8: 313 (1895). For type locality of *brevinodis,* see above.
3. *Myrmica rubra* L. subsp. *scabrinodis* Nyl. var. *fracticornis* n. var. (*Myrmica lobicornis fracticornis* Emery)
   ☿ ♀. Dakota. 8: 313–314 (1895). According to Emery the Dakota specimens represent a transitory form between the var. *fracticornis* and the var. *sabuleti.*
   Type locality of *fracticornis,* Buffalo, N. Y.
4. *Myrmica rubra* L. subsp. *scabrinodis* Nyl. var. *sabuleti* Meinert (*Myrmica americana* Weber)
   Presumably ☿ ♀ ♂. S. Dakota. One of several localities. 8: 314 (1895). Emery remarked that other workers from S. Dakota are smaller and darker colored than *sabuleti* and are therefore much nearer the var. *schencki.*
   Type locality of *americana,* Colebrook, Conn.
5. *Crematogaster lineolata* Say subsp. *lineolata* Say typical var. *cerasi* Fitch (*Crematogaster* (*Acrocoelia*) *lineolata* (Say))
   ☿. Dakota. One of several localities. 8: 282–283 (1895).
   Type locality of *cerasi,* N. Y., that of *lineolata,* Ind.
6. *Solenopsis molesta* Say (*Solenopsis* (*Diplorhoptrum*) *molesta* (Say))
   ☿ ♀ ♂. Dakota. One of several localities. 8: 277–278 (1895). According to Emery females from S. Dakota are slightly darker than the typical form.
   Type locality of *molesta,* Ind.
7. *Leptothorax* (*Leptothorax*) *muscorum* Nyl. var. (*Leptothorax* (*Mychothorax*) *canadensis yankee* Emery)
   1 ☿. Hill City, S. Dakota. 8: 317–318 (1895). Wheeler considered the above-mentioned specimen to belong to his *muscorum* var. *sordidus,* the type locality of which was Boulder, Colo.
   For type locality of *yankee,* see below.

*8. *Leptothorax* (*Leptothorax*) *canadensis* Prov. var. *yankee* n. var. (*Leptothorax* (*Mychothorax*) *canadensis yankee* Emery)

☿ ♀. S. Dakota. One of the original localities. 8: 317, 319 (1895). Emery states that a female from S. Dakota was scarcely larger than the worker, with the thorax dark brown, the sculpture rougher.

Type locality of *yankee,* Hill City, S. D.

*9. *Leptothorax* (*Leptothorax*) *hirticornis* n. sp. (*Leptothorax* (*Mychothorax*) *hirticornis* Emery)

1 ☿. Washington, D. C., from Mr. Pergande. 8: 317, 319 (1895). The present author has shown (Proc. Ent. Soc. Wash. 41: 176 (1939)) that the type locality of *hirticornis* is Hill City, S. D. and not Washington, D. C. He believes that *hirticornis* is an inquilinous form which will be found in the nest of some species of *Formica,* most probably *obscuripes* Forel or *melanotica* Emery. There is also reason to assume that this ant will have ergatoid males superficially resembling those of *Formicoxenus nitidulus* (Nyl.) of Europe.

*10. *Leptothorax* (*Leptothorax*) *curvispinosus* Mayr subsp. *ambiguus* n. subsp. (*Leptothorax* (*Leptothorax*) *ambiguus* Emery)

☿. Hill City, S. Dakota (Pergande). One of the original localities. Type locality of *ambiguus,* Hill City, S. D.

11. *Leptothorax* (*Leptothorax*) *rugatulus* n. sp. (*Leptothorax* (*Leptothorax*) *rugatulus* Emery)

☿. S. Dakota. One of the two original localities. 8: 317, 321 (1895).

Type locality of *rugatulus,* Colo.

*12. *Leptothorax* (*Leptothorax*) *tricarinatus* n. sp. (*Leptothorax* (*Leptothorax*) *tricarinatus* Emery)

1 ☿. Hill City, S. Dakota, from Mr. Pergande. Only locality mentioned. 8: 318, 321–322 (1895).

Type locality of *tricarinatus,* Hill City, S. D.

13. *Brachymyrmex heerii* Forel, subsp. *depilis* n. subsp. (*Brachymyrmex depilis* Emery)

☿. Dakota, from Mr. Pergande. One of the original localities. 7: 635 (1893).

Type locality of *depilis,* D. C.

14. *Camponotus herculeanus* L.
No castes mentioned by Emery. Dakota. One of several localities. 7: 674 (1893).
Apparently the form or forms Emery had before him were what Creighton (1950) calls *pennsylvanicus* (Degeer) and *pennsylvanicus modoc* Wheeler. Type locality of *pennsylvanicus,* Pa., of *modoc,* Calif.
15. *Lasius* (*Lasius*) *niger* L. var. *neoniger* n. var. (*Lasius* (*Lasius*) *niger neoniger* Emery)
☿. Hill City, S. Dakota. One of several localities. 7: 639 (1893). Emery remarks that only a few workers from Hill City agree fairly well in color and pilosity with the typical *niger* but are smaller than the common Palearctic form.
Type locality for *neoniger* has not been designated.
16. *Lasius* (*Lasius*) *brevicornis* n. sp. (*Lasius* (*Chthonolasius*) *brevicornis* Emery)
☿ ♀ ♂. Dakota. One of the original localities. 7: 637–640 (1893).
Type locality of *brevicornis,* D. C.
17. *Lasius* (*Lasius*) *flavus* L. (*Lasius* (*Chthonolasius*) *flavus nearcticus* Wheeler)
☿ ♀. Dakota. One of several localities. 7: 637–638 (1893).
Type locality of *nearcticus,* Ill.
18. *Lasius* (*Acanthomyops*) *claviger* Roger (*Acanthomyops claviger* (Roger))
☿ ♀. Dakota. One of several localities. 7: 638, 642 (1893).
Type locality of *claviger,* Pa.
19. *Lasius* (*Acanthomyops*) *interjectus* Mayr (*Acanthomyops interjectus* (Mayr))
No caste or castes indicated. Dakota. One of several localities. 7: 638, 642 (1893).
Type locality of *interjectus,* N. J.
20. *Formica* (*Formica*) *fusca* L. subsp. *subpolita* Mayr var. *neogagates* n. var. (*Formica* (*Proformica*) *neogagates* Emery)

Presumably ☿ ♀ ♂. Castes not definitely indicated. Dakota. One of the original localities. 7: 646, 661–662 (1893). Emery mentions workers and a female from Hill City that are not entirely typical.

Type locality of *neogagates,* Beatty, Pa.

*21. *Formica* (*Formica*) *lasioides* n. sp. (*Formica* (*Proformica*) *lasioides* Emery)

3 ☿. Hill City, S. Dakota, from Mr. Pergande. Only locality mentioned. 7 : 646, 664 (1893).

Type locality of *lasioides,* Hill City, S. D.

22. *Formica lasioides* Em. var. *picea* n. var. (*Formica* (*Proformica*) *lasioides* Emery)

☿. Hill City, S. Dakota, from Mr. Pergande. One of two localities mentioned. 8 : 335 (1895). According to Emery the workers from Hill City form a transition from *picea* to *lasioides.*

Type locality of *vetula* (n. name for *picea*), Yale, B. C., for *lasioides,* see above.

23. *Formica* (*Formica*) *pallide-fulva* Latr. subsp. *fuscata* n. subsp. (*Formica* (*Neoformica*) *pallide-fulva nitidiventris* Emery)

☿♀. Hill City, S. Dakota. One of two localities mentioned. 7: 645, 656 (1893). According to Emery somewhat lighter and shining specimens, including a female from Hill City form a transition to *nitidiventris.*

Type locality of *nitidiventris,* D. C.

*24. *Formica* (*Formica*) *fusca* L. var. *subænescens* n. var. (*Formica* (*Formica*) *fusca* L.)

☿. S. Dakota. One of the original localities. 7: 646, 659–660 (1893). Type locality of *subænescens,* S. D., of *fusca,* Europe.

*25. *Formica* (*Formica*) *fusca* L. var. *neorufibarbis* n. var. (*Formica* (*Formica*) *neorufibarbis* Emery)

☿. S. Dakota. One of the original localities. 7: 646, 660 (1893).

Type locality of *neorufibarbis,* Hill City, S. D.

*26. *Formica* (*Formica*) *dakotensis* n. sp. (*Formica* (*Formica*) *dakotensis* Emery)

☿. Hill City, S. Dakota, from Mr. Pergande. Only locality mentioned by Emery. 7: 644, 652–653 (1893).
Type locality of *dakotensis,* Hill City, S. D.

27. *Formica* (*Formica*) *fusca* L. *subpolita* Mayr var.? *specularis* n. var. (*Formica* (*Formica*) *dakotensis* Emery)
♀. Dakota, received from Mr. Pergande. One of the original localities. 7: 663 (1893).
Type locality of *specularis,* Wis., of *dakotensis,* see above.

28. *Formica* (*Formica*) *rufa* L. subsp. *integra* Nyl. var. *hæmorrhoidalis* n. var. (*Formica* (*Formica*) *integra hæmorrhoidalis* Emery)
☿. Dakota. One of the two original localities. 7: 644, 652 (1893).
Type locality of *hæmorrhoidalis,* Colo.

29. *Formica* (*Formica*) *rufa* L. subsp. *obscuriventris* Mayr var. *rubiginosa* n. var. (*Formica* (*Formica*) *obscuripes* Forel)
☿. Dakota. One of the original localities. 7: 644, 650 (1893). Creighton, 1940, (Amer. Mus. Novitates No. 1055, p. 5) suggested that Emery had a mixed series when describing *rubiginosa: Formica rufa obscuripes* Forel (Colo.), *F. rufa integra* Nyl. (Nebr.), *F. rufa melanotica* Emery and *F. rufa gymnomma* Wheeler (S. Dak.). Creighton (1950) considers both *rubiginosa* and *melanotica* a synonym of *obscuripes,* and *gymnomma* a synonym of *obscuriventris* Mayr. The type locality for *obscuripes,* Green River, Wyo., for *melanotica,* Wis., for *gymnomma,* Cold Spring Harbor, Long Island, N. Y., and for *obscuriventris,* Conn.

*30. *Formica* (*Formica*) *ulkei* n. sp. (*Formica* (*Formica*) *ulkei* Emery)
☿. Hill City, S. Dakota, from Mr. Pergande. Only locality mentioned. 7: 643, 653–654 (1893).
Type locality of *ulkei,* Hill City, S. D.

*31. *Formica* (*Formica*) *sanguinea* Latr. subsp. *puberula* n. subsp. (*Formica* (*Raptiformica*) *puberula* Emery)
1 ☿. Hill City, S. Dakota. 7: 643, 648 (1893). Other specimens from Colorado Emery considered as a transitory

form between *puberula* and *subintegra* Emery.

Type locality of *puberula,* Hill City, S. D., of *subintegra,* D. C.

32. *Polyergus rufescens* Latr. subsp. *breviceps* n. subsp. (*Polyergus rufescens breviceps* Emery)

☿. S. Dakota. One of the original localities. 7: 666 (1893).

Type locality of *breviceps,* Breckenridge, Colo.

THE LONG ISLAND ENTOMOLOGICAL SOCIETY

According to Samuel E. Cassino's ''Naturalists' Directory'' for 1878, the first to be issued, the ''Long Island Entomological Society, Brooklyn'' was organized March 14, 1877. Its president in 1878 was the Rev. George D. Hulst, then 32 years old, and its corresponding secretary was W. V. Andrews, 67 years old. It had a membership of 25 and also a library. The late Charles W. Leng, in his ''Memories of Fifty Years Ago'' (Bull. Brooklyn Ent. Soc., Feb. 1923) said that he and several other boys, of the Polytechnic School in Brooklyn, who were interested in insects, organized the Polytechnic Entomological Society which met in the homes of the members. Some of the older men who attended the boy's society were J. Akhurst of Brooklyn, coleopterist and lepidopterist, W. V. Andrews, a retired British army officer who sold Edwards' ''Butterflies of America'' on a commission basis, and P. Elbert Nostrand, a Polytechnic student who had graduated in 1875. Nostrand nominated George D. Hulst as a member and it was on his suggestion that the name was changed to the Long Island Entomological Society. Later Franz G. Schaupp, coleopterist of Brooklyn presented plants for the amalgamation of the Long Island Society and the Brooklyn Entomological Society (organized in 1872), but they were not acceptable to the majority of members. Later several members joined the Brooklyn Society individually. Apparently the Long Island Society did not last very long.—H. B. W.

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New York Entomological Society

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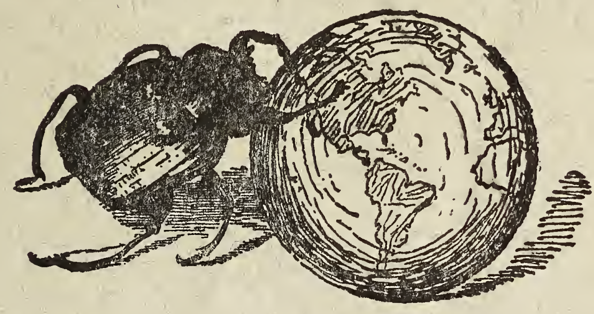

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NEW SPECIES OF SERICA (SCARABÆIDÆ) IX

By R. W. Dawson

University of Minnesota

In the present paper seven new species of *Serica* are described, *coalinga, deserticola, lodingi, panda, peleca, rhypha* and *scaphia;* one new subspecies is proposed, *ventura dorsalis;* three species names are reduced to subspecific rank, *ventura personata, georgiana lecontei,* and *ligulata prœtermissa; errans* Blatchley is reduced to a synonym of *pusilla; egregia* is rediscovered after a century of collecting in California; plates are given of four previously described species (*serotina, elmontea, pruinipennis,* and *watsoni*); the species names *watson, craighead* and *oliver* are emended by the addition of the letter "i"; and finally a summary of the distribution of all the known species of the genus by states is appended.

Serica coalinga, new species.

♂. Length 9 mm.; width 4 mm. Color light reddish brown, elytra with a feeble grayish bloom and conspicuous, bristling, fulvous hairs, chiefly following the line-like striæ. Margins and under surface of body with conspicuous, fulvous hair.

Clypeus densely punctured, feebly tumid just below the center, depressed near the margins which are continuous and strongly elevated.

Front more strongly and less densely punctured than the clypeus.

Pronotum with moderately strong punctures separated by one to two diameters.

Elytra with the striæ rather strongly and closely punctured, the punctuation encroaching on the intervals, especially the wider ones, and leaving the narrow ones nearly impunctate medially.

The genital armature of the male (Plate III) shows a clearly distinct type, but from the ventral aspect of the claspers (inside of the curve) indicates some relationship to Saylor's species *oliveri* and *joaquinella.*

Type: ♂ and Allotype: ♀. A mated pair taken at Coalinga, California, June 6, 1937 by R. W. Dawson, and deposited in the collection of the California Academy of Sciences.

Paratype: One ♂, Coalinga, California, May 22, 1934 (L. S. Slevin) in the writer's collection.

Serica deserticola, new species.

♂. Length 8 mm.; width 4.5 mm. Color reddish brown, dulled by a heavy gray or silvery bloom covering the vertex, pronotum and elytra.

Clypeus shining and densely covered with fine punctures, margins continuous and moderately reflexed, more strongly so in front.

Pronotum heavily pruinose, minutely and obscurely punctate.

Elytra with line-like striæ marked by single rows of fine punctures. General surface heavily pruinose, obscurely, minutely punctured on the flat intervals.

Under surface, especially of the thorax, moderately, but conspicuously, covered with erect, pale ferruginous hairs.

Genital armature of the male (Plate IV) essentially symmetrical, except for the shortening of the left clasper.

Superficially *deserticola* resembles *acicula* but is smaller, more heavily pruinose, especially on the pronotum, and the punctuation is finer and more obscure. The intervals of the elytra are more nearly equal in width and the narrow intervals less evident and flatter. There is also a superficial resemblance to *senta*. But *senta* is larger, less pruinose, with fine erect hairs in the striæ, coarser puncturation, and more convex intervals of the elytra. The genital armatures of the three species easily serve to distinguish them.

Type: ♂. Yermo, San Bernardino Co., California, April 11, 1936 (J. A. Comstock), deposited in the Los Angeles Co. Museum.

Paratypes. 4 ♂ and 1 ♀, with exactly the same data.

Serica lodingi, new species.

♂. Length 11 mm.; width 6 mm. Color dark, opaque, chocolate brown with an iridescent luster approaching that of the species *sericea*.

Clypeus a lighter, reddish brown, shining like the front and middle legs, and moderately covered with coarse, bristling, concolorous hairs. Surface of clypeus nearly flat, margains only feebly elevated, clypeal notch obsolete, puncturation minute, dense and partially confluent.

Pronotum ''velvety'' and iridescent, minutely and densely punctured. Elytra with strongly impressed, narrow striæ; finely and densely punctured especially along the striæ, luster like that of pronotum.

Genital armature (Plate V) resembling that of *parallela*.

Type: ♂. Swain, Alabama, June 19, 1934 (H. P. Loding), deposited in the collection of the U. S. National Museum.

Paratypes: 5 ♂, 15 ♀.

Alabama: "Ala." 1 ♂; Fort Payne 1 ♂, 2 ♀; Jackson Co. 4 ♀; Monte Sano, Madison Co. 3 ♀; 1 ♂; National Forest 1 ♂; Squaw Shoals, Warrior River 1 ♂; Sinks, Bibb Co. 2 ♀; Swain 2 ♀.
Tennessee: Grassy Cove, Cumberland Co. 2 ♀.

In its larger size, dark color and luster *lodingi* resembles *sericea,* but in the structure of the genital armature the resemblance is to *parallela.*

The species is dedicated to the distuinguished collector and student of the Coleoptera, the late H. P. Loding, to whom I am indebted for most of my Alabama records of *Serica.*

Serica panda, new species.

♂. Length 9 mm.; width 5 mm. Color light reddish brown, surface bare and shining.

Clypeus finely and very densely punctured, side margins slightly elevated, broadly and deeply separated from the front margin by the clypeal notches. Front margin of clypeus evenly arcuate when viewed from above, appearinig abruptly and strongly elevated due to a strong transverse depression extending across between the clypeal notches, Just above this depression is a transverse ridge which varies somewhat in strength in the three type specimens.

Pronotum with rather fine punctures separated by one to two diameters.

Elytra with striæ well-marked and bearing three to four confused rows of closely placed punctures.

Genital armature of male (Plate VI) strongly asymmetrical, somewhat resembling the armature of *campestris* rather than the armature of *vespertina* with which *panda* might be confused on the basis of external characters.

Type: ♂. Monte Sano, Madison Co., Alabama, June 13, 1932 (H. P. Loding), deposited in the collection of the U. S. National Museum.

Paratypes: 2 ♂. Dubois Co., Indiana, April 26, 1902 (W. S. Blatchley) 1 ♂, sent to the writer by Mr. Blatchley many years ago; and Princeton, Kentucky, April 10, 1948 (P. O. Ritcher) 1 ♂.

On the basis of size, color and clypeal structure *panda* could be confused with *vespertina.* But in *panda* the clypeal notch is broader and deeper, the transverse impression above the anterior reflexed margin of the clypeus deeper, and the transverse ridge above the impression lower on the clypeus, distinctly below the level of the eye canthus.

Serica peleca, new species.

♂. Length 9 mm.; width 5 mm. Color a fairly light, but dull, golden brown, surface polished and shining.

Clypeus moderately depressed below the fronto-clypeal suture and at the sides, leaving a slightly tumid center. Puncturation fine and dense, the punctures separated by about their own diameter. Clypeal notch narrow but dividing the moderately reflexed margin.

Pronotum with distinctly coarser punctures than on the clypeus, separated by one to two diameters.

Elytra clearly striate, the striæ with three rather regular rows of strong, closely placed punctures spreading laterally almost to the crest of the interspaces. Genital armature of male (Plate VII) symmetrical and somewhat resembling that of *georgiana*.

Type: ♂. Gainsville, Florida, March 25, 1929, deposited in the collection of the U. S. National Museum.

Paratypes: Same data as the type, 1♂, 2♀.

Tallahassee, Florida (T. H. Hubbell) April 15, 1945, 1 ♀; April 23, 1924, 1♂.

The Tallahassee specimens are not quite typical but appear to belong here.

There is little to distinguish this species from the other southeastern forms, and it is doubtful whether it could be separated even by comparison without the aid of the genital armature of the male.

Serica rhypha, new species.

♂. Length 7 mm.; width 4 mm. Color light but dull golden brown, surface polished and shining.

Clypeus flat, margins moderatly reflexed, only slightly stronger in front, clypeal notch obsolete to very feebly indicated. Puncturation fine, the punctures separated by slightly more than their own diameter.

Pronotum with coarser punctures, separated by one to four diameters.

Elytra with striæ impressed and line-like, with fairly coarse, closely placed punctures arranged in one to three confused lines. Intervals impunctate or with a very few scattered punctures.

Marginal and ventral pubescence concolorous with the body, short, sparse and inconspicuous, most evident on the coxæ.

Genital armature of the male (Plate VIII) so radically different from that of any other species occurring in the United States as to suggest an invader from another fauna. The external characters are generalized and present nothing distinctive.

Type: ♂. Leon Co., Florida, 13 miles southwest of Tallahassee, April 15, 1945 (T. H. Hubbell). Deposited in the collection of the U. S. National Museum.

Paratypes: 5 ♂, 2 ♀, with the same data.

Serica scaphia, new species.

♂. Length 10 mm.; width 5 mm. Color light reddish brown, shining, surface practically devoid of the bloom and iridescent luster characteristic of most of the southwestern species.

Clypeus with strongly reflexed margins, relatively wide anteriorly, with rounded angles and obsolete clypeal notches; puncturation fine and dense, the punctures separated by about half their own diameter. Antennal club longer than usual, very slightly longer than the anterior width of the clypeus.

Pronotum with sides and hind angles strongly rounded; puncturation fine and dense especially near the hind angles.

Elytra with line-like striæ, strengthened by a single row of fine, closely placed punctures, intervals finely and irregularly punctured; sutural and alternate intervals a little narrower and more convex than the others. Margins of elytra, pronotum, coxæ and femora fimbriate with erect, fulvous hairs.

Genital armature of male (Plate IX) clearly distinct from that of any of the described species.

Type: ♂. Olig, San Joaquin Valley, California, May 2, 1941 (Kenneth Frick), deposited in the collection of the California Academy of Sciences.

Paratypes: 5 ♂ with the same data.

Serica ventura personata Dawson.

1932 *Serica personata* Dawson, Journ. N. Y. Ent. Soc., XL, p. 531.

Reducing *personata* to a subspecies is a new interpretation of its classification. See Plate X for a comparison of the genital armature with that of *ventura*.

Serica ventura dorsalis, new subspecies.

The subspecies name *dorsalis* is proposed to designate a marked variation in the form of the genital armature of the male as indicated on Plate X. The emargination of the reflexed rim of the claspers, and the basal extension of the claspers deep into the emargination of the back of the stalk of the armature are such striking characters as to require recognition.

The reader must realize that the figures on the plate represent three individual specimens (holotypes) and that the series now before the writer shows a number of intergrades and variations.

The variations plus the limited coastal range (Ventura to Santa Ana, California) would seem to preclude recognizing three species. Subspecific names are here employed in the hope of promoting greater clarity and uniformity in naming specimens. On the basis of external characters *dorsalis* is not separable from typical *ventura.*

The discovery of specific characters in the genital armature in the genus *Serica* has made it possible to bring some order and stalibity into its classification. But the student must not suppose that all problems end with this discovery. Progressive geographical variation occurs in the armatures of practically all the species. Sometimes the extremes are radical and puzzling, and sometimes specific limits are nearly impossible to define. But that is as it should be if evolution is the law of life and is still in progress. If all species were like pickets in a fence, clearly and finally separable it would constitute a category of evidence nearly fatal for the theory of evolution. May the variation here depicted for *ventura* make one think twice before naming new species of *Serica.* It can be equalled in several other series.

Type: ♂, Mint Canyon (Solemint) Los Angeles Co., California, June 21, 1949 (H. E. Cott), deposited in the collection of the California Academy of Sciences.

Paratypes: 30 ♂, 21 ♀ with exactly the same data, from the collection of A. T. McClay.

The species *Serica elongatula* Horn from Owen's Valley (See Plate XXI, Vol. XXX, Journ. N. Y. Ent. Soc.) is closely allied to the *ventura* complex. Evidence at present does not justify uniting all the forms under that name, but that may be a possibility for the future.

Serica georgiana lecontei Dawson.

1921. *Serica lecontei* Dawson, Journ. N. Y. Ent. Soc., XXIX, p. 160.

The synonymy here indicated seems justified by the examination of a large amount of material from a wide range of territory, —some 1,378 specimens. In many localities the remarkable tumidity of the clypeus of *Serica georgiana* Leng fades insensibly to the flat configuration of lecontei. Again the inflated stalk of the genital armature of *lecontei* weakens to that of *georgiana*. Thus neither character will serve to distinguish the forms in all localities. The combined range of the two forms is approximately from the Mississippi river to the Atlantic coast. *Georgiana* occurring in most of this area, and *lecontei* being marginal,—the Gulf coast (S. Miss., S. Ala. and N. Fla.), the Atlantic coast to Nova Scotia and the water-way of the St. Lawrence and Great Lakes into northern Minnesota. The form *lecontei* seems to occur alone in the Canadian territory and again on the Gulf coast, and the form *georgiana* alone in the central area of the range. Both occur together in the coastal states of North Carolina to New Hampshire.

A strangely parallel case occurs in the forms *Serica vespertina* Gyllenhal and its variety accola. The extreme clypeal ridge of typical *vespertina* fades by degrees to the flat configuration of *accola*. *Vespertina* is common in the Atlantic states and *accola* extends as far west as Lincoln, Nebraska. This later relationship was recognized before the publication of the names. The curious fact is that the clypeal ridge of *vespertina* and the clypeal tumidity of *georgiana* are by all odds the most striking external structural characters exhibited by the shiny, brown *Serica* of the eastern United States, and were naturally the characters first seized upon by the early writers Gyllenhal and Leng in defining species.

Serica ligulata prætermissa Dawson.

1932. *Serica prætermissa* Dawson, Journ. N. Y. Ent. Soc., XL, p. 536.

Since the description of *ligulata* and *prætermissa* some 1,680 have been examined and a more or less complete series of intergrades found, as well as specimens which were more "ligulate" than the type of *ligulata*. Since the variation is marked and definitely related to the geographic or perhaps more specifically the ecological distribution of the forms, the writer believes *prætermissa* should be regarded as a subspecies.

Serica pusilla Dawson.

1922. *Serica pusilla* Dawson, Journ. N. Y. Ent. Soc., XXX, p. 162.

1929. *Serica errans* Blatchley, The Florida Entomologist, XIII, p. 35.

1932. *Serica pusilla errans* Dawson, Journ. N. Y. Ent. Soc., XL, p. 538.

The examination of additional material has confirmed the opinion that *errans* should be rated as a synonym of *pusilla.*

Serica egregia Dawson.

1921. *Serica egregia* Dawson, Journ. N. Y. Ent. Soc., XXIX, pp. 165–166.

The unique type of *egregia* collected a century ago has recently been matched by 12 ♂, 1 ♀ taken in Los Angeles Co. and 1 ♂ in San Benito Co.

It has taken a long time to duplicate some of the early material reviewed by Le Conte and Horn.

Serica serotina Le Conte.

1856. *Serica serotina* Le Conte, Journ. Acad. N. S., Phila., Ser. 2, III, p. 275.

The inclusion of *serotina* in this series of figures completes the review of the species described by Le Conte. The genital armature of the male (Plate XI) shows one of the most distinct or isolated types known in the genus. Some size variation occurs in the armature, but there is very little structural modification. In the series of specimens at hand the length of the body varies from 8–11 mm. The clypear structure also varies. The strongly reflexed anterior margin of the clypeus varies from evenly arcuate to broadly emarginate with sub-angulate, prominent corners at the junction with the side margins.

Specimens examined: 176, from California and Oregon, taken from a wide variety of localities, and usually few at a time.

Serica elmontea Saylor.

1939. *Serica elmontea* Saylor, Proc. Ent. Soc. Wash., Vol. 41, p. 56.

A supplement to Saylor's figures is here offered (Plate XII). The claspers of the armature are usually seen closed, but are capable of lateral rotation through a 90° angle. The opening of the claspers displays a curious, sclerotized structure on the left side as shown on the plate.

Specimens examined 157, from southern and from Baja California.

Serica pruinipennis Saylor.

1935. *Serica pruinosa* Saylor (not Burmeister) Journ. Ent. Zool., 27, p. 2.

1936. "*Series prunipennis*" Saylor (typographical error for *Serica pruinipennis*) Journ. Ent. Zool., 28, p. 4.

1939. *Serica prunipennis,* Fourth Supplement to Leng Catalogue of Coleoptera, p. 51.

The name *pruinosa* was preoccupied by Burmeister; the correction "*pruinipennis*" was misspelled in the headline (but not in the text) and the error copied in the Fourth Supplement of the Coleoptera Catalogue. It now stands corrected in the Fifth Supplement. The type specimens were labelled "Coalinga, Kings Co.", but Coalinga is in Fresno Co. Finally one of the rarest and most distinctive characters among the American species of *Serica* (a partial fourth lamina in the antennal club) was not noted in the original description, but later recorded as one of the distinctive characters for the species *mendota* Saylor. This might well puzzle one in identifying *pruinipennis.*

It is hoped that these comments, along with Plate XIII, will aid in stabilizing the name and in the identification of the species.

Specimens examined: 28 from Kings and Fresno Counties in California, including the holotype.

Serica watsoni Saylor.

1939. *Serica watson* Saylor, Proc. Ent. Soc. Wash., vol. 41, pp. 57–58.

Specimens examined, 216, from El Monte and Pine Valley, San Diego Co., and from White Water, Riverside Co., California.

The specimen used in drafting Plate XIV is typical for the average of the long series from the type locality.

The specific rulings of the International Code certainly justify emending the specific names *watson, craighead* and *oliver* proposed by Mr. Saylor by the addition of the letter "i," and such emendation is here proposed.

THE GEOGRAPHICAL DISTRIBUTION OF NORTH AMERICAN SERICA

For a little over thirty years the writer has recorded the data from all the specimens of *Serica* submitted to him for determination, as well as from those of his own collecting,—some 21,000 specimens. It is here summarized by states so that one can determine his probable local fauna at a glance. Such a listing, of course, cannot be complete, but it is much more nearly so than can be gleaned from the present literature. In cases of doubt (females only, old labels etc.) the records have been omitted. It is easier to add to a list than subtract from it.

ALABAMA: *apatela, atricapilla, carolina, evidens, georgiana, georgiana lecontei, intermixta, lodingi, loxia, mystaca, panda, parallela, sponsa, trociformis blatchleyi, vespertina, vespertina accola.*

ARIZONA: *alternata, anthracina, concinna, curvata, porcula.*

ARKANSAS: *arkansana, contorta, evidens, georgiana lecontei, texana* (1 ♂), *vespertina accola.*

CALIFORNIA: *abdita, acicula, acontia, alleni, alternata, alternata exolita, alternata patruela, anthracina, caliginosa, catalina, chætosoma, chicoensis, coalinga, cruzi, curvata, cuyamaca, descerticola, egregia, elmontea, elongatula, falcata, falli, fimbriata, joaquinella, ligulata, ligulata prætermissa, joaquinella, laguna, mckenziei, mendota, michelbacheri, mixta, oliveri, pavonia, perigonia, porcula, prava, pruinipennis, repanda, sandiegensis, satrapa, scaphia, sculptilis, searli, senta, serotina, solita, stygia, subnissa, ventura, ventura personata, ventura dorsalis, watsoni.*

COLORADO: *alternata, anthracina, concinna, curvata, intermixta.*

CONNECTICUT: *atricapilla, elusa, georgiana, georgiana lecontei, intermixta, mystaca, parallela, sericea, tristis, trociformis blatchleyi, vespertina.*

DELAWARE: *georgiana lecontei.*

DISTRICT OF COLUMBIA: *atricapilla, carolina, georgiana, georgiana lecontei, intermixta, iricolor, mystaca, opposita, parallela, sericea, trociformis blatchleyi, vespertina.*

FLORIDA: *æmula, aspera, atricapilla, delicata, georgiana lecontei, intermixta, iricolor, peleca, pusilla, rhypha, spicula, tantula, vespertina.*

Georgia: *aspera, atricapilla, carolina, georgiana, georgiana lecontei, intermixta, iricolor, loxia, mystaca, panda, parallela, peleca, sericea, spicula, trociformis* (typical), *vespertina.*

Idaho: *anthracina, curvata, sericea.*

Illinois: *atricapilla, campestris, evidens, georgiana, georgiana lecontei, intermixta, loxia, mystaca, parallela, sericea, sponsa, vespertina accola.*

Indiana: *campestris, evidens, georgiana, intermixta, loxia, mystaca, panda, parallela, sericea, sponsa.*

Iowa: *campestris, evidens, intermixta, mystaca, sericea, sponsa.*

Kansas: *campestris, evidens, intermixta, mystaca, ochrosoma, sericea, sponsa, vespertina accola.*

Kentucky: *atricapilla, campestris, evidens, georgiana, georgiana lecontei, intermixta, loxia, mystaca, panda, sericea, sponsa, trociformis blatchleyi, vespertina.*

Louisiana: *atratula monita, campestris, mystaca, parallela.*

Maine: *atricapilla, georgiana lecontei, sericea, tristis.*

Maryland: *atricapilla, georgiana, georgiana lecontei, imitans, intermixta, iricolor, loxia, mystaca, opposita, parallela, sericea, trociformis blatchleyi, vespertina.*

Massachusetts: *atricapilla, elusa, georgiana, georgiana lecontei, intermixta, iricolor, mystaca, parallela, sericea, tristis, trociformis blatchleyi, vespertina.*

Michigan: *atricapilla, georgiana, georgiana lecontei, intermixta, loxia, mystaca, parallela, sericea, sponsa, tristis, vespertina.*

Minnesota: *atricapilla, georgiana lecontei, intermixta, mystaca, parallela, sericea, tristis.*

Mississippi: *atricapilla, campestris, georgiana lecontei, intermixta, parallela, sericea.*

Missouri: *campestris, evidens, intermixta, iricolor, loxia, mystaca, sericea, sponsa, trociformis blatchleyi, vespertina accola.*

Montana: *anthracina, curvata, intermixta, sericea.*

Nebraska: *anthracina, campestris, curvata, evidens, intermixta, mystaca, ochrosoma, sericea, vespertina accola.*

Nevada: *alternata, anthracina, curvata, falcata, perigonia, porcula.*

New Hampshire: *atricapilla, elusa, georgiana, georgiana lecontei, intermixta, iricolor, parallela, sericea, tristis.*

NEW JERSEY: *atricapilla, carolina, georgiana, georgiana lecontei, imitans, intermixta, iricolor, mystaca, opposita, parallela, sericea, sponsa, trociformis blatchleyi, vespertina.*

NEW MEXICO: *alternata, anthracina, concinna, intermixta, porcula.*

NEW YORK: *atricapilla, elusa, georgiana, georgiana lecontei, intermixta, iricolor, mystaca, opposita, parallela,* (*peregrina* introduced) *sericea, sponsa, tristis, trociformis blatchleyi, vespertina.*

NORTH CAROLINA: *aspera, atricapilla, carolina, georgiana, georgiana lecontei, intermixta, iricolor, loxia, mystaca, parallela, sericea, trociformis, trociformis blatchleyi, vespertina.*

NORTH DAKOTA: *curvata, intermixta, sericea.*

OHIO: *atricapilla, elusa, georgiana, intermixta, iricolor, mystaca, parallela, sericea, sponsa, trociformis blatchleyi, vespertina.*

OKLAHOMA: *atratula, campestris, contorta, mystaca, ochrosoma, sericea.*

OREGON: *anthracina, curvata, falcata, falli, serotina.*

PENNSYLVANIA: *atricapilla, elusa, georgiana, georgiana lecontei, imitans, intermixta, iricolor, mystaca, parallela, sericea, sponsa, trociformis blatchleyi, vespertina.*

RHODE ISLAND: *georgiana, georgiana lecontei, iricolor, mystaca, trociformis blatchleyi.*

SOUTH CAROLINA: *aspera, atricapilla, carolina, georgiana lecontei, imitans, intermixta, mystaca, parallela, vespertina.*

SOUTH DAKOTA: *anthracina, intermixta, sericea.*

TENNESSEE: *atricapilla, georgiana, intermixta, iricolor, lodingi, mystaca, parallela, sericea, sponsa, trociformis blatchleyi, vespertina.*

TEXAS: *æmula, atratula, atratula, monita, contorta, georgiana, mystaca, porcula, texana.*

UTAH: *alternata, anthracina, concinna, curvata, perigonia, sericea.*

VERMONT: *atricapilla, georgiana lecontei, sericea, trociformis blatchleyi.*

VIRGINIA: *atricapilla, georgiana, georgiana lecontei, intermixta, iricolor, mystaca, parallela, sericea, trociformis blatchleyi, vespertina.*

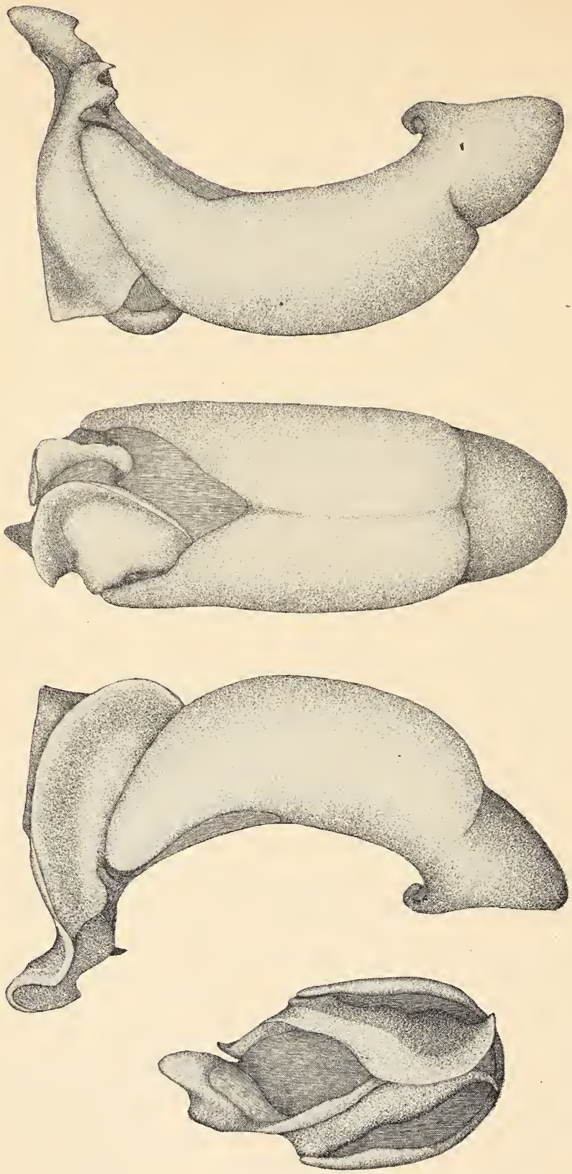
Washington: *anthracina, curvata, falcata, sericea.*
West Virginia: *georgiana.*
Wisconsin: *atricapilla, lecontei, intermixta, loxia, parallela, sericea, sponsa, tristis.*
Wyoming: *anthracina, curvata.*

CANADA

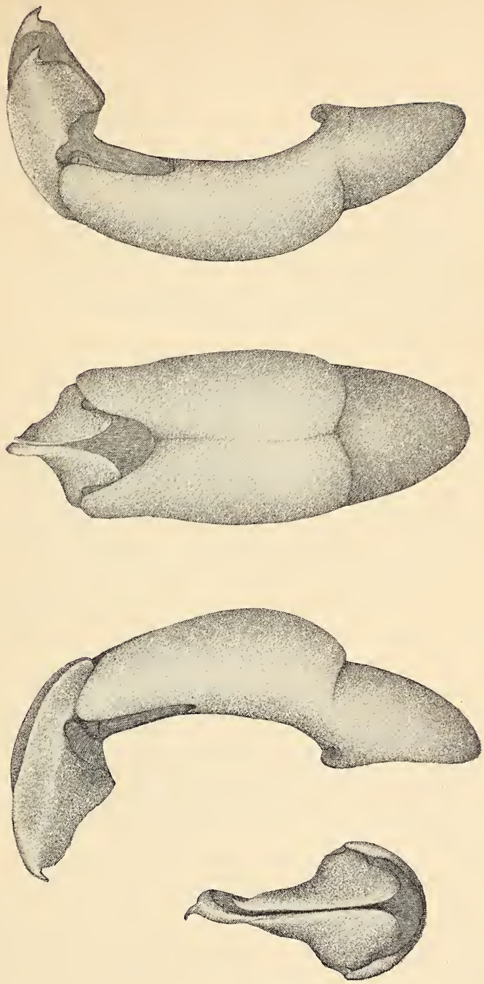
Alberta: *intermixta.*
British Columbia: *anthracina, curvata, intermixta, sericea.*
Manitoba: *atricapilla, curvata, intermixta, sericea, tristis.*
New Brunswick: *atricapilla, tristis.*
Nova Scotia: *atricapilla, georgiana lecontei, tristis.*
Ontario: *atricapilla, georgiana lecontei, intermixta, parallela, sericea, tristis.*
Quebec: *atricapilla, elusa, georgiana lecontei, intermixta, parallela, sericea, tristis.*
Saskatchewan: *curvata.*

MEXICO

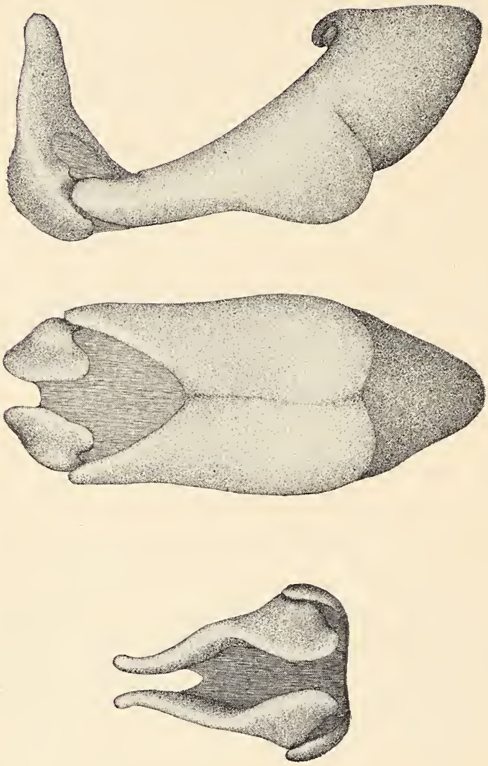
Baja California: *alternata exolita, chætosoma, craigheadi, elmontea, ensenada, mckenziei, michelbacheri, pilifera, ligulata prætermissa, rossi, sculptilis, serensia.*



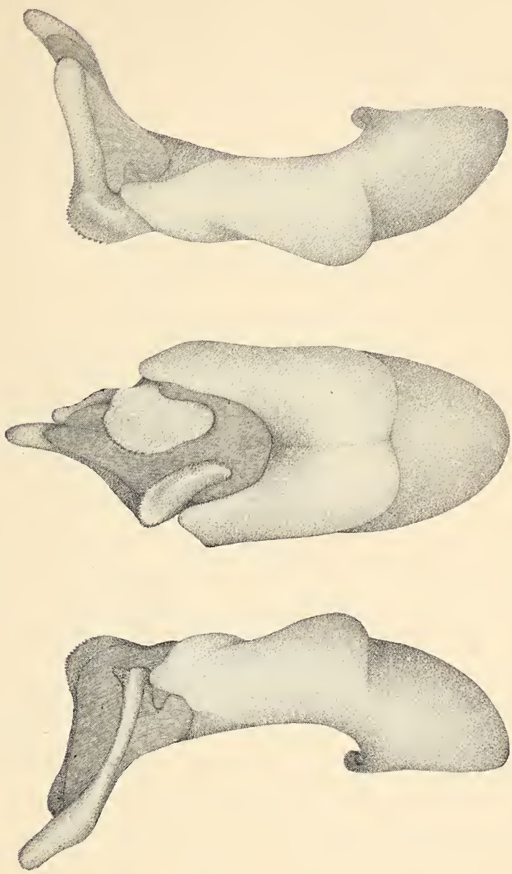
Serica coalinga n. sp.



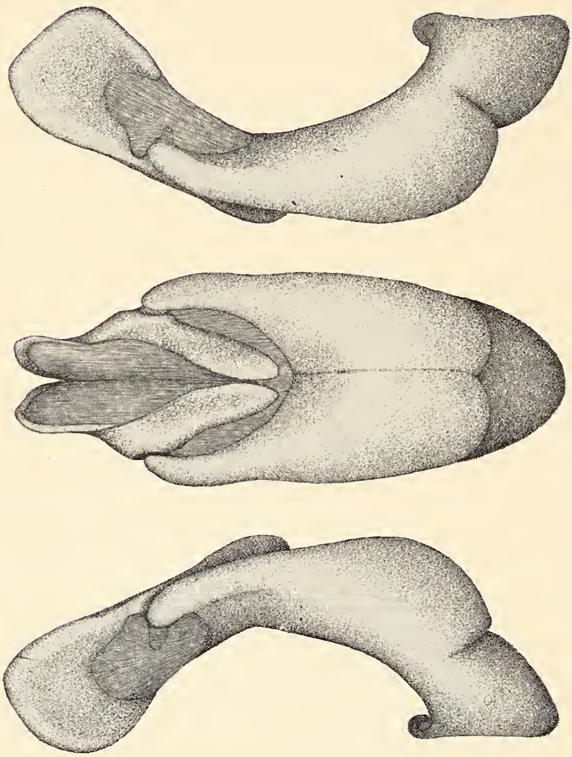
Serica deserticola n. sp.



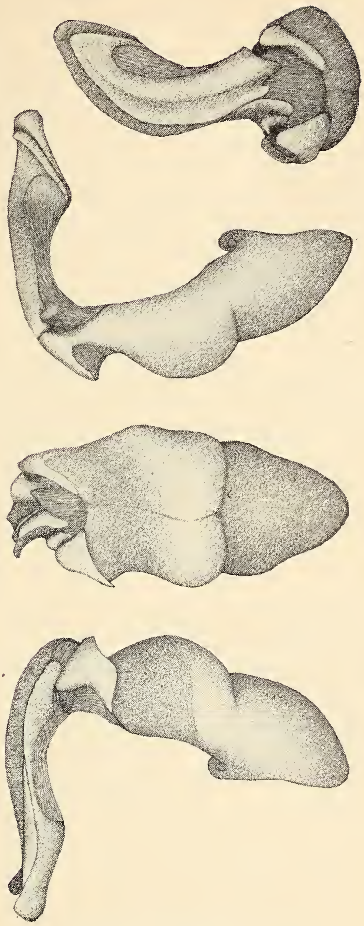
Serica lodingi n. sp.



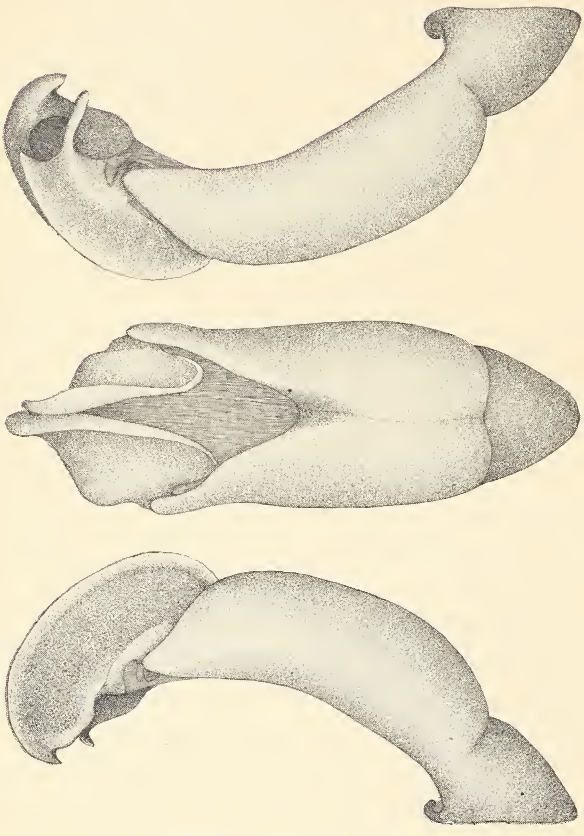
Serica panda n. sp.



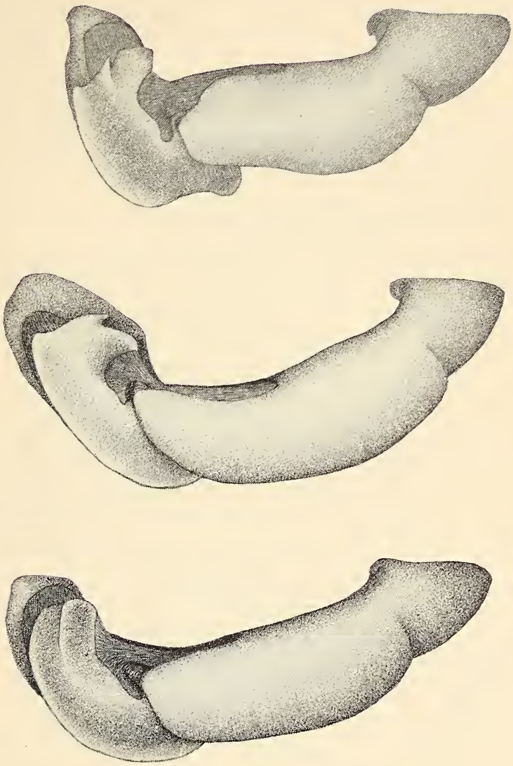
Serica peleca n. sp.



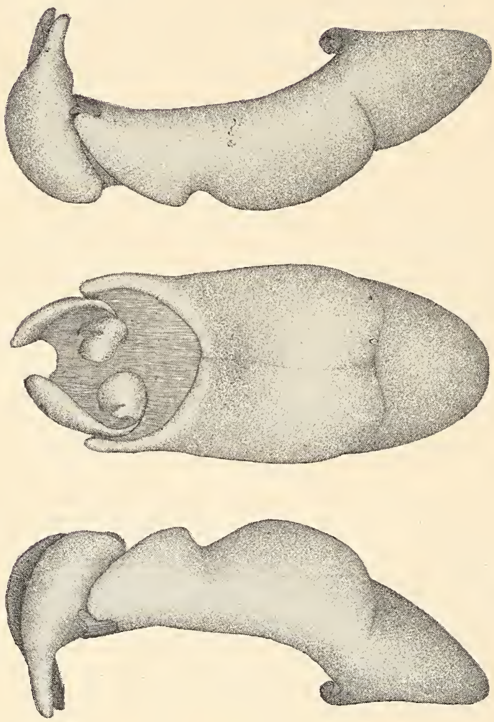
Serica rypha n. sp.



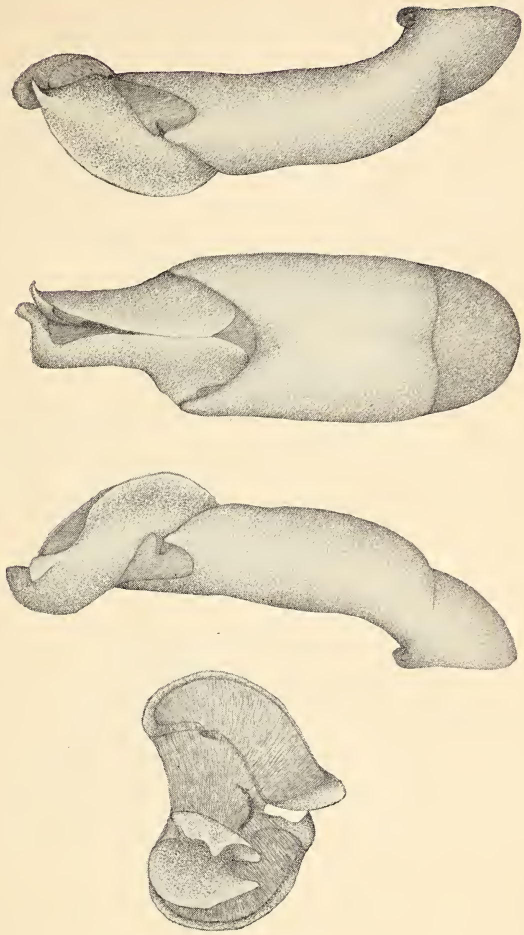
Serica scaphia n. sp.



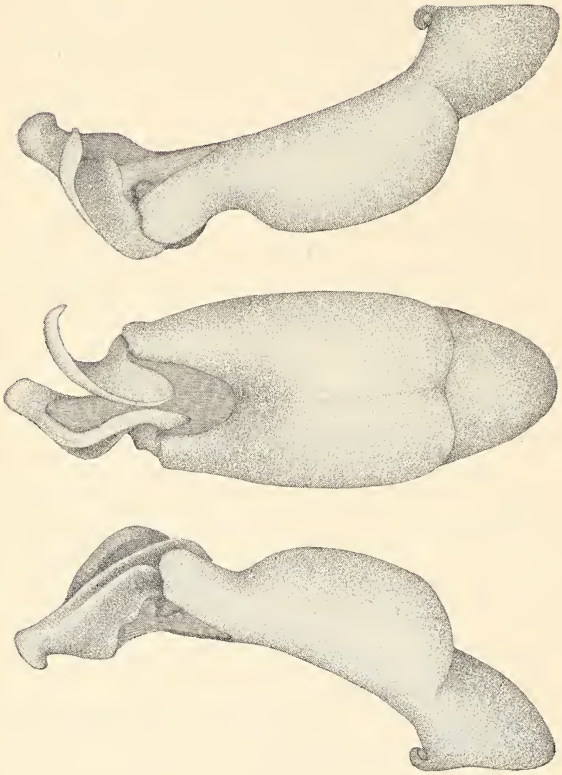
1. Serica ventura dorsalis n. ssp.
2. Serica ventura personata Dawson
3. Serica ventura Dawson



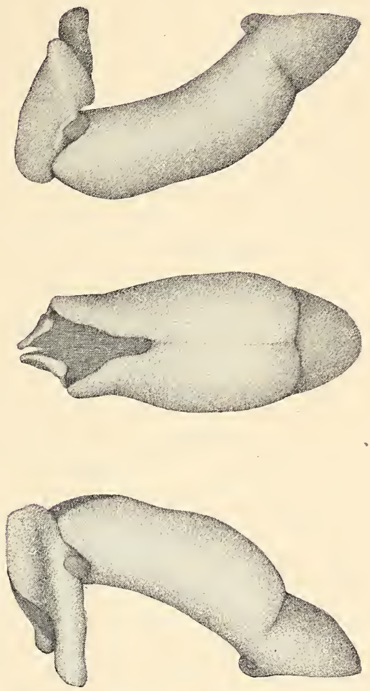
Serica serotina Le Conte



Serica elmontea Saylor



Serica pruinipennis Saylor



Serica watsoni Saylor

HYDROPHILUS IN SALT WATER

On November 18, 1949 while walking along a long wharf projecting out into the greyish-green waters of Aransas Bay on the south Texas Coast, the writer saw a large, fresh-water beetle swimming slowly along near the surface about 100 yards from shore. It appeared to be one and one-half to two inches long and the color was shiny black. Since the slow motion led to the suspicion that the insect was not at ease or was possibly moribund in the marine environment, an attempt was made to capture it with a small stick. This effort caused it to dive out of sight quickly and agilely, so that doubts of its well-being were quickly dissipated. It was not seen again.

The simple process of exclusion leaves little doubt as to the generic classification of the insect. By appearance and size it could only have been a member of Dytiscidæ or Hydrophilidæ. However, no *Dytiscus* in Texas attain such large size and the animal must have belonged to the Hydrophilidæ. Members of the genus *Hydrocharis* of that family are known to enter brackish pools, but again smaller size excludes them, and indicates *Hydrophilus* as the proper genus.

It is well known that insects in salt water are uncommon and none seem to be completely adapted except the strider, *Halobates,* of the high seas. In some twenty years of observation on bays on the Gulf Coast the writer has seen no diving beetles in salt water, although corixids are occasionally taken in water which is barely brackish near river mouths. Furthermore, no record of *Hydrophilus* in the marine environment has been seen. The salinity where the specimen was seen, was determined to be 22.0 per mille, which is about 63.0 per cent of full sea water. It should be added that numerous rains had preceded the time of this observation and the presence of numerous ponds on shore lead to the conclusion that the sea-going *Hydrophilus* was not forced into salt water by drouth or lack of the normal habitat.—G. GUNTER, Institute of Marine Science, The University of Texas, Port Aransas, Texas.

PRELIMINARY STUDIES OF FLEAS ON RATS (RATTUS NORVEGICUS) IN NEW JERSEY[1]

Elton J. Hansens[2] and John Hadjinicolaou[3]

The few studies of fleas on rats which have been made in the northeastern United States have been limited to seaports such as New York (Williams, 1929 and Fox and Sullivan 1925) and Philadelphia (Vogel and Cadwallader 1935). Studies in these areas have shown *Xenopsylla cheopis,* the oriental rat flea, to be the dominant species.

In the spring of 1951 a survey of domestic rat parasites was started in New Jersey to determine ultimately the kinds of ectoparasites and their distribution in the state. These studies are being supported in part by the New Jersey State Department of Agriculture. This paper briefly summarizes the data on fleas taken from rats (all *Rattus norvegicus*) between June 1, 1951 and January 31, 1952. Most of the animals were taken in northeastern New Jersey where initial studies were made on rats inhabiting garbage and refuse dumps. The place names used in the discussion do not necessarily denote that the dump is owned or operated by the municipality mentioned.

To obtain fleas and other ectoparasites, rats were captured on the dumps by driving them from their burrows with calcium cyanide or by running a bulldozer through the area and killing the rats as they emerged. As soon as killed, each animal was placed in a two quart jar containing a quart of water, and small quantities of lindane and a wetting agent. Several different wetting agents were tried with equal success. Each jar was set aside for at least 2 hours and then was shaken vigorously 100

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[2] Associate Research Specialist in Entomology.

[3] Director of Entomological Laboratory, School of Hygiene, Athens, Greece, studying at Rutgers University as Exchange Research Scholar under Smith, Mundt, Fullbright Acts.

times to wash parasites from the animal. After this washing the rat was removed, and length and sex were recorded. Liquid remaining in the jar was passed through a sieve (60 meshes to the inch) to collect the parasites. Parasites and debris collected on the screen were washed from the screen and stored in 70% alcohol. For study, fleas were mounted on slides in the usual fashion and identified by the junior author. Doubtful specimens were checked by Dr. Harry D. Pratt of the United States Public Health Service in Chamblee, Georgia.

Data for fleas taken from rats collected in dumps between June 1 and September 30, 1951 are set forth in Table I.

TABLE I

FLEAS TAKEN FROM RATS CAPTURED IN DUMPS IN NEW JERSEY FROM JUNE 1 TO SEPTEMBER 30, 1951.

	No. Coll.	Total Rats	Total Fleas	*Xenopsylla cheopis*	*Nosopsyllus fasciatus*	*Ctenocephalides felis*
Englewood	4	13	0			
Teaneck	1	1	0			
Palisades Park	6	20	0			
Fairview	4	69	2	2		
Secaucus	5	89	14			
Union City	4	72	0			
Jersey City	3	58	37	35	1	1
Hackensack	3	35	0			
Hasbrouck Hgts.	1	4	0			
Lyndhurst	3	13	0			
N. Arlington	4	80	6	2	2	2
Newark	5	103	130	116	11	3
Rahway	5	54	3			3
Perth Amboy	8	164	33	32		1
South River	5	82	17	16		1
Bloomingdale	5	45	0			
Boonton	1	2	1			1
Pine Brook	5	46	2			2
Dover	1	8	2			2
Newton	1	15	1			1
Phillipsburg	1	6	1	1		
Hightstown	1	11	0			
Bordentown	1	12	0			
Camden	1	6	12	12		
		1008	261	230	14	17

Greatest numbers of fleas were taken from the large rat populations found in the larger dumps. *Xenopsylla cheopis* was by far the most abundant flea making up 88.1% of the fleas collected and 89.7% of those collected in the metropolitan area. Only two other fleas were taken, namely, *Ctenocephalides felis* and *Nosopsyllus fasciatus.* The flea index was low, only 0.26 fleas being taken per rat at the locations shown in Table I. The first 16 locations in the table can be considered as representative of northeastern New Jersey. In these areas 902 rats had 242 fleas for a flea index of 0.27. It is worthy of note that *X. cheopis* was the predominant flea but occurred only in the localities surveyed which were closest to port facilities, i.e., New York harbor or Raritan Bay.

The seasonal distribution of fleas followed the pattern found in other surveys in this part of the country—a low flea population in June increasing to late August and then dropping very rapidly. In late August at one location, the flea incidence reached a high of 5.1 *X. cheopis* per rat for the 20 rats captured.

Through the winter additional collections have been made in dumps in various areas of the state, as shown in Table II.

TABLE II

Location	County	No. Coll.	Total Rats	Total Fleas	*Xenopsylla cheopis*
Fairview	Hudson	1	18	0	
Secaucus	"	2	9	2	2
Union City	"	1	10	0	
Jersey City	"	2	26	0	
N. Arlington	Bergen	2	21	0	
Newark	Essex	2	35	0	
Rahway	Union	3	33	0	
Perth Amboy	Middlesex	2	24	31	31
South River	"	2	21	0	
Belvidere	Warren	1	11	0	
Washington	"	1	11	2	2
Flemington	Hunterdon	1	11	0	
High Bridge	"	1	10	0	
Lambertville	"	1	10	0	
Bernardsville	Somerset	1	10	0	
Raritan	"	1	10	0	
Wrightstown	Burlington	1	1	0	
Bordentown	"	1	12	0	
Westmont	Camden	1	7	0	
Audubon	"	1	1	0	
Woodbury	Gloucester	1	4	0	
Salem	Salem	1	10	0	
Deerfield	Cumberland	1	2	0	
Atlantic City	Atlantic	1	5	0	
			312	35	35

It will be noted that these collections were made in 24 areas spread through 14 of New Jersey's 21 counties. However, in these winter collections, *X. cheopis* was the only flea taken and that at only 3 locations. Rats at one new location outside a port area, namely, Washington, were found to have this flea. No other species of fleas were taken in these winter collections. A total of 35 fleas were removed from the 312 rats taken on dumps.

Through the winter, some collections were made in buildings by the use of snap traps. Data for these collections are set forth in Table III.

TABLE III

FLEAS FROM RATS TAKEN INDOORS IN SNAP TRAPS FROM OCTOBER 1, 1951 TO JANUARY 31, 1952.

	No. of Buildings	Total Rats	Total Fleas	*Xenopsylla cheopis*	*Nosopsyllus fasciatus*	*Ceratophyllus gallinæ*
Jersey City	6	25	52	52		
Springfield	1	1	0			
Union	1	1	0			
Kingston	1	6	0			
Hampton	1	1	0			
Belvidere	1	5	2		2	
Frenchtown	1	1	2			2
Flemington	3	14	1		1	
White House Sta.	1	1	0			
Pennington	1	1	2		2	
Hopewell	1	2	0		1	
Vineland	1	11	4		4	
Bridgeton	1	1	1		1	
TOTAL	20	70	64	52	10	2

Most extensive trapping was done in Jersey City, where 25 rats were taken in 6 buildings. Eighteen of these rats were taken from a heavily infested feed mill. The only fleas taken on these rats were *X. cheopis*. The flea index for this rather small sample of the rat population was 2.08 per rat. This index is nearly 10 times that for summer collections of rats in dumps.

As shown in Table III, the other collections were made mostly in rural areas. In these places *N. fasciatus* was occasionally encountered and was the only flea captured except for one collection at Frenchtown. Here in a poultry hatchery on the only rat trapped a male and a female *Ceratophyllus gallinæ,* the common chicken flea, were taken. As far as we know this is a new host record.

SUMMARY

Between June 30, 1951 and January 31, 1952, 1390 *Rattus norvegicus* were captured in New Jersey in a preliminary study of the ectoparasites of domestic rats. A total of 360 fleas were taken from these animals. *Xenopsylla cheopis* was collected from 8 dumps in northeastern New Jersey and from 3 other locations. Of the total fleas taken in the metropolitan area from June 1 to September 30, 89.7% were *X. cheopis.* Other fleas collected were *Nosopsyllus fasciatus* and *Ctenocephalides felis.* In winter collections (October to January) only *X. cheopis* was taken from rats on dumps. Rats trapped in buildings were found infested with *X. cheopis* in a large city and with *N. fasciatus* in rural areas. Two specimens of *Ceratophyllus gallinæ* were taken from a rat trapped in a poultry hatchery at Frenchtown. It is planned to continue these studies and to expand them into other areas of New Jersey.

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NORTH AMERICAN LEPTOTHORAX OF THE TRICARINATUS–TEXANUS COMPLEX (HYMENOPTERA: FORMICIDÆ)

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One of the least known groups of our North American *Leptothorax,* subgenus *Myrafant,* are the closely related forms belonging to the tricarinatus-texanus complex. This group includes forms recently treated by Creighton (April 1950) in his "Ants of North America" under the names *texanus texanus* Wheeler, *texanus davisi* Wheeler, *tricarinatus tricarinatus* Emery, *tricarinatus neomexicanus* Wheeler. These ants are in general characterized by their 12-segmented antenna, scape commonly failing by its greatest breadth to reach the posterior border of the head, thorax without mesoepinotal constriction, clypeus with a longitudinally rugulose shield or plate at the middle of its anterior border. extraordinarily large and broad postpetiolar node, and rather abundant, coarse, grayish or whitish, suberect to erect body hairs. So far as is known, all forms live in small colonies within the soil. Their food is probably largely, if not exclusively, the flesh of small arthropods.

L. tricarinatus tricarinatus is the oldest form. It was inadequately described by Emery in 1895 from a holotype worker collected at Hill City, South Dakota, by Titus Ulke. As the type was deposited in the collection of Emery in Europe, apparently no American workers have ever seen it. When Wheeler revised the North American forms of *Leptothorax* in 1903, he therefore had to base his key and description of *tricarinatus* entirely on literature. Apparently Creighton also did not see the holotype or any specimen from the original nest when he published the section of *Leptothorax* in his book on ants referred to above. I have been more fortunate than Wheeler and Creighton in being able to examine not only a worker from the original nest series (in the collection of the United States National Museum) but also approximately 200 specimens collected from South Dakota, Colorado, Iowa, and Utah. Of these, approximately 190 are from various localities in South Dakota and some indeed from localities not very far from the type locality. I have every reason to believe that *tricarinatus tricarinatus* will eventually be found in North Dakota, Wyoming, Nebraska, Montana and possibly Minnesota. Because of the large number of specimens available to me, many of which show considerable variation, I have decided to redescribe the worker fully and also to present for the first time a description of the male.

Although I have examined from one to three worker cotypes of all the other forms, lack of sufficient specimens has prevented me from making so thorough a study of these forms as with *tricarinatus tricarinatus*. Hence instead of giving full redescriptions, I will make only casual remarks.

This article includes a key for separating the workers of each form, and data on taxonomy, biology, and distribution, as well as references to all known literature.

1. Epinotum usually bearing a pair of distinct spines (infrequently the spines are perhaps short enough to be confused with those termed dentiform or tuberculiform). Petiolar node in profile, stout, thick anteroposteriorly, the dorsal surface usually meeting the anterior and posterior surface in such a way as to form a rather distinct subrectangle 2

   Epinotum bearing a pair of short, dentiform or tuberculiform spines. Petiolar node not as described above 3

2. Dorsal surface of postpetiolar node densely and finely granulate or punctulate. Atlantic Coastal States from Massachusetts and New York to Florida .... *texanus davisi* Whlr.

   Dorsal surface of postpetiolar node distinctly rugulose-reticulate, often rather coarsely so. Minnesota, Michigan, Ohio and North Carolina, to Mississippi, Oklahoma and Texas .... *texanus texanus* Whlr.

3. Dorsal surface of the head with much of the area largely smooth and shining, especially the median and posterior regions. Front bearing a number of unusually large and easily visible punctures. Dorsal surface of thorax more or less uniformly finely granulate or punctulate, sometimes though, rather smooth and shining. Arizona, New Mexico and Utah .... *tricarinatus neomexicanus* Whlr.

   Dorsal surface of head subopaque or opaque, lacking the largely smooth and shining areas described above. Punctures on the front of the head either indistinct or absent. Dorsal surface of thorax not as described above. Iowa and South Dakota to Colorado and Utah. *tricarinatus tricarinatus* Emery

Leptothorax (Myrafant) tricarinatus tricarinatus Emery

Leptothorax (*Leptothorax*) *tricarinatus* Emery, 1895, Zool. Jahrb. Abt. f. System. 8: 318, 321–322. ☿.—Wheeler, 1903, Proc. Acad. Nat. Sci. Phila. 55: 223, 247–248. ☿. (Pl. 12, fig. 17, ☿).—Wheeler, 1909, Jour. N. Y. Ent. Soc. 17: 82. ☿.—Buren, 1944, Iowa State Col. Jour. Sci. 18: 286, 288. ☿.—Creighton, 1950, Harvard Univ., Bul. Mus. Compar. Zool. 104: 257, 273. ☿♀.

WORKER.—Length 2–2.6 mm.

Head subrectangular, distinctly longer than broad, with almost straight posterior border, rounded posterior corners and weakly convex, somewhat subparallel sides. Antenna 12-segmented; scape lacking approximately its greatest width of reaching the posterior border of the head; funiculus with a distinct 3-segmented club, the last segment of which is clearly longer than the combined lengths of the two preceding segments; first funicular segment approximately as long as the three succeeding segments. Eye oval, rather prominent, situated approximately its greatest length from the base of the mandible. Clypeus with a distinct shield or plate at the middle of its anterior border, which usually bears a distinct median and two lateral, longitudinal carinæ; each side of the shield commonly bearing a number of smaller and less distinct longitudinal carinæ. Frontal area poorly defined or obsolescent. Mandible of the usual shape, with five teeth, of which the apical is the largest. Thorax in profile, moderately convex; from above, widest at the well-rounded prothoracic humeri, narrowest laterally in the region of the mesoepinotum, dorsal surface without sutures or a mesoepinotal impression. Epinotum bearing a pair of short, dentiform or tuberculiform spines. Dorsal portion of petiolar node in profile forming an obtuse angle or else a weakly developed subrectangle. Postpetiolar node from above, large, transverse, but not twice as wide as the petiolar node; approximately 1½ times as broad as long, with almost straight anterior border, rounded anterior shoulders and weakly convex, somewhat subparallel sides. Gaster from above, oval, with angular humeri.

Head, thorax, petiole and postpetiole subopaque or opaque; clypeal shield, frontal area and gaster rather smooth and shining. Mandible longitudinally striated, the surface bearing scattered, piligerous punctures. Dorsal surface of head largely punctate or granulate, but also with a number of delicate rugulæ extending from the clypeus toward the occiput; cheek, and region between the eye and the frontal carina largely rugulose or rugulose-reticulate. Dorsum of thorax distinctly but not extraordinarily coarsely rugulose or rugulose-reticulate, the sculpturing usually less coarse on the mesonotum than on the pronotum and epinotum. Petiolar node rugulose-reticulate. Postpetiolar node usually finely punctulate or granulate, occasionally finely rugulose-reticulate in addition.

Body with rather abundant, well scattered, coarse, grayish or whitish, suberect to erect hairs. Hairs on the leg similarly colored but smaller and more appressed; coxa, trochanter and femur with a few scattered, suberect to erect hairs. Scape with fine, rather dense, appressed pubescence. Pubescence of gaster composed of distinct but sparse, well scattered, appressed pile.

Dark brown to brownish black but not jet black; mandible, base of each funiculus, pronotal collar, apex of coxa, trochanter, base of femur, tibia and articulations of leg lighter.

Male.—Length 1.8–2 mm.

Head, including eyes, broader than long, with rounded posterior border and rounded posterior angles. Eye large, strongly convex, protuberant, situated approximately one-fourth its length from the base of the mandible. Ocelli small, arranged in a triangle on the vertex of the head but scarcely protruding above the general surface of the head. Clypeus convex in the middle, lacking the characteristic shield or plate of the worker. Mandible rather small, subtriangular, with an apical and several less distinct teeth. Antenna 13-segmented; last 4 funicular segments forming a well defined club, the apical segment of which is longer than the combined length of the 2 preceding segments; scape rather stout and short but longer than the space between the frontal carinæ; first funicular segment pyriform. Mayrian furrows lacking or obsolete on the thorax, the parapsidal sutures present but not easily discernible. Anterior wing pale grayish or whitish; veins pale and rather indistinct, usually forming a closed cubital and a discoidal cell, the discoidal cell however sometimes poorly developed or lacking; stigma well developed but indistinct because of its pale color. Epinotum in profile, subangular, bearing a pair of weak longitudinal carinæ or else a pair of indistinct tooth-like protuberances. Leg rather long and slender, with slightly enlarged femur and tibia. Postpetiolar node from above, subcampanulate, not twice as wide as the petiolar node. Gaster from the same aspect, oval. Stipes stout, bluntly subtriangular.

Much of the body with finely punctulate or granulate sculpturing; scutellum, mesopleuron, dorsal surface of petiolar and postpetiolar nodes and gaster, smooth and shining.

Pilosity similar to that of the worker but apparently not so abundant, long or coarse.

Color similar to that of the worker but even darker; the mandible, pronotal collar and articulations of the leg not as light or as contrastingly marked.

Type locality—Hill City, South Dakota, Titus Ulke collector (not Theodore Pergande as stated in other publications).

This form has been redescribed from a specimen from the original nest series as well as specimens from various localities mentioned below:

Colorado: Greeley, W. J. Zaumeyer; .8 miles west of La Junta, V. E. Romney. Iowa: Inwood and Oak Grove State Park, Wm. F. Buren; Sioux City, C. N. Ainslie. South Dakota: Canning, Walker, Meckling, Philip, Cottonwood, Wall and Interior of the Badlands, Presho, Lemmon, Chamberlain, Eagle Butte, Fort Pierce, Reva Alkali Flats, Kenebec, Highmore, all collected by H. C. Severin; Hayes, V. G. Davidson. Utah: 20 miles southwest of Nephi, R. W. Fautin.

In addition to the general characters given for the group on page , and those mentioned in the key, the worker possesses a dark brown to brownish black body with contrasting lighter areas as described above. Workers vary considerable in size, development of the epinotal spines, shape of the petiolar node, and sculpturing, especially the sculpturing of the clypeal shield, thorax and postpetiolar node.

Unlike the worker, the male has few good characters that will help to distinguish it. Probably the best are its rather uniformly sculptured, finely granulate or punctulate body, pale anterior wing with indistinct veins which usually form a closed cubital and discoidal cell, and the subcampanulate postpetiolar node, the dorsal surface of which is usually shining.

The male varies in size, venation of wings, sculpturing, and shape of the epinotum. There is little information available on the biology of *tricarinatus tricarinatus*. Buren records the form as nesting in the ground in small colonies in at least two localities in Iowa. Severin in South Dakota has collected specimens from alkali flats and the Badlands. He has also taken individuals while sweeping various grasses and weeds at Canning. At Greeley, Colorado, the ants were collected from a bean field, and at La Junta from a region bearing the Russian thistle, *Salsola pestifer* Nels. The food of the workers is not known, but it probably comprises small arthropods supplemented by honeydew. In South Dakota males have been collected in various localities from July 26 to September 14.

Leptothorax (Myrafant) tricarinatus neomexicanus Wheeler

Leptothorax neomexicanus Wheeler, 1903, Proc. Acad. Nat. Sci. Phila. 55: 223, 248–249. ☿. (Pl. 12, fig. 18, ☿).—Wheeler, 1906, Bul. Amer. Mus. Nat. Hist. 22: 341.—Creighton, 1950, Harvard Univ., Bul. Mus. Compar. Zool. 104: 256, 273. ☿ ♀.

I have checked a cotype worker against Wheeler's original description and it failed to agree with the description in the following respects: The scape does not extend a distance equal to its greatest width beyond the posterior angle of the head as stated by Wheeler (the scape of my specimen scarcely attains the posterior angle of the head much less surpasses it). Wheeler remarked that the humeri of the thorax are rounded, whereas in my specimen the transverse pronotal carina seems to meet each humerus in a very faint but perceptible angle. He also recorded the sides of the petiole as "somewhat convex" when to me they appear to be practically straight. The postpetiole is stated to be nearly as long as broad, subglobular, but as a matter of fact it is distinctly broader than long and nearly subrectangular. The original color was described as black, and this may have been the case, but the specimen I examined was nearly uniform brown, with the mandibles, terminal portions of the femora and tibiæ and all of the tarsal segments except the last, yellowish, as given by Wheeler.

L. tricarinatus neomexicanus can be readily distinguished from the other forms by the very short, dentiform or tuberculiform spines of the epinotum and by the nature of the body sculpturing. The dorsal surface of the head, thorax, petiole and postpetiole is largely and more or less uniformly covered with a granulate or punctulate sculpture which is so delicate that much of these body areas, especially the head and thorax, are shining in certain lights.

The worker varies considerably in size and sculpture. Smallest workers are approximately 2 mm. in length and largest workers 2.5 mm. The sculpturing on the head and thorax is highly variable, so much so, that on some specimens much of these areas are highly glabrous. Occasionally there are smooth areas practically devoid of sculpture.

Type locality.—Manzanares, New Mexico, Mary Cooper.

The fore-going remarks are based on a single cotype worker and also on the number of workers indicated by parentheses after the localities listed below:

Arizona: Kohonino Forest on the rim of the Grand Canyon (3), W. M. Wheeler. New Mexico: Ingan Mts. (1), C. N. Ainslie. Utah: White Valley in Millard County (4), R. W. Fautin.

The biology of this form is the least known of any member of the group. The only available notes are those by Wheeler concerning the original specimens, which he states that he found living as a small colony beneath a stone in the Kohonino Forest on the rim of the Grand Canyon. Wheeler considered the ants living in this location as typical of the Rocky Mountain fauna of the same or similar altitudes (6,000–8,000 feet). The specimens collected in White Valley, Millard County, Utah, are from an arid, desert type of country.

Leptothorax (Myrafant) texanus texanus Wheeler

Leptothorax texanus Wheeler, 1903, Proc. Acad. Nat. Sci. Phila. 55: 223, 245–247, ☿ ♀ ♂. (Pl. 12, fig. 16 ☿.)—Smith, 1932, Ent. News 43: 160. ☿.—Talbot, 1934, Ecol. 15: 420.—Wesson and Wesson, 1940, Amer. Midl. Nat. 24: 98.—Gregg, 1944, Ann. Ent. Soc. Amer. 37: 456, 466–467. ☿.—Gregg, 1946, Amer. Midl. Nat. 35: 748.—Creighton, 1950, Harvard Univ., Bul. Mus. Compar. Zool. 104: 256, 272. ☿ ♀.

Wheeler's original description very well fits the specimens examined by me. However, I cannot agree with his statements that the outline of the postpetiole from above is subelliptical and that the postpetiole is fully twice as broad as the petiole. In my specimens the postpetiole is slightly less than twice as wide as the petiole.

L. texanus texanus is very closely related to *texanus davisi* and on superficial appearances the two forms might easily be confused. The most dependable character for separating them is the sculpturing of the postpetiolar node which in *texanus* is roughly rugulose-reticulate whereas in *davisi* it is finely granulate or punctulate. The thoracic dorsum of *texanus* is usually more roughly sculptured and therefore more opaque or subopaque but in certain individuals this character is variable and therefore cannot be fully relied upon. The specimens examined varied in size from 2.25 to 2.8 mm.

Like *Davisi, texanus* varies considerably in size, sculpture and in the proportions of the postpetiolar node. All the specimens I have seen have distinct epinotal spines, but it is possible that on occasions they are small enough in certain individuals to be confused with those termed dentiform or tuberculiform.

Type locality.—Milano in Milam County, Texas, W. M. Wheeler (not in Millan County as cited by Wheeler).

Specimens studied; two worker cotypes, and also the number of workers indicated in parentheses after the localities listed below:

Alabama: Peterson in Tuscaloosa County (2), Edward O. Wilson, Jr. Illinois: Momence (2), Robert E. Gregg. Indiana: Ogden (2), Mary Talbot. Louisiana: DeRidder (3), Wm. F. Buren. Michigan: Indian River in Cheboygan County, C. H. Kennedy; Flat Rock (1), Houghton Lake State Park (1), and Douglas Lake (22), Mary Talbot. Minnesota: Hunter's Hill (1), Duluth, A. Wiljamaa. Mississippi: Louisville, M. R. Smith; Ripley, S. W. Simmons. Missouri: Columbia (1), Mary Talbot. North Carolina: Pilot Mt. in Wayne County (1), D. L. Wray. Ohio: Holland (3), Mary Talbot. Oklahoma: Wichita Natl. Forest, Harmon and Latimer Counties, W. Fisher.

Although this form has been collected over a wider range and more often than any other member of the complex, the records from most States have been based on a few stray specimens rather than on collections of numerous colonies. From the data obtained it appears that *texanus texanus* forms small colonies in shallow nests in the soil. Most of the soils from which it has been reported are sandy or sandy loams. Mary Talbot, however, reports that she collected workers from a clay loam soil at Columbia, Missouri, and D. L. Wray collected the form from a reddish clay soil in North Carolina at an altitude of 1100 feet. Kennedy stated that he secured a colony from a clump of grass roots in Michigan, but he did not make it clear whether the ants were nesting in the soil around the grass or in the grass roots themselves. The form appears adapted to nesting in the soil openly or else under cover of trees and perhaps other vegetation. Edward O. Wilson, Jr., collected specimens from an open mixed woods and this has been my experience also. *Texanus texanus* seems well adapted to and highly characteristic of the sand dunes of Illinois and Indiana. Some of the best notes I have on the form are from Mary Talbot, which are herewith quoted verbatim. "In Ohio, *L. texanus* has been taken at the 'Oak Openings.' This is a remarkable area of sandy soil lying principally in the western part of Lucas County (northwest of Toledo). The 'Oak

Openings' territory represents the western extremity of ancient Lake Warren, a glacial lake which preceded Lake Erie. It is characterized by sandy ridges alternating with low marshy strips of prairie on which grow many plants rare or lacking in the rest of the State. The commonest oaks are the black oaks, *Quercus velutina* Lem., and white oak, *Q. alba* L. Abundant, characteristic plants are bracken fern, *Pterus aquilina* L., black blueberry, *Vaccinium atrococcum* Gray, blazing star, *Liatris scariosa* Willd., false foxglove, *Gerardia virginica* L., showy puccoon, *Lithospermum gmelini* Mich. The environment in which the ants were found was a sandy ridge sparsely covered by small black oaks. There was much open sand with scattered clumps of grass, bergamot, blazing star, lupine, blueberry. A nest found consisted of a few cells at the intertwining roots of a clump of grass just beneath a scum-like moss which grows in little clumps on the sand. At this same grass roots was a nest of *Paratrechina parvula,* another ant which in the north tends to be restricted to sandy places.

"Other collection records of *texanus* show it living in habitats remarkably similar to this one. In Michigan it was taken at Flat Rock on an oak ridge of sand in which grew bracken, blueberry and little mounds of moss and once in Roscommon County in an open oak-pine sand woods around clumps of bracken, sweet fern, and scums of dry moss. In northern Indiana it has been found in the pine dunes and the black oak dunes. Here again it was in fairly open sand and the nest was found just under the surface covered by a little moss. Again the colony chanced to be near that of a *Paratrechina parvula* nest. Here it was found that the ants form definite, though invisible, trails across the sand and moss. These trails are loose and only two or three ants are commonly seen at one time but each follows exactly the same pattern."

Males have been collected in Texas in late May, in Ohio in early July and in Michigan in late July.

Leptothorax (Myrafant) texanus davisi Wheeler

Leptothorax texanus davisi Wheeler, 1905, Bul. Amer. Mus. Nat. Hist. 21: 385. ☿ ♀.—Sturtevant, 1931, Psyche 38: 75.—

Creighton, 1950, Harvard Univ., Bul. Mus. Compar. Zool. 104: 257, 272–273. ☿ ♀.

This form is characterized by the petiolar node which when seen in profile is thick anteroposteriorly with the dorsal surface meeting the anterior and posterior surface in such a manner as to form somewhat of a distinct subrectangle; the extraordinarily large and broad postpetiolar node which is approximately $1\frac{1}{3}$ to $1\frac{1}{2}$ times as broad as long, with the dorsal surface of the node finely granulate or punctulate; epinotum bearing a pair of spines which infrequently are small enough to be confused with those termed dentiform or tuberculiform; sculpturing of the thorax generally weaker than that of *texanus texanus* so that part, or most of the surface in some lights at least, has a glabrous appearance.

Workers examined varied in size from 2.2 to 2.5 mm. in length. The sculpture of the body is quite variable, especially on the clypeal shield and on the dorsum of the thorax. The epinotal spines are also variable in length as mentioned above.

Type locality.—Lakehurst, New Jersey, W. M. Wheeler.

The above remarks are based on three cotype workers and five topotype workers and also on the number of workers indicated in parentheses under the localities listed below:

Florida: University of Florida Conservation Reserve, Welaka in Putnam County (5), Arnold Van Pelt. Massachusetts: South Wellfleet, A. H. Sturtevant. New York: Mattuck (1), Flanders (1), Greenport (2), Long Island, all collected by Roy Latham.

The biology of *texanus davisi* is very poorly known. Wheeler (1905, p. 385) remarked as follows concerning the type series: "Like the Texan form, *davisi* nests in pure white sand, forming slender galleries a few inches in length. It moves about rather slowly on the sunlit surface of the sand in search of small insects." Concerning the Massachusetts individuals Sturtevant (1931, p. 75) stated "One nest, in white sand." With regard to the ants collected in the University of Florida Conservation Reserve at Welaka, Arnold Van Pelt wrote me as follows: "*davisi* shows a preference for the higher, drier areas of the Reserve, but it was not taken abundantly in any plant association. On many of the occasions I collected it, several individuals were grouped together, probably resting, and there was no indication of a nest. All of these were in the sand which contained only a thin layer of organic matter on the surface, below which the soil was a fine sand. The areas in which it occurred were always relatively open, but in some areas, such as the *Quercus lævis-Pinus palustris* association (turkey oak sandhills), there is shade for at least part of every day. The largest nest I was able to find contained 18 workers and a queen, with no immatures. This nest seemed to have no apparent opening to the surface, and the whole nest was within one-quarter inch of the surface in the sand. Other nests were under light litter.''

BOOK NOTICE

British Butterflies by E. B. Ford. Penguin Books Inc., 3300 Clipper Mill Road, Baltimore, Md. 1951. $7\frac{1}{4} \times 5$ inches. 31 pages + 16 colour plates. Decorated boards. 95¢.

This neat, little book was printed by Penguin Books Ltd. in Great Britain. The workmanship is outstanding and the sixteen color plates by Paxton Chadwick are beautifully done. In spite of its title, this book was not intended for use as a guide. Rather, it was Dr. Ford's intention to present, in summary form, a few of the more interesting biological problems presented by the butterflies. He hoped, thereby, to arouse the curiosity of workers in other fields and the layman, toward a better understanding of these interesting creatures.

The butterfly life history is briefly told and the families similarly explained. There follows a very readable account of Dr. Ford's work in chemical classification and brief discussions of the subjects of coloration, variability, migration and habitats. This book makes a fine addition to the entomologist's library and most amazingly, it can be purchased for the price of a ham sandwich and a bottle of beer.—F. A. S.

STUDIES ON THE NUTRITIONAL VALUE OF SOYBEAN FLOUR TO TRIBOLIUM CONFUSUM DUV.[1, 2]

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It is generally stated that the confused flour beetle, *Tribolium confusum*, can attack peas and beans as well as grains and many other things (Good 1936). There is, however, little information regarding this insect as a pest of soybean products. Mickel & Standish (1946) in studying the susceptibility of edible soya products to attack by *T. confusum* found that this insect could not develop normally on their samples of soy flours and soy grits. The rate of larval development was so greatly decreased that serious infestation seemed unlikely. The reasons for the deficiences of soy as a food for this beetle were not determined by these authors. It is the purpose of the present paper to report some studies trying to account for the unsuitability of one particular soybean flour as food for this insect.

MATERIALS AND METHODS

A defatted soybean flour, Nutrisoy R, supplied through the courtesy of Dr. J. W. Hayward of the Archer-Daniels-Midland Company, was used in all the experiments.[3] The flour was light

[1] Paper No. 2287 Scientific Journal Series, Minnesota Agricultural Experiment Station, St. Paul 1, Minnesota.

[2] A more preliminary report on this work was submitted by S. L. in partial fulfillment of the requirements for a Master of Science degree. Both authors would like to acknowledge their appreciation to Dr. Gottfried Fraenkel for critically reading the manuscript.

[3] The defatting during manufacture was performed by extraction with hexane. An analysis of this particular sample was made for us by chemists at the Archer-Daniels-Midland Company. This analysis gave: moisture 7.29%, protein 52.76%, water soluble nitrogen 46.8%, fat 0.96%, fiber 2.79%, ash 5.73%, calcium 0.44%, phosphorus 0.67%, urease 0.30%, choline 0.222%, thiamin 3.41 parts per million, riboflavin 4.36 p.p.m., carotene 3.04 p.p.m. The analysis was made when the experiments were begun (August 1948); the sample was then used for experiments extending over a period of somewhat more than two years.

yellow in color, very fine, rather powdery and free flowing. It could pass a 100-mesh wire screen readily, and the particles did not stick together to form lumps.

The soybean flour was used alone: either extracted,[4] or autoclaved,[5] or untreated; it was also tested in combinations with yeast,[6] or with whole wheat flour,[7] or with sterol and the B vitamins[8] reported to be required by the insect under study (Fraenkel & Blewett 1942–1947). Whole wheat flour alone, yeast alone, and whole wheat flour plus yeast were employed as check diets.

The stock culture of beetles was maintained at about 26° C. and 70 per cent R.H. on whole wheat flour plus 5 per cent dried yeast. Eggs were sifted from the medium and hatched at 30° C. and 70 per cent R.H. For all tests newly hatched larvæ ($<$ 24 hours old) were used.

Both individual and mass-rearing methods were used. For mass-rearing tests, newly hatched larvæ were tested in lots of 25 on the various diets. Rearing was done mostly in flat stender dishes (4.5 $\times$ 2 cm.) which were found to be satisfactory for preventing escape even when less palatable foods were used. In earlier experiments 1.5 gram, and in later ones 4 grams, of each diet were used per replicate. These amounts were more than adequate because preliminary tests indicated that only about 10 mg. of food were consumed by a single larva. Four to nine replicates were made for each diet. For individual rearing tests, newly hatched larvæ were introduced into short vials (1.6 $\times$ 2 cm.) in which 0.1 or 0.2 gram of food material had been placed.

[4] In a Soxhlet apparatus for two hours with a mixture of ethyl ether and absolute ethyl alcohol in the proportion of 2.5: 1 by volume. The extracting solvent was later driven off by drying in a vacuum oven at 65° C. for a day or two.

[5] At 15 lbs. for 20 minutes.

[6] Strain G primary dried yeast prepared by the Anheuser-Busch, Inc.

[7] Passed through a 60-mesh wire screen which removed most of the bran material.

[8] The sterol and the B vitamins used were C.P. preparations. The amounts used per gram of diet were as follows: thiamin hydrochloride 4 μg., riboflavin 6 μg., niacinamide 32 μg., pyridoxine 4 μg., calcium pantothenate 16 μg., folic acid 0.8 μg., biotin 0.05 μg., choline chloride 0.5 mg., *p*-aminobenzoic acid 0.5 mg., inositol 0.5 mg., and cholesterol 10 mg. The B vitamins were dissolved in a small quantity of distilled water, added to the diet, and then well mixed.

The dishes or vials containing the newly hatched larvæ plus food were placed in glass containers in which a R.H. of 70 per cent was maintained by means of a sulfuric acid solution prepared according to Buxton & Mellanby (1934). No attempt was made to check the humidity within the containers but the acid solution was replaced occasionally with fresh solution to assure approximate constancy. Neither the containers nor the insects were sterilized but no visible amount of mold develops at this humidity. After several months the flour does become lumpy.

The insects were left to grow for the first two weeks undisturbed; frequent inspections were made thereafter to look for pupæ. The pupæ were removed as soon as they were found and stored immediately in an oven at about 55° C. until all the pupæ in a lot had been collected. Then the pupæ were dried at 105–110° C. overnight and again for 1 hour periods until constant weight was obtained. From the group value, the dry weight of an individual pupa in the lot was calculated by averaging. The weights given in the table are the means of the weights so calculated for all the lots.

The adequacy of the different flour preparations were compared on the basis of pupal weight, percentage of the insects that pupated, and duration of the larval stage. The data were subjected to the analysis of variance, and the significance of the difference of the means is based at the 5 per cent level. In no case was variation between different replicates of a single treatment found to be significant.

RESULTS

Most of the results are summarized in Table 1 and presented graphically in Figures 1 and 2. The results obtained from mass and individual rearing corresponded very closely, although in general the individual rearings resulted in somewhat higher pupal weight, higher percentage of pupation, and shorter larval period (individual rearing experiments were based on twenty specimens per curve).

In Table 1 and Figure 1 it is shown that on Nutrisoy flour alone, the growth of the confused flour beetle was very much delayed. In terms of pupal weight, percentage of pupation, larval

TABLE I

PUPAL WEIGHTS, PERCENTAGES OF PUPATION, AND LARVAL DURATIONS OF TRIBOLIUM CONFUSUM GROWN ON VARIOUS DIETS REPRESENTED IN FIGURES 1 AND 2

Diet	Pupal Weight (mg., dry)		Per Cent Pupation		Larval Duration (days)	
	Fig. 1	Fig. 2	Fig. 1	Fig. 2	Fig. 1	Fig. 2
Nutrisoy R alone	0.63[1]	0.66	79.6	82	51.5	51.0
Nutrisoy R + whole wheat flour (3: 1)	0.75	....	95.6	......	24.1	....
Nutrisoy R + whole wheat flour (1: 1)	0.79	....	89.3	......	22.3	....
Nutrisoy R + yeast (10: 1)	0.85	....	97.3	......	21.7	....
Nutrisoy R + B vitamins	....	0.72	....	80	....	42.0
Nutrisoy R + cholesterol	....	0.84	....	92	....	32.3
Nutrisoy R + choselterol + B vitamins	....	0.92	....	98	....	29.5
Autoclaved *Nutrisoy R*	....	0.66	....	80	....	59.4
Extracted *Nutrisoy R*	—	0.38[2]	0.0	1[2]	—	106. [2]
Extracted *Nutrisoy R* + extract of *Nutrisoy R*	0.69	....	55.1	......	65.0	....
Extracted *Nutrisoy R* + yeast (10: 1)	0.84	....	97.8	......	21.7	....
Extracted *Nutrisoy R* + cholesterol	....	0.85	....	90	....	37.9
Extracted *Nutrisoy R* + cholesterol +B. vitamins	....	0.87	....	95	....	32.0
Whole wheat flour	0.83	....	96.4	......	19.8	....
Whole wheat flour + yeast (10: 1)	0.99	1.03	99.6	99	18.2	17.9
Yeast alone	0.88	....	98.2	......	21.9	....
Significant difference at:						
5 per cent level	0.04	0.06	6.4	9	3.5	3.8
1 per cent level	0.06	0.09	8.6	12	4.7	5.2

[1] Weight of late pupæ only. These were appreciably smaller than early ones which were inadvertently overheated and ruined.

[2] The lone pupa obtained on extracted *Nutrisoy R* was presumably made possible by the growth of microorganisms. At least, the powdery flour was getting lumpy after such long standing in the container.

duration and spread of pupation time, Nutrisoy is clearly much inferior to whole wheat flour, and more so to whole wheat flour plus yeast.

When whole wheat flour was added to the Nutrisoy, the food value of the latter was considerably increased. Actually, the curves for 3 : 1 and 1 : 1 mixtures cross (Fig. 1), but the differ-

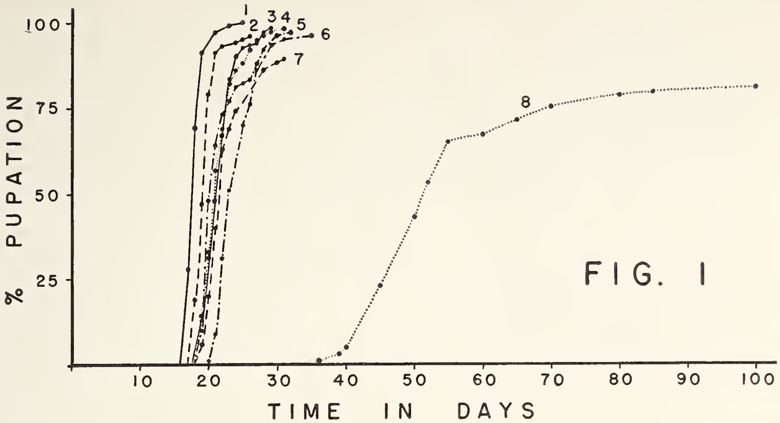

FIG. 1. Growth curves for larvæ of *Tribolium confusum* reared on various diets. Each curve based on data from 225 individuals. Curve no. 1 is for whole wheat flour + yeast, no. 2 for whole wheat flour alone, no. 3 for Nutrisoy R + yeast, no. 4 for yeast alone, no. 5 for extracted Nutrisoy R + yeast, no. 6 for Nutrisoy R + whole wheat flour (3: 1), no. 7 for Nutrisoy R + whole wheat flour (1: 1), and no. 8 for Nutrisoy R alone. The first seven curves are difficult to follow accurately in the reproduction but that does not matter because it is only the extremes (which can be followed) which show statistically significant differences.

ences are not statistically significant. However, irrespective of which percentage was used the mixture diets were much superior to Nutrisoy alone although somewhat inferior to whole wheat flour alone.

To check whether the fat content of Nutrisoy possibly contained a toxic component, the Soxhlet extract of Nutrisoy was added to an equivalent amount of whole wheat flour. Growth was not quite as good as on the whole wheat flour control but not greatly different either.[9]

However, after Soxhlet extraction, the Nutrisoy itself became completely unsuitable as food. As a matter of fact, most of the larvæ put on this diet died within a few weeks without any sign of growth. A few larvæ lived for four to five months but the largest size attained corresponded only to second or third or at

[9] Actually our first test of whole wheat flour plus soy extract resulted in high mortality and poor growth. Perhaps the solvent was inadequately removed; at least we were not able to repeat this result.

most fourth instar larvæ grown on whole wheat flour, although they may perhaps have molted a larger number of times (Mickel & Standish 1946). A single exception is recorded in the table: one dwarf pupa was obtained after 106 days when the flour had become lumpy. Presumably uncontrolled microorganisms could be responsible for supplying small amounts of growth factors.

Addition of Nutrisoy extract to extracted Nutrisoy gave results roughly comparable to those obtained from Nutrisoy itself.

Addition of yeast to either the extracted or the untreated Nutrisoy improved the nutritional value of the original diets greatly, so much so that the diets became practically as good as whole wheat flour although never as good as whole wheat flour plus yeast. It will be noted that yeast alone proved to be a good food; it was about as good as whole wheat flour.

The above results, compared with the known nutritional requirements of *T. confusum* (Fraenkel & Blewett 1942–1947) suggested that sterol and B vitamins, among other things, might have been responsible for the deficiency of the Nutrisoy flour. Experiments recorded in Table 1 and Figure 2 substantiated this idea although the addition of these known chemicals did not make the Nutrisoy diets approximate the controls.

When B vitamins were added to the Nutrisoy, the mixture produced significantly faster growth and heavier pupæ but no significant difference in percentage of pupation. The effect of the addition of cholesterol was more pronounced; when added to extracted Nutrisoy it not only restored the latter's food value but significantly increased the growth rate, pupal weight and percentage of pupation.

When both B vitamins and cholesterol were added to the Nutrisoy, the results showed no significant difference as to whether the Nutrisoy had been extracted or not; in both cases the food value of the Nutrisoy had been considerably improved. The addition of B vitamins does result in statistically significant differences from the addition of sterol alone (Table 1 and Figure 2) but explanation of the fact that statistically significant differences are shown in some cases by pupal weight and per cent pupation and in other cases by larval duration requires further study. In another test, not included in the graphs, the addition of glucose to the Nutrisoy + B vitamin + sterol diet did not result in producing any significant differences from the control.

In spite of the addition of cholesterol and B vitamins, the Nutrisoy remained far short of the efficiency of whole wheat flour plus yeast in terms of pupal weight and growth rate. Obviously yeast and whole wheat flour must add something else that favors growth when mixed with Nutrisoy.

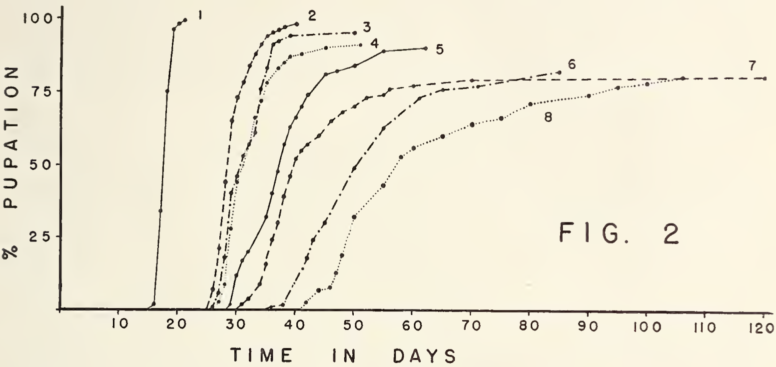

FIG. 2. Growth curves for larvæ of *Tribolium confusum* reared on Nutrisoy R flour with various supplements. Each curve based on data from 100 individuals. Curve no. 1 is for whole wheat flour + yeast, no. 2 for Nutrisoy R + cholesterol + B vitamins (see footnote no. 8), no. 3 for extracted Nutrisoy R + cholesterol + B vitamins, no. 4 for Nutrisoy R + cholesterol, no. 5 for extracted Nutrisoy R + cholesterol, no. 6 for Nutrisoy R alone, no. 7 for Nutrisoy R + B vitamins, and no. 8 for autoclaved Nutrisoy R alone.

In view of the fact that utilization of soybean protein by some vertebrates has been reported to be improved by autoclaving the soybean flour (Liener *et al.* 1949), the same treatment was tried here. However, the treatment proved to have no effect on pupal weight and per cent pupation while the larval duration on autoclaved Nutrisoy was found to be significantly longer.

DISCUSSION

When all the food preparations are compared[10] on the basis of pupal weight, percentage of pupation and larval duration, it will

[10] Data from experiments represented in Figure 1 and Figure 2 are not strictly comparable, since the two experiments were preformed at different times. Nevertheless, because the results for whole wheat flour plus yeast and for Nutrisoy from the two sets of experiments are very close, they are assumed to be adequately comparable for purposes of this discussion.

be noted that they can be divided roughly into three groups. On the favorable end are the whole wheat flour, yeast, and preparations of Nutrisoy that contained yeast, with whole wheat flour plus yeast always best. On the unfavorable end are Nutrisoy flour, autoclaved Nutrisoy flour, and extracted Nutrisoy flour, the last being entirely inadequate. In between are the mixtures whole wheat flour plus Nutrisoy flour, Nutrisoy flour plus cholesterol, Nutrisoy flour plus B vitamins, and Nutrisoy flour plus cholesterol plus B vitamins. It is interesting to note that cholesterol was more effective than the B vitamins but that the combination of the two was clearly best.

Obviously, Nutrisoy flour is not as good a food for the confused flour beetle as whole wheat flour. However, it is not entirely inadequate for the insects under the reported conditions, because approximately 80 per cent still developed to pupation although at a much slower rate. Some of the pupæ were spared to continue development and adults emerged (no observations were made to determine their reproductive capacity). From the results, it seems that the Nutrisoy flour used in these experiments was more favorable to the insect than the soy flours and soy grits used by Mickel & Standish (1946), which, they observed, "are not foods in which this insect can develop normally." However, the conditions under which the insects were reared and the food materials were not identical, therefore no direct comparison of results can be made.

In general, soybeans are high in protein, fat, and ash content but relatively low in carbohydrates (Markley & Goss 1944, Hafner 1942, Liener *et al.* 1949). Apparently, the high protein and low carbohydrate content would not explain the inferiority of the Nutrisoy flour, because Fraenkel & Blewett (1943c) have shown that absence of carbohydrate in the diet induced no increased mortality in this species and that the growth rate, though low, was still satisfactory.[11]

The vitamin requirements of the species have been worked out by Fraenkel & Blewett (1942–1947). *Tribolium confusum* re-

[11] Also another test, not reported in detail, showed little difference when glucose was added to Nutrisoy plus sterol and B vitamins.

quires thiamin, riboflavin, niacin, pyridoxin, pantothenic acid, biotin, folic acid and a sterol; it may also need some choline, *p*-amino-benzoic acid, and inositol.

Soy beans are reported to be a good source for numerous vitamins including thiamin, niacin, pantothenic acid, biotin, riboflavin, and pyridoxin (See Markley 1950). We have not found any report on the presence of folic acid. The analysis supplied for our Nutrisoy sample agrees with the above at least for the components analyzed (Footnote No. 3), and also records the presence of choline. Perhaps only one of the B vitamins is concerned with the improvement in weight and growth rate resulting from the addition of the B vitamin complex.

Deficiency of sterol was found to be responsible to a fairly large extent for the deficiency of Nutrisoy flour as food to *T. confusum.* The oil of soybeans is reported to contain about 0.4 per cent sterols (stigmasterol, sitosterols and dihydrositosterol) (Markley & Goss 1944), but the Nutrisoy flour used in the present study is a ''defatted'' product (0.96 per cent fat; = ca 5 per cent of original) which, to judge from our data, must contain some utilizable sterol but not enough for *T. confusum.* Although the sterol content of yeast is not very high (0.5–0.75 per cent sterols and ergosterols according to the manufacturers), apparently it did supply enough so that there was practically no difference whether the Nutrisoy flour to which the yeast was added had been extracted or not.

When Nutrisoy flour was mixed with whole wheat flour, there seemed to be some unfavorable effect of the mixture to the insect, although in vertebrate nutrition the proteins of wheat and soybean are said to be supplementary (Hove, Carpenter & Harrel 1945, Sherman 1946). Compared to the mixtures, the whole wheat flour was significantly superior in terms of pupal weight and larval duration, although there was no significant difference in pupation percentage. Such differences must be due to some factor in the soy flour other than could be explained by the lower concentration of the whole wheat flour, unless one assumes that the larvæ could and did select soy flour particles from the mixture; this seems highly unlikely. As discussed before, the fact that whole wheat flour plus yeast was significantly superior to

Nutrisoy flour plus yeast and Nutrisoy flour plus cholesterol plus B vitamins suggests that the Nutrisoy flour was in some respects inadequate. In vertebrate nutrition studies, raw soybean meal has been found to contain trypsin inhibitors which have a deleterious effect on the growth of experimental animals (Ham & Sandstedt 1944, Ham, Sandstedt & Mussehl 1945). Liener *et al.* (1949), using soy flour of the same trade name (Nutrisoy XXX) to feed rats, showed that diets containing autoclaved (20 minutes at 15 lbs. pressure) soybean meal consistently supported better growth than the unheated meal, the heat treatment therefore inactivated these inhibitors. In our experiment, however, no such improvement was obtained.

It is possible that the soy protein is inadequate for the insect, but since we do not know the amino acid requirements of the insect or the amino acid composition of the Nutrisoy flour, there is no basis for speculation. While the data do not eliminate the possibility that soy flour may contain some inhibitory component, it will be recalled that addition of dried yeast to the Nutrisoy flour made it adequate and that the addition of whole wheat flour also gave favorable growth, while the addition of B vitamins and sterol gave improved but slow growth (also small size). We can interpret this as the yeast having supplied B vitamins, sterols and something else to the soy flour; the additional factor may have been a protein supplementing the soy protein.

SUMMARY

In rearing tests at 30° C. and 70 per cent R.H. with Nutrisoy R, a defatted soybean flour, it was found that:

1. The Nutrisoy flour used is not a good food for *Tribolium confusum* larvæ when compared with whole wheat flour but about 80 per cent pupation can be obtained if the experiment is continued for three months.

2. After extraction with an ether-alcohol mixture the Nutrisoy flour was rendered entirely unsuitable for the growth or even maintenance of life of *T. confusum.*

3. The food value of Nutrisoy flour for *T. confusum* was nearly equal to the controls when dried yeast was added. This was true irrespective of whether or not the flour had been ex-

haustively extracted with an ether-alcohol mixture. Whole wheat flour was also effective but less so than yeast.

4. Addition of the extract of the Nutrisoy flour to the extracted soy flour produced nearly the original food value for *T. confusum* again. Addition of cholesterol greatly enhanced the value of both extracted and normal Nutrisoy flour. Addition of pure B vitamins also improved the food value of the Nutrisoy flour considerably, but much less so than the addition of cholesterol. Addition of glucose was without significant effect.

5. The deficiency of sterol and B vitamins, however, can not wholly account for the deficiency of Nutrisoy flour as a food for this beetle.

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ASSOCIATION FOR THE STUDY OF ANIMAL BEHAVIOUR

Recently, the editor received a copy of The Bulletin of Animal Behaviour, No. 9, March, 1951, publication of the Association (founded March 13, 1936). The bulletin contains three Karl Von Frisch papers on Recent Advances in the Study of the Orientation of the Honey Bee, a paper by W. H. Thorpe on Animal Behaviour Terminology, a paper by O. Koehler on The Ability of Birds to Count and one by E. A. Armstrong on The Nature and Function of Animal Mimesis. This bulletin and the previous eight numbers cover a wide variety of behavior topics. Nonmembers of the Association may purchase copies at the price of 7 s. 6 d. and obtain information on membership by addressing the Hon. Secretary, Alastair N. Worden, Cromwell House, Huntingdon, England.—F. A. S.

KEY TO THE AMERICAN GENERA OF THE SUBFAMILY CRYPTOCHEILINÆ (HYMENOPTERA: PSAMMOCHARIDÆ) MALES AND FEMALES

BY R. R. DREISBACH
MIDLAND, MICHIGAN

Banks (1) separated the subfamilies Cryptocheilinæ and Auplopodinæ (Pseudageninæ) on the basis of the attachment of the abdomen to the thorax. In the case of the Auplopodinæ the basal segment of the abdomen narrows in front to form a short petiole and enlarges at its juncture with the propodeum. In the middle, the sides of this basal segment are concave, thus making the basal tergite hourglass-shaped in vertical view. In the Cryptocheilinæ, on the other hand, the basal segment is straight-sided (or slightly convex) and not petiole-like, and may be narrowed gradually or suddenly.

The writer (2) published on the genera of this subfamily for North America, but only for the females. The genera keyed in this paper represents all the genera of this subfamily for North and South America, including Chile. The latter country was not included in Banks' paper[1] of the South American species, as he stated that he would consider that country separately. Much use has necessarily been made of the keys in Banks' papers. However, his keys were mostly for the female sex and only occasionally did they cover the male sex. Adipogon Banks is placed in Dipogon Fox, and the latter is changed from the Auplopodinæ (Pseudageninæ) to this subfamily, since the first abdominal segment comes nearer to being straight-sided than hourglass-shaped. Further, the genitalia approaches more nearly to Priocnemis in its character than that of any other genus. It is hoped that these keys will enable a worker to arrive at the correct genus in either sex.

The genera not yet found in North America are marked with an asterisk.

KEY TO THE GENERA OF CRYPTOCHEILINÆ. MALES AND FEMALES

1. First recurrent vein meets the second cubital cell close to top of cell; the fore wing has a semitransparent area enclosing an opaque spot, in first discoidal cell; claws with two teeth on inner margin; under surface of terminal tarsal joint with a row of strong spines on each side .... *Hemipepsis Dahlbom*
1. First recurrent vein meets the second cubital cell near the middle; first discoidal cell without an opaque spot; claws with a single tooth or cleft 2
2. Wings rudimentary .... *Myremecosalius* Ashmead
2. Wings well developed 3
3. A stout, slightly curved spine in front of each mid coxæ; female with second ventral segment with a raised area or two mammæ on the second ventral segment just behind the transverse groove; genitalia of male characteristic, the ædeagus with wide flaring tips, volsellæ with brushes of long hair, subgenital plate broad and almost flat; both sexes with toothed claws and female with strong teeth and spines on posterior tibiæ; males with short teeth only; large species .... *Priocnemioides* Radoszowski
3. No tooth or spine in front of mid coxæ; no mammæ on second ventral of female; male genitalia not like above; claws may be toothed or split 4
4. Males 5
4. Females 25
5. First two pair of claws cleft, last pair toothed; subgenital plate long and slender; antennæ slender toward tip .... *Priochilus* Banks
5. Claws not as above 6
6. All the claws cleft or split 7
6. Fore pair claws split and the last two pair toothed, or all toothed 10
7. Transverse vein in fore wings straight across; third cubital cell as broad as long, almost rectangular, with a deep median bend in third intercubital vein (concave on inside); parameres longer than the rest of genitalia; ædeagus is slender and split in middle, and volsellæ have a deep curve about the middle on outer side; labial palpi very long .... *Minagenia* Banks
7. Transverse vein in fore wings oblique, the third cubital cell is longer than broad and the third intercubital vein does not have the median bend; or if somewhat like above, very hairy species with banded wings 8
8. Antennæ distinctly clavate with the joints from about nine through twelve the thickest; last segment of abdomen compressed; dorsal part of pronotum flat, front part vertical; subdiscoidal vein in rear wing ends much basad of cubitus .... *Balboana* Banks
8. Antennæ not clavate and last segment of abdomen not compressed; if

the pronotum is vertical in front, then not otherwise as in preceding couplet and also very hairy with banded wings 9

9. Front part of pronotum rounded and not with banded wings. *Anacyphonyx* Banks

9. Front part of pronotum vertical; very hairy species, banded wings; legs short, front femora stout, parameres thick and generally much longer than rest of genitalia; volsellæ and parapenal lobes narrow, short .... *Dipogon* Fox

10. Fore claws split; last two pair toothed; clypeus very long 11

10. All the claws toothed 12

11. Clypeus much raised above mouth parts, often with a sharp tooth in center of anterior margin; species not long for their size, similar to the rest of subfamily; markings on body not like those of the genus *Pœcilopompilus* Howard (*Batazonus* Ashmead) in the subfamily Psammocharinæ; volsellæ with a hook at upper end, parameres generally broad, subgenital plate broad, ovate, and almost flat for most part .... *Priocnessus* Banks

11. Clypeus not raised above mouth parts and never with a sharp tooth on the middle of anterior margin of clypeus; long slender species reminiscent of the Agenoid type, often with markings like those of Pœcilopompilus Howard; volsellæ without hooks, very broad. *Amerocnemis* Banks

12. No distinct spines on last joint of posterior tarsi 13

12. Distinct spines either lateral or median on posterior tarsi 16

13. Pronotum vertical in front 14

13. Pronotum rounded in front; basal vein generally very much basad of transverse vein in front wing 15

14. Basal vein ends very close to transverse vein in fore wings but slightly basad; first recurrent vein received by second cubital cell much beyond middle; second recurrent bent outward in middle, the attachment on cubitus about opposite its attachment on the subdiscoidal vein; stigma larger, and extending two fifths of its length into marginal cell the latter broader and shorter about one fourth as wide as long, stigma one half as long as marginal cell; third cubital cell shorter, about one third longer than the second cubital cell; volsellæ scalloped on inner side, subgenital plate almost rectangular .... *Calicurgus* Lepeletier

14. Basal vein much basad of transverse in forewings; first recurrent vein received by second cubital at middle or before; second recurrent vein sloping outward more or less so that it is nearer tip of wing on the cubital vein than on the subdiscoidal; stigma smaller extending one fourth of its length into marginal cell, the latter narrower and stigma only one third as long as marginal cell; volsellæ not scalloped on inner side, subgenital plate with base much broader than upper half, which is much narrower .... *Nemagenia* Banks

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17. No constriction between the pronotum and thorax............*Adirostes** Banks
18. Malar space very long; last joint of mid and posterior tarsi with distinct lateral spines; front femora strongly thickened. *Chirodamus* Haliday[1]
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21. Clypeus plainly truncate 23
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[1] South American forms, according to Banks, loc. cit.

23. Joints of flagellum not twice as long as broad; propodeum not striate; abdomen long-haired above .... *Derochilus* Banks
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discoidal vein in rear wings either interstitial with, or basad of cubitus; not marked like *Pœcilopompilus* 32

31. Clypeus much raised above mouth parts, often with a sharp tooth in center of anterior margin; species not long for their size, similar to rest of subfamily; markings on body not like those of Pœcilopompilus in subfamily Psammocharinæ .... *Priocnessus* Banks

31. Clypeus not raised above mouth parts, and never with a tooth on the middle of anterior margin of clypeus; long, slender species, reminiscent of the Agenoid type, often with markings like those of Pœcilopompilus Howard .... *Amerocnemis* Banks

32. No distinct spines under last joint of posterior tarsi 33

32. Distinct spines either lateral or median under posterior tarsi 36

33. Pronotum vertical in front 34

33. Pronotum rounded in front 35

34. See couplet 14, first part .... *Calicurgus* Lepeletier

34. See couplet 14, second part .... *Nemagenia* Banks

35. Antennæ above the clypeus by a slightly shorter distance than length of pedicel; scape with erect hair beneath; pronotum somewhat vertical like the preceding; species more hairy than in the following couplet; upper surface of posterior tibiæ not carinate, but with minute elevations at the base of spines that hardly exceed length of tibial hair .... *Dinocnemis* Banks

35. Antennæ located just above clypeal border; no erect hair below on scape; upper surface of posterior tibiæ carinate; not hairy species .... *Priocnemis* Schiödte

36. Malar space very long; last joint and mid tarsi with distinct lateral spines; front femora strongly thickened .... *Chirodamus* Haliday[1]

36. Malar space short, fore femora not thickened 37

37. No teeth on posterior edge of hind tibiæ; last joint of mid and posterior tarsi with median teeth beneath .... *Reedemia** Banks

37. Posterior tibiæ with distinct teeth above as well as stout spines 38

38. Propodeum nearly level on dorsal surface; sides elevated, from spiracle to near posterior dorsal end, as a rounded ridge, so that the sides are vertical 39

38. Propodeum sloping in a curve to tip or at least without the rounded ridge and vertical sides 40

39. A strong constriction between the pronotum and thorax, sometimes with a spine or mammæ in front of middle coxæ. Chile ......*Spichtostethus**

39. No constriction between the pronotum and thorax .... *Adirostes** Banks

40. Marginal cell broadly rounded at tip; clypeus broadly concave below; pronotum flat and not greatly produced below, when seen from side; antennæ slender, propodeum rarely striate .... *Cryptocheilus* Panzer

40. Marginal cell somewhat acute at tip; clypeus broadly concave in front or truncate 41

41. Abdomen strongly hairy above, rest of body also strongly hairy, including legs; antennæ rather stout and heavy .... *Onochares* Banks

41. Abdomen not hairy above except at base and tip; antennæ very slender; propodeum usually ridged or striate transversely; pronotum, from side, curving down from back to front, not at all flat.
Chirodamus heiligbrodtii Cresson
42. Joints of flagellum not twice as long as broad; propodeum not striate; abdomen long-haired above .... *Derochilus* Banks
42. Joints of flagellum mostly twice as long as broad; abdomen short haired above .... *Chirodamus* Haliday

Since this paper was written, the Synoptic Catalog of the Hymenoptera of America North of Mexico has been published. In this catalog Townes places *Minagenia* in the Ceropalinæ, with which the writer cannot agree. The genitalia of the male Ceropalinæ are so very much different than any other group of the Psammocharidæ that the writer believes they should really constitute a separate family.

The writer also has considerably different ideas with regard to the suppression of some genera and placing them as synonyms of other genera, and also does not agree with the removing of some of the species now listed in the genus *Priocnemis* to the genus *Myrmecosalius*.

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1. Banks, N. 1946. Bull. Mus. Comp. Zool. 96, No. 4, pp. 404, 463–525.
2. Dreisbach, R. R. 1949. Mich. Acad. Sci. Arts, and Letters 33, pp. 65–67.

THOMAS BOREMAN'S NATURAL HISTORY OF 1744, AND HIS ENTOMOLOGICAL EXPLANATION OF THE IGNIS FATUUS

By HARRY B. WEISS

Reference has been made previously in this JOURNAL to the entomology of Boreman's natural histories.[1] Some months ago, through the kindness of Albert E. Lownes, of Providence, Rhode Island, I was permitted to examine his copy of Boreman's 1744 natural history entitled "A Description Of a great Variety of Animals and Vegetables; Viz. Beasts, Birds, Fishes, Insects, Plants, Fruits and Flowers. Extracted from the most considerable Writers of Natural History; And Adapted to the Use of all Capacities, but more particularly for the Entertainment of Youth. Being a Supplement to A Description of Three Hundred Animals. Illustrated with above Ninety Copper Plates, whereon is curiously Engraven every Animal and Vegetable described in the whole Book. The Second Edition. London: Printed for R. Ware, at the Bible and Sun in Amen-Corner, Warwick-Lane. MDCCXLIV. Where may be had, 1. A Description of Three Hundred Animals, price 2s. 6d. 2. A Description of some curious and uncommon Creatures, price 2s." $6\frac{1}{2} \times 3\frac{3}{4}$ inches. [VI] + 140 p. Engraved frontispiece.

This book, which is one of the three popular natural histories compiled by Boreman, carries full page, unnumbered plates inserted in appropriate places in the text. Of the "information" in the volume a statement "To the Reader" includes the following: "And sure I am, such studies as these are vastly superior to the Tales, Fables, and Stories of Love, used in Schools, and deserve the regard of Parents and Teachers; as conducing more to the Honour of God, and the real Benefit of Youth."

The subject matter consists of short and long textual accounts of various animals and plants with accompanying, crudely drawn, grotesque looking illustrations. "Book the Fourth", pages

[1] Jour. N. Y. Ent. Soc., 47 (3): 213–217; (4): 351–352. 1939.

51–84, "Of Insects", includes descriptive accounts of the silkworm, butterfly, weevil, long-horned beetle, a sphinx moth, praying mantis, leaf insect, roaches, various spiders including the tarantula, ants, blue-bottle fly, silver-fish, book-mite, and corn-weevil. These popular descriptions were valueless for identification purposes and do not even seem quaint or entertaining at this time. However popular entomology was like that when the book was written, as may be noted from the following quotations.

"Fig. 3. Is an Indian Insect of the Chafer Kind; very common to be met with upon the Pomegranate Tree; of a heavy and sluggish nature; and therefore easily catch'd. It is furnish'd with a long tube or trunk, under its nose; which it very dextrously fixeth in the sweet Flowers to suck the Honey out, thro' the same." The figures accompanying this mystifying description are those of an adult cicada and its pupa.

Of the "Blue Fly", it is stated, "This kind of Fly is a very beautiful Creature, and has many things about it very notable. The Head, Eyes, Wings, and Feet, are full of Ornaments and Contrivances; and afford no less pleasing an Object to the Mind to speculate upon, than to the Eyes to behold; there is a most admirable and curious Mechanism in the Foot of this little Animal; whereby the Flies are inabled to walk against the sides of Glass, perpendicularly upwards." Boreman drew freely from various authors including Hooke and Maria Sibylla Merian.

Page 111 of Boreman's book is a second title page dated 1736, as follows: "Natural and Philosophical Conjectures on the Ignis Fatuus, or Jack in the Lanthorn: Endeavoring to prove, that The Light so called proceeds from Some Flying Insect; And not from a Fired Vapour, as generally believ'd. With A Description and Curious Figure of the Indian Lanthorn Fly, a Nocturnal Insect, which carries a Light in dark Nights, equal to that of our Will with a Whisp." London: Printed for T. Boreman, near Child's Coffee-House in St. Paul's Church-Yard. MDCCXXXVI.

Following this second title page is a lengthy discussion (p. 113–137) attempting to prove that the light called by that name proceeds from some nocturnal flying insect. In support of this idea, the compiler quotes Madam Merian's account of the Indian Lanthorne Fly published in her "Insects of Surinam". He also mentions Fr. Willughby and Mr. Ray, as recording in the "Philosophical Transactions" (London) their belief that some night-flying insect, or the shining of many male glow worms (in England) was responsible for the light, although Sir Thomas Derham held a contrary opinion, as a result of his observations in Italy. The "late" R. Bradley, F. R. S., also supposed the Ignis fatuus "to be no more than a group of small enlightened insects rather than an inflammable vapor". Fire flies too were considered as responsible. After reviewing the evidence on both sides, the author concludes: "But whether the Ignis Fatuus be of the Papilionaceous, Libella, Beetle-kind, or other, it must remain a Doubt, till time discovers it: And all that is attained in this Attempt, is only to show the probability of its being a living Animal, rather than a Vapour."

Apparently time has not yet discovered the cause of this rare phenomenon, the Will-o'-the-Wisp, that appears as a pale, bluish, steady or intermittent flame over marshes and stagnant bodies of water. According to Dr. E. Newton Harvey in his "Living Light," Princeton, 1940, the flame has been attributed to burning phosphine, a gas which although self-inflammable, is not a decomposition product of organic matter, and to methane, a decomposition product that is not self-inflammable. Dr. Harvey suggests the possilibity of electrical origin, or large clusters of luminous fungi or swarms of luminous gnats, or "perhaps a wisp of fog hanging over a swamp and seen in moonlight or starlight."

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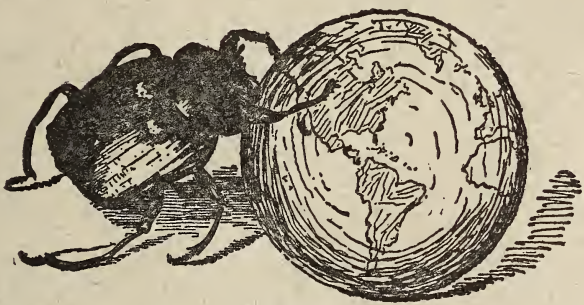

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VOLUMETRIC INDICES FOR THE PARTS OF THE INSECT BRAIN. A COMPARATIVE STUDY IN CEREBRALIZATION OF INSECTS

By Carla Ratzerdorfer

New York City, N. Y.

INTRODUCTION

The degree of cerebralization is a well-known and useful criterion for determining the level of differentiation and for the approach to a better knowledge of the phylogenetic position of an animal group or species.

In the highest classes of vertebrates, i.e. mammals and birds, quantitative methods have been used as a means of determining brain development and differentiation level. The results obtained from these studies strongly prompt the testing of the applicability of quantitative methods in other systematic groups.

The present study was therefore undertaken with the aim of applying new methods to the quantitative study of the insect brain.

Ever since Dujardin (1850) described the presence of the mushroom bodies and referred to them as the "seat of the intelligence," attempts have been made to assign a phylogenetic position to the different orders of insects and other Arthropoda, this position being determined mainly by the degree of development of the mushroom bodies.

The quantitative study of the brain of insects has been approached by three different methods.

1. Reduction of the brain to simple three-dimensional geometric figures (rotatory ellipse, Dujardin 1850; other geometrical bodies, Pandazis 1930).

2. Linear measurements to determine the proportion of the mushroom bodies (Alten 1910, Pietschker 1910, quoted by Pandazis 1930).

3. Measurements of areas giving relative sizes of Arthropod brain centers (Brun 1923, Hanström 1926, 1930, Goossen 1949).

General surveys of the applied quantitative methods are found in Pandazis 1930 and Goossen 1949.

In the realm of the vertebrates, the impetus for the study of the cerebralization of the mammalian brain was given by Dubois (1897) who introduced special quantitative methods.

Portmann (1946, 1947) and Wirz (1950), however, have shown the error in Dubois' formula and its inapplicability in studying brain development. Sholl (1948) independently, on the basis of a new method, has come to a similar conclusion.

Since Portmann's work of 1938, a method of weighing the centers of higher associations of the brain has been used and these weights compared with the stem-remnant, a part of the brain defined by Portmann (1942) and Sutter (1943), representing a more primitive apparatus, and remaining therefore more or less constant among the different groups under analysis. The indices obtained from these comparisons give us a means of studying the relative masses of the higher association centers. Of special methodical interest for this study is the work of Fritz (1949) on birds; his general outline of procedure has been adapted in the present analysis. In association with the vertebrate studies, an attempt was made to determine brain indices of insects by a comparison of two brain portions, the one of which was to correspond to a certain extent to the vertebrate stem-remnant and was therefore to be used as a comparison value; it was to reveal a possible lower degree of differentiation than the compared part, which could then be considered as being of a higher level of differentiation.

Details of the brains of the analyzed forms will be considered only in relation to the discussion of the results observed.

ACKNOWLEDGMENT

I am deeply indebted and grateful to Dr. A. Portmann for his elucidating criticisms, his stimulating suggestions, and above all for the active personal part he took in the drafting of this paper. I also wish to thank the staff and personnel of the Zoological Institute of the University of Basel for their generous help, which contributed greatly to the achievement of this study.

MATERIALS AND METHODS

In this study the brains of seven orders of adult insects were analyzed. The insects, one individual of each type, were decapitated and their heads were fixed immediately in Bouin fluid, alcoholic modification of Duboscq, or in a sublimate of alcoholic acetic acid fluid. To prevent irreparable tearing of sections due to the hard chitin covering of the brain, newly hatched adult specimens were used wherever possible and their heads separated under the dissecting microscope. In the cases of the bee and the grasshopper, the chitin coverings were carefully separated after a 24 hour fixation. The tissues were prepared by the paraffin method with methylbenzoate and benzol as intermediate substances; serial sections were cut at 10 micra and stained in Meyer's hematoxylin and benzopurpurine.

To help in the understanding of the subsequent study of the insect brain, it seems advisable to give a brief account of its main characteristics. The insect brain can be divided into the following parts (Fig. 1.):

1. The protocerebrum comprising the optic arch, and the ocelli, the central body, the fibrillar arch, and the mushroom bodies with 1 to 3 lateral globuli groups.
2. The deutocerebrum, the center of the antennal globuli.
3. The tritocerebrum consisting of the tritocerebral lobes and the tritocerebral commissure, beneath the œsophagus. It is not well developed and in some forms (e.g. bee) cannot be recognized.

Typical pterygote brains have certain features in common. These according to Hanström (1928) are: a lateral optic lobe with three masses (a fourth accessory optic mass is present in *Lepismachilis* and in the order Plecoptera; Hanström (1940) has called it "the accessory medula externa"); lateral mushroom bodies with an inner root and an anterior root, and a central body made up of paired bodies. A fibrillar arch should also be mentioned.

The parts of the brain considered in this study were the protocerebral lobes, the central body, the fibrillar arch, the fibrillar part of the mushroom bodies including the calices, stalks, and

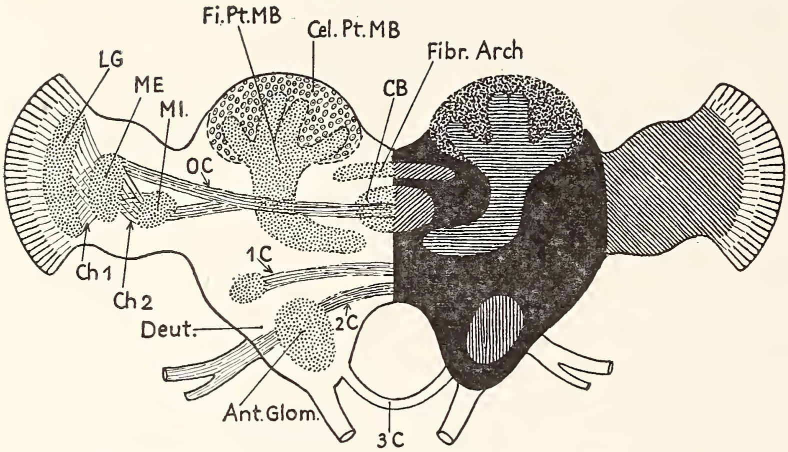

FIG. 1. Frontal view of insect central nervous system with tritocerebrum removed:

Left side: Diagram of proto- and deutocerebrum after Weber.

Right side: proto- and deutocerebrum showing parts measured in this study.

Hatched portions = optic centers, antennal glomeruli, fibrillar arch, central body and fibrillar part of mushroom bodies

Dotted portion = cellular part of mushroom bodies

Black portion = Cerebral remnant.

LG. = lamina ganglionaris, ME, MI = medulla externa, interna, $Ch_{1,2}$ = external and internal chiasma, O.C. = optic commissure, 1, 2, 3, C = commissures, C.B. = central body, Fibr. Arch. = fibrillar arch, Fi. Pt. MB. = fibrillar part of mushroom bodies, Cel. Pt. MB. = cellular part of mushroom bodies, Deut. = deutocerebrum, Ant. Glom. = antennal glomeruli.

roots, and the cellular part including the cells of the mushroom bodies, the optic lobes with their three or four masses taken as a whole, and the antennal glomeruli (medullary portion only). In several instances, delimitation became a problem, especially in the cases of the cells of the mushroom bodies and the inner medullary mass of the optic lobes. Other sources of errors include shrinking, mounting of the tissues, drawing, cutting, weighing; moreover, except for the bee and the termite, no attention was paid to the sex of the specimen in question, the species revealing no obvious sexual differences.

We are fully aware of these sources of error. Nevertheless, the purpose of this study was not a definite determination of the quantitative relations of brain portions but rather a preliminary survey of the contrasts which can be demonstrated with a new comparative method.

Every whole section was projected by means of a projecting prism attached to a microscope's ocular; the thus magnified portions of the brain were drawn on white resistant paper.

The magnification was measured by means of a slide micrometer and was found to vary between 162 and 264, depending upon the type of microscope and size of the ocular used. The parts of the brain were then cut with a pair of hand scissors and weighed on an aperiodic, prismatic, reflecting balance, on which the fourth place could be read off immediately from a reading index. We could rely upon the instrument when carrying a 10 gram load to repeat to 1 in the fourth place i.e. to 0.1 mg. or one-half scale division. Two readings were taken, the mean weights determined, and the volumes calculated, taking as a standard the weight of a piece of the above mentioned white paper having an area of 100 cm^2. From these data the absolute volumes in μ^3 were determined in the following manner:

$$\frac{G\,100}{\sigma W}\cdot\frac{1}{M^2}\cdot 100\,(=\mathrm{mm}^2)\cdot 10^6\,(=\mu^2)\cdot 10\,(=\mu^3) = \text{absolute volume in } \mu^3$$

where: G = weight in gram of the part analyzed
σW = weight in gram of the standard
M = magnification

When serial sections were complete, the volume of a definite part of the brain could be determined by weighing that portion in toto. But, wherever a section was lost, the resulting space had to be taken into account and a new origin had to be determined to calculate the volume.

Let us say that one section is lost; the preceding section which is taken as the origin, is taken twice and the thickness becomes

20 μ; if two sections are lost the preceding section is taken three times and the origin becomes 30 μ. In this manner, the space left by the lost sections has been compensated for. It is clear that in such an interrupted series each available section had to be weighed separately.

The insect brain does not show a part comparable with the stem-remnant of birds and mammals. In order to calculate the indices, we took a part of the brain containing all the portions of the cerebrum (proto- and deutocerebrum, without the more or less doubtful tritocerebrum, which is of no special functional significance). We will designate this part as the cerebral remnant. For each brain a series of index numbers was calculated, these resulting from the comparison of the volume of each portion to the volume of its protocerebral remnant. The index derived from this comparison is expressed as follows:

$$\text{Index} = \frac{\text{Volume of part of the brain under analysis}}{\text{Volume of protocerebral remnant.}}$$

In the case of *Blattella germanica* (Orthoptera) two indices were calculated for the olfactory lobes: one resulting from the olfactory lobes plus a certain part x, the other without this said portion. This so-called part x is a piece of medullary tissue, filling the dorsal space between the proto- and deutocerebrum and not clearly delimited. Haller (1905) however, thinks that it belongs to the deutocerebrum, for he observed a lesser amount of this tissue in *Blattella* than in the Myriapoda and explains this phenomenon as being the result of an increased concentration of the antennal ganglion. Furthermore, having in this analysis always considered the accessory protocerebral lobes (situated between the antennal ganglia and the central body, and bordering on the side of the latter) as part of the cerebral remnant, it became imperative in the case of *Lepismachilis* to give two sets of indices, the one obtained from the cerebral remnant without the accessory lobes, the other from the cerebral remnant with the accessory lobes included; the volume of the accessory protocerebral lobes was also calculated. For *Lepismachilis* indices also have been determined for three glomerular masses present in the region of the fibrillar arch, in the so-called "pars intercerebralis" of pterygote insects. The exact identification is not known; it is suggested that these represent the main and lateral ocellar glomeruli. The protocerebral lobes were further expressed in per cent of the total brain volume with the exclusion of the protocerebrum.

It should be emphasized that the great advantage of this method lies in the fact that the different portions of the brain under analysis are not included in that part (cerebral remnant) which is taken as a basis for determining their relative sizes. Whenever portions are compared with the total brain volume, they must necessarily be included in it; measurements so taken lead to erroneous interpretations of relative sizes. Such a method of calculating relative sizes might be a reason for the observations that have led to the conclusions of a constancy of the fibrillar arch and central body. To determine the difference between the weighing and planimeter method of calculating volumes, the last-mentioned method was also applied in the case of the bee; the exactitude of the precision balance, however, is known to be twice that of the planimeter.[1]

Formula applied in the case of the planimeter

Planimeter number obtained by contouring a section of the part of the brain under analysis[2]

$$= x$$

$$x \cdot 10^{-1} = \frac{x \text{ cm}^2}{{}^3\text{M}^2} \cdot 10^2 = x \text{ mm2} \cdot 10^6 = x\mu^2$$

$$= \text{absolute area}$$

$$x\mu^2 \cdot \text{origin } (10\mu) = x\mu^3 = \text{absolute volume}$$

We have arranged the orders of insects studied according to a definite scheme, the purpose of which is to be explained in a subsequent chapter. These are the orders analyzed:

A. Thysanura	: 1. Machilidæ	: *Lepismachilis notata*
B. Plecoptera	: 1. Perlidæ	: *Chloroperla grammatica*
C. Orthoptera	: 1. Blattellidæ	: *Blattella germanica*
	: 2. Acrididæ	: *Stenobothrus* species

[1] The results obtained from the two methods showed a difference of 4%.

[2] 1000 (Planimeter number) = 100 cm², obtained by measuring the contour of 100 cm².

[3] Magnification.

D. Isoptera : 1. *Termes badeus* (worker)
E. Hymenoptera: 1. *Apis mellifica* (worker)
F. Lepidoptera : 1. *Ephestia kühniella* Z.
G. Diptera : 1. *Musca domestica*

GENERAL RESULTS

The still debatable phylogenetic position of the different groups of insects makes it impossible to explain and discuss the results of this analysis in the light of a well-established ancestral history.

The present results will show that there is not a clear correlation between the degree of cerebralization and morphological development: a low level of brain differentiation must not always be associated with low morphological development.

Different correlation types shown in the studies of vertebrate cerebralization (especially Wirz 1950) can probably also be demonstrated in insects. Our results will show different levels of cerebralization occurring in this classification, a low or high degree of differentiation being by no means restricted to a primitive or an evolved type of general organization.

The criteria used for the determination of our correlation types are the generally acknowledged principles of Arthropod morphology and the reliable data of insect paleontology found in all general textbooks.

In the present study three Tables were drawn up in order to help us in the determination of the degree of cerebralization. The indices in Table I indicate the relative development of the different parts of the brain; Table II shows the degree of cerebral differentiation in each of the types of insects under analysis. A complete list of the indices is given in Table III.

In the subsequent classification, the centers of lower integration, i.e., fibrillar arch and central body, have been omitted from our consideration, since their indices do not present contrasts sharp enough to be used in determining the degree of cerebralization. They will be discussed in another chapter.

Special emphasis is put on the central representation of the sense regions (distant receptors), as far as it is possible to isolate them; these are the optic centers and the olfactory sense organs, i.e., the antennal glomeruli. Peripheral sense organs are the main apparatus of orientation. A morphological differentiation of these organs alone, however, does not suffice to provide the animal with an adequate possibility of orientation; the centers for these organs situated in the central nervous system must also be developed for a proper reception and integration of stimuli. In this manner only will a morphological differentiation of the peripheral sense organs be of greater value. It is suggested that in the more evolved type of central nervous system these centers will sometimes show a higher level of differentiation.

An orientation dominated by the olfactory sense organs is usually associated with an archaic general structure, while a visual type of orientation can be related to more evolved forms. These two types of orientations correspond to the macrosmatic, or archaic, and microsmatic, or modern types, known in mammals. In our description we apply these two terms in the study of insect cerebralization.

In agreement with the general morphological interpretation the mushroom bodies are considered as centers of high integration. We have separated the mushroom bodies into a fibrillar and a cellular part. The cellular part (cells of the mushroom bodies) is believed to be of special significance in the degree of brain differentiation. This criterion will be elaborated upon in the discussion.

Through the confrontation of the morphological and paleontological data with our quantitative results, we obtain correlation types which can be arranged in two main groups.

A. Levels of primitive general organization
(Ametabola—Hemimetabola)

Type I—*Machillis*

In our series this apterygote shows the most primitive type of general organization: there is no metamorphosis and it is wingless. The complete number of abdominal segments is already present in the larval stage. The mouth parts are of the primitive chewing, or mandibulate type. Brain indices show us a typical macrosmatic or archaic type, but with more or less well-developed compound eyes and optic centers. This development of visual orientation in a macrosmatic form may well be a specialization within the type *Machilis*, for this insect is known to

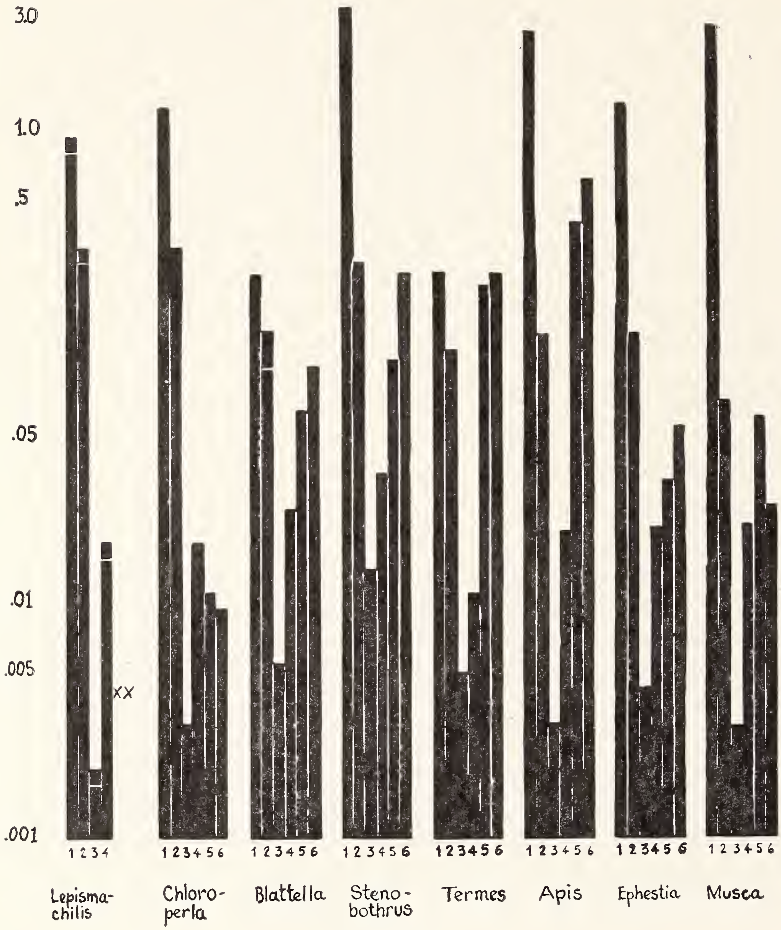

TABLE I

Indices showing the relative development of the different parts of the brain.

1. = *Lepismachilis*
2. = *Chloroperla*
3. = *Blattella*
4. = *Stenobothrus*
5. = *Termes*
6. = *Apis*
7. = *Ephestia*
8. = *Musca*

White stripes = A. *Lepismachilis:* two sets of indices resulting from
1. Cerebral remnant and cerebral accessory lobes.
2. Cerebral remnant without accessory cerebral lobes.

B. *Blattella:* two sets of indices calculated for antennal glomeruli resulting from
1. Olfactory lobes and part x.
2. Olfactory lobes without part x.

x = both cells of mushroom bodies and mushroom bodies missing in *Lepismachilis.*

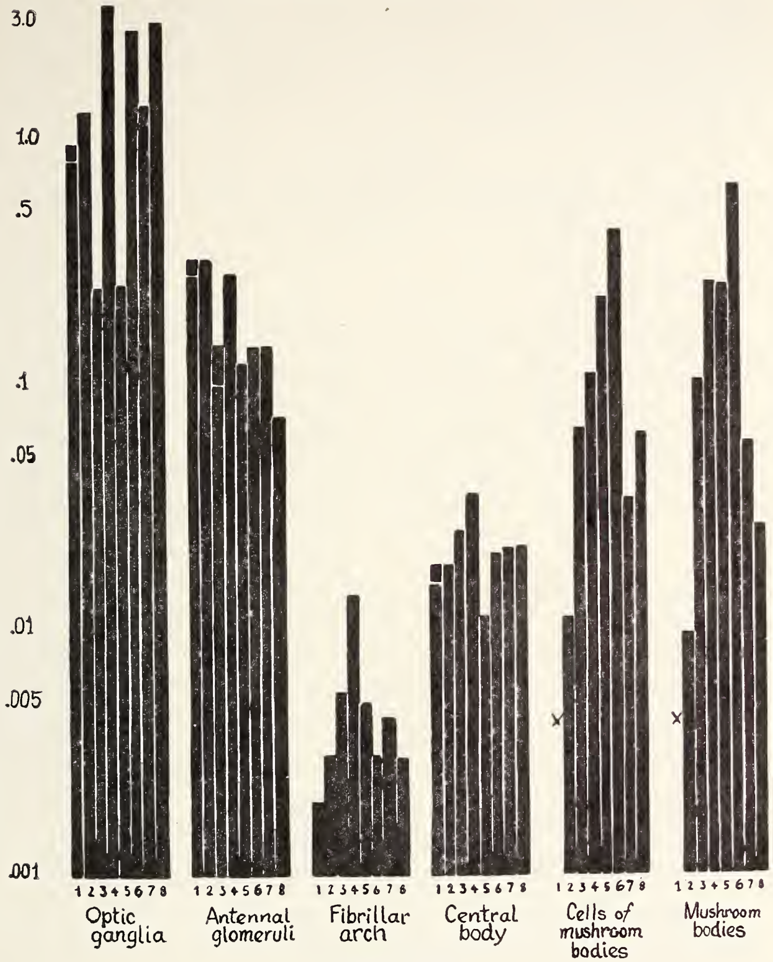

TABLE II

Indices showing the degree of cerebral differentiation in each of the types of insects.

1. = optic ganglia
2. = antennal glomeruli
3. = fibrillar arch
4. = Central body
5. = Cells of mushroom bodies
6. = Mushroom bodies

For other details see Table I.

have compound eyes of a higher state of differentiation than the rest of the apterygotes.

Our failure to locate the mushroom bodies compels us, for this study, to consider the mushroom bodies as lacking, at least in the typical form *Machilis*. The controversy which has arisen as to their position and even the doubt as to their existence, will be presented in the discussion.

TABLE III

Parts	*Lepismachilis*	*Chloroperla*	*Blattella*	*Stenobothrus*	*Termes*	*Apis*	*Ephestia*	*Musca*
Optic ganglion	.9665 .8262[4] .3279	1.399	.2516 .1044	3.575	.2592[6]	2.822	1.477[6]	3.029
Ant.glomeruli	.2803[4] .0020	.3285	.1587[5]	.2844	.1309	.1559	.1570	.0741
Fibrillar arch	.0017[4] .0189	.0031	.0056	.0150	.0051	.0031	.0044	.0030
Central body	.0162[4]	.0188	.0251	.0360	.0121	.0206	.0216	.0221
Cells of mushroom bodies	....	.0188	.0665	.1151	.2271	.4259	.0340	.0636[7]
Mushroom bodies	.... .0105	.0096	.1077	.2586	.2553	.6447	.0581	.0265[7]
Ocellar glomeruli	.0090[4]							
Acessory protocerebral lobes	.1692							
% Protocerebrum of total brain without protocerbrum	67% 113[4]%	59%	18% 16[5]%	23%	77%	25%	58%	31%

[4] Cerebrum remnant + accessory protocerebral lobes.
[5] Ant. glomeruli + part x.
[6] Arbitrary delimitation between protocerebral lobe and optic ganglion.
[7] Arbitrary delimitations.

Type II—*Chloroperla*

A primitive type of winged hemimetabolic insect. It shows a well-segmented abdomen and antennæ composed of a great number of homogeneous segments. The mouth parts are somewhat reduced but of an archaic pattern. The form is a macrosmatic type, but showing more or less well-developed compound eyes and optic centers; the mushroom bodies show a low degree of organization.

Type III—*Blattella*

A typical hemimetabolic insect with chewing mouth parts. The antennæ are composed of a great number of homogeneous segments but the optic centers are poorly developed, thus reducing the function of the compound eyes. Antennal glomeruli and mushroom bodies are more or less well-developed. On account of the unidentifiable part x, the results for the antennal glomeruli are to be considered as somewhat unreliable. The mushroom bodies are well developed, in contrast to the primitive general organization. This morphological differentiation has attracted the attention of many an author and its significance will be discussed.

Type IV—*Stenobothrus*

A hemimetabolic insect with typical chewing mouth parts and homogeneous highly-segmented antennæ. In contrast to this primitive organization, brain and sense organization indicate that this form must be considered as "evolved." The two principal sense organs show an equal development, (more or less well differentiated) the mushroom bodies being well differentiated.

Type V—*Termes* (worker)

This form, which shows a primitive organization, is specialized (e.g. social life). The workers are wingless and have degenerated compound eyes and optic centers poorly developed. The relatively high degree of differentiation of the mushroom bodies may perhaps be associated with the type of social behaviour occurring within this group.

B. Levels of evolved general organization (Holometabola)

Type I—*Apis* (worker)

An evolved general organization, holometabolic development and highly evolved social life. The bees are, as a rule, distinguished from other Hymenoptera by the transformation of the mouth parts into a proboscis. The two main distant receptors show a more or less parallel development and the mushroom bodies attain the highest degree of morphological differentiation observed among the types analyzed.

Type II—*Ephestia*

Structurally evolved, with reduced mouth parts of the sucking, or haustellate type. There is an equal development of the principal distant receptors, but the mushroom bodies show a relatively low degree of differentiation.

Type III—*Musca*

A holometabolic form with specialized mouth parts forming a proboscis of the licking type; the antennæ are composed of three segments, the outer one bearing on its front a fine, projecting bristle, frequently feathered. In agreement with this morphological differentiation, the analysis of the brain proves *Musca* to be a microsmatic insect. The relatively low development of mushroom bodies brings further evidence substantiating the hypothesis that evolved morphological features do not presuppose a parallel development of the brain.

DISCUSSION

The segmentation of the brain into several parts, each of which shows its particular evolution, enables us to replace the diagrammatic linear arrangement of evolutionary sequence by a modulated representation of cerebralization types.

Above all, the types thus ascertained afford us a quantitative basis for the distinction of a cerebralization which on the one hand strongly depends on a specialization of the highest distant receptor centers (optic and olfactory centers), and which on the other hand is expressed by the degree of development of the mushroom bodies.

Our method, by means of a more comprehensive application, will contribute to the studies of Franz, Sewertzoff and others on the distinction of evolutionary directions (Elevation—Specialization; Aromorphose, Idioadaptation); our quantitative method will prove these evolutionary tendencies.

In the subsequent discussion we shall try to throw some light upon this problem and to show at the same time the possibilities of our quantitative method for an evolutionary evaluation of the different types of cerebralization.

A. Mushroom Bodies

In agreement with the general tendency of morphology we have considered the mushroom bodies as centers of highest integration. A discussion of these centers will be approached from two angles: 1. their origin, 2. their quantity and significance.

1. Origin.

This study does not contribute to the problem concerning the origin of the mushroom bodies, but our analysis of *Lepismachilis,* an apterygote, in which no mushroom bodies could be located, shows us that the transition of apterygotes to pterygotes is not a mere matter of degree. The question of the presence of the mushroom bodies in *Machilis* and the attempt at finding structures homologous to the true mushroom bodies of the pterygotes have given rise to a great many controversies, of which the two conceptions of Holmgren (1914) and Hanström (1940) are representative examples. Holmgren claimed that in *Machilis* the globular apparatus is not present as an independent structure, but that it can be recognized as glomerular thickenings in the accessory protocerebral lobes. In support of his theory Holmgren stated that both the commissures of the accessory lobes and those of the globular apparatus in *Japyx* (Japygidæ) behave in a similar manner; he added, however, that the globular apparatus of *Machilis* (glomerular thickenings and the accessory lobes) corresponds to the (stalk) globular apparatus and the accessory lobes of the pterygote insects.

Hanström, on the other hand, pointed out the "absence of any recognizable mushroom bodies"; nevertheless, he has tried to find structures homologous to the lateral mushroom bodies of the other insects. Although Hanström associated with mushroom bodies glomerular compactions present in the vicinity of the lateral ganglionic cell layer, he nevertheless stated: "dass bei den Machiliden gar keine Strukturen vorkommen, die mit Sicherheit mit den pilshutförmigen Körpern der pterygoten Insekten homolog sind." This problem of homology shows us that *Machilis* cannot at the present state of the discussion be directly compared either morphologically or biometrically with pterygotes.

2. Their quantity and significance.

The problem of the quantity of the mushroom bodies as a measure of psychic faculties and in a comparative way as the measure of evolutionary tendency, has given rise to much scepticism, because there was in many cases a wide divergence between the level of differentiation of the mushroom bodies and the degree of general organization, or the type of metamorphosis. Thus Viallanes (1893, quoted by Hanström 1928) had found the largest mushroom bodies in *Limulus* (*Xiphosura*), a form to which in general a very low differentiation is attributed. From this finding many authors have come to the conclusion that the quantity of the mushroom bodies cannot be used as a measure for the degree of differentiation. On the other hand, however, the view has been advocated that a high degree of brain evolution may occur within groups of generally archaic structure.

The two most commonly mentioned examples of this divergence are *Blatta* and the termites, both hemimetabolic and morphologically primitive insects. Holmgren (1916) and Brun (1923) have pointed out the marked differentiation of the mushroom bodies of *Blatta,* a differentiation comparable to that of the social Hymenoptera. Much has also been said about the nature of the mushroom bodies of the termites, forms in which instinct and psychic activities are very much pronounced. The morphological studies of Thompson (1916) and Bretschneider (1913) conclude that the mushroom bodies of the termites present both primitive and advanced characteristics, while Hanström (1930) on the basis of histological observations placed them side by side with the social Hymenoptera. It must be emphasized that insects with social life usually display well-developed mushroom bodies. In this study we have accepted the criterion that well differentiated mushroom bodies are prerequisites for the unfolding of social behaviour. The conception that preadaptive structures are laid down before the actual general adaptation occurs has been given to the world by Cuénot.

We have considered the quantity of the mushroom bodies as a criterion for determining the level of brain differentiation, a criterion of independent value. As a first approach, we have studied the degree of cerebralization, disregarding the state of the general organization of the insect. The subsequent confrontation of our results with other morphological data point out the complexities of correlations existing between brain development and morphological differentiation and have led us to classify these correlations into different types (see pp. 137–142). These different ways of cerebralization suggest that the evolution of the brain has proceeded independently of both the general morphological differentiation and the types of metamorphosis. The idea of an independent brain evolution may lead to a better understanding of the highly differentiated state of the mushroom bodies in social insects that are otherwise termed primitive. With this view in mind, the problem of *Blatta* which has caused so much speculation may be brought to a solution by recent observations of the existence of a social state in this genus. It should be recalled that Haller (1905) had already assumed a "keeping together" of individuals in *Blatta*.

The known variations occurring within the order Orthoptera become obvious from our results. Our studies of *Blattella* and *Stenobothrus* suggest that, in this order of insects at least, several independent lines of evolution must have taken place.

In discussing the significance of the mushroom bodies, their quality, meaning the histological differentiation of their cells, should also be taken into account. Several authors, in fact, have considered the quality as the sole valid criterion in dealing with the evolutionary significance of the mushroom bodies. Thus Holmgren (1916) said: "Nicht nach der Quantität der Globuli soll das "psychische" Leben beurteilt werden, sondern nach der Qualität." On the other hand, Bretschneider (1915) and Goossen (1949) pointed out that the higher the number of cells of the mushroom bodies, the greater were the psychic faculties of the insect. They thus reverted to the idea of Kenyon, who as early as 1896 had described the "intellective cells" of the mushroom bodies in the bee and had correlated greater complexity of structure with greater intelligence.

In this respect an attempt was made at separating a fibrillar (mushroom bodies) from a cellular part (cells of mushroom bodies), to see whether a biometric analysis of the cells would second the results obtained for the mushroom bodies proper. The indices for the mushroom bodies and their cells show an almost perfect parallel development. The cells can therefore also be considered as centers of integration and the differences of quality in various species can show evolutionary trends.

B. Centers of distant receptors

A glance at our indices shows that the quantitative determination of proportional masses also offers a good comparable measure for the central representation of the distant receptors.

Morphologists, as well as physiologists, generally agree that among the sensory regions, the optic centers provide a higher degree of orientation, since they present possibilities of much acuter means of discrimination between stimuli, than do the olfactory organs and their antennal glomeruli. Whether we consider Molluscs, Annelids, Arthropods, or Vertebrates—we constantly find that the higher organization plan always shows a better development of the visual form of the distant receptors.

The indices for *Lepismachilis* and *Chloroperla,* both primitive forms, show that they belong to the true macrosmatic type (see p. 140). These two forms, however, have in addition well-developed compound eyes and optic centers. The results also classify *Blattella* among macrosmatic insects, showing an antagonistic development of the sense organs. We must acknowledge that as long as the exact nature of the socalled part x has not been definitely determined, this classification must remain open to objection. *Blattella* is also known for its well differentiated compound eyes, but undeveloped optic centers; this condition may well be one of the features belonging to the general primitive character of this form.

In contrast to those primitive forms, *Musca* offers a good example of the microsmatic or evolved type (see p. 140); an antagonism between the sense organs is readily observable.

Our study reveals in some cases a more balanced type: the two distant receptors showing a parallel development. To this third type belong *Stenobothrus, Apis,* and *Ephestia.*

Regarding the development of the mushroom bodies and that of the distant receptors as measures of the level of differentiation and considering that a higher development of the mushroom bodies and visual orientation are associated with forms that can be called "evolved," we may conclude that insects showing both these conditions (*Apis*) are to be classified as more "evolved" than others (*Termes*) which have only well developed mushroom bodies, but lack visual orientation.

The repeated suggestion that *Stenobothrus* is to be regarded as evolved and that this group has followed an independent line of evolution, is once more emphasized by a comparison with *Blat-*

tella. Although *Blattella* is known to have well-developed mushroom bodies, we must consider *Stenobothrus* as the higher form, since it makes use of visual orientation, while at the same time displaying well-differentiated mushroom bodies; moreover, acoustical distant receptors add to the sensory potential of the group; *Blattella,* on the other hand, is undoubtedly a macrosmatic insect.

C. Lower centers of integration.

Several authors have regarded the fibrillar arch and central body as primary reflex or first-degree association centers of a relatively general and widespread function. They based this hypothesis on the observation that the fibrillar arch and central body remain more or less constant among the different orders of insects. Bretschneider (1914, 1924) had claimed a parallelism between the degree of development of the optic lobes and the fibrillar arch. He had found both crossed commissures going from the optic lobes to the fibrillar arch and also ocelli nerves in close association with this fibrillar arch. Jonescu (1909) and Kühnle (1913) had already regarded the fibrillar arch as the center for the ocelli. In opposition to Bretschneider, Holmgren (1916) had observed that in *Japyx, Campodea,* and *Tomocerus,* where ocelli and compound eyes are entirely lacking, a well-developed fibrillar arch is nevertheless present. Goossen (1949) found that with increasing body size, a decrease in the length of the fibrillar arch compared with the width of the protocerebral lobes takes place. Further work on the relation of brain development to body size should be done. We have little to add to this controversy concerning the fibrillar arch and the optic lobes; the present study has not found a quantitative correlation between the two parts in question.

We agree, however, with the authors who have considered these loci as primary reflex centers; our indices show that no really important quantitative contrasts are to be found between the different groups, that is, if we compare the indices of these two parts with the obvious differences presented by the indices of the remaining portions examined in the study.

Bretschneider (1913) had come to the conclusion that the unfolding of the mushroom bodies produced a regression of the central body and described the latter's development as being inversely proportional to that of the mushroom bodies; other authors have questioned this statement. Holmgren (1916) in his work on Arthropoda took the central body as his base for drawing the phylogeny of insects. In his scheme, the accepted phylogeny seemed to be entirely disrupted; an exception was seen in the closely related Hymenoptera groups and Holmgren concluded that for this order at least Bretschneider's rule may be acceptable. It is interesting to note that Goossen's recent work (1949) gave additional data to support Bretschneider's hypothesis. Comparing portions of the brain of closely related forms with body length, he found an inverse proportion between the central and mushroom bodies. Goossen also observed in the central body of *Peripatus,* ganglion cells similar in nature to the globuli cells of the mushroom bodies, meaning that the central body had functions taken over by the mushroom bodies in higher types. Our quantitative results demonstrate that in some cases at least, a certain antagonism exists between the lower and higher centers of integration (e.g. *Blattella, Termes, Apis*); these data would then bring additional support to Bretschneider's and Goossen's hypotheses. Nevertheless, it is to be emphasized that this condition does not always hold good, since forms with poorly developed mushroom bodies may also show low indices for the lower integration centers (e.g. *Lepismachilis, Chloroperla*), and on the other hand specimens with well differentiated mushroom bodies may at the same time be provided with developed lower integration centers (e.g. *Stenobothrus*). A third category may even be mentioned, a group in which no obvious quantitative relation seems to exist between the lower and higher centers of integration (e.g. *Ephestia, Musca*). These results point out once more that different correlation possibilities are to be taken into account.

The steady increase in the development of the mushroom bodies, together with a parallel regression of the central body may well be taken as measures for tracing evolution, providing that closely related forms in a large number of groups be studied.

D. Cerebralization and type of metamorphosis

The type of metamorphosis has developed into an important criterion for determining the phylogenetic position of the insect group. The use of this criterion has gained widespread recognition from the mere fact that the evolutionary types of metamorphosis (from ametabolic, to hemimetabolic, and finally to holometabolic types) seem to follow an orthogenetic trend in direct correlation with the degree of morphological differentiation. The evolutionary importance of the facts of metamorphosis has been strengthened by the close agreement with paleontological data.

Nevertheless, the type of metamorphosis is an insufficient criterion for a general determination of the level of differentiation and can be applied only in connection with all the other available facts on the differentiation of an insect group.

Our results give sufficient ground for a careful distinction between different possibilities of correlation: we can easily show that hemimetabolic as well as holometabolic types of ontogenesis can be linked to high cerebralization. Among the hemimetabolic forms analyzed, *Stenobothrus, Termes,* and to a certain extent also *Blattella,* can certainly be considered as evolved as far as the degree of cerebralization is concerned. On the other hand, among the evolved holometabolic forms, we have *Ephestia* and *Musca,* both showing a relatively low degree of cerebralization, while in the group of Hymenoptera several levels of cerebralization are represented. Although we only analyzed *Apis mellifica,* it is known that the Tenthredinidæ, Cynipidæ, and Uroceridæ present a lower degree of development than either the Formicidæ, Vespidæ or Apidæ. In this connection it should be mentioned that social life among insects is linked with a higher degree of differentiation of the mushroom bodies; we thus have social forms developing among the higher levels of Hymenoptera. The fact of the independent evolution of cerebralization in hemimetabolic and holometabolic types has not escaped the morphologists: Bugnion, in 1921, wrote: "Die Höchststehenden Formen (Dipteren, Hymenopteren) finden sich unter den Gruppen mit vollkommener Verwandlung. Immerhin is zuzugeben, dass gewisse Orthopteren, Hemipteren, auf anderen Wege zu nahezu gleichen Höhe der Organisation gelangt sind."

The type of metamorphosis is often used in an exclusive and one sided manner as the most important morphological criterion. In many entomological works the arrangement hemi- holometabola is a valid criterion of the ascending degree of differentiation of the insects.

The quantitative determination of the degree of cerebralization will prove itself to be a good means of modifying this general linear arrangement. It has shown us the relatively great independence of the degree of cerebralization from the type of metamorphosis.

SUMMARY AND CONCLUSION

1. In this study the degree of cerebralization of insects has been tested by weighing and determining the volumes of different portions of the brain. Indices were calculated by comparing the volumes of a given integration center of high differentiation to the volume of a less differentiated part of the brain, which we have called the cerebral remnant. (Fig. 1)

2. For eight types of insects of very different morphological levels, indices of the following integration centers were calculated: mushroom bodies, fibrillar arch, central body, optic ganglia, antennal glomeruli.

3. The indices for the mushroom bodies and their cells revealed these organs as centers of highest association and centers of psychic faculties. This biometric analysis brings forward new evidence for the evolutionary significance of the quality of the cells of the mushroom bodies.

4. Our indices show, from a comparison of the centers of olfactory and visual distant receptors, that a distinction similar to those found in mammals proves useful; we find macrosmatic, or archaic, and microsmatic, or evolved types. A third, or balanced type also occurs among the forms studied.

5. The centers of lower integration are considered as primary reflex centers. In some instances only, an antagonism between the developments of the lower and higher integration centers is present.

6. This quantitative study has furthermore shown that the type of metamorphosis cannot be used as the only valid criterion of the ascending degree of differentiation of the insects; different degrees of brain development can be correlated with either the hemi- or holometabolic types of metamorphosis.

7. The comparison of the indices enables us to distinguish different trends of evolution and brings new material for a more objective and exact determination of the level of differentiation. We lay special emphasis upon the fact that high cerebral evolution may be correlated both with an archaic general structure and with an evolved morphological level.

8. The applicability of the volumetric index method for measuring the degree of cerebralization of insects has been established.

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THE CONTROL OF EPIDEMIC TYPHUS

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Control phases of epidemic typhus have advanced enormously during the past decade. Prior to World War II this disease was one of the most dreaded, especially during war time and post war periods of readjustment of the population. The disease is caused by *Rickettsia prowazeki* and is transmitted by the human body louse *Pediculus humanus* De G.

At the outbreak of World War II the Medical Department of the United States Army was anxious to develop a method of delousing which would replace the cumbersome method of treating clothing by steam. Fumigation with Methyl Bromide in gas tight chambers, and rubber bags was the first step toward replacing steam.

Although Methyl Bromide was a definite improvement over steam it had disadvantages. It was a cumbersome method but was employed at most of the Eastern ports for treating the clothing of German and Italian prisoners of war. The author, who was stationed at The Surgeon General's Office, was responsible for the technical supervision and procedure for delousing these prisoners.

During the early part of the war, MYL and DDT powders were developed. These offered great advantages over either steam or Methyl Bromide. The record of typhus control at Naples, Italy by MYL and DDT during the war and by DDT in some of the large epidemics in Japan following the war is now history. The author was connected with the USA Typhus Commission in Japan and in addition to setting up disinfestation at many ports, took an active part in combating some of the larger epidemics, especially at Osaka.

During the author's stay at the various ports in Japan over 2,000,000 Japanese, Koreans, Formosans, Chinese and other asiatics were dusted with DDT. The baggage of these individuals was also dusted at the same time. During the Osaka epidemic, approximately 1,400,000 Japanese subjects were dusted in 4 days. These examples fully justify all the efforts expended in research toward the development of chemical powders for the control of lice.

While serving as liaison for The Surgeon General's Office to the U.S. Department of Agriculture at Orlando, Florida, the author personally conducted research which may lead to improvements on the standard DDT louse powder. The results of this research were used in a thesis presented to the Graduate School of Cornell University in partial fulfilment of the requirement for the PhD degree in Medical Entomology and Parasitology. The following remarks and data have been extracted from that thesis. The data indicate the relative toxicity of 106 compounds which were selected as the most toxic of over 10,000 subjected to screening tests.

In the beaker tests the 106 compounds which had been found to be 100 percent effective on adult lice for 31 days or more at 10,000 parts per million were further diluted and the better chemicals were again tested at still lower concentrations. Only 13 chemicals were found to be worthy of further study.

By dilution methods, DDT was shown to be inferior to the other twelve promising chemicals at a concentration of 100 p.p.m., and at 50 p.p.m. DDT was inferior to eight chemicals. Three chemicals; heptachlor, aldrin and dieldrin were more outstanding than DDT, all giving 100 percent kill at concentrations of 6.25 p.p.m. Aldrin gave 100 percent kill at concentrations of 3.125 p.p.m.

For comparison of these three chemicals with DDT the average percent mortality of lice is extracted from table 4 of the above mentioned thesis, as follows:

Chemical	Concentration, parts per million					
	100	50	25	12.5	6.25	3.125
Aldrin	100	100	100	100	100	100
Heptachlor	100	100	100	100	100	100
Dieldrin	100	100	100	100	100	100
DDT	88	63	15	3	5	0

Durability tests were made with all chemicals at concentrations of 10,000 parts per million. Durability tests with thirteen of the more promising materials were made at concentrations of 50, 25, 12.5, 6.25, and 3.125 p.p.m. At concentrations of 50 p.p.m., DDT gave a 50 percent kill for one day and none thereafter. The remaining twelve at this concentration were still effective after one day of aging. The most durable chemicals, parathion and dieldrin, gave 100 percent mortality through the eighth and fifth day, respectively, at a concentration of 12.5 p.p.m.

In comparative tests, both pyrophyllite alone and the combination of pyrophyllite and Frianite were very toxic. Gypsum and Dilroc alone and in combination with Frianite showed little toxicity to lice. At low concentrations of toxicants, walnut shell flour combined with the diluents that were toxic to lice caused a marked decrease in effectiveness of each toxicant.

In storage tests for about one year in brown glass bottles, with sixteen chemicals impregnated on gypsum, heptachlor deteriorated but the others did not.

In dust tests, with gypsum, at concentrations of 500 p.p.m. there were 12 chemicals of 13 tested which were superior to DDT. Several of these, however, were not effective at lower dilutions.

Six of the chemicals tested were outstanding as lousicides. For comparison of these with DDT the average percent mortality of lice is extracted from table II of above mentioned thesis, as follows:

Chemical	Concentration in parts per million					
	500	250	125	50	25	12.5
Heptachlor	100	100	100	100	97	38
Dieldrin	100	100	100	100	93	32
Lindane	100	100	100	100	91	23
Parathion	100	100	100	97	63	11
Aldrin	100	100	100	95	87	41
Chlordane	100	100	100	70	11	0.7
DDT	12	3	0	0	1	1

Several chemicals demonstrated fumigant qualities. Those that showed fumigant qualities at a concentration of 10,000 parts per million were further diluted and tested again. Six chemicals, ethyl tetràdiethiopyrophosphate, aldrin, heptachlor, chlordane, lindane and dieldrin, at a concentration of 100 p.p.m., gave kills which varied from 100 percent to 17 percent in the order named. At 50 p.p.m., the kill varied from 93 to 0 percent kill. At 25 p.p.m. none of the chemicals showed fumigant action.

From a study of the second test table it will be seen that several chemicals made into louse powders are a great deal more toxic than DDT.

For these studies the toxicity to warm blooded animals of the various chemicals tested was ignored. It is known that Parathion is certainly too hazardous to be used in any form of louse control. Many of the others may also be hazardous but the author feels that some of these may be useful should lice become resistant to DDT.

A PREMATURE EMERGENCE OF PERIODICAL CICADA

Follow-up of a report as of June 7, 1952 that locusts were singing in the woods near Allenwood, Monmouth County, New Jersey, disclosed the presence of large swarms of the periodical cicada or seventeen-year cicada (Magicicada septendecim Linn.) in an area roughly two miles square along Route 34, near Allenwood Circle.

Brood II, due in 1955, and brood X, due in 1953, are the only broods reported from Monmouth County by William T. Davis (Circular 97, N. J. Dept. Agri., 1926) and more or less state-wide in extent. Brood VIII, due in 1951 was listed only from Essex County. It, therefore, seems probable that this appearance is a premature emergence of brood X.—WILLIAM M. BOYD.

THE GENITALIA AND TERMINAL SEGMENTS OF THE MALE CARPENTER ANT, CAMPONOTUS PENNSYLVANICUS DEGEER (FORMICIDÆ, HYMENOPTERA)[1]

By James Forbes[2]

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This study describes and figures the external genitalic valves, the ninth and tenth abdominal terga, and the eighth and ninth sterna of the male Carpenter Ant, *C. pennsylvanicus* DeGeer.

Measurements have been taken for various parts of the structures described to compare *pennsylvanicus* with species of *Camponotus* described by Clausen (1938). The male genitalia as an aid in classifying ants is becoming more important now that more male ants are being associated with their corresponding workers and queens. Although the pattern of the genitalia is quite constant within the family and although the shapes of the individual parts of the genitalia are surprisingly similar within each genus, detailed studies are revealing important species differences (Clausen, 1938; Weber, 1947). Clausen found that subgenera of the genus *Formica* can be distinguished by genitalic differences and that genitalic differences are also found in species of the genera *Lasius* and *Camponotus*. Weber (1948) reports variations in one of the genitalic valves for some of the *Myrmica*.

In referring to the parts of the terminal segments, the terminology of Snodgrass (1941) has been used. Table I shows a comparison of the terminology of Snodgrass with that of Clausen.

The male ants for this study were collected from the same nests and at the same time as collections of ants were made for a previous anatomical and histological study of workers (Forbes, 1938). This investigation was begun shortly after the worker

[1] This name follows Creighton's ''The Ants of North America.'' Formerly referred to as *Camponotus herculeanus pennsylvanicus* DeGeer.

[2] The author wishes to thank Doctor Mont Cazier and H. F. Schwarz of the American Museum of Natural History for permission to examine the *Camponotus* males in the collection of that institution.

form was completed; the part concerned with measurements has been finished recently. The drawings for the paper have been made with the assistance of a Promar drawing apparatus (Siebert, Wetzlar).

TABLE I

COMPARISON OF THE TERMINOLOGY OF SNODGRASS (1941) AND CLAUSEN (1938)

Snodgrass	Clausen
Lamina annularis or Basal Ring	Cardo
Lamina parameralis or Basiparamere	Squamula
Paramere	Stipes
Cuspis volsellaris	Lacinia
Digitus volsellaris	Volsella
Lamina ædeagalis or Penis valve	Sagitta
——————[3]	Spatha

[3] Snodgrass has no term to indicate the spatha of Clausen, which is the lightly sclerotized, united, medial, dorsal margins of the laminæ ædeagales or the dorsal wall of the ædeagus.

OBSERVATIONS

The strongly sclerotized valves of the genitalia of *C. pennsylvanicus* project ventrally from the posterior end of the abdomen between the tenth tergum and the ninth sternum (fig. 7); the ninth and tenth terga are usually withdrawn beneath the eighth. The basal segment of the genitalia, the lamina annularis or basal ring, is roughly circular in shape. It is broad on its dorsal surface but is reduced to a narrow band on its ventral surface. The anterior margin of this basal ring is attached dorsally and dorsolaterally to the reflected ventral surfaces of the ninth and tenth terga, and it is attached ventrally and ventrolaterally to the posterior, intersegmental membrane of the ninth sternum. The posterior margin of the basal ring supports the three pairs of valves which constitute the genitalia (fig. 8).

Each of the outer pair of valves consists of a large, basal segment, the lamina parameralis, and a narrow, finger-like, distal extension, the paramere (fig. 12). The laminæ paramerales are laterally convex, they practically meet ventrally, and their dorsal proximal margins do touch (fig. 8). They partially ensheath the middle and inner valves laterally and proximally. Sense pores and hairs are found chiefly on the ventral, median surfaces of the laminæ paramerales and around the distal ends of the parameres. Figure 11 indicates some of the variations of the dorsal margins of the outer valves. Measurements made on thirteen outer valves indicate variations as follows:

Portion of Valve	Minimum	Maximum	Average
total length (3)[4]	1036.8 μ	1188.0 μ	1109 μ
length of paramere (1)	496.8 μ	594.0 μ	536 μ
width of lamina parameralis (7)	594.0 μ	831.6 μ	694 μ

[4] The numeral or letter in parenthesis is the identifying symbol of the measurement as illustrated in text figure I. These symbols are used throughout the paper and have been chosen to agree with Clausen's designations except for those indicating measurements of the subgenital plate and the pygostyles.

Each of the middle pair of valves consists of a basal portion, the lamina volsellaris, from which a lateral and a median lobe extend distally (figs. 8 and 17). The lateral lobe is the cuspis volsellaris and the median lobe is the digitus volsellaris. The cuspis volsellaris is the shorter lobe, and its rounded, posterior end is directed dorsally. The large, blunt posterior end of the digitus volsellaris extends beyond the end of the cuspis lobe and is pointed ventrally and tilted slightly laterally. The middle pair of valves is assumed to be clasping segments because of the forceps-like arrangement of the cuspis and the digitus lobes (Wheeler, 1926, pp. 20–30) and because of the similar function of the middle pair of valves in other Hymenoptera (Snodgrass, pp. 22–24). The presence of small, sensory pegs, sensilla basiconica, on the opposing surfaces of the cuspis and the digitus further supports the idea of the clasping function of these lobes (fig. 8). Many sense pores are found at the distal end of the digitus, and sense hairs and sensory pores are found on the ventral surface of the lamina volsellaris and the cuspis lobe. Measurements made on eleven middle valves indicate that the length (VII) varies from 637.2 μ to 691.2 μ with an average of 663 μ. The distances between the caudal margins of the cuspis and the digitus volsellaris (V) is from 108.0 μ to 172.8 μ and averages 147 μ. Variations in the distances between the dorsal margins of the cuspis and the digitus volsellaris (I) are from -16.2 μ to $+21.6$ μ with an average of $+1.5$ μ. A zero reading for this measurement would indicate that the dorsal margins of the two lobes are even or level; the minus reading indicates that the dorsal margin of the cuspis is situated ventral to the dorsal margin of the digitus, while a plus reading indicates that the dorsal margin of the cuspis is dorsal to the dorsal margin of the digitus. Clausen (p. 295) designates this measurement (I) as being taken between the "caudal" margins of these two lobes. The term "dorsal" is more appropriate. Clausen states in his description of the species of *Camponotus* (p. 332) that the dorsal margin of the cuspis does not reach the dorsal surface of the digitus volsellaris; he clearly shows this in his illustrations. Thus, according to the measurement scheme just explained, all Clausen's measurements for symbol (I) in Table II are negative in value. The observations on *pennsylvanicus* show that the dorsal margin of the cuspis, in practically all cases, is level with or slightly above the dorsal surface of the digitus volsellaris.

The inner pair of valves forms the ædeagus or intromittent organ and consists of two laterally compressed plates, the laminæ ædeagales. These plates are united dorsally by a lightly sclerotized membrane, the spatha of Clausen; the ventral and posterior margins are free (figs. 8 and 15). Each lamina ædeagalis has its greatest height proximally, and it tapers distally and ventrally to end in a slightly recurved hook (fig. 9). The ventral edge is serrate. A strongly sclerotized, prominent ædeagal apodeme supports the proximal, lateral wall of the lamina ædeagalis and projects anterolaterally. Many ædeagal muscles are attached to this apodeme. A number of sense pores are located on the posterior regions and the ventral margins of the laminæ ædeagales. These sensilla and some of the connecting nerve fibers which can be seen when examining these valves have been noted and figured by Adlerz (1886) for *C. ligniperda* and by Clausen for *Formica rufa*. The ejaculatory duct of the male reproductive system opens between the laminæ ædeagales at the dorsal, anterior region just beneath the membrane which unites the two valves dorsally. A fold of the upper, median surface of each lamina ædeagalis forms a narrow furrow which extends the length of the valve and is roughly parallel with the dorsal edge. This fold, which I am naming the "sperm gutter," has not been described for any other ant, so far as I know (figs. 9, 15 and 16). These sperm gutters start on the inner surfaces of the laminæ ædeagales at the end of the ejaculatory duct. The median, proximal surfaces of the inner valves are joined vertically for just a very short distance below the ejaculatory duct. Measurements of ten inner valves shows variations as follows:

Portion of Valve	Minimum	Maximum	Average
total length (b)	561.6 μ	642.6 μ	603 μ
greatest width (c)	345.6 μ	453.6 μ	403 μ
length of serrate edge between first and last distinct tooth (e)	281.6 μ	372.6 μ	324 μ
number of distinct teeth (Z)	17	24	19.8

The ninth and tenth terga lie dorsal to the genitalia and are covered by the eighth tergum. The ninth tergum is separated medially and is arranged as lateral sclerites of the membranous tenth tergum (fig. 10). Snodgrass (p. 41) reports this formation for a *Formica* sp., and he describes similar arrangements of the ninth tergum for other ants. The anus opens on the posterior margin of the tenth segment, and the pygostyles arise from the posterolateral portions. The pygostyles are short, sclerotized, finger-like extensions of this segment which project beyond the caudal margin of the eighth tergum (fig. 7). The numerous sense hairs which cover the pygostyles are more abundant around the free ends. A large sense hair arises from the ventral, posterior region and curves slightly dorsally. Measurements of the lengths (M) of fourteen pygostyles show that they vary from 216.0 μ to 270.0 μ with an average length of 241 μ. Measurements of the widths (N) of eleven vary from 64.8 μ to 86.4 μ with an average width of 74 μ. Measurements of the thicknesses (T) of three taken across the dorsal surfaces show variations from 43.2 μ to 45.9 μ with an average thickness of 44 μ.

The eighth sternum is a large segment roughly rectangular in shape (figs. 7 and 18). The posterior, median margin curves slightly cranially. About eight prominent sense hairs are found in this posterior, median region. This segment is figured so that comparisons can be made with the figures of Clausen and Snodgrass for related ants.

TABLE II

SUMMARY OF MEASUREMENTS[5] OF THE GENITALIC VALVES AND THE TERMINAL SEGMENTS OF *Camponotus* SPECIES TO COMPARE MEASUREMENTS REPORTED BY CLAUSEN WITH MEASUREMENTS FOR *C. pennsylvanicus*

Segment	Symbol[6]	Measurements for *Camponotus* Species				
		Subgenus *Colobopsis: truncata*	Subgenus *Camponotus*:			
			vagus	*fallax*	*herculeanus*	*pennsylvanicus*
Half of	A	21	13	27	53	142
Genitalia	B	82	89	105	178	67
Inner	a		115	123	267	279
Valve	b	275	381	368	605	603
	c		246	275	427	403
	e		297	255	346	324
	Z[7]	14	18.5	16.6	19.88	19.8
Middle	I	– 16	– 9	– 16	– 26	+ 1.5
Valve	III	93	162	152	243	201
	V	27	65	87	128	147
	VII	239	342	346	516	663
Outer	1	262	292	295	519	536
Valve	3	485	644	637	997	1109
	4	64	134	127	135	178
	7	375	424	473	747	694
Subgenital	W	514	510	805	900	957
Plate	L	286	400	425	580	620

[5] All measurements expressed in micra except for symbol Z.
[6] The symbols are explained in the legend to PLATE XV.
[7] Number of distinct teeth on ventral margin of lamina ædeagalis.

The ninth sternum (figs. 7 and 14), which is also referred to as the subgenital plate, is shield-shaped with the median portion of its anterior margin extended cranially to form a marked projection. Figure 13 indicates variations of the cranial process of this segment. Usually six to eight prominent sense hairs are found in the posterior, median region. Measurements of the widths (W) of twelve subgenital plates show variations from 864.0 μ to 1004.4 μ with an average width of 957 μ. Measurements of the lengths (L), excluding the cranial process, of a similar number vary from 572.4 μ to 691.2 μ with an average length of 620 μ.

DISCUSSION

The averages of measurements of the genitalia and the terminal segments described for *C. pennsylvanicus* are arranged in Table II together with similar measurements reported by Clausen for other species of the genus. A comparison of these averages indicates that *pennsylvanicus* is closer to *herculeanus* than to the other species listed; this is not surprising since these two forms are often grouped as subspecies of the same species. For these two species, the average measurements indicate that the genitalic valves of *pennsylvanicus* are longer and narrower than those of *herculeanus* and that the length of the lamina ædeagalis is practically the same for both.

Consideration was given to the size of the genitalia in relation to the overall body length. The genitalic measurements, as summarized from Table II, show *truncata* to be the smallest; *vagus* and *fallax* are approximately the same in size and are larger than *truncata; herculeanus* and *pennsylvanicus,* again approximately the same in size, are the largest. The papers of Wheeler (1910), Emery (1916), and Bondroit (1918) give the following body lengths for the males of these species: *truncata* 4–5 mm., *vagus* 9–11 mm., *fallax* 7–8 mm., *herculeanus* 8.5–11 mm., and *pennsylvanicus* 9–10 mm. Body lengths of *pennsylvanicus* males in the collection of the American Museum of Natural History and in my own collection fall within the limits reported. One male in my own collection, however, measures about 8.5 mm. These figures for body length shown *truncata* to be the shortest, *fallax* next, with *vagus, herculeanus* and *pennsylvanicus* all approximately the same and the longest. No definite conclusions are indicated by these comparisons. Whether a correlation exists can be determined only on the basis of a study of more species.

The arrangement of the cuspis and the digitus lobe of the middle valve of *pennsylvanicus* together with the sensory pegs on the opposing surfaces of these lobes strongly suggests a clasping function. No published account could be found which gives the positions of the genital valves in *Camponotus* or other related forms in copula, nor are there immediately available copulating pairs from which to make observations. Clausen reports, after examining pairs of *M. scabrinodis* Nyl. and *M. rubra ruginodis* Nyl. which were captured and preserved in copula, that only the inner pair of valves is inserted into the vagina. The middle pair of valves and the parameres of the outer pair clasp the point of the female abdomen on either side of the female genital opening. The middle valve of *ruginodis* has a well developed cuspis lobe; this is not the case in all *Myrmica* species so far studied (Weber, 1948). Further observations by Clausen show the occurrence of sensory pegs or "warts" on the middle valves of various genera including *Camponotus.* These sensory pegs are absent on the middle valves of *Myrmica rubra levinodis* Nyl., which he describes as a typical member of the genus *Myrmica.*

Clausen's descriptions of *M. ruginodis* in copula state that the inner pair of male genital valves, the laminæ ædeagales, are inserted into the female's vagina from a dorsal, posterior position. This inverts the position of the ædeagus within the vagina so that the dorsal wall lies on the ventral surface of the vagina and the ventral serrate edges of the ædeagal valves contact the dorsal vaginal wall. The valves lie close together, and the sperm passageway is only along this now ventrally situated dorsal part of the inner valves. If the valves in *C. pennsylvanicus* take the same positions during copulation as those assumed by *M. ruginodis,* the sperm gutters which are described in this paper might be important in properly disposing the sperm within the female tract. At the present the purpose of these sperm gutters is not certain.

The ninth sterna or subgenital plates of the four species of the subgenus *Camponotus* compared in this paper are all similar in shape. Again for this segment there is a closer similarity between *pennsylvanicus* and *herculeanus* than between *pennsylvanicus* and the other species. An examination of the outlines of the subgenital plates figured by Clausen for the different forms which he studied shows significant variations in the shape of this segment between subfamilies and genera. Smith (1943, pp. 276–278) has used the shape of the "hypopygium" for separating males of a few subfamilies. All this suggests that the shape of the ninth sternum has a value in separating subfamilies and genera. The minor variations of this segment might prove useful in separating subgenera and even species.

SUMMARY

This study describes and figures the external genitalic valves, the ninth and tenth abdominal terga, and the eighth and ninth sterna of the male Carpenter Ant, *C. pennsylvanicus* DeGeer.

The genitalic valves and the terminal segments of *pennsylvanicus* are similar in arrangement and shape to those of other described species of the genus.

Measurements are recorded for various parts of these structures, and *pennsylvanicus* is compared with species of *Camponotus* reported by Clausen (1938). The measurements place *pennsylvanicus* closer to *herculeanus* than to other species of the genus.

The genitalic valves of *pennsylvanicus,* in general, are longer and narrower than those of *herculeanus* with the exception of the length of the inner valve which is practically the same in both species.

A chitinous fold of the upper, median surface of each inner valve forms a furrow extending the length of the valve. This furrow is described for the first time. It is named the "sperm gutter" because of its position on the inner valve and because of its relation to the end of the ejaculatory duct.

Since no published account gives observations of species of *Camponotus* in copula, the positions of the genitalic valves in copulating pairs of the genus *Myrmica,* as described by Clausen, are discussed to outline the possible functions and the probable positions of the valves in *Camponotus* during copulation.

The shapes of the subgenital plates of ant subfamilies and genera show significant variations. This suggests that this segment might be of value in separating these taxonomic groups.

The minor variations of this segment might have importance for separating subgenera and even species.

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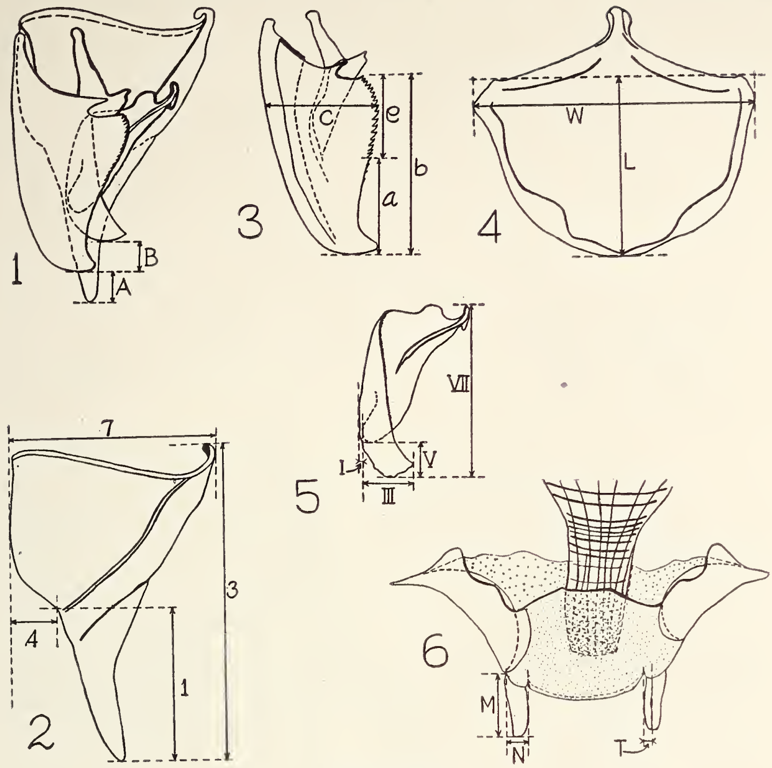
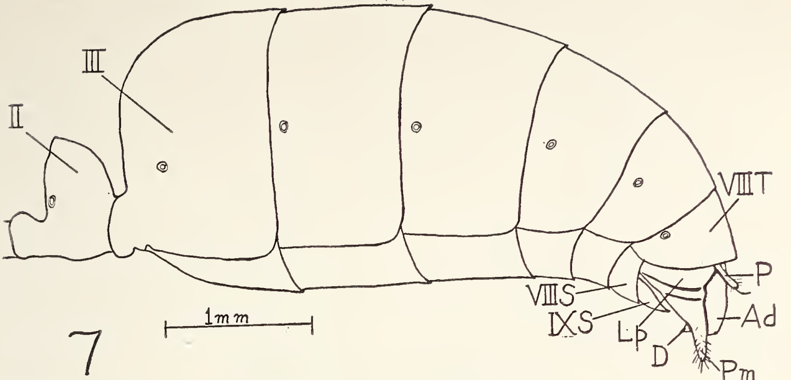


Explanation

The genitalic valves and terminal segments of *Camponotus pennsylvanicus* showing the scheme for measurements. Fig. 1, Median sagittal view of the genitalia which shows the three valves of one side in position: A, distance between caudal margins of the paramere and the lamina ædeagalis; B, distance between caudal margins of the lamina ædeagalis and the digitus volsellaris. Fig. 2, Lateral view of outer valve of genitalia: 1, length of paramere; 3, total length of outer valve; 4, distance between dorsal margins of the lamina parameralis and the paramere; 7, total width of outer valve. Fig. 3, Median view of inner valve, lamina ædeagalis: a, distance from caudal margin to the first distinct tooth; b, total length of ventral margin; c, width at right angles to b; e, length of serrate edge between first and last distinct tooth. Fig. 4, Ventral view of the subgenital plate, IXth sternum: L, length of subgenital plate excluding cranial projection; W, width of subgenital plate. Fig. 5, Median view of middle valve: I, distance between the dorsal margins of the cuspis volsellaris and the digitus volsellaris; III, distance between dorsal margin of cuspis volsellaris and the point of the digitus volsellaris; V, distance between caudal margins of cuspis volsellaris and digitus volsellaris; VII, total length of middle valve. Fig. 6, Dorsal view of the pygostyle-bearing Xth tergum: M, length of pygostyle; N, width of pygostyle; T, thickness of pygostyle on dorsal surface.

EXPLANATION OF PLATE XVI

FIG. 7, Lateral view of male gaster. Fig. 8, Dorsal view of genitalia. Fig. 9, Detailed lateral view of lamina ædeagalis, inner valve. Fig. 10, Detailed dorsal view of the IXth and Xth terga. Figures 8, 9, and 10 are drawn to the scale indicated at the lower left of the plate. II–III, 2nd and 3rd abdominal segments; VIIIT–IXT, 8th and 9th abdominal terga; VIIIS–IXS, 8th and 9th abdominal sterna; X, tenth or anal segment; A, anus; Aa, ædeagal apodeme; Ad, ædeagus; C, cuspis volsellaris; D, digitus volsellaris; Da, dorsal surface of ædeagus; L, lamina ædeagalis; La, lamina annularis or basal ring; Lp, lamina parameralis; M, anal muscle; P, pygostyle; Pm, paramere; R, rectum; S, sperm gutter.


II
III
VIIIT
P
Ad
Pm
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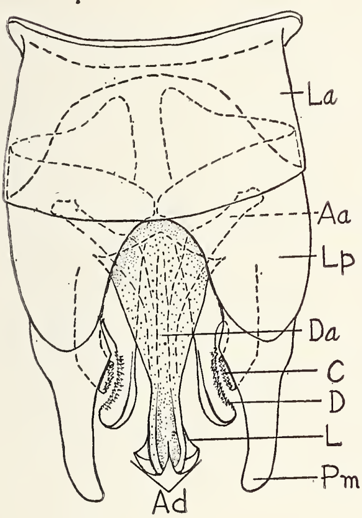
IXS
VIIIS
1mm

7


La
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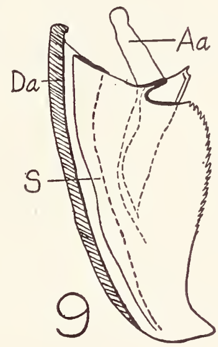
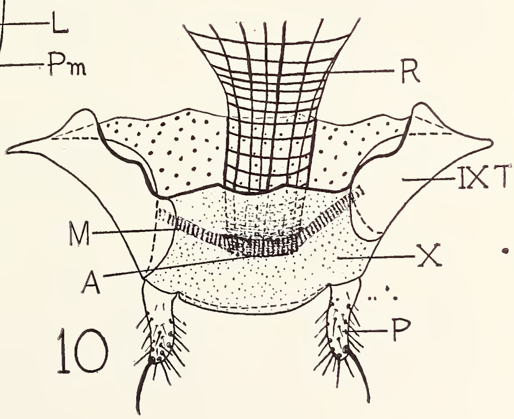
8


Aa
Da
S

9

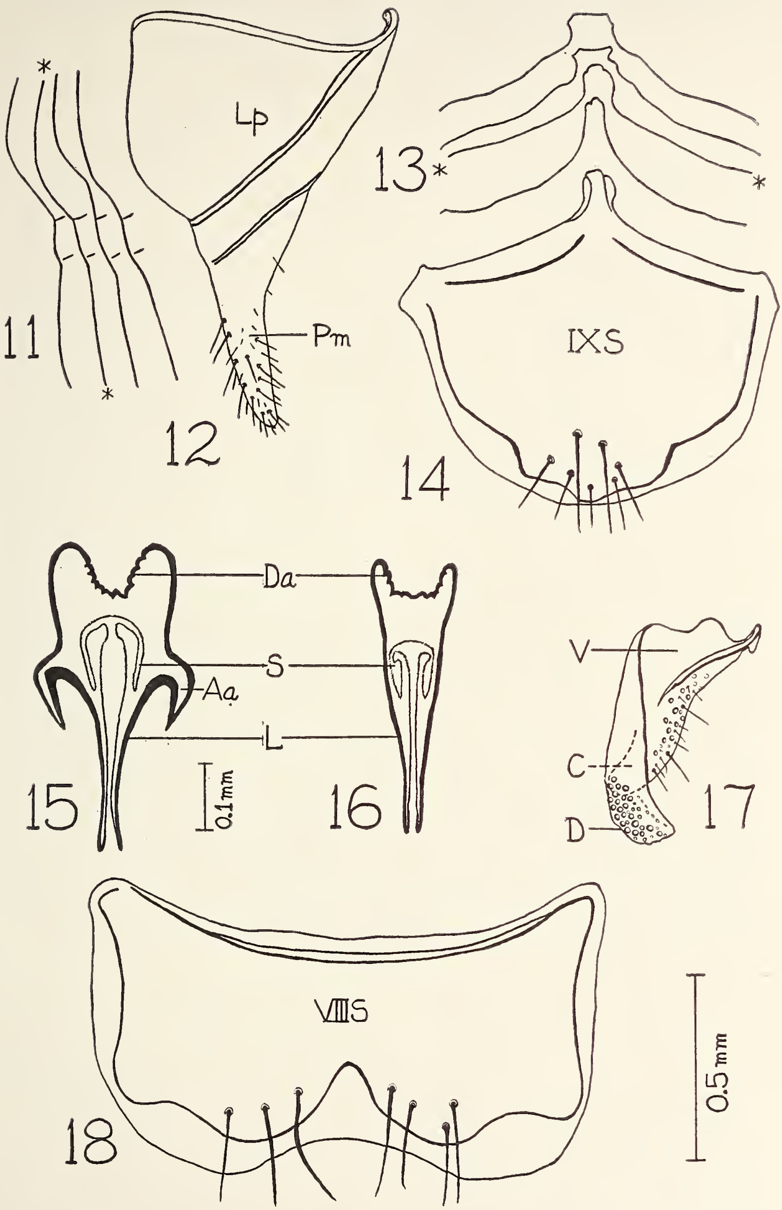

R
IXT
M
X
A
P

10

0,5 mm

Explanation of Plate XVII

Fig. 11, Outlines of various shapes of the dorsal margin of the outer valve —the one marked with * is the outline of fig. 12. Fig. 12, Detailed lateral view of the outer valve. Fig. 13, Outlines of various shapes of the cranial projection of the IXth sternum, the subgenital plate—the one marked with * is the outline of fig. 14. Fig. 14, Detailed ventral view of the IXth sternum. Fig. 15, Outline of a cross-sectional view of the ædeagus taken through the middle. Fig. 16, Outline of a cross-sectional view of the ædeagus taken through the beginning of the posterior third. (Figures 15 and 16 show the position of the sperm gutters on the median surfaces of the laminæ ædeagales.) Fig. 17, Detailed median view of the middle valve. Fig. 18, Detailed ventral view of the VIIIth sternum. Figures 12, 14, 17, and 18 are drawn to the scale indicated at the lower right of the plate. VIIIS–IXS, 8th and 9th abdominal sterna; Aa, ædeagal apodeme; C, cuspis volsellaris; D, digitus volsellaris; Da, dorsal surface of ædeagus; L, lamina ædeagalis; Lp, lamina parameralis; Pm, paramere; S, sperm gutter; V, lamina volsellaris.


11
12
13
14
15
16
17
18
Lp
Pm
IXS
Da
S
Aa
L
0.1mm
V
C
D
VIIIS
0.5mm

AN ADDITIONAL SYNONYM IN *ANNAPHILA* (LEPIDOPTERA, PHALÆNIDÆ)

By Frederick H. Rindge
The American Museum of Natural History

Dr. Eugene Munroe of the Division of Entomology, Department of Agriculture, Ottawa, recently called the author's attention to the species described as *Brephos fletcheri* J. B. Smith (1907, Canadian Ent., vol. 39, p. 370), wondering whether or not it was correctly placed. This moth was described in the family Brephidæ by Smith, although most authors have regarded this group as a subfamily of the Geometridæ. An examination of the type in the collection of Rutgers University shows that this species was incorrectly determined by Smith; it is unquestionably an *Annaphila,* and it falls as a synonym of *arvalis* Henry Edwards (1875, Proc. California Acad. Sci., ser. 1, vol. 6, p. 136). The pattern and structures of the type, including the genitalia (the type is a male and not a female as stated on the type label) agree with the descriptions and illustrations given for *arvalis* in "A revision of the genus *Annaphila* Grote (Lepidoptera, Phalænidæ)," by Rindge and C. I. Smith, 1952, Bull. Amer. Mus. Nat. Hist., vol. 98, p. 210, fig. 1F. This extends the range of *arvalis* into the southern British Columbia; the type locality for *fletcheri* is Goldstream, B. C. (not Coldstream as given in the original description), March 23, 1902 (E. M. Anderson). A second male, from the collection of the Provincial Museum, Victoria, British Columbia, has been examined. It is from the same locality as Smith's type, and is dated March 22, 1903; this specimen is badly faded but is definitely referable to *arvalis* Henry Edwards.

THE STORY OF HARTONYMUS HOODI CASEY (COLEOPTERA: CARABIDÆ)

By J. Douglas Hood
Professor of Biology, Cornell University

The late Mr. Charles A. Hart, of the Illinois State Laboratory of Natural History—now the State Natural History Survey—was one of America's most competent systematic entomologists, though his published output was not great. In the field he could recognize at a glance most of the insects encountered, and give accurately not only their generic and specific names, but also the name of the authority, and tell whether or not the author's name should be placed in parentheses.

While I was under his egis, living at his home, we spent virtually every week-end, as well as many hours before and after work or classes, to and from the office, collecting or mounting material. In the fall of 1907, at Topeka and Havana, Illinois, he called my attention to a large and unusually-colored carabid beetle which was abundant under boards and other debris in the sandy areas along the Illinois River, especially at the Devil's Neck and Devil's Hole, but which he had been unable to identify. As an undergraduate student deeply interested in Coleoptera, I naturally collected every specimen on which I could lay my hands and spent many hours trying to place it in the proper genus, without success, and was finally forced to conclude that my trouble arose from the fact that it belonged in a new genus.

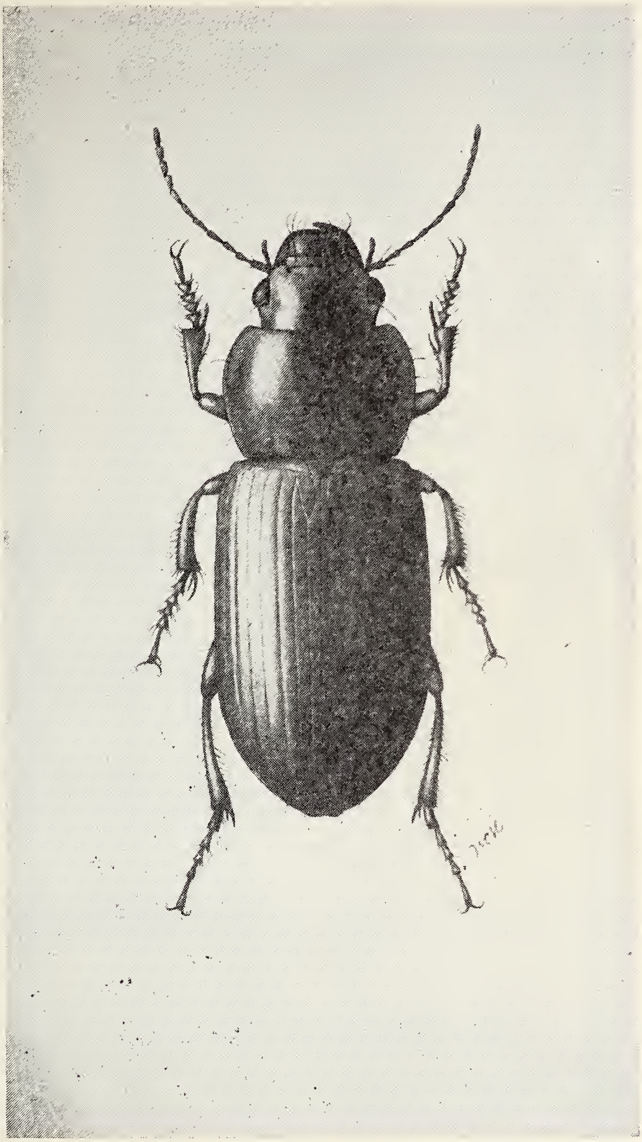
Mr. Hart insisted that I describe it, but the step seemed then too momentous a one to be taken without great deliberation. However, I finally brought myself to have Mr. William C. Matthews, on September 17, 1911, make the illustration which accompanies this note; and in 1913 or 1914, while with the old Bureau of Biological Survey, in Washington, telephoned to Colonel Thomas L. Casey to ask him to check my determination. The description was already written and about to be published.

When I called upon the Colonel at Stonleigh Court, where he lived and worked, at 4 P.M., just before his customary time of leaving for the Cosmos Club, he was in his study with his large binocular microscope covered for the day. As I explained my errand, with the closed box of beetles in my hand, telling him that they certainly represented a new genus allied to *Selenophorus* but that I could not understand why such a large and common and distinctive species could have been overlooked by collectors, I am sure that he listened to my tale with impatience. I know that he looked at his watch at least once. He must have thought that the beetle was some common species such as *Harpalus testaceus,* for he seemed rather brusque when he asked to see the specimens. Opening the box, he looked at the long rows which filled it, without a lens, and then he closed the box deliberately, placed it on the near corner of his desk, and aligned it with extreme care, not looking up. Finally he turned to me—and I remember his words well—and said, "I am an old man. This is the finest carabid that I have ever seen or will see, and I hope that you will allow me to describe it." He had already, within minutes, chosen a generic and specific name, the former based on my own and the latter having to do with color; but when I insisted that the genus not be named for me, but for Mr. Hart, he agreed. No thought entered my mind that our agreement would still permit him virtually to Latinize the collectors' label, which read "Hart and Hood."

There is perhaps little point in publishing all this, except that it throws some slight light upon Casey's nature and his intimate knowledge of the beetles; and it necessarily has to be written in the first person. But one should keep in mind that my bill for the drawing was six good dollars, and that they were earned at the rate of fifteen cents an hour—the standard rate at that time for student help at Illinois, when board was three dollars a week and a good room only one!

* * * * *

It might be well to append some additional information on the species, largely brought out in an exchange of letters between H. F. Wickham and the writer. The following is from a letter to him dated September 7, 1911: "I am sending you herewith a pair of the new genus and species of Harpalini. Although Mr. Hart and I are both moderately certain that the species is new and that it represents a new genus as well, we would greatly appreciate a statement from you in regard to it. In a linear ar-



Hartonymus hoodi Casey, paratype, × 6. Drawn by William C. Matthews.

rangement of the genera, this might well be placed after *Harpalus* and preceding *Selenophorus;* it appears to be very distinct from either. At Havana, Illinois, it is a truly abundant species and seems to reach maturity in October—perhaps as early as September, though certainly no sooner than the middle of August. It has not been taken in the spring; like other Carabidæ, however, it must certainly pass the winter as adult. Its resemblance to *Harpalus testaceus* and *H. erraticus* (which are both very common in such sandy situations), together with the fact that it never seems to be present during the late spring and early summer months, may possibly account for its previous non-discovery."

Wickham replied under date of September 8, 1911: "I have examined it carefully, and do not think it can possibly go into any of the North American genera of Harpalini. Your suggestion of placing it between *Harpalus* and *Selenophorus* is logical, in our present system, but I am struck with several features which seem to ally it rather with the Dapti. I doubt if the arrangement in the LeConte and Horn classification represents the genetic relationships at all closely. The insect occurs at Iowa City, in a small sand area along the river. I have it dated October 7, October 15, and March 30, so that your suspicion as to hibernation must be correct."

On September 12, 1911, I replied in part as follows: "Mr. Hart and I feel greatly indebted to you for your trouble in looking at the species and for your corroboration of our opinion regarding its systematic position. Mr. Hart had noticed the distinctly Daptine affinities at the time he had but a single female of the species, and in fact had assigned it to that series."

Casey's description was published in his Memoirs on the Coleoptera, V, pp. 165–167, November, 1914, from the material which Mr. Hart and I had taken at Topeka, Illinois. As mentioned above, we also found it at Havana, Illinois, and Wickham had material from Iowa City, Iowa—always in sandy areas.

Some of Casey's comments may be of interest in comparison with what has been said above: "That so conspicuous and aberrant a generic type should, in the thickly settled state of Illinois, so long have remained undiscovered, is merely a reminder that our Coleoptera are still only known in comparatively small part;

the peculiar pallid coloration of the body gives an appearance of immaturity, which may however possibly have led many a collector to reject it as undesirable material—always an unsafe procedure.'' Then, after mentioning a variety of characters which show it to be allied to *Harpalus,* he goes on to say, ''the only strong evidences of affinity in the direction of *Selenophorus* are the triple series of elytral punctures, uniformly punctate abdomen, and the *Discoderus*-like facies of the body; as however the triple series are unknown in *Harpalus* and allied genera, it would seem most fitting to place the genus here and not in the Harpalini. This genus is the best example known to me of the almost interminable cross affinities, which render a satisfactory subdivision into tribes and genera so difficult and uncertain throughout the Harpalinae.''

ENTOMOLOGICAL PALINDROMES

Ala. Wing.

Alula. Expanded axillary membrane of wing in Diptera and Coleoptera.

Givra anna Dyar. Specific name. (Lep.)

Agapema anona Ottol. Specific name. (Lep.)

Ababa Csy. Genus of Coleoptera.

Atta. Genus of Ants.

BOOK NOTICE

A Brief History of Entomology Including Time of Demosthenes and Aristotle to Modern Times with over Five Hundred Portraits. By Herbert Osborn. Columbus, Ohio: The Spahr & Glenn Company, 50 E. Broad St. 9 x 6 inches. iv + 303p. $4.50 postpaid.

Entomologists interested in the history of their science may now welcome another contribution to the history of entomology from Professor Herbert Osborn. This is the third volume by that author whose previous contributions on this subject were "Fragments of Entomological History," Parts I and II (1937 and 1946). The present volume, in three parts, was written primarily for beginning students or laymen and considering the size of the field, its coverage is of necessity brief. For this reason specialists in the history of entomology should not be disappointed in omissions or curtailments of certain facts which may have been covered in Professor Osborn's previous volumes. In part I, Chapter I, (p. 10–46), entitled Entomology in Commerce and Industry, discusses ecology, insect migration, insect illustration, entomological societies and periodicals, collegiate instruction and insect collections. Chapter II, (p. 47–65) includes statements about classification, anatomy, physiology and paleontology. Chapters III (p. 66–88) and IV (89–102) cover economic and medical entomolgy. In Part II, Chapter I (p. 103–171) is devoted to Regional Entomology—and therein may be found statements referring to some of the entomological work done in the various countries of the world. Part III (p. 173–294) is devoted to personal, thumb-nail sketches of The Founders and Leaders of Entomological Science, over 900 in number together with portraits of 522 of them.

Throughout the volume, the stress is upon individuals and their entomological works. The long, distinguished and varied entomological career of the author is compressed into four inadequate lines, which do nothing to indicate the esteem and respect in which he is held for his personal and professional accomplishments over many years. And one of his amazing accomplishments is his present volume at the age of ninety-six. It is a privilege to congratulate the author for his scholarship and zeal.

—HARRY B. WEISS.

A NEW MEALYBUG PARASITE (HYMENOPTERA: ENCYRTIDÆ)

By B. D. Burks

Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, United States Department of Agriculture

As Compere has pointed out (Univ. Calif. Pubs. in Ent. 8 (1): 15–22, 1947), there is a compact group of encyrtid genera related to *Anagyrus,* all of which, with one exception, are parasitic on mealybugs. While I was working out the identity of some mealybug parasite material submitted for identification, I segregated one form which was closely related to *Anagyrus* but could not be placed generically. Study of the literature and the material of the family Encyrtidæ in the U. S. National Museum collection finally showed that this form represented an undescribed genus. Several years ago Mr. A. B. Gahan placed in the National Museum collection specimens of this same form, which he had also segregated as an unknown genus. The material he studied had likewise been reared from mealybugs.

Anathrix, new genus

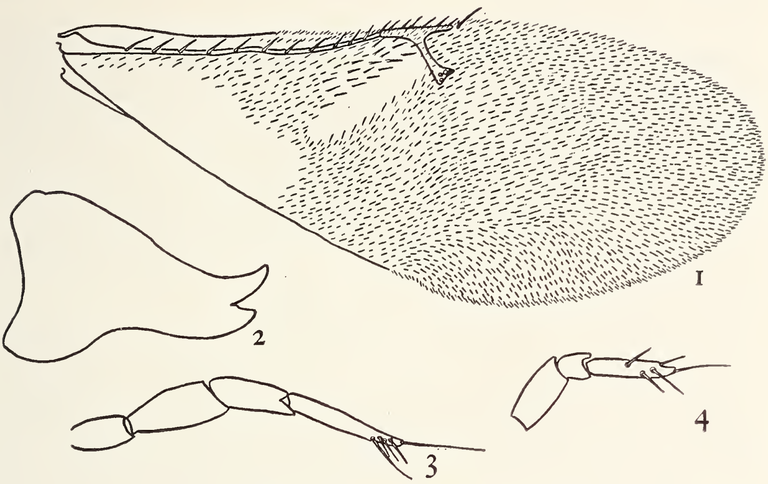
Description.—Head lenticular in shape; mandibles minute, each with two acute teeth, these teeth approximately of equal size; maxillary palp with four segments, labial with three; antennæ inserted near clypeus, slightly below level of ventral margins of compound eyes; a broadly-rounded, vertical ridge present between antennal bases; scape slender, cylindrical, its apex reaching level of vertex; pedicel slender, elongate; funicle with six segments, first segment one-half as long as scape and much longer than pedicel, following segments much shorter than first, club 3-segmented, sutures obscure; malar space narrow; eyes hairy; frons shagreened and with fairly dense, setose punctures distributed over the surface. Pronotum transverse, each postero-lateral margin deeply incised to fit projecting anterior angle of prepectus; mesoscutum shining; axillæ connate on meson, a short, longitudinal carina at their points of junction, this carina extending a short distance onto scutellum; surface of scutellum very minutely and closely pitted and dull, entire scutellum rather densely pubescent and one pair of long bristles borne near posterior angle; forewing with marginal vein longer than wide, shorter than stigmal vein and slightly longer than postmarginal; an asetose area extending obliquely posteriorly from stigmal vein; stout, black bristles present on outer apical margin of mesotibia and on ventral and outer sides of midtarsal segments; two spurs at apex of each hind tibia, one long, the other short. Propodeum with a patch of dense, short hair near either lateral margin, spiracles round; gaster with most of dorsal surface occupied by last tergite, cerci migrated anteriorly almost to base of gaster; ovipositor not projecting, apices of sheaths blunt, usually entirely hidden.

Type.—**Anathrix argyrus,** new species.

This genus is somewhat intermediate between *Anagyrus* Howard and *Leptomastix* Foerster. It agrees with *Leptomastix* in having the axillæ connate and medianly carinate, but differs in having both the marginal vein of the forewing and the antennæ much shorter; it agrees with *Anagyrus* in having the marginal vein short in relation to the stigmal vein, the frons being shagreened, and the scutellum bearing one pair of bristles, but it is distinguished from that genus by having the antennal scape slender and cylindrical. The scape in *Anagyrus* is flattened and greatly widened. The genus *Fulgoridicida* Perkins is closely related to *Anathrix,* but has the antennal pedicel twice as long as the first funicle segment. The genus *Anagyrodes* Girault has characters rather similar to those of *Anathrix,* but the two may be differentiated in that *Anagyrodes* has the postmarginal vein twice as long as the stigmal and the hind tibia has two short spurs. *Ericydnella* Girault is also characterized as being related to *Anathrix,* but the axillæ are not connate and medianly carinate. I have not seen authentically determined specimens of the genera *Anagyrodes* or *Ericydnella,* but have based my conclusions about them from the characterizations given in their original descriptions. Both were described from the Australian region.

In Compere's key to the genera related to *Anagyrus* (l. c., p. 17), this new form runs out near *Heterarthrellus* Howard. Compere had not, however, seen specimens of that genus and stated in his discussion that it was difficult to place it from the description alone. Howard's genus is represented by the type and a fairly good series of specimens of the genotype species in the National Museum collection. Study of these specimens showed that *Heterarthrellus* has the entire thoracic notum minutely pitted and dull, the antennal scape is almost as broad as in *Anagyrus,* the postmarginal and stigmal veins of the forewing are approximately equal in length, and the axillæ are not connate on the meson. As will be seen from the characterization given above for *Anathrix,* it differs in all these characters.

In Ashmead's key to the genera of the Encyrtidæ (Carnegie Mus. Mem. 1 (4): 286–311, 1904), *Anathrix* will run to the couplet separating *Anagyrus* and *Anusia* Foerster, from both of which it is excluded by its slender antennal scape. In Girault's key (Queensland Mus. Mem. 4: 179–183, 1915), it runs to *Fulgoridicida.* In Mercet's key (Fauna Ibérica, Himenópteros, Fam. Encírtidos, Madrid, pp. 60–73, 1921), it runs to



Explanation of Figure

1, Forewing; 2, Mandible; 3, Maxillary palp; 4, Labial palp.

Ericydnus Walker; in that genus the wings are usually wanting, but when they are present the postmarginal vein in each forewing is much longer than the marginal.

Anathrix argyrus, new species

Female: Length, 1.8–2.0 mm., mandible with dorsal tooth, fig. 2, slightly longer and more acute than ventral tooth; maxillary palp, fig. 3, with first and third segments short, subequal in length, second segment twice as long as either, fourth segment twice as long as third; labial palp, fig. 4, with first and third segments subequal in length, second segment only one-third as long as third. Antennal scape cylindrical, slightly enlarged toward apex; lengths of parts of antenna of holotype in mm.: scape 0.41, pedicel 0.12, first funicle segment 0.21, second 0.12, third 0.12, fourth 0.11, fifth 0.09, sixth 0.08, club 0.24. Interantennal protuberance entirely asetose, extending from clypeal margin to a point halfway between clypeus and anterior ocellus, ventral half of this protuberance smooth, rest of its surface minutely reticulated; face shagreened, setose pits distributed in a rather haphazard manner over most of the surface, setæ arranged in rows along either lateral margin of interantennal protuberance and transversely along ventral margins of either antennal socket; eyes with dense, short hair; length of malar space three-eighths as great as height of compound eye; width of face at dorsal end of interantennal protuberance one and one-half times as great as maximum anterior width of a compound eye; ocellocular line one-third as long as postocellar line; line from dorsal margin of anterior ocellus to vertexal carina two and one-quarter times as long as line from posterior margin of lateral ocellus to vertexal carina.

Mesoscutum and tegulæ rather densely clothed with fairly long hair, the pubescence borne by axillæ and mesoscutellum shorter, finer, and slightly more dense; surface of mesoscutum shining, almost smooth, showing very faint surface reticulations; tegulæ with minute, elongate alveoli; axillæ and mesoscutellum very closely and minutely pitted, dull; pleura minutely alveolar. Forewing, fig. 1, with a vaguely-defined, small, brown cloud at inner margin of stigmal vein; marginal vein three times as long as wide, stigmal vein one and one-half times as long as marginal, postmarginal two-thirds as long as marginal; each hind wing with three hamuli, submarginella vein with one bristle near base; a few setæ borne on ventral surface of each mid coxa, hind coxa bearing hair on outer and ventral surfaces.

Each lateral area of propodeum densely covered by woolly hair, spiracle located three times its own diameter from anterior margin of propodeum. Length of gaster slightly greater than length of alitrunk; first visible tergite of gaster rather densely clothed with short hair anteriorly and laterally, postero-median area glabrous; last tergite sparsely clothed with longer hair, this tergite occupying more than two-thirds of dorsal surface of gaster; each cercus bearing four long bristles, three stout and one slender; gastral sternites sparsely hairy laterally and on median ventral area.

Head and body black with silvery hair and setæ; antennal scape tan, pedicel and funicle black, club white; forewings faintly infumated, subhyaline, hindwings hyaline; all coxæ black, basal half to two-thirds of each femur black, apices of femora tan, tibiæ and tarsi tan, claws black.

Male.—Unknown.

Type locality.—Berryville, Va. Types.—U. S. N. M. no. 61201.

Described from 9 specimens, as follows: Holotype female, Berryville, Va., May 6, 1945, reared from *Ferrisiana virgata* (Cockerell), D. W. Clancy; Paratypes: Winchester, Va., May 12, 1944, reared from *Ferrisiana virgata* (Cockerell), D. W. Clancy, 6 ♀; Brownsville, Tex., Feb. 8, 1936, collected on cotton, P. A. Glick, 1 ♀; Ste. Anne Sorel, P. Q., June 16, 1950, A. Robert, 1 ♀. All types deposited in the U. S. National Museum collection.

INHIBITION OF GROWTH OF A MOLD QUANTITATED TO DEMONSTRATE THE EFFECT IN INSECT SPECIMEN BOXES[1]

By CDR John D. DeCoursey, MSC, USN[2] and
CDR A. P. Webster, MSC, USN[3]

Naval Medical Field Research Laboratory
Camp Lejeune, North Carolina

INTRODUCTION

One way to protect insect collections contained in specimen chests from molding is to incorporate a substance within the chest, the vapors of which are fungicidal or fungistatic. Further, the substance should have the property of low volatility so that prolonged action is obtained.

Two such substances, having the required physical properties, which have been used for years in insect collections to protect them from museum pests, and which are in common use by every housewife to protect clothes, are naphthalene and paradichlorobenzene.

Bolcato (1) found that naphthalene vapors inhibited sporification of aspergilli; and Bishopp (2) says that both naphthalene and paradichlorobenzene are mold inhibitors, but that naphthalene is considered preferable for insect collections because of its lower volatility. The following study was undertaken in order to evaluate the quantitative effect of naphthalene vapor as a fungistatic agent against a single mold—*Penicillium.*

EXPERIMENTAL METHOD

Four Petri dishes were prepared with Sabouraud's dextrose media (Difco dehydrated media) by seeding with a piece of mycelial mat transferred from a contaminant (*Penicillium*) on a Sabouraud's agar plate. Two of the dishes were sealed with scotch tape and placed aside as controls. The other two were treated with naphthalene by suspending 0.2 gram of naphthalene

[1] This work is not to be construed as necessarily reflecting the views of the Navy Department.

[2] Head, Department of Entomology.

[3] Research Director.

crystals from the inner surface of the Petri dish cover by means of a small square of bobbinet held in place by adhesive tape. These dishes were also sealed with scotch tape and placed beside the controls at room temperature (approximately 78° F.). The diameter of the mold, during its growth, was measured in the

TABLE 1

GROWTH OF *Penicillium*

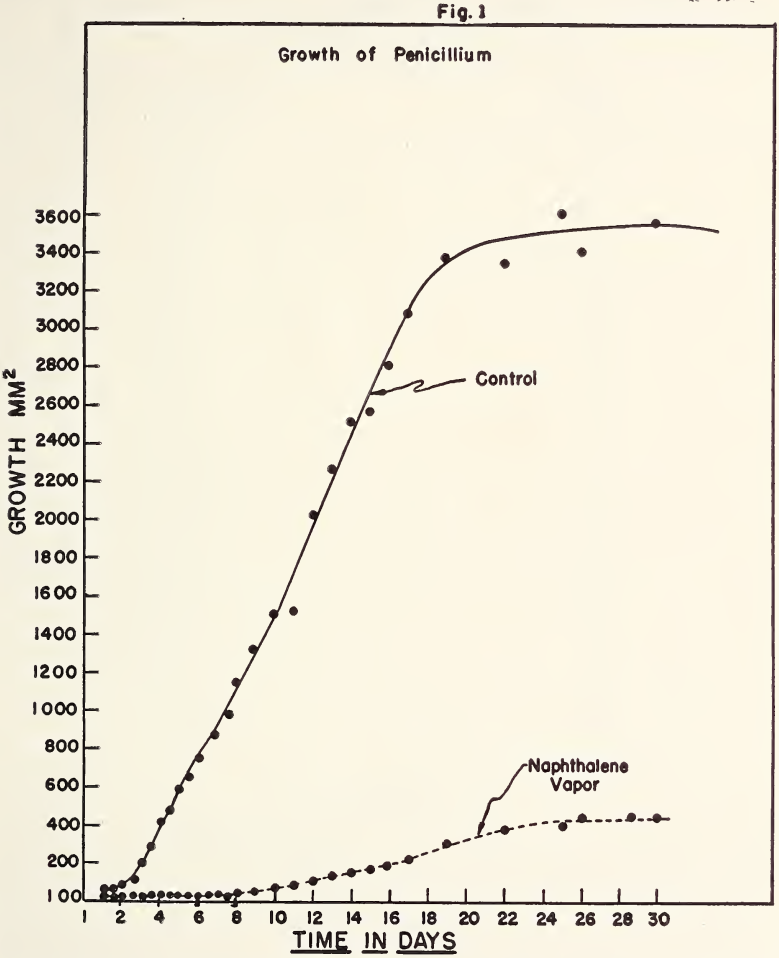
Time Days	Growth Naphthalene Treated mm^2	Growth Control mm^2
0	......	......
1	21	26
1.5	22	47
2	23	74
2.5	25	96
3	23	194
3.5	24	269
4	24	417
4.5	24	464
5	24	583
5.5	26	645
6	28	747
6.5	29	740
7	29	876
7.5	27	979
8	31	1158
9	42	1314
10	62	1514
11	88	1518
12	102	2023
13	139	2261
14	150	2498
15	165	2561
16	192	2804
17	222	3068
19	296	3370
22	373	3349
25	412	3605
26	421	3406
30	423	3563

four dishes by taking multiple readings, always at the same points, with a millimeter rule. Two readings a day were taken for the first seven days when the mold growth was most rapid and occasional readings thereafter. Subsequently the mean diameters of the treated and untreated molds were obtained and the surface area of the mold calculated.

RESULTS AND DISCUSSION

Table 1 shows the mean growth of *Penicillium* treated with naphthalene vapor in a closed Petri dish, compared with the untreated control. Figure 1 is a plot of the data from Table 1. Table 2 shows a comparison by day of growth of the naphthalene

Fig. 1



treated in per cent of the control. Figure 2 is a plot of the growth of the naphthalene treated mold in percent of the control growth.

The area of the control mold increased rapidly. The amount of growth was approximately 200 mm^2 per day. The growth of the naphthalene vapor treated mold was almost completely inhibited until the eighth day when a slight increase was noted. After the eighth day the naphthalene treated mold slowly increased in surface area for about 16 more days at which time

TABLE 2

COMPARISON OF NAPHTHALENE TREATED AND CONTROL GROWTH OF *Penicillium*

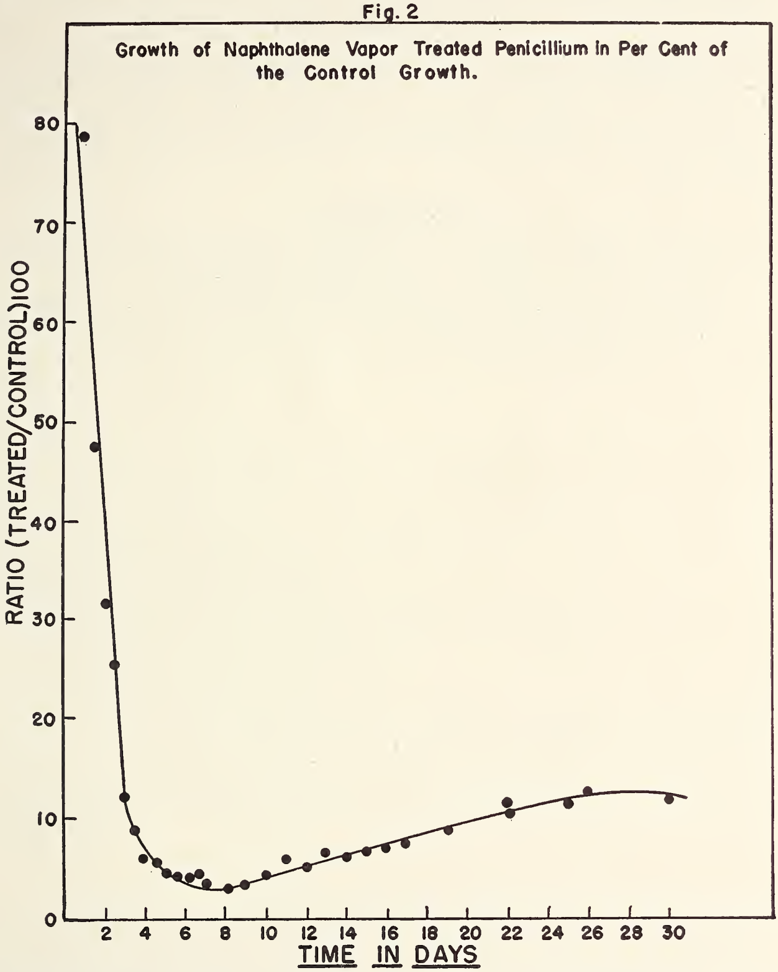
Time Days	Naphthalene/Control per cent
1	78.8
1.5	47.4
2	31.6
2.5	25.7
3	12.1
3.5	8.8
4	5.8
4.5	5.1
5	4.1
5.5	4.0
6	3.8
6.5	4.0
7	3.3
7.5	2.7
8	2.7
9	3.2
10	4.1
11	5.8
12	5.0
13	6.1
14	6.0
15	6.4
16	6.9
17	7.2
19	8.8
22	11.1
25	11.4
26	12.4
30	11.9

growth apparently ceased. Growth of the control also appeared mature on this same (24th) day. Grossly, the treated mold was whiter than the untreated control and showed considerable aerial growth. This aerial growth was about 5 mm in the center, whereas no such aerial growth was noted in the controls. At no time during its course of growth after the third day was the naphthalene treated mold over approximately 12 percent of the surface area of the control.

SUMMARY

The vapor of naphthalene crystals has a marked fungistatic action on *Penicillium* as shown by a comparison study of the growth of the mold on Sabouraud's media in a Petri dish. The

Fig. 2



growth of the mold under the influence of naphthalene vapor was completely inhibited up to the eighth day when slow growth took place to an apparent mature value of about 420 square millimeters on the 24th day, as compared with rapid growth of the control to an apparent mature value of about 3560 square millimeters on the 24th day. At no time during its course of growth after the third day was the naphthalene treated mold over approximately 12 percent of the surface area of the control.

ACKNOWLEDGMENTS

The authors wish to express their appreciation to LCDR W. W. Taylor, Jr., MSC, USN; J. G. Doub, HM1, USNR; and R. W. Gay, HA, USNR for their kind assistance in the conduct of this study.

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PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

Meeting of April 17, 1951

A regular meeting of the Society was held April 17, 1951, at the American Museum of Natural History; President Gaul in the chair. There were eleven members and two guests present.

The Field Committee announced a field trip to Alpine, New Jersey, for a Sunday in May. The June field trip will be to the home of Mr. Chris E. Olsen.

The Secretary announced that Dr. William B. Creighton, a member of the Society, had been awarded a Guggenheim Fellowship to carry out his studies on migratory ants.

Dr. Vishniac informed the Society of a new Chrysomelid beetle which has been introduced to fight the toxic Klamath weed. This represents a new introduction of a beetle to control a weed. Cattle and sheep who eat this weed become photosensitized. Dr. Spieth commented that the conservationists will not like this introduction, as it benefits the sheep grazers.

There being no further business, Dr. Vishniac introduced Dr. Sally Schrader of Columbia University who spoke on "The Cytotaxonomy of Mantids."

Dr. Schrader pointed out that the cytologist could contribute to an evolutionary significant taxonomy. The chromosomes are a valid, conservative character. For this work in cytotaxonomy, the nymphs must be collected. Dr. Schrader recounted her collecting experiences. The most interesting of these was finding a deep canyon, the tree-top fauna of which could be collected from an adjacent plateau.

There are three lines of chromosomal specialization in male meiosis:

1. Prolongation of pairing of homologous chromosomes.
2. A non-chiasmate type of bivalent.
3. The pre-metaphase stretch.

Dr. Schrader then discussed a peculiar type of compound sex chromosome which is not only cytologically but taxonomically significant. She pointed out the necessity for a revision of certain sub-families as a result of the presence or absence of this character. A discussion followed Dr. Schrader's presentation.

L. S. Marks, *Secretary.*

Meeting of May 1, 1951

A regular meeting of the Society was held May 1, 1951, at the American Museum of Natural History; President Gaul in the chair. There were 14 members and 10 guests present.

The Secretary reported on the latest correspondence concerning the Ninth International Congress of Entomology.

President Gaul announced that he had received news of the death of Dr.

William Proctor, and had appointed a Committee of Mr. Schwarz, Mr. Pallister and Mr. Marks to draw up a tribute. The tribute to Dr. William Proctor was read by Mr. Herbert F. Schwarz, and ordered incorporated into an obituary to be published in the next issue of the JOURNAL.

Dr. Vishniac wished to know whether water-striders ever go under water voluntarily. The concensus of opinion was in the negative. He then introduced the speaker of the evening, Past-President Dr. T. C. Schneirla who spoke on the Army Ant.

Dr. Schneirla reviewed the work that had been done on *Eciton hamatum* and *Eciton burchelli.* With the aid of slides and motion pictures, he then explained the development of sexual broods, colony division and mating in these ants.

L. S. MARKS, *Secretary.*

MEETING OF MAY 15, 1951

A regular meeting of the Society was held May 15, 1951, at the American Museum of Natural History; President Gaul in the chair. There were 11 members and 10 guests present. There being no formal business, President Gaul turned the meeting over to the Vice-President, Dr. Clausen. The meeting was devoted to activity reports by members of the Society and invited guests. .

President Gaul showed some pictures on the anatomy of wing muscles in the hornet. Dr. Forbes mentioned his own investigation of the genitalia of the Carpenter Ant and then introduced one of his graduate students at Fordham University, Mr. John Tafuri. Mr. Tafuri, who has been working with Dr. Schnierla on problems of polymorphism in the Army Ant, explained a system where, by the use of certain anatomical features, the larval age of certain polymorphic forms could be determined. Dr. Schneirla commented on the excellence of the paper and pointed out that it represented collaboration between the Museum and the University.

Mr. Marks then reported on some details of the lepidopterous head. The morphology of the head in Lepidoptera, exclusive of the mouthparts, has been a neglected subject. The so-called transfrontal suture often reported for Lepidoptera was found to be not homologous with this suture in other orders, and several explanations of this were offered.

Mrs. Vaurie reported on her Revision of the Broad-nosed Weevils, an economically important group. The shape of the scales in this weevil was found to be a character of taxonomic importance.

Dr. Schneirla then reported on Miss C. Jackson's experiments in insect psychology. She found that in a dozen runs, ants (*Formica inorta*) would learn the shortest run.

Dr. Vishniac reported further on his polarization studies. He is now working on behavior in the water striders. Dr. Donohoe reported that the degree of infestation of the sheep tick in New Jersey was severe. There were no ticks last year. He suggested perhaps that some wild animal might act as the reservoir.

L. S. MARKS, *Secretary.*

Meeting of October 2, 1951

A regular meeting of the Society was held October 2, 1951, at the American Museum of Natural History; President Gaul in the chair. There were 10 members and 4 guests present.

Mr. Pohl, co-delegate of the Society to the International Congress at Amsterdam advised the Society of his inability to attend the International Congress.

Mr. Harriot reported for the Field Committee. The Field trip of May 20 was postponed until May 27. Because of the inclement weather, few members showed up and the collecting was poor. The field trip of June 10 to Mr. Chris Olsen's was attended by a number of members of the Society.

The Secretary read a letter of appeal from the Zoological Society of London, the publishers of the ZOOLOGICAL RECORD. Because of its importance, Dr. Forbes suggested that this letter be read at several subsequent meetings.

The Secretary informed the Society of the recent appointment of Dr. R. B. Swain to the Point Four program, and of the death of the English myrmecologist, Dr. Donis Thorpe. President Gaul then called on various members and guests to relate their experiences of this past summer.

Mr. Pohl visited the French Museum of Natural History. Dr. Jeannel, the director, has retired and in his place, subject to verification by the Academy of Sciences and the Ministry, Dr. Chopard has been elected. Mr. Pohl also visited with Dr. Bertrand, the expert on water beetles and with Prof. Portier of the Sorbonne. Prof. Portier has published a book on the biology of the Lepidoptera.

Mr. Harriot collected Diptera and some butterflies at Alpine, New Jersey.

Mr. Gaul found that the wing beat in Diptera was almost identical with the wing beat of the Hymenoptera which they imitate. He called this phenomenon audio-mimicry.

Mr. Roensch was stung while taking motion pictures of the ichneumon fly Megarhyssa.

Dr. Clausen reported on the prevalence of Tingids in the Bronx this summer.

Mrs. Vaurie spent the summer at the Lerner Marine Laboratories and collected Buprestids by day, and Longicorn beetles by night. She also bred Cerambycids in breeding cages. Mrs. Vaurie then mentioned that she had used the Berlase funnel to collect minute insects.

Mrs. Donohoe then spoke of her new interest in acarinology. She has been making a survey of all the mite families.

Dr. Donohoe then explained the Berlase funnel. A discussion on the funnel followed, with Messrs. Gaul, Marks, Donohoe, Mrs. Donohoe and Dr. Clausen participating.

Dr. Donohoe told of his teaching Nature Study to children whose ages ranged from 5 to 13.

President Gaul then spoke in some detail on his wing muscle experiments.

The wing muscles do not contract as fast as the wings beat. The abdominal movements are synchronized with the contraction of the wing muscles. There are about 20 contractions a second for a wing beat of 120.

L. S. MARKS, *Secretary.*

MEETING OF OCTOBER 16, 1951

A regular meeting of the Society was held October 16, 1951, at the American Museum of Natural History; President Gaul in the chair.

The Secretary read the letter from the Zoological Society of London in reference to support of the ZOOLOGICAL RECORD and the President appointed Mr. Sam Harriot a committee of one to coordinate the raising of money for the Record.

Mrs. Vaurie called the attention of the Society to the COLEOPTERISTS BULLETIN, published by the Coleopterists Society.

The speaker of the evening, Dr. Charles Vaurie, then spoke on his collecting trip with Mrs. Vaurie in the Western United States for Cicindellidæ. The trip was in the Northwestern States from Central Iowa to Wyoming, Colorado and the Canadian province of Alberta. It took about 11 weeks and they collected about 7,000 tiger beetles. Dr. Vaurie showed slides of various species, including some of the rarer color forms. The meeting adjourned at 9: 20 P.M.

L. S. MARKS, *Secretary.*

MEETING OF NOVEMBER 20, 1951

A regular meeting of the Society was held November 20, 1951, at the American Museum of Natural History; President Gaul in the chair. There were 12 members and 5 guests present.

Mr. Edgar D. Mullgrav, 3758 Tenth Avenue, New York 34, New York, was proposed for membership.

Mr. Schwarz, as delegate to the New York Academy of Science reported on the proposed change in Article 6 of the by-laws of the New York Academy of Science. The amended article would exclude the votes of the delegates of the affiliated Societies in Council. A discussion followed. The President announced he would call an Executive Committee Meeting to discuss the question of our relations with the New York Academy of Science.

President Gaul suggested a Publicity Committee and appointed Mr. Pohl to it.

The speaker of the evening was Miss Alice Gray who spoke on Wasps Nests. In reality, she said it was a preliminary survey of the nests of social Hymenoptera in the collection of the American Museum of Natural History.

By means of an ingenious pictorial key Miss Gray separated the nests into two major and several minor categories. The talk was illustrated both by Kodachromes taken by Dr. Clausen and by the actual specimens. Miss Gray pointed out the paucity of the literature on the subject.

L. S. MARKS, *Secretary.*

Meeting of December 4, 1951

A regular meeting of the Society was held December 4, 1951, at the American Museum of Natural History; President Gaul in the chair. There were 19 members and 27 guests present.

President Gaul appointed a Nominating Committee consisting of Dr. Cazier and Messrs. Pallister and Harriott and an Auditing Committee of Dr. Gertsch and Mr. Huntington. Mr. Edgar D. Mullgrav, 3758 Tenth Avenue, New York 34, New York, was elected to membership.

The Secretary read the recommendation of the Executive Committee that the Society elect Dr. A. Petrunkevitch to Honorary membership. Upon the motion of Dr. Spieth, Dr. Petrunkevitch was unanimously elected. The total number of Honorary members now stands at 9 out of a possible 12.

There being no other business, the Society heard Dr. Petrunkevitch speak on ''Macro-evolution in Arachnida.'' Dr. Petrunkevitch made a careful distinction between Macro- and Micro-evolution. This concept is due to the geneticist, Goldschmidt, and has been adopted by the paleontologist, Simpson. Dr. Petrunkevitch traced the evolution of the sternal plates in Scorpions as an illustration of his thesis. He showed, furthermore, how the whip scorpions have greater claim to the title ''living-fossil'' than does Limulus, the King Crab. Then, using the weaving of spiders as an example, he tried to show evolutionary patterns in instinct. Dr. Petrunkevitch terminated his talk by calling attention to various species which in his opinion have reached their evolutionary peak.

L. S. Marks, *Secretary.*

Meeting of December 18, 1951

A regular meeting of the Society was held December 18, 1951, at the American Museum of Natural History, President Gaul in the chair. There were 8 members and 3 guests present.

The Secretary called the attention of the members to the fact that Dr. Vishniac had won several prizes of the Biological Photographers Association.

The matter of the New York Academy of Sciences was again discussed.

Mr. Harriot reported that he had taken in $20.00 for the ZOOLOGICAL RECORD.

Mr. Pohl announced he had spoken to the Secretary about ''The Voice of America.'' A letter is in preparation.

Dr. Vishniac, in a highly amusing digression, informed the members of the censorship regulations relative to the publication of certain intimate pictures of insects.

The scientific discussion of the evening was ''The Orthoptera.'' It was led by Drs. James Forbes and John Rehn. Reminiscent of the early days of the Society, the members and guests sat about the speakers' table. As the discussion progressed, specimens and books were passed back and forth. Dr. Forbes presented the traditional viewpoint in Orthopteran Taxonomy. Dr. Rehn, in turn, presented some of the newer concepts. The members and guests agreed that it was a most interesting and informative meeting.

L. S. Marks, *Secretary.*

The
New York Entomological Society

Organized June 29, 1892—Incorporated February 25, 1893

Reincorporated February 17, 1943

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 24, N. Y.

Annual dues for Active Members, $4.00; including subscription to the Journal, $6.00.

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

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CONTENTS

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NEW LABIDOSTOMMIDÆ WITH KEYS TO THE NEW WORLD SPECIES (ACARINA)[1]

By Bernard Greenberg
University of Kansas

This paper describes three new species of *Labidostomma* and a new species of *Eunicolina* and includes keys for the differentiation of the eight known New World species of Labidostommidæ. This family has been infrequently collected in North America. The literature begins in 1823 with Thomas Say's description of *Erythrœus mammilatus* from "east Georgia". Jacot (1938) noted its resemblance to *Labidostomma* and Banks (1947) redescribed the species and placed it in *Labidostomma*. The only other species described from North America is *Labidostomma* (= *Ceratoacarus* = *Nicoletiella*) *pacificum* collected in Oregon by Ewing in 1913. The experience of the author and that of others who have attempted to collect this family seems to indicate that these mites are relatively rare. Whether this is actually due to small, sporadic populations, seclusive habits or a combination of ecological factors is still to be determined.

The separation of the genera *Nicoletiella* and *Labidostomma* is based primarily on the presence or absence of antero-lateral projections of the dorsum. It is doubtful that such a taxonomic division is a good one, especially since there is a transitional group represented by such species as *L. absoloni* (Willmann) and *L. longipes* Willmann; furthermore, little evidence exists that

[1] Contribution No. 810 from the Department of Entomology of the University of Kansas.

this structure is correlated with other morphological differences. Therefore, the author follows the practice of Grandjean (1942) and Baker and Wharton (1952) in synonymizing *Nicoletiella* with *Labidostomma.* More extensive collecting of the family will doubtless bring to light a fuller spectrum of variation enabling us to establish more valid taxonomic criteria. In this connection, it is noteworthy that in the American species studied, smooth cheliceræ and a famulus co-exist, and conversely, serrate cheliceræ and the famulus are mutually exclusive. If a study of the European species supports this observation, then the splitting of *Labidostomma* into two genera based on this combination of characters may be justified. Interestingly enough, in the *Eunicolina* species described in this paper, smooth cheliceræ and the pre-tarsal famulus are again associated. Corroborative studies of European forms may indicate a more basic separation of the genera along these lines than by the present criterion which differentiates *Eunicolina* from *Labidostomma.*

KEY TO THE NEW WORLD SPECIES OF LABIDOSTOMMIDÆ

1. Numerous single-pored tubercles extending caudad from level of lateral eyes; usual pair of multi-pored lateral tubercles absent.
Eunicolina porifera, n. sp.
Single-pored tubercles absent; pair of multi-pored lateral tubercles usually present .... *Labidostomma* 2
2. Dorsal body setæ plumose; spurs of tarsus I about half the length of tarsus; 360 μ long (without gnathosome) .... **L. plumosum,** n. sp.
Dorsal body setæ simple; spurs of tarsus I one third the length of the tarsus or smaller; 500 μ or longer 3
3. Lateral tubercles absent; tending toward olive green.
L. brasiliense Sellnick
Lateral tubercles present; yellow or brownish red 4
4. Cheliceræ toothed; famulus absent from pre-tarsus of leg I 5
Cheliceræ untoothed; famulus present (Fig. 4) 6
5. Dorsum with slight antero-lateral projections; lateral tubercles proportionately large (61 μ to 69 μ long); 500 μ long.
L. neotropicum (Stoll)
Dorsum without antero-lateral projections; lateral tubercles smaller (40 μ to 50 μ long); 700 μ long .... **L. barbæ,** n. sp.
6. Length 1200 μ; reddish brown; tubercle of proximal cheliceral seta strongly produced .... *L. pacificum* (Ewing)
Length 700 μ to 800 μ; lemon yellow or brownish yellow; tubercle of proximal cheliceral seta proportionately shorter 7

7. Dorsum with sculpturing confined to the propodasoma, otherwise granular, and with slight swellings in front of lateral eyes; brownish yellow .... *L. mammilatum* (Say)
   Dorsum uniformly sculptured, with no swellings in front of lateral eyes; lemon yellow .... **L. caloderum**, n. sp.

KEY TO THE KNOWN SPECIES OF EUNICOLINA

1. Proximal cheliceral seta mounted on a tubercle; median eye sessile; tip of fixus notched 2
   Proximal cheliceral seta sessile; median eye on tubercle; tip of digitus fixus unnotched .... *tuberculata* Berlese
2. Dorsum with antero-lateral projections; maxillary plate with usual 3 pairs of setæ; tubercles continuous along the sides of the podasoma. **porifera**, n. sp.
   Dorsum without antero-lateral projections; maxillary plate with 6 pairs of secondary setæ in addition to primary ones; tubercles absent from a portion of the sides of the podasoma .... *nova* Sellnick

Labidostomma caloderum, new species
(Figs. 1, 2, 3, 4)

This species closely resembles *L. mammilatum* (Say) but differs in the uniform sculpturing of both dorsum and venter which, in the latter, is confined to the propodosoma; the absence of lateral bulges in front of the eyes and the difference in color will further serve to distinguish this species. Both resemble *L. cornutum* (Canestrini and Fanzego) which, however, is larger and bears more prominent antero-lateral projections of the dorsum.

Lemon yellow mites with idiosoma proportionately slender (Fig. 1); dorsum with antero-lateral projections, somewhat concave behind lateral tubercles; 700 μ long, 425 μ wide.

Cuticle of dorsum and venter with rather uniformly distributed polygonal sculpturing; polygonal areas patterned as in *L. luteum* Kramer (Thor, 1931). Transverse ridges behind anterior pseudostigmata evanescent toward median line. Median eye and pair of lateral eyes present. All body setæ simple; dorso-central setæ subequal and generally shorter than dorso-lateral setæ. Posterior pseudostigmatic bases larger than anterior; both pairs pseudostigmatic setæ branched, anterior pair longer but with shorter branches; each posterior pseudostigma occupies anterior end of narrow trough in cuticle which runs lengthwise to fade in opisthosomal region. Sclerotized plate of ventral opisthosoma with anterior border broadly arcuate, occupying most of area behind legs IV (exclusive of genital and anal plates.)

Cheliceral blades somewhat shorter in proportion to length of cheliceral base than in other New World species. Opposing surfaces of digitus fixus and digitus mobilis lack teeth with latter rugulose; inner surface of distal portion of former smooth; tip of digitus fixus with bilobed notch for retention of moveable blade, inner lobe larger (Figs. 2, 3). Curved mandibular appendix (Grandjean, 1942), 19 μ, located externally near articulation of both blades. Cuticle of cheliceral base with characteristic polygonal pattern except in proximal portion which is striated. Distal and proximal cheliceral setæ with no diagnostic differences; tubercle from which latter arises, however, smaller in this and other New World species than in *L. pacificum* (Ewing).

Approximate length of legs as follows (excluding claws): I—620 μ; II—448 μ; III—413 μ; IV—531 μ. Ratio of length of leg I to leg II roughly the same as ratio of leg IV to leg III. Pre-tarsus of leg I with dorsal famulus on distal third (Fig. 4); paired dorsal spurs subequal, frequently with outer one 1 or 2 μ longer; all setæ simple. Pre-tarsus, tarsus and tibia of leg I with greater number of whip-like setæ than other legs—presumptive evidence of a sensory, possibly tactile function considering the palpating behavior of legs I. Tarsus II with two dorsal spurs, proximal one longer; unbranched setæ located primarily on dorsal and inner surfaces, except where tip of tarsus bears plumose setæ. Leg II with some tibial setæ branched; some genual setæ may show aborted branches. Tarsus III with branched and unbranched setæ and one slender, dorsal spur. Tibia III with simple setæ and pair of dorsal spurs, one about the middle and other more proximad. Tarsus IV with branched and unbranched setæ and no spurs. Tarsus, tibia, genu and femur of leg IV each with a whip-like dorsal seta. All leg setæ not specifically noted are simple.

Type material—Holotype male collected in soil on the University of Kansas Natural History Reservation, Douglas County, Kansas, on October 15, 1950 by the author and D. T. Dailey. Five male and five female paratypes collected under rocks in Lawrence, Douglas County, Kansas, March 28, 29, and April 1, 6, 1952 by R. E. Beer, W. LaBerge and C. C. Hall. The holotype and several paratypes have been deposited in the Snow Entomological Collections, University of Kansas. Paratypes will be placed in the collections of the United States National Museum.

Labidostomma barbæ, new species

(Figs. 5, 6, 7, 8)

This species resembles *L. integrum* Berlese from which it differs in the shape and setation of the maxillary plate, the outline of the anterior border of the dorsum, and its somewhat greater breadth in relation to its length.

Generally lemon yellow, though one entirely red specimen was taken in the same collecting area which is indistinguishable from the others in the cleared state. Idiosoma more rotund than *L. caloderum;* without antero-lateral projections of dorsum or concavity behind lateral tubercles; 700 μ long, 480 μ wide (Fig. 5).

Polygonal patterning of dorsum characteristically distributed in podasoma and gradually disappearing in opisthosoma; venter uniformly patterned. Polygonal areas as in *L. caloderum* but with slightly thicker borders. Transverse ridge between anterior and posterior pseudostigma. Median eye and pair of lateral eyes present. All body setæ simple; dorso-central setæ subequal, about same length as dorso-lateral setæ. Anterior and posterior pseudostigmatic bases subequal; both pairs pseudostigmatic setæ subequal, branched, but posterior pair with longer branches. Ventral opisthosomal plate parallel-sided, enveloping genital plate in male, but only partially enveloping genito-anal plate in female.

Digitus mobilis of chelicera serrate for half its length, size of teeth diminishing distally, becoming rugulose on distal half. Tip of digitus fixus bilobed with inner lobe larger (Fig. 6.). Curved mandibular appendix 26 μ long. Cuticle of cheliceral base with characteristic pattern except in proximal portion which is striated. Proximal cheliceral seta longer in *barbæ* than in *caloderum* in most cases, while the reverse obtains for distal cheliceral setæ.

Legs about same length as in *caloderum.* Leg I, however, thicker in this species—average maximum width of tarsus is 64 μ in barbæ and 48 μ in *caloderum.* Pre-tarsus of leg I without famulus; paired dorsal spurs subequal, usually with outer one 1 to 3 μ longer (Fig. 8); otherwise leg I as in *caloderum.* Tarsus II with two subequal dorsal spurs, the more distal stouter; fewer unbranched setæ than in *caloderum,* not located dorsally, but primarily on inner surface. Tibia II with some distal setæ branched. Tarsus III predominantly with branched setæ, simple ones proximal; one small dorsal spur. Tibia III primarily with simple setæ and pair of dorsal spurs, one about the middle and other more proximal. Tarsus IV with branched and unbranched setæ and no spurs. Tarsus, tibia, genu and femur of leg IV each with a whip-like dorsal seta. All leg setæ not specifically noted are simple.

The forms to be described as the deuto- and tritonymphal stages of *barbæ* were not reared in the laboratory but were taken on two separate occasions from the same collecting site. The assumption that they belong to this species is based on the following: they share the same diagnostic structures with the adults of this species; and they were collected together with these adults. They differ from the adults only in characters typical of nymphal forms, e.g., size, color, and structure of the genital and anal plates.

Both deuto- and tritonymphs are grey with gnathosome and distal segments of legs I yellow; opisthosoma yellow to light amber. These forms are softer-bodied and less sclerotized than the adults. Their occurrence in moist leaf mold under a heavy canvas is consistent with the predilection of adults of this family for moist, dark situations.

Deutonymph—400 μ long, 330 μ wide. Polygonal patterns distributed more laterally, extending dorsally from cheliceral bases to level of genital plates; otherwise absent from opisthosoma. Genital plates, contiguous or nearly so, with 3 pairs of setæ, and 2 pairs of suckers with anterior pair larger. Anal plates also with 3 pairs of setæ (Fig. 7). Approximate length of legs as follows: Leg—I 425 μ; II—307 μ; III—260 μ; IV—333 μ. Leg I proportionately thicker than in adults in both deuto- and tritonymphs.

Tritonymph—533 μ long, 413 μ wide. Integumental pattern as in deutonymph. Genital plates larger than in latter, less adnate, with suckers as before, varying in number of setæ—one specimen with 8 pairs, another with 12 pairs. Anal plate with 3 pairs of setæ, bearing a greater resemblance to adult form, about same distance from genital plate as in deutonymph (Fig. 7).

Type material—Holotype male, 4 male paratypes, 3 deutonymphs and 2 tritonymphs collected by the author in leaf mold under a heavy canvas in mixed hardwood stand about 3 miles southeast of Thomasville, Thomas County, Georgia, June 27, 1951; 2 paratype females and 1 deutonymph from moss, same location, July 23, 1951 and July 24, 1951, respectively, by the author. The holotype and several paratypes have been deposited in the Snow Entomological Collections, University of Kansas. Paratypes will be placed in the collections of the United States National Museum.

Labidostomma pacificum (Ewing)

Ceratoacarus pacificus Ewing 1913, Jour. Ent. and Zool., 5: 127.
Nicoletiella pacifica (Ewing), 1931 Sig Thor, Bdellidæ, Nicoletiellidæ, Cryptognathidæ. Das Tierreich, 56: 76.

Two tritonymphs taken "in soil from a mountain range, Colorado" by G. M. Goldsmith, date unknown, are now in the collections of the United States National Museum. Their length, 825 μ and 873 μ, and cheliceral characters including pronounced tubercle, strongly suggest that they are the immature forms of *pacificum,* previously known only from Oregon.

Labidostomma plumosum, new species
(Figs. 9, 10, 11, 12, 14)

This species differs from all other members of the family known to the author, by the presence of plumose dorsal body setæ. Other diagnostic differences are its small size, proportionately long spurs on tarsus I, the distinctive sculpturing of some areas of the integument (Figs. 10, 12), and the marked tendency toward plumose setæ.

Yellow brown when cleared. Idiosoma similar in shape to *caloderum* but lacking antero-lateral projections; 360 μ long, 205 μ wide, the smallest member of the family (Figs. 9, 15).

Polygonal patterns of dorsum largest in anterior and lateral areas, smaller and fading in median and caudal areas. Transition in pattern illustrated in Fig. 12. Median and pair of lateral eyes present. All dorsal body setæ plumose except first dorso-lateral seta; ventral setæ simple; dorso-central and dorso-lateral setæ subequal. Anterior and posterior pseudostigmatic bases subequal; pseudostigmatic setæ about same length, anterior one more branched. Ventral opisthosomal plate as in *caloderum*.

Digitus mobilis serrate on proximal half, size of teeth diminishing distally, becoming rugulose on distal half; inner surface of digitus fixus without prominence (Fig. 10). Tip of digitus fixus trilobed with innermost lobe largest and partially serrate (Fig. 11). Curved mandibular appendix about 9 μ long. Integumental sculpturing as in Fig. 10.

Approximate length of legs as follows: Leg I—300 μ; II—215 μ; III—200 μ; IV—266 μ. Pretarsus of leg I without famulus; pair of dorsal spurs about half as long as segment (Fig. 14); all setæ simple. Tibia I and genu I with branched setæ. Tarsus, tibia and genu of legs II, III and IV with branched setæ. Whip-like setæ not observed; spurs normally found on tarsus II and tibia III difficult to discern due to small size.

Type material—Holotype female and two female paratypes collected in oak leaf mold, Gale's Canyon, Winters, California, November 10, 1947 by A. T. McClay; deposited in the collections of the United States National Museum.

Eunicolina porifera, new species
(Fig. 13)

This is the first record for the genus in the Western Hemisphere. It differs from the descriptions of the two known European species in the following characteristics: the chelicerae are not serrate, the tip of the digitus fixus is bilobed, the proximal cheliceral seta is mounted on a tubercle, secondary maxillary

Table I. SUMMARY OF DIAGNOSTIC CHARACTERS

	L. caloderum	*L. barbæ*	*L. plumosum*	*E. porifera*
Length (without gnathosome)	700 μ	700 μ	360 μ	767 μ
Antero-lateral projections	present	absent	absent	present
Dorsal body setæ	simple	simple	plumose	simple
Length of pre-tarsal spurs, leg I	⅓ length of tarsus or less	⅓ length of tarsus or less	about ½ length of tarsus	⅓ length of tarsus or less
Famulus, pre-tarsus of leg I	present	absent	absent	present
Paired spurs, tarsus II	proximal one longer	subequal; distal one stouter	———	distal one longer
Genual setæ of legs	simple	simple	branched	simple
Digitus mobilis of chelicera	rugulose	serrate	serrate	rugulose
Tip of digitus fixus	bi-lobed inner lobe larger	bi-lobed inner lobe larger	tri-lobed innermost lobe largest	bi-lobed inner lobe larger
	neither lobe serrate	neither lobe serrate	innermost lobe serrate	neither lobe serrate
Prominence on inner surface of digitus fixus	present, smooth	present, rugulose	absent	present, smooth

setæ are absent, and the tubercles are not absent from a portion of the sides of the podasoma. The first three characteristics enumerated will separate this species from *E. tuberculata* Berlese, the type species, while the latter two serve to separate it from *E. nova* Sellnick.

Brownish grey; idiosoma similar to *L. barbæ* in shape, but larger; anterior border of dorsum broadly arcuate between antero-lateral projections; 767 μ long, 545 μ wide.

Polygonal patterns most conspicuous anteriorly and laterally, scattered in opisthosoma. Median eye and pair of lateral eyes present, all sessile. All body setæ simple. Dorso-central and dorso-lateral setæ subequal. Anterior pseudostigmatic setæ slightly shorter and more sparsely branched than posterior ones. Sclerotized plate of ventral opisthosoma as in *L. caloderum*. Tubercles, about 30 each side, commencing at level of leg II, extending uninterrupted caudad, absent from only small arc of posterior border of dorsum. Anteriorly, tubercles have dorso-lateral and lateral orientation; more laterally situated posteriorly. Each tubercle has a single pore and in profile resembles medieval Spanish helmet; some dome shaped, others pointed (Fig. 13). Usual multi-pored lateral tubercles absent.

Cheliceræ similar to *L. caloderum*. Opposing surfaces of fixed and moveable blades lack teeth, latter rugulose; tip of right digitus mobilis of holotype quadrifurcate; inner surface of distal prominence of digitus fixus smooth; tip of latter with a bilobed notch, inner lobe larger. Proximal cheliceral seta mounted on tubercle. Other structures as in *L. caloderum* but proportionately larger.

Approximate length of legs as follows: Leg I—740 μ; II—531 μ; III—472 μ; IV—650 μ. Tarsus II with distal spur longer than proximal one. Tibia II with simple setæ. Chætotaxy of remaining segments of leg II and of legs I, III and IV resembling *L. caloderum*.

Type material—Holotype female and 1 female paratype collected in leaf mold, Cape Henry, Virginia, May 22, 1927 by H. S. Barber; deposited in the collections of the United States National Museum.

ACKNOWLEDGMENT

The author gratefully acknowledges the assistance given him by Dr. Charles D. Michener, Chairman of the Entomology Department, University of Kansas, Dr. Robert E. Beer of the same department, and Dr. Edward W. Baker of the United States National Museum. The latter generously placed the collections of the National Museum at the author's disposal.

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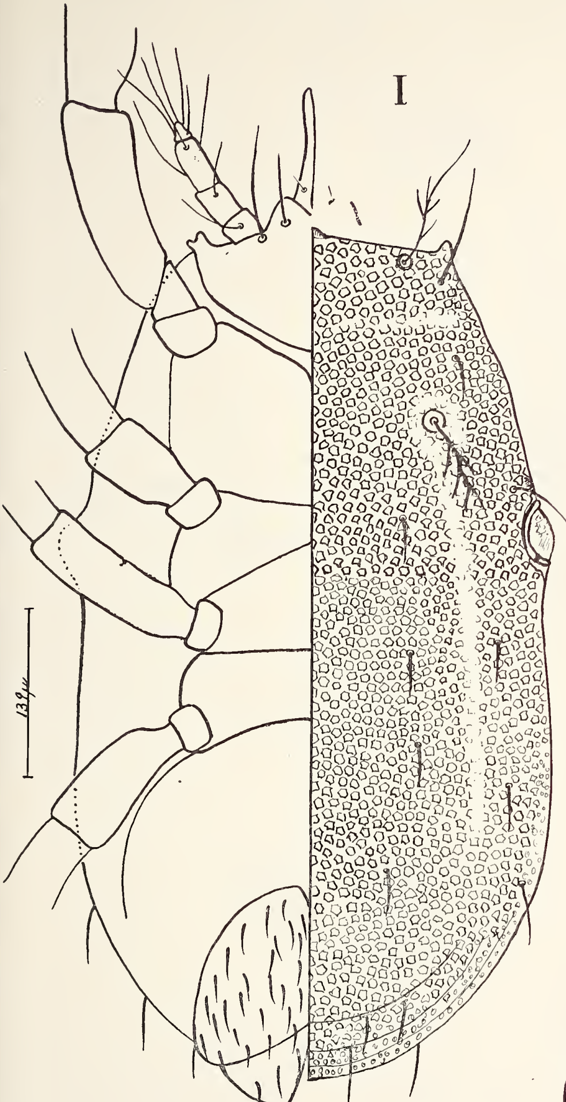
EXPLANATION OF PLATE XIX

Labidostomma caloderum, n. sp.

1. Dorso-ventral aspects.
2. Left chelicera.
3. Distal aspect of chelicera, enlarged.
4. Pre-tarsus of leg I showing dorsal spurs and famulus.



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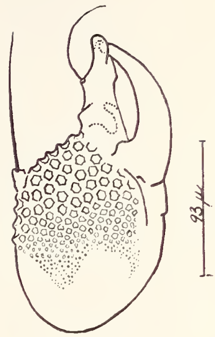

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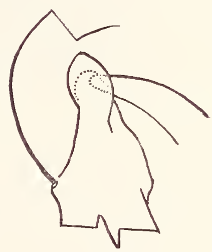

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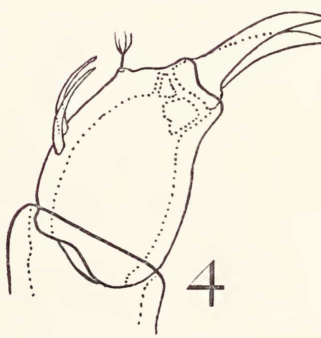

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EXPLANATION OF PLATE XX

Labidostomma barbæ, n. sp.

5. Dorso-ventral aspects: *dc,* dorso-central, and *dl,* dorso-lateral setæ.
6. Left chelicera.
7. Genital and anal plates of deutonymph and tritonymph.
8. Pre-tarsus of leg I showing dorsal spurs.

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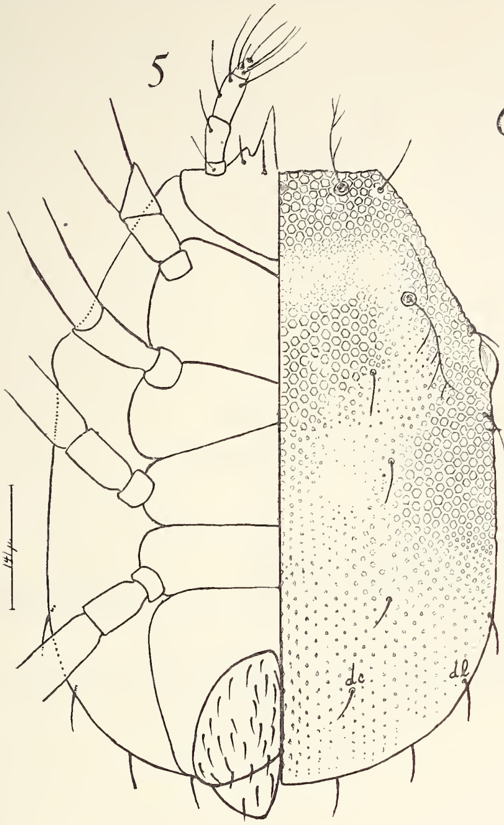

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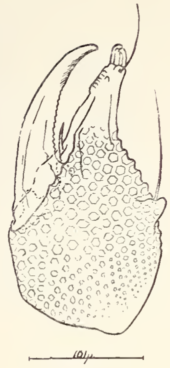

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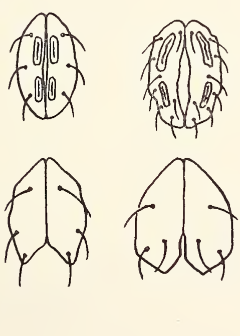

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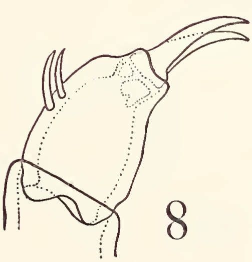
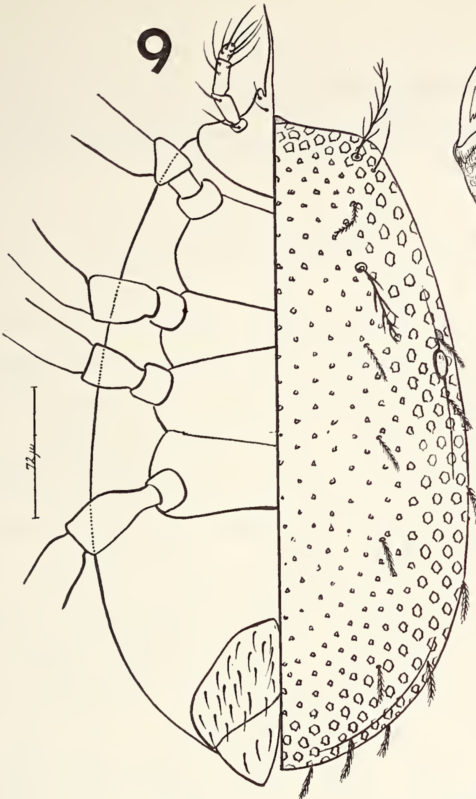


EXPLANATION OF PLATE XXI

Labidostomma plumosum, n. sp.

9. Dorso-ventral aspects.
10. Left chelicera.
11. Tip of *digitus fixus* of chelicera, enlarged.
12. Portion of integumental pattern of dorsum.
13. *E. porifera.* Lateral portion of podasoma showing dorsal and lateral tubercles: *a,* eye.
14. Pre-tarsus of leg I showing dorsal spurs of *plumosum.*
15. Comparison of dorsal plates: *a, L. caloderum; b, L. barbæ; c, L. plumosum.*



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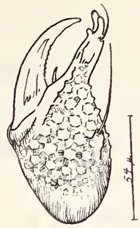

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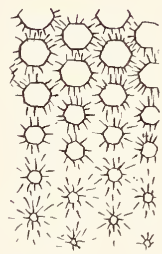

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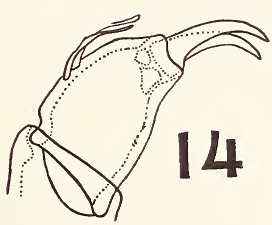

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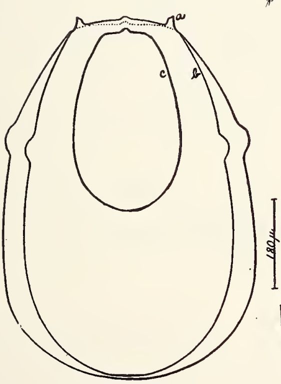

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BOOK NOTICE

Green Treasury. By Edwin Way Teale. Dodd, Mead and Company. New York City, N. Y., Dec. 1952. $8\frac{1}{2} \times 5\frac{1}{2}$ inches. xxii + 615 p. $5.00.

"Green Treasury" is an anthology of nature writing consisting of one hundred eighty-two selections of writings from Aristotle and Pliny to Rachel Carson. This is an anthology in the true sense of the word, for the collection contains the classics of the great naturalists. Outstanding contributions from some eighty-seven authors and from all parts of the world are included.

The selections, mostly of one or two pages in length, are grouped into eleven chapters containing items composed around the same subject. The following chapters are formed: The Waters, The Land, The Sky, Night and Day, The Seasons, Plants, Animals, Reptiles, Insects, Birds and Man and Nature.

This book should be of real value in introducing the subjects of natural history and naturalists to the unintroduced. And the naturalist, among others, is also provided with a wealth of inspiration and reference in very compact form. This is of real importance in this day of hustle and television.

It was interesting to note that Henry D. Thoreau is represented by twelve items for a total of forty pages. The longest article, "The Moose Hunt," taken from *The Maine Woods* is only twelve pages in length. These extracts from Thoreau's writings are admirable introductions to his work, as are the eight articles for a total of thirty pages from the works of William Henry Hudson.

"Green Treasury" is an excellent and valuable addition to Teale's growing list of excellent and valuable books.—F. A. S.

THE GENUS PACHYBRACHIUS IN THE UNITED STATES AND CANADA WITH THE DESCRIPTION OF TWO NEW SPECIES (HEMIPTERA: LYGÆIDÆ)

By Harry G. Barber, Collaborator,
Bureau of Entomology and Plant Quarantine,
United States Department of Agriculture

Genus PACHYBRACHIUS Hahn

Pachybrachius Hahn, 1826, Icon. Mon. Cinicum, fasc. I, No. 18; Barber, 1939, Sci. Surv. Porto Rico and Virgin Islands 14: 351; China, 1943, in the Generic Names of British Insects, Part 8, p. 239.

Orthœa Dallas, 1852, List Hemip. Brit. Mus., Vol. 2, p. 580 (in part); Van Duzee, 1917, Cat. Hemip. No. Amer., p. 183; Barber, 1918, Psyche 25, 76; Blatchley, 1926, Heterop. E. No. Amer., p. 397; Bueno, 1946, Entom. Amer. 26: 66, 79.

Pamera Say, 1832, Hemip. No. Amer., p. 16 (in part); Le Conte, Compl. Writ., Vol. 1, p. 333 (in part); Stal, 1874, Enum. Hemip., Pt. 4, p. 147 (in part).

Characters of the genus: Body elongate, narrow, either nude or very slightly pilose. Head slightly exserted, base of head most often, rather suddenly contracted, postocular margin usually nearly equal to the preocular margin to base of the antenna, much broader across eyes than anterior margin of the pronotum. Antennæ slender; basal segment shorter than head, surpassing apex of head, usually by nearly one-half of its length. Basal segment of rostrum shorter than head. Pronotum strongly constricted at middle or just behind middle; anterior lobe narrower and usually never more than doubly longer than the posterior lobe; collar distinct; posterior margin fairly straight. Corium finely punctate; clavus punctate in irregular series. Anterior femora strongly incrassate, provided below with several spines, often arranged in two series.

Type of the genus: *Pachybrachius luridus* (only included species).

This genus is closely related to *Ligyrocoris* from which it differs by the absence of the lunate, strigose vitta on either side of the base of venter. The genus is very widely distributed in the warmer parts of the world.

Five species are recognized from the United States and two new species are added herewith.

Pachybrachius luridus Hahn

Pachybrachius luridus Hahn, 1826, Icon. Mon. Cimicum, fasc. 1, no. 18.

Pamera lurida, Oshanin, Kat. Palaark. Hemip., p. 33; Lethierry and Severin, 1894, Cat. Gen. Hemip., Vol. 2, p. 193.

Orthœa lurida, Parshley, 1923, Ent. News 34: 22; Blatchley, 1926, Heterop. E. No. Amer., p. 398, 400; Bueno, 1946, Entom. Amer. 26: 80; Moore, 1950, Natur. Canad. 77: 14.

Head shining, subequal to the anterior lobe of the pronotum. Basal segment of the antenna exceeds apex of head by less than one-half of its length. Pronotum uniformly dull fuscous, or sometimes the posterior lobe may be slightly paler, finely pilose, deeply, sharply constricted just behind the middle; anterior lobe one-third longer and nearly one-fourth narrower than the posterior lobe. Scutellum equilateral. Commissure one-half as long as scutellum. Corium nearly as long as head and pronotum combined, devoid of a transverse median fascia. Anterior tibia strongly curved. Length 4.50–5.00 mm.

This is an European species collected at Montreal, Canada, by E. R. J. Beaulne, as reported first by Parshley, 1923, and by Moore in 1950. It is possibly an adventitious species as no other records have been published.

Pachybrachius fracticollis (Schilling)

Pachymerus fracticollis Schilling, 1839, Beitr. Z. Entom. 1: 82; Tab. 7, fig. 6.

Pamera fracticollis, Oshanin, 1912, Kat. Palaark, Hemip., p. 33; Lethierry and Severin, 1894, Cat. Gen. Hemip., Vol. 2, p. 192.

Orthœa fracticollis, Parshley, 1923, Ent. News 34: 22; Blatchley, 1926, Heterop. E. No. Amer., p. 400; Bueno, 1946, Entom. Amer. 26: 80; Moore, 1950, Natur. Canad. 77: 14.

Head slightly shining, one-fourth wider than long. Basal segment of antenna exceeds apex of head by one-half of its length. Pronotum nude; anterior lobe but little shorter and one-third narrower than the posterior lobe, the latter testaceous, with five, rather vague, longitudinal fasciæ. Scutellum a little longer than wide. Commissure more than half as long as scutellum. Corium devoid of a transverse fascia; costal margin much longer than head and pronotum combined. Anterior tibia fairly straight. Length 5.50–6.00 mm.

This is another European species and the data for it are the same as for the preceding species.

Pachybrachius basalis (Dallas)

Rhyparochromus basalis Dallas, 1852, List Hemip. Brit. Mus., Vol. 2, p. 575.

Orthœa basalis Van Duzee, 1917, Cat. Hemip. No. Amer., p. 185; Barber, 1923, Conn. Geol. Nat. Hist. Surv., Bull. 34, p. 727; Blatchley, 1926, Heterop. E. No. Amer., pp. 399, 401; Bueno, 1946, Entom. Amer. 26: 81.

Pamera curvipes Stal, 1874, Enum. Hemip., Pt. 4, p. 148 (NEW SYNONYMY).

Head about one-fourth wider than long, slightly shining. Basal segment of antenna scarcely exceeds apex of head. Pronotum nude, anterior lobe a little longer than the head; one-third longer and nearly one-third narrower than the posterior lobe, the latter fuscous with two central fascia and humeral angles paler. Scutellum almost equilateral. Commissure one-third shorter than scutellum. Corium devoid of a transverse fascia; costal margin straight, equal to head and pronotum combined. Anterior tibia strongly curved. Length 6.50–7.00 mm.

Distribution: Canada through the eastern part of the United States west to Kansas, Texas and into Mexico.

Pachybrachius vincta (Say)

Pamera vincta Say, 1832, Heterop. Hemip. No. Amer., p. 16; Le Conte, 1859, Compl. Writ., Vol. I, p. 333.

Pamera parvula Distant, 1882, Biol. Cent. Amer., Rhynch., Vol. 1, p. 206, Tab. 19, fig. 12.

Orthœa vincta, Van Duzee, 1917, Cat. Hemip. No. Amer., p. 183; Blatchley, 1926, Heterop. E. No. Amer., pp. 398, 400; Bueno, Entom. Amer. 26: 81.

This is the smallest member of the genus occurring in the United States. Head a little longer than anterior lobe of the pronotum. Basal segment of antenna scarcely exceeds apex of the head. Pronotum nude, the two lobes nearly equal. Scutellum nearly equilateral. Commissure equal to the length of scutellum. Corium equal to the length of the head and pronotum combined, a conspicuous, wide, fuscous fascia along the posterior margin, with no median transverse fascia. Anterior tibia gently curved towards base. Length 3.40–4.00 mm.

Distribution: This is very widely distributed throughout the warmer parts of the world from whence it has been described under a variety of names. In the United States it occurs through the southern states, extending its range into Mexico, Central America, South America and the West Indies.

Pachybrachius bilobata (Say)

Pamera bilobata Say, 1832, Heterop. Hemip. No. Amer., p. 17; Le Conte, 1859, Compl. Writ. Say, Vol. 1, p. 334; Stal, 1874, Enum. Hemip., Pt. 4, p. 150; Distant, 1882, Biol. Centr. Amer., Rhynch., Vol. 1, p. 207, Tab. 17, fig. 25; Barber, 1914, Bull. Amer. Mus. Nat. Hist. 33: 514.

Lygæus (*Plociomera*) *servillei* Guerin, 1857, *in* La Sagra, Hist. de Cuba, Ins., p. 399; Stal, 1874, Enum. Hemip., Pt. 4, p. 150 (places *servillei* Guerin as a synonym of *bilobata* Say).

Plociomera servillei, Stal, 1862, Entom. Zeit. 23: 312.

Orthœa bilobata, Van Duzee, 1917, Cat. Hemip. No. Amer., p. 184; Blatchley, 1926, Heterop. E. No. Amer., pp. 399, 402; Bueno, 1946, Entom. Amer. 26: 81.

Pachybrachius bilobatus, Barber, Sci. Surv. of Porto Rico and the Virgin Islands. 14 (3): 552, 553–554.

Say's description is quite accurate so far as the color goes, and he adds in a following note: "This varies considerably in the coloring of the head and thorax, which are sometimes even obscure cinerous, with obsolete, blackish lines, and on the posterior part of the thorax of many specimens are three distinct, black lines."

As mentioned by Say this is quite a variable species, not only as to the degree of infuscation of various parts of the body, as well as the appendages, but also as to the length of the antennæ and the proportional lengths of the two lobes of the pronotum. It should be noted that in the male the anterior lobe is always relatively longer than in the female.

It is apparent that Say's description pertains not only to the more typical form with longer pronotum and antennæ but includes also the darker form with shorter pronotum, antennæ and heavily infuscated legs. This latter form was later described by Dallas as *Rhyparochromus scutellatus* from North America.

Distribution: Occurs throughout the southern states and widely distributed in the neotropical regions.

Pachybrachius bilobata subspecies *scutellatus* (Dallas); new status.

Rhyparochromus scutellatus Dallas, 1852, List Hemip. Brit. Mus., Vol. 2, p. 575.

Pamera scutellatus, Stal, Enum. Hemip., Pt. 4, p. 150; Lethierry and Severin, 1894, Cat. Gen. Hemip., Vol. 2, p. 192 (as synonym of *bilobata*).

Rhyparochromus scutellatus Dallas has been considered by various authors as a synonym of *P. bilobata* Say. In order to fix the exact status of Dallas' species the author referred the question to Dr. W. E. China, of the British Museum of Natural History. He very kindly furnished the following information: "There are two distinct species (both males), mounted side by side on the same card and bearing the type label. The original description is apparently based on both specimens, some characters of one and some of the other being included. In these circumstances I presume that we are at liberty to fix either of the two as the type of [*scutellatus*], whichever is convenient." In commenting on the differences between the two specimens he further states, "The other differs from the first [typical *bilobata*] in the shorter anterior lobe of the pronotum and much shorter antennæ, especially the second and third segments. The whole of the anterior femora and the apical (except extreme apex) of the middle and hind femora of this species are dark, brownish black."

The author therefore concludes that Dallas' name, *scutellatus,* must apply to this smaller, darker form, with the shorter antennæ but as it intergrades with *bilobata* it seems advisable to treat it as a subspecies, rather than a distinct species.

Distribution: In the United States this subspecies is more common in the southeastern states as specimens have been seen from Georgia, Florida and Alabama. In the neotropical regions it occurs in Central America and the West Indies.

Pachybrachius albocinctus, new species

Plociomera servillei, Stal, 1862, Entom. Zeit. 23: 312 (not Guerin).

Orthœa servillei, Van Duzee, 1917, Cat. Hemip. No. Amer., p. 184 (not Guerin); Blatchley, 1926, Heterop. E. No. Amer., pp. 399, 403 (not Guerin); Bueno, 1945, Entom. Amer. 26: 80 (not Guerin).

Pachybrachius servillei, Barber, 1939, Sci. Surv. Porto Rico and Virgin Islands, Vol. 14, pp. 352, 354 (not Guerin).

Head, pronotum, scutellum laterally, pleura, for the most part and the venter ferruginous. Corium, for the most part, humeral angles of pronotum, basal three segments of the antenna and bases of femora and all tibiæ, stramineous. Base of the terminal segment of antenna broadly white. Median longitudinal line of the scutellum and maculations of the corium fuscous. Membrane fuliginous, with conspicuous pale veins and apical patch. Body very sparsely pilose.

Head as wide as long; preocular part equal to the remainder of head; postocular margin gently rounded. Antennæ rather short, but little shorter than the pronotum and costal margin of corium combined; lengths of the respective segments are as follows: 20, 45, 35 and 50. Basal segment of rostrum a little longer than basal segment of antenna. Pronotum a little longer than head; anterior lobe one-third longer than the posterior lobe, the latter slightly paler with three rather obscure, longitudinal fasciæ; faintly and sparsely punctate. Scutellum noticeably longer than wide, finely, sparsely punctate on the basal disk, more coarsely punctate along the sides. Clavus with three irregular series of fine punctures. Commissure half as long as scutellum. Incrassate fore femora with several sharp spines arranged in two series on the apical half. Length 4.75 mm.

Much the same color and general appearance of *P. bilobata* and often confused with it. It averages smaller, the antennæ are much shorter in relation to the length of head and pronotum combined; besides which the terminal segment of the antenna has a wide, white, basal ring.

There is considerable question, in the author's mind, whether this may not be the *Pachymerus annulicornis* of Herrich-Schæffer (Wanz. Ins., Vol. 9, p. 208). That author's description of the species is very brief and he mentions no locality.

Distribution: In the United States it is found from southern New York south to Florida and west through Louisiana to Texas. It is widely spread in the neotropical regions where it is known from Mexico, Central America and also from the West Indies where it is a common species.

Holotype: Beaumont, Jefferson Co., Texas, May 23, 1927, H. Notman, United States National Museum Cat. No. 61523. Paratypes, males and females: UNITED STATES: New York: Greenport, L. Is., July 11, 1948, Roy Latham. Maryland: 2, Annapolis, Jan. 23, 1932, H. G. Barber; Plum Point, Aug. 9, 1913, H. G. Barber; 7, Curtis Creek, P. R. Uhler; Bladensburg, Aug. 17, 1913, W. L. McAtee; Branchville, Apr. 10, 1915, W. L. McAtee; Plummer's Island, Mar. 30, 1913, W. L. McAtee; Lakeland, C. F. Baker. District of Columbia: 3, Anacostia, Aug. 22, 1913; 3, Washington, May 16, 1914, July 15, 1914, and July 24, 1907. Virginia: 3, L. Drummond, Sept. 10, 1933, P. W. Oman; Mt. Vernon, June 27, 1915, W. L. McAtee; 7, "Virginia." Ohio: Columbus, Nov. 16, 1916, C. J. Drake. Illinois: Olive Branch, Oct. 1, 1909, W. J. Gerhard; Quincy, 1870; Pulaski, May 20, 1907, W. J. Gerhard. Michigan: Grand Junction, July 15, 1914. Missouri: Portageville, Aug. 11, 1939, R. C. Froeschner; St. Louis, Sept. 1910, J. F. Abbott; Quinlan, Feb. 22, 1942. North Carolina: Wilmington, Apr. 6, 1914, H. G. Barber. Georgia: Myrtle, Mar. 14, 1906, A. A. Girault; St. Simons Is., July 19, 1931, C. A. Frost; 2, Peach Co., June 17, 1943, W. F. Turner; Thomasville, Mar. 13, 1903, T. D. O'Connor. Florida: Ft. Lauderdale, Feb. 18, 1919, Apr. 24, 1928, A. Wetmore; 2, Clearwater, Aug. 2, 1917, M. D. Leonard; 8, Everglade, May 1912, W. T. Davis; 3, Belle Glade, Mar. 22, 1927, June 4, 1927, M. D. Leonard; Canal Point, July 20, 1927, and Gainesville, July 15, 1918, C. J. Drake; Leon Co., Mar. 19, 1903, T. D. O'Connor; Okeechobee, Mar. 7, 1913, W. S. Blatchley; Ocala, Feb. 10, 1923, F. M. Craighead; 8, Paradise Key, Mar. 3, 1919, H. S. Barber; 1, Aug. 31, 1925, T. H. Hubbell; Lake Myaka, Apr. 19, 1939, W. S. Blatchley; Maron Co., Oct. 1, 1938, and Putnam Co., July 30, 1938, Hubbell and Friauff. Mississippi: Aberdeen, June 26, 1921, Natchez, May 25, 1909, E. S. Tucker. Alabama: Coleta, H. H. Smith. Texas: College Station, May 20, 1935; Palestine, July 7, 1906, F. C. Bishopp; Victoria, July, J. D. Mitchell; Beaumont, May 24, 1927; 2, Brownsville, June, Snow Coll., Runge, Oct. 24, 1906.

Neotropical: MEXICO: Cordoba, V. C., Apr. 17, 1900, F. Knab; Precidio River, Sin., Sept. 26, 1918, J. A. Kusche; Venodio, Sin., 1918, J. A. Kusche; 2, Vera Cruz, P. R. Uhler; 23, from various parts, intercepted on fruits and vegetables at certain ports in the United States. HONDURAS: Enders, Middleton; "Honduras," July 26–Aug. 2, 1933; 6 intercepted at United States ports on bananas. GUATEMALA: 5 intercepted at United States ports on bananas, etc. PANAMA: 4, Trinidad R.; 4, Panama. COLUMBIA: 3. ECUADOR: 6, Guayaquil. BRAZIL: 1, Benito Prov. WEST INDIES: CUBA: 2, Baragua, May 17, 1932, L. C. Scaramuzza; 2, Camaito, Havana, Aug. 23, 1913, H. Morrison; 2, Camaguay, Baragua, June 5, 1932, Christenson; 6, Cuba, Uhler Coll. JAMAICA: ST. DOMINGO, Mar. 1928. HAITI: Bayeux, Sept. 17, 1925. GRENADA IS.: P. R. Uhler Coll. TRINIDAD: 3. All in the collection of the United States National Museum.

Paratypes contained in collections other than that of the United States National Museum: Snow Insect Collections, University of Kansas: FLORIDA: 41, Deerfield; 14, Royal Palm Park; 6, Lake Placid; 3, Lacoochee; 6, Suwanee Springs; 1, Sebastian; 1, New Smyrna; 1, Morrison Field. LOUISIANA: 4, Burros; 1, Creole. TEXAS: 3, Hidalgo; 1, Cedar Lane. Chicago Natural History Museum: ILLINOIS: Gorham, Aug. 8, 1932, A. B. Wolcott; 8, Olive Branch, Oct. 4, 9, 1909, Bosky Dell, Oct. 27, 1909, W. J. Gerhard. E. O. Esselbaugh collection: FLORIDA: Homestead, Jan. 13, 1946. James A. Slater collection: LOUISIANA: 3, Harahan, Aug. 14–19, 1944.

Pachybrachius occultus, new species

Very sparsely pilose. Head, anterior lobe of pronotum, except the pale collar, margins of scutellum, ferrugineous; anterior margin of the pronotum, posterior lobe of pronotum, anterior two-thirds of corium, basal two segments and most of third segment of antennæ and the legs testaceous; central disk of scutellum, ill-defined, postmedian, transverse fascia of corium, apex of third and all of terminal segments of antennæ fuscous; a large preapical, subtriangular, white spot on the corium; membrane fuliginous with faint pale veins and an apical, sordid, white spot.

Head equally wide as long; preocular part but little longer than the remainder of the head; base of head behind the eyes gradually contracted, this margin very nearly straight, a little shorter than preocular margin to the base of the antenna. Antenna long, almost twice as long as head and pronotum combined; basal segment exceeds apex of head by one-half of its length; lengths of the respective segments as follows: 30, 60, 55 and 60.

Pronotum little longer than the head, anterior lobe smooth, not quite twice as long as posterior lobe and nearly one-fourth narrower; posterior lobe sparsely, finely punctate, humeral angles smooth, pale. Scutellum one-fifth longer than wide and about one-fifth shorter than pronotum, very finely, sparsely punctate on the disk, more coarsely punctate along the sides. Commissure less than half as long as scutellum. Clavus with about two irregular rows of fine punctures. Corium sparsely punctate; costal margin not concavely sinuate. Incrassate fore femora with a rather prominent preapical spine, preceded and followed by a few smaller spines. Length 5.50 mm.

Holotype male: Kimberly, Idaho, Oct. 3, 1930, David E. Fox, United States National Museum Cat. No. 61524. Paratypes, males and females: IDAHO: 1, Tuttle, June 16, 1939; 1, Twin Falls, July 29, 1930, David E. Fox; nymph, Hansen, June 1, 1929. UTAH: 1, Randolph, Aug. 21, 1942, G. F. Knowlton, R. S. Roberts; 1, Duchesne, Oct. 3, 1937, G. F. Knowlton, F. C. Harmston. MONTANA: Hobson, Aug. 21, 1922, C. C. Sperry. All in the collection of the United States National Museum. COLORADO: 1, Mesa, July 14, 1937, B. Patterson, J. H. Quinn, in the Chicago Natural History Museum.

This species is totally unlike any other member of the genus. The Montana specimen has the base of the head, anterior lobe of the pronotum and the scutellum, fuscous.

Key to Pachybrachius Hahn[1]

1. Corium devoid of a transverse, postmedian fuscous fascia 2
   Corium with a more or less conspicuous postmedian, transverse, fuscous fascia 5
2. Apical margin of corium with a conspicuous, broad, fuscous fascia. Head one-third wider than long. Anterior lobe of pronotum one-fourth longer than posterior lobe. Scutellum one-fourth longer than wide. Antenna evidently longer than costal margin of corium. Body nude. Small species, 3.25–4.00 .... *vincta* (Say)
   Apical margin of corium devoid of a conspicuous fuscous fascia 3
3. Anterior tibia of male straight towards base. Scutellum but little shorter than pronotum, longer than wide. Head equilateral. Preocular part of head equal to the remainder. Head longer than anterior

[1] Three United States species which were considered by Stal to belong to *Pamera* and so listed by Lethierry and Severin, 1894, Cat. Gen., Vol. 2, p. 194, belong to other genera as follows: *P. nitidicollis* and *P. setosa* Stal, 1874, Enum. Hemip., Pt. 4, p. 150, belong to *Ligyrocoris; Rhyparochromus vicina* Dallas, 1852, List Hemip. Brit. Mus., Vol. 2, p. 576, is a synonym of *Ligyrocoris sylvestris* (L.) teste Dr. W. E. China in correspondence.

lobe of pronotum. Antenna very nearly the length of the costal margin .... *fracticollis* (Schilling)

Anterior tibia of male strongly curved. Scutellum much shorter than pronotum. Head subequal to anterior lobe of pronotum. Antenna shorter than costal margin 4

4. Preocular part of head about half as long as remainder. Scutellum equilateral. Commissure less than half as long as scutellum. Basal segment of antenna distinctly longer than basal segment of rostrum .... *basalis* (Dallas)

Preocular part of head more than half as long as remainder. Scutellum longer than wide. Commissure half as long as scutellum. Antenna a little shorter than costa, basal segment equal to basal segment of rostrum .... *luridus* (Hahn)

5. Costal margin of corium anteriorly straight. Transverse fascia of corium often ill-defined; a large preapical, subtriangular, white spot. Head equilateral. Basal segment of antenna equal to preocular part of head .... **occultus**, new species

Costal margin of corium gently, sinuately, arcuated opposite apex of scutellum. Transverse postmedian, fuscous, fascia of corium distinct 6

6. Terminal segment of antenna broadly white at base. Head gradually contracted back of eyes, postocular margin gently rounded. Antenna commonly shorter than pronotum and costal margin combined. Scutellum paler laterally .... **albocinctus**, new species

Terminal segment of antenna entirely fuscous. Head more abruptly contracted back of eyes, postocular margin fairly straight. Antenna long, but little shorter than pronotum and costal margin combined. Scutellum unicolorous. Anterior femora testaceous .... *bilobatus* (Say), s. s.

Antenna shorter. Anterior femora fuscous, with base and apex pale. Posterior lobe of pronotum with conspicuous, longitudinal, fuscous fasciæ .... *bilobatus* subspecies *scutellatus* (Dallas)

THIRTEEN ENTOMOLOGICAL PAMPHLETS
1655–1846

By Harry B. Weiss

"From pamphlets may be learned the genius of the age, the debates of the learned, the follies of the ignorant, the bévues of government, and the mistakes of courtiers. Pamphlets are as modish ornaments to gentlewomen's toilets as to gentlemen's pockets, they carry their reputation of wit and learning to all that make them their companions."—Myles Davies's *Icon Libellorum.*

Pamphlets have always been a part of the circulatory system for the dissemination of entomological knowledge and opinions. Beginning moderately numerically, they eventually reached flood proportions in which volume they have since continued. The present little paper is an attempt to list a few of the early entomological pamphlets in order to indicate, to some extent, the interests of entomologists and readers of the times during which they were published.

In 1874 there appeared in London, "A catalogue of a unique and interesting collection of upwards of twenty-six thousand ancient and modern tracts and pamphlets, collected and arranged by John Russell Smith," who offered them for sale at stated prices. From this catalogue, the thirteen titles were selected. Except for a few additional ones on bees, the thirteen represented nearly all the entomological pamphlets among the twenty-six thousand. The prices following the titles are those that were quoted by Smith in 1874.

1. The Reformed Commonwealth of Bees, with the Reformed Virginian Silk Worm, containing many Excellent and Choice Secrets, Experiments, and Discoveries, for attaining of National and Private Profits and Riches. 1655. 4to. 3s.

This is an abbreviated title. The correct one is "The Reformed Commonwealth of Bees. Presented in several Letters and Observations to Samuel Hartlib Esq. with The Reformed

Virginian Silk-Worm, Containing many excellent and choice secrets, experiments, and Discoveries for attaining of National and Private Profits and Riches. London, Printed for Giles Calvert at the Black-Spread-Eagle at the West-end of Pauls, 1655''. The first 64 pages constitute a treatise on bees. This is followed by a second title page that precedes 42 pages of text on the care and breeding of silkworms. The second title, which is long, begins ''The Reformed Virginian Silk-Worm, Or a Rare and New Discovery of a speedy way, and easie means. . . . For the feeding of Silk-Worms in the Woods, on the Mulberry-Tree-leaves in Virginia. . . .'' and ends ''London, printed by John Streater for Giles Calvert at the Black-Spread-Eagle, at the West-end of Pauls, 1655''. The statement ''to the reader'' is signed by Samuel Hartlib.

This publication is an example of the pamphlets printed in England dealing wholly or in part with silk culture and designed to interest the Virginia colonists in the planting of mulberry trees and the rearing of silkworms. One of the earliest of such was a 28 page pamphlet by John Bonoeil ''Observations to be followed, for the making of fit rooms to keepe silk-wormes in'' etc. This was printed at London in 1620, by Felix Kyngston. In spite of such propaganda, the colonists found tobacco to be a more profitable crop than silk.

2. Swammerdam's Natural History and Anatomy of the Ephemeron, a Fly that lives but five hours. 4to. plates. 1681. 1 s. 6 d.

The correct title of this pamphlet is ''Ephemeri Vita: or the Natural History of the Ephemeron. A Fly that lives but Five Hours. Written Originally in Low-Dutch by Jo. Swammerdam, M. D. of Amsterdam. London. Printed for Henry Faithorne, and John Kersey, at the Rose in St. Paul's Church-yard, 1681''. This had originally appeared in Low-Dutch in 1675 as a work of 420 pages. Its extreme length was due to Swammerdam's pious meditations and ''poetry upon the various accidents of the life, and extraordinary mechanism of this creature''. The curtailed 58 page pamphlet with its 5 plates advertised by Smith contains only the ''philosophical part, the Natural History and Anatomy of this strange Fly''.

3. A Treatise of Buggs, etc. By John Southall. London, 1730. 8vo. plate. 1 s. 6 d.

This pamphlet that was sold for one shilling when it was originally published, was priced at 1 s. 6 d. by Smith, 144 years later. It is about bed bugs and a liquid insecticide which Mr. Southall used against them, a supposedly secret preparation from a person in Jamaica. It includes a long list of charges for ridding various pieces of furniture of them. A detailed account of this pamphlet appeared in the June, 1931 issue of this JOURNAL, 39 (2): 253–260 and also in Dr. F. E. Lutz's "A Lot of Insects" published in 1941.

4. Compendious Account of the whole Art of Breeding, Nursing, and Right-ordering of the Silk-worm [London] 1733. 4to. folding plate. 2 s. 6 d.

5. Natural History of Bugs, containing an account of their Nature, Breeding, Food, Climate, and Prodigious Increase and Multiplication, with Directions to Destroy them. [London] 1736. 8vo. 1 s.

This may be a later edition of Southall's 1730 "Treatise".

6. Enquiry into the Nature, Order, and Government of Bees, with new, easy, and effectual Method to preserve them by Rev. John Thorley. [London] 1765. 8vo. plates. 1 s. 6 d.

This pamphlet is probably a condensation of "Melisselogia, Or The Female Monarchy. Being an Enquiry into the Nature, Order, and Government of Bees", etc., "by Mr. John Thorley. London, Printed for the author. 1744". Thorley was a minister and a beekeeper who lived at Chipping Norton, Oxford County. By 1743 he had had 40 years of experience as a beekeeper.

7. Vermin Killer, being a Ready Way to destroy Rats, Badgers, Otters, Worms, Bugs, &c. [London] 1775. 12mo. 1 s.

The complete title of this 52-page pamphlet is "The Vermin-Killer: Being A very necessary Family-Book, Containing Exact Rules and Directions for the artificial killing and destroying all Manner of Vermin, viz. Bugs, Rats and Mice, Fleas and Lice, Moles, Pismires, Flies, Catterpillars, Snakes, Weasles, Frogs, etc.! This was written by W. W. and printed at London in 1775. Its title page is descriptive of its contents, and its remedies include hellebore, brimstone, glue, salt water, lard, and morning dew.

8. English Lepidoptera, or the Aurelian's Pocket Companion by Moses Harris. [London] 1775. 8vo. 1 s.

Moses Harris was an English eighteenth century entomologist, artist and engraver. His above work, printed in London, 1775 was entitled "The English Lepidoptera, or the Aurelian's Pocket Companion, containing a Catalogue of upward of four hundred Moths and Butterflies &c." Among his works are "The Aurelian or Natural History of English Insects", London, 1766, with 45 plates drawn, engraved and colored by Harris and "An Exposition of English Insects", published at London in 1776.

9. Complete guide to the Management of Bees throughout the Year. By Daniel Wildman. [London] 1799. 8vo. plates. 1 s. 6 d.

10. Hints for Promoting a Bee Society. [London]. 1796. 8vo. plate. 1 s.

11. Kirby and Spence's Appendix to the first edition of Introduction to Entomology. [London] 1817. 8vo. 1 s.

The first edition of "An Introduction to Entomology" by Kirby and Spence was published in London, in 1815. The appendix referred to above was probably Chapter XV of John Freeman's "Life of the Rev. W. Kirby", this chapter dealing with the origin and progress of "An Introduction to Entomology". This appendix was made a part of later editions of the book.

12. Universal Vermin Killer. [London] 1824. 12mo. plate. 9 s.

It is not known if this title has any connection with number 7. Appearing fifty years later than number 7 and being priced at 9 shillings, it was probably an entirely different pamphlet.

13. Curtis's Natural History and Economy of various Insects affecting the Corn Crops in the Field and Granary, including Moths, Weevils, and other Beetles. [London] 1846. 8vo. plates. 1 s.

This pamphlet was probably a reprint of Curtis's paper in the Journal of the Royal Agricultural Society of England, London, 1845.

THE RESULTS OF SEVERAL YEARS COLLECTING PARASITIC FLIES (DIPTERA, TACHINIDÆ)

By Franklin S. Blanton
Lt. Colonel, MSC., USA

As early as 1931 the writer began making some collections of parasitic flies. Serious collecting was begun on the advice of Dr. Robert Matheson of Cornell University and the late Dr. J. M. Aldrich of the U. S. National Museum. Prof. H. J. Reinhard of Texas Agricultural Experiment Station, who identified the writer's collection also stimulated further studies in this interesting group of flies.

At the beginning of World War II the writer was unable to continue studies in the group. Some of the notes made from 1930 to 1942 have recently been "unpacked" and it was decided to prepare this paper since several new records of distribution are available.

The fauna of Long Island, N. Y., where the writer was stationed for 12 years, is more southern than the upper part of the state. Several additions to the state list have therefore been made.

The list of species published at the end of this paper represents those collected by the writer unless otherwise indicated. In addition to the 189 species listed 87 species were received from other collectors, most of which were presented to the writer by Prof. Reinhard. The writer's entire collection of several thousand specimens of this family was recently presented to Cornell University at Ithaca, N. Y.

As a student at Cornell University the writer had an opportunity to study the very fine collection there and although taxonomic notes were never published some of the general notes are worth presenting at this time.

Aldrich (1915) published notes on the family which present a striking correlation on abundance of species. It is felt worth while to present his table and include a column for the Cornell collection made prior to the presentation of my collection to that institution. This information is presented as follows:

"The following figures show something about the relative abundance of species:"

	Aldrich	Cornell
Represented by one specimen	66	112
By two specimens	24	55
By three specimens	23	39
By four specimens	21	39
By five specimens	11	20
By six specimens	13	8
By seven specimens	11	18
By eight or more specimens	63	125
Total species	232	416

Aldrich stated "that about 25% of the species are represented by a single specimen, an equal proportion by eight or more, and that the other 50% fell between these extremes." It is very interesting to note that the percentages of species in the Cornell collection are not too far apart from the figures presented by Aldrich in 1915.

Some very careful notes were made on the Cornell collection by Dr. Robert Matheson in 1935. In looking over those it was interesting to note that a total of ninety-nine different collectors had contributed to the collection. It is only natural to expect collectors to limit their efforts to the groups in which they are interested at the particular time but a single specimen saved may later prove to be a new record or even a new species. It therefore behooves the collector to save everything. It was observed that fifty-nine collectors collected only one species each; eight collectors collected two species; seven collectors collected three species; six collectors collected four species; two collectors collected five species, etc. The bulk of the collection was made by the following:

Collector	*Collections*	*Species*
Blanton	481	178
Reinhard	144	133
Huckett	147	103
West	135	76
Bradley	91	61
Shannon	61	50
Leonard	56	46
Young	41	34
Davis	53	31
Krombein	25	18
Pechuman	16	14

Since Prof. Henry Dietrich became curator of the collections at Cornell University he has added considerably to the collection and he should no doubt be included in the tabulation.

LIST OF SPECIES*

Achætoneura aletiæ Riley. Willard, N. C., October

Achætoneura? cuculliæ Web. Burlington, Vt., July

Achætoneura frenchii Will. Babylon, June

Achætoneura? melalophæ Allen. Babylon, July

Achætoneura sp. Salisbury, N. H., July

Acroglossa hesperidarum Will. Fire Island Beach, N. Y., July; Babylon, June; Gorham, N. H., July; Woodstock, N. H., July; Bretton Woods, N. H., July; Carolina Beach, N. C., May

Actia americana Tns. Selden, Sept.; Islip, June; Dix Hills, May; Babylon, June; Halfway Hollow Hills, May; Near West Rupert, Vt. Mother Myrick Mt. Vt., July

Actia autumnalis Tns. Babylon, Sept.; Halfway Hollow Hills, May; Near West Rupert, Vt. Mother Myrick Mt. Vt., July; East Barre, Vt., July

Actia diffidens Curr. Babylon, June

Actia interrupta Curr. Babylon, June–July; Woodstock, N. H., July

Actia palloris Coq. Near West Rupert, Vt. Mother Myrick Mt. Vt., July; Manchester–Peru, Vt., July

Admontia degeerioides Coq. (of Coq.) Babylon, June–August

* Unless otherwise indicated all specimens are from Long Island, N. Y.

Admontia pergandei Coq. Babylon, August

Admontia sp. Babylon, August; Selden, September; Brentwood, September

Amedoria lutuosa Mg. Babylon, May; Huntington, Aug.; Farmingdale, July

Amedoria quinteri Tns. Babylon, May, July, August; Halfway Hollow Hills, May

Anachætopsis tortricis Coq. Riverhead, May

Anetia (*Lydella* sp.) Islip, July

Aphria ocypterata Tns. Babylon, June; Islip, June

Aplomya cæsar Ald. Babylon, June; Heckscher St. Park, May

Aplomya confinis Fall. Babylon, May, July & Aug.; Dix Hills, August; Centereach, Sept.; Farmingdale, June; Near West Rupert, Vt. Mother Myrick Mt., July; Middlebury, Vt., July; Great Barrington, Mass., July; Manchester to Peru, Vt., July; Mt. Washington, N. H., July

Aplomya crassiseta A. & W. Babylon, May & June

Aplomya epicydes Wlk. Middlebury, Vt., July

Aplomya affinis Fall. Bretton Woods, N. H., July; Near West Rupert, Vt. Mother Myrick Mt., July

Archytas apicifera Wlk. Fairfax, S. C., April; Atmore, Ala., Aug. (Alton Blanton)

Archytas aterrima Desv. Dix Hills, Oct.; Orient Point, Sept.; Brentwood, Sept.; Babylon, June; Vermont & New Hampshire, July; Willard, N. C., Oct.

Archytas californiæ Wlk. Vermont, New Hampshire, July

Archytas piliventris v.d. W. Jacksonville, Fla., Oct.; Panama City, Fla., Oct.

Archytas vulgaris Curr. Willard, N. C., Oct.

Arctophyto sp. Babylon, May

Belvosia borealis Ald. Willard, N. C., October

Belvosia semiflava Ald. Willard, N. C., October

Belvosia unifasciata Desv. Babylon, June–Sept.; Vermont, July; Willard, N. C., October

Beskia ælops Wlk. Willard, N. C., May; Bratt, Fla., Sept.

†*Bonellimyia hæmorrhoidalis* Fall. Near West Rupert, Vt.

† According to Brooks (Cat. Ent. LXXVI. p. 195) this is a European species.

Mother Myrick Mt., July; Peak of Mt. Mansfield, Vt., July; Stow to Mt. Mansfield, Vt., July; Manchester–Peru Vt., July; Mt. Equinox, Vt., July; Gorham, N. H., July

Bonnetia comta Fall. Babylon, June, Sept.; Dix Hills, Sept., Oct.; Orient Point, June, September

Catalinovoria cauta Tns. Babylon, June

Celatoria diabroticæ Shim. Babylon, Aug.; Willard, N. C., May, Oct.

Ceracia dentata Coq. Babylon, May, June, Aug., Sept. & Nov.; Farmingdale, June; Bretton Woods, N. H., July; Atmore, Ala., Nov.

Ceratomyiella conica Tns. Centereach, September

Chætogædia analis v.d. W. Brandon, Middlebury & Near West Rupert, Vt., July

Chætogædia crebra v.d. W. Babylon, Oct.

Chætophlepsis tarsalis Tns. Babylon, May–July

Chrystotachina alcedo Lw. Near West Rupert, Vt., Mother Myrick Mt., July

Cistogaster ? diversa Lw. (of authors). Stow-Mt. Mansfield, Vt., July

Cistogaster immaculata of Coq. Mqt. Babylon, July–Aug.; Dix Hills, June; Road 20 to Haverhill, N. H., July; Stow-Mt. Mansfield, Vt., July; Willard, N. C., May–Oct.

Clistomorpha triangulifera = *Hyalomyodes triangulifera* Lw. Babylon, May, June; Near West Rupert, Vt. Mother Myrick Mt., July; Middlebury, Vt., July

Cnephalia hebes pansa Sn. Babylon, Sept.; Dix Hills, October; Carolina Beach, N. C., May

Compsilura concinnata Mg. Near West Rupert, Vt. Mother Myrick Mt., July; Middlebury, Vt., July

Copecrypta ruficanda v.d. W. Willard, N. C., October; Bratt, Fla., Sept. (Alton Blanton)

Cryptomeigenia ? menaspis Wlk. Islip, June; Babylon, May–June; Washington, D. C., May

Crytomeigenia ? simplex Curr. Babylon, April, May; Heckscher St. Park, May; Wyandanch, June; Halfway Hollow Hills, May

Cryptomeigenia sp. Babylon, May & June; Centereach, May

Cuphocera hirsuta Tns. Babylon, June, Aug.; Centereach, September; Halfway Hollow Hills, June; Vermont, Connecticut, Maine, July

Cylindromyia decora Ald. Babylon, June; Woodstock, N. H. July; Gorham, N. H., July

Cylindromyia desiades Wlk. Babylon, June, Aug.; Crawfords Notch, N. H., July; Stowe, Mt. Mansfield, Vt., July

Cylindromyia euchenor Wlk. Wildwood St. Park, June; Babylon, May

Cylindromyia fumipennis Bigot. Babylon, Sept.; Fire Island, Sept.

Cylindromyia pusilla Ald. Babylon, July; Islip, June

Cyrtophlœba coquilletti Ald. Babylon, May; Dix Hills, May; Halfway Hollow Hills, May

Dexodes xylota Curr. Babylon, May; Dix Hills, May

Dexodes sp. Babylon, May; Dix Hills, May

Dinera sp. Babylon & Islip, June–July; Numerous specimens Dix Hills, Farmingdale, July

Dinera grisescens Mg. Babylon, June–Oct.

Doryphorophaga aberrans Tns. Farmingdale, June

Doryphorophaga doryphoræ Riley. Centereach, May; Dix Hills, May; Babylon, June; Brandon, Vt., July

Doryphorophaga macella Reinhard. Babylon, May, Aug., Sept., Oct.

Doryphorophaga sedula Reinhard. Babylon, June; Farmingdale, June

Epalpus signiferus Wlk. Dix Hills, Deer Park, Brentwood, Apr.; Babylon, Apr., June

Epigrimyia polita Tns. Willard, N. C., May

Epigrimyia sp. Selden, Sept.; Cold Springs Harbor, Aug.

Ernestia amelus = Mericia ampela Wlk. Centereach, Sept.; Babylon, May

Ernestia = Mericia arcuata Toth. Babylon, April–June; West Hills, June; Manchester to Peru, Vt., July

Ernestia = Mericia flavicornis Br. Near West Rupert, Vt., July; Manchester–Peru Vt., July

Ernestia = Mericia platycarnia Toth. Near West Rupert, Vt. Mother Myrick Mt., July; Manchester–Peru, Vt., July

Ervia ? triquetra Oliv. Farmingdale, July
Erycia arator Ald. Babylon, June
Erycia (pilateo) ? n. sp. Islip, July; Chinquapin, N. C., Oct.
Euclytia flava Tns. Babylon, July
Eulasiona comstockii Tns. Babylon, May & June; Near West Rupert, Vt. Mother Myrick Mt., July
Euryceromyia robertsoni Tns. Babylon, June, Sept.
Eutrixa exilis Coq. Babylon, May; Palisades, N. J., Nov.
Exorista larvarum L. Babylon, June, July & Sept.; Farmingdale, June; Salisbury, N. H., July; Manchester–Peru, Vt., July; Near West Rupert, Mother Myrick Mt., Vt., July; Brandon, Vt., July
Exorista simulans = *Guerinia simulans* Mg. Islip, July; Babylon, May–July; Farmingdale, June; Manchester, Peru, Vt., July; Brandon, Vt., July; Near West Rupert, Vt. Mother Myrick Mt., July; Salisbury, N. H., July
Exoristoides slossonæ Coq. Babylon, June–July
Fabriciella algens Wd. East Barre, Vt., July
Fabriciella florum Wlk. Babylon, May, June, July & Oct.; Selden, Sept.; Dix Hills, Oct.
Fabriciella hispida Toth. Maine, July
Gœdiopsis ocellaris Coq. Manchester to Peru, Vt., July
Genea analis Say = *Genea aurea* James. Babylon, June, July
Genea aldrich Toth. Babylon, June; Islip, July
Gonia frontosa Say. Babylon, Dix Hills, Deer Park, Islip, April, May, June & July (Mostly on Willow blossoms)
Gonia sagax Tns. Halfway Hollow Hills, Babylon, April, May & June; Dix Hills, May & June
Gonia senlis Will. Babylon, June
Gymnosoma fuliginosa of Coq. Desv. Babylon, Aug. & Sept.; East Barre, Vt., July
Hemyda aurata Desv. Babylon, July
Hineomyia setigera Coq. Babylon, June–July, May–Sept.; East Barre, Vt., July; Middlebury, Vt., July
Hyalomyiopsis aldrichi Tns. Babylon, May, June; Brentwood, Sept.
Hystrica abrupta Wd. Near West Rupert, Vt. On Poison Parsley, July; Mother Myrick Mt., July

Leschenaultia ? exul. Tns. Babylon, April–June

Leschenaultia sp. (Blepharipeza) Dix Hills, Babylon, May; West Hills, N. Y., June; Near West Rupert, Vt., July

Leskiomima tenera Wd. Babylon, June; Islip, July

Leucostoma atra ? Tns. Babylon, July

Leucostoma senilis of Coq. Tns. Dix Hills, Aug.

Lispidea palpigera Coq. Babylon, June

Lispidea sp. Mt. Washington, N. H. Alpine Garden, July

Lixophaga plumbea Ald. Babylon, Apr., May & June; Brentwood, May; Farmingdale, June; Medford Sta., Sept.; Huntington, July; Dix Hills, May; Bratt, Fla., Sept.

Lixophaga variabilis Coq. Babylon, June–July; Islip, July; Farmingdale, June; Manchester–Peru, Vt., July; Chinquapin, N. C., Oct.

Lydina areos Wlk. Babylon, May to Sept.

Lypha setifacies (West) Babylon, May

Metavoria orientalis Tns. Islip, July

Microphthalma disjuncta Wd. Islip, July; Dix Hills, August; Babylon, June & July

Myiophasia metallica Tns. Babylon, June–Sept.; Farmingdale, June; Oak Beach, Aug.; Islip, July–Aug.; Peekskill, N. Y., Aug.; Brentwood, Sept.; Halfway House to Gorham, N. H., July; Middlebury, Vt., July; Manchester to Peru, Vt., July; Atlantic City, N. J., Sept.; Wilmington, N. C., Oct.

Myobiopsis similis Tns. Babylon, August

Nemorilla floralis Mg. Dix Hills, August; Babylon, July–Aug.

Oedematocera gilvipes Coq. Babylon, July

Oestrophasia signifera v.d. W. Babylon, July

Ormia montana Tns. Milton, Fla., Oct.

Oxynops anthracina Sig. Babylon, July, Sept.

Parachytas decisa Wlk. East Barre, Vt., July

Paradidyma singularis Tns. Babylon, May, June & Aug.; Farmingdale, June; Heckscher St. Park, May; Atlantic City, N. J., Sept.

Parlispe sp. Islip, June

Peleteria anaxias Wlk. Babylon, May–June

Peleteria apicalis Wlk. Babylon, June, July; Vermont, July

Peleteria iterans Wlk. Peak of Mt. Mansfield, July; Oliver B. C., May

Phasmophaga antennalis Tns. Babylon, June

Phorocera claripennis Mcqt. Babylon, May, June & Aug.; Heckscher St. Park, May; Near West Rupert, Vt., Mother Myrick Mt., July; East Barre, Vt., July; Middlebury, Vt., July; Salisbury, N. H., July

Phorocera einaris Smith. Cold Springs Harbor, Aug.; Babylon, July

Phorocera ? reinhardi A. & W. Babylon, April

Phorocera silvatica Ald. Babylon, May–June; Islip, May; Dix Hills, May

Phrynodella polita Tns. Babylon, June–Oct.; Heckscher State Park, May

Phrynofrontina discalis Coq. Babylon, Aug., Sept.

Phryxe vulgaris Fall. Brandon, Vt., July; Near West Rupert, Vt., Mother Myrick Mt., July; Mt. Equinox, Vt., July; Middlebury, Vt., July; Half Way House—Gorman, N. H., July

Plagiomima cognata ? Ald. (discolored). Babylon, Aug.

Plagiomima similis Tns. Babylon, June, Aug. & Sept.; Willard, N. C., Oct.

Polistomyia plumipes Fabr. Babylon, July

Pseudochæta argentifrons Coq. Selden, Sept.; Babylon, Aug.

Pseudotachinomyia æqualis Rein. Heckscher State Park, May; Babylon, May

Pseudotachinomyia webberi Smith = *P. slossonæ* Tns. Dix Hills, May & June; Halfway Hollow Hills, May; West Hills, June; Babylon, May & June; Farmingdale, June

Pseudeuantha coquilletti Ald. Babylon, July–Aug.; Farmingdale, June; Mt. Equinox, Vt., July

Ptilodexa sp. (several species). Babylon, May–Sept.; Oak Beach, Selden, May–Sept.

Pyraustomyia penitalis Coq. Babylon, June

Schizotachina ? convecta of Coq. Wlk. Babylon, May; Selden, Sept.; Islip, July; Dix Hills, Aug.

Schizotachina longicornis Coq. Babylon, July

Siphona geniculata of Coq. de G. Babylon, April–Sept.; Dix Hills, June & Oct.; Flume—North Woodstock, N. H., Aug.

Siphophyto floridensis Tns. Babylon, May, July; Islip, June; Selden, Sept.

Siphosturmiopsis phyciodis Coq. Babylon, June, August; Farmingdale, June
Siphosturmiopsis melanpyga Rein. Babylon, May; East Barre, Vt., July
Spathmeigenia ? aurifrons Curr. Farmingdale, June; Islip, June
Sturmia crescentis Reinhard. Babylon, June (Paratype)
Sturmia pilatei Coq. Willard, N. C., Oct.
Tachinomyia apicata Curr. Babylon, May & June; Dix Hills, June; Centereach, May; BelleDaire, June; West Hills, June; Heckschers St. Park, May
Tachinomyia panœtins Wlk. Babylon, April–June; Dix Hills, April; Halfway Hollow Hills, May
Tachinomyia ? variata Curr. Babylon, May & June; Dix Hills, May; Halfway Hollow Hills, May. Numerous specimens
Pseudomyothyria ancilla Wlk. Babylon, July–Aug.; Atlantic City, N. J., Sept.
Tachinophyto floridensis Tns. Babylon, Sept.
Tachinophyto vanderwulpi Tns. Tin City, N. C., Oct.; Wilmington, N. C., Oct.
Thelaira americana Brks. Babylon, June–July; Dix Hills, June–July
Theresia tandrec Desv. Babylon, July–Aug. On tree trunks, especially oak trees at end of Paumanake Ave., just before dark.
Trichopoda pennipes Fabr. Anawalk, N. Y., Aug.; Trenton, N. J., June; Fairfax, S. C., April
Viviania georgiœ BB. Babylon, July–Aug.; Islip, May
Viviana sp. Babylon, May–June
Voria ruralis Mg. Babylon, July
Metachœta atra Coq. Babylon, May–June & August; Middlebury, Vt., July
Micromintho melania Tns. Islip, July; Selden, Sept.; Farmingdale, June
Wagneria vernata West. Babylon, May
Winthemia datanœ Tns. Babylon, July, Aug. & Sept.; Centereach, Sept.; Laural Beach, July; Willard, N. C., May
Winthemia fumiferanœ Toth. Halfway Hollow Hills, May

Winthemia quadripustulata Fabr. Heckscher St. Park, May; Babylon, June; West Hills, June; Near West Rupert, Vt. Mother Myrick Mt., July

Winthemia rufopicta Bigot. Heckscher State Park, May; Babylon, June & Sept.; Middlebury, Vt., July; Near West Rupert, Vt., Mother Myrick Mt., July

Xanthomelana atripennis Say. Ocala, Fla., November; Middlebury, Vt., July

Xanthophyto labis Tns. Near West Rupert, Vt., July

Zenillia blanda O. S. Babylon, June; Islip, June

LITERATURE CITED

Aldrich, J. M. 1915. Results of twenty-five years collecting in the Tachinidæ, with notes on some common species. Ann. Ent. Soc. Amer. **8**: 79–84.

BOOK NOTICE

A Textbook of Arthropod Anatomy. By R. E. Snodgrass. Comstock Publishing Associates. Cornell University Press. Ithaca, New York, 1952. $9\frac{1}{4} \times 6$ inches. x + 363 p. 88 figs. $6.00.

This textbook of arthropod anatomy that was published December 15, 1952 is a concise, authentic, descriptive account of the comparative anatomy of arthropods and the author's name and reputation constitute a warranty of the book's excellence. A chapter is devoted to each of the eleven classes of arthropods. Preceding the description of the general anatomy of the examples in each class there is a discussion of the antiquity of each class, its resemblance to other groups, distinguishing characteristics and those common to other groups, food habits, etc., which serves to introduce the groups, especially the lesser known ones. The eleven chapters deal specifically, for the most part, with the general external structure of a trilobite; a king crab; an eurypterid or aquatic animal of the Paleozoic era; the sprawling, leggy pycnogonids that live in the sea; a scorpion, a spider and a tick of the Arachnida; three crustaceans, shrimplike Anaspides, a crayfish, and the isopod *Ligyda exotica;* four true centipedes, the common house centipede, a species of *Lithobius, Otocryptops sexspinosa* and a geophilid; a polydesmoid and a juliform diplopod; the minute Pauropoda; the Symphyla; and the Diplura, Thysanura, and the cockroach in the Hexapoda. A list of references, and subject and author indexes complete the attractively printed and bound volume. There are 88 "figures" or plates containing more than 640 line drawings, most of them by the author. Although the author's studies have led him to the interesting conclusion "that the facts of arthropod structure are not consistent with any proposed theory of arthropod interrelationships," this has no bearing upon the scope of the book and its descriptions and illustrations covering external and in many cases, internal anatomy. With such a lucid text and so many adequate drawings, together with specimens, it would seem that one could almost dispense with instructors. However it should be invaluable in classrooms to both students and instructors.—H. B. WEISS.

MIRIDÆ FROM LIGHT TRAPS

S. W. Frost[1]

The Pennsylvania State College

Few references are found in literature concerning the attraction of Miridæ to lights. Occasional notes on phototrophic species appear from time to time. Of 200 species recorded by Knight and McAtee[2] in the vicinity of Washington, D. C., eleven were taken at lights. Recent studies by the author indicate that some species are strongly attracted and that traps may be used successfully for determining populations. Plant bugs are small and generally come freely to lights. Although a large number of species have been taken in Pennsylvania, only eight occurred frequently enough to be discussed. Other species were taken in noticeable numbers namely, *Capsus ater* L., *Hyaliodes vitripennis* (Say), *Reuteroscopus ornatus* (Reut.) and *Phytocoris puella* Reut.

While some species were intercepted frequently, others were never taken. This may be due to the fact that the traps were often operated in areas of low populations or too distant from hosts of the bugs. The pear plant bug *Neolygus communis* Knight, for example, came to lights from May 30 to June 10 only when a trap was placed on or near an infested pear tree. Certain economic species such as the apple red bugs *Lygidea mendax* Reut., and *Heterocordylus malinus* Reut., the box elder bug *Leptocoris trivittatus* (Say) and the four lined plant bug *Pœcilocapsus lineatus* Fab., were never taken in light traps. The absence of *Pœcilocapsus lineatus* may result from the fact that the traps were placed at a height of 6 to 8 feet above the ground and beyond the range of the flight of this species.

[1] Authorized for publication on November 8, 1951, as paper No. 1705 in the journal series of the Pennsylvania Agricultural Experiment Station.

[2] Knight, H. H. and W. L. McAtee (1929). Bugs of the family Miridæ of the District of Columbia and vicinity. Proc. U. S. Nat. Mus. 75(13): 1–77.

The Miridæ mentioned in this paper were taken from eighteen light traps located in widely separated areas of Pennsylvania. The New Jersey mosquito trap with a 25 watt frosted bulb was used in all localities except Martinsburg where the Minnesota type trap was used. This trap differs in having no motor or fan but is equipped with four baffles which direct the insects into a cyanide jar at the bottom. It was equipped with a 150 watt bulb. The trap located at Lancaster was provided with a 100 watt lamp.

In general the traps were operated from May 15th to September 20th and from 7 P.M. to 7 A.M. However, some of the traps were operated for only a few nights during the season. These are indicated in the accompanying table. As a rule no mirids

MIRIDÆ TAKEN FROM LIGHT TRAPS, PENNSYLVANIA 1948

	Period of Collection	Presque Isle	Grove City	Racoon Creek	Indian Cr. Res.	Ohiopyle	Tionesta	Philipsburg
Nights Operating		16	33	72	97	72	49	40
Lygus oblineatus	5/29–9/20	2	7	25	31	13	40	11
Adelphocoris rapidus	6/ 4–9/20	0	17	14	26	30	30	2
Plagiognathus politus	6/20–9/19	0	15	30	29	12	406	3
Polymerus basalis	6/ 7–9/ 3	0	1	2	0	0	7	1
Trigonostylus ruficornis	6/ 3–9/20	37	35	10	293	231	143	124
Stenotus binotatus	6/ 4–9/ 9	4	6	0	14	4	2	0
Orthotylus flavosparsus	7/27–9/20	0	0	2	5	0	0	0
Ilnacora stalii	6/24–9 /4	0	0	6	2	1	0	0
Total		43	81	89	700	291	628	141

were taken when the temperature fell below 60° F. With similar light intensities, the New Jersey trap proved most satisfactory for capturing these insects.

A brief summary is given of the areas where the largest captures were made, since the locations of traps play an important part in the nature of the insect catches. The trap at Indian Creek reservoir was located in a more or less open area surrounded only by distant woods. The one at Tionesta was placed on a dam in a very open area and far from surrounding woods. Three traps were located at State College; two in open cultivated country planted to young fruit trees and field crops, the other in a semi-wooded area. The Lancaster trap was situated in an open area where tobacco, corn and similar crops were grown. The Martinsburg trap was operated in an open area adjacent to extensive plantings of sweet corn. At Pottstown the trap was located more or less in the open. The traps at Racoon Creek, Ohiopyle, Camp Barree, Buck Hill Falls and Caledonia were located in wooded areas.

State* College	Camp Barree	Caledonia	Williamsport	Buck H. Falls	Lancaster	Pottstown	Tinicum	Martinsburg	Total
206	27	54	71	51	95	69	40	48	1,840
413	0	2	179	11	1,106	79	2	312	2,233
352	8	8	45	5	1,350	44	1	202	2,134
1,033	5	7	121	5	1,065	112	0	525	3,368
20	0	1	4	0	79	3	0	32	150
916	12	0	172	17	931	111	0	440	3,472
78	0	6	10	2	75	15	0	2	218
347	0	0	73	4	159	16	0	203	809
0	0	0	97	0	18	31	0	3	158
3,159	25	24	701	44	4,783	411	3	1,719	12,542

* Catches from 3 traps.

The accompanying chart does not show the seasonal variations in the catches which reflect differences in the habits of the species and the effects of climatic conditions. Species such as the tarnished plant bug *Lygus oblineatus* (Say) hibernate as adults and naturally are on the wing earlier than some species. The rapid plant bug *Adelphocoris rapidus* (Say) and the pear plant bug *Neolygus communis* Knight hibernate as eggs and would not be expected to appear at light traps until winged forms appeared. Low temperatures, other conditions remaining constant, depress the captures considerably. Moderate wind velocities and precipitation seem to increase the catches.

Adelphocoris rapidus (Say) came to the traps almost continually from June 4th until September 16th. There were only a few nights during this period that no adults were taken. All of these nights showed low temperatures.

The tarnished plant bug *Lygus oblineatus* (Say) was active from May 24th to September 20th. From May 24th to June 15th the catches were low and sporadic with no catches exceeding 14 on a single night. From June 16th to August 20th the takes were almost continuous. This species has several generations a year which accounts for the rather continuous occurrence.

The little black mirid *Plagiognathus politus* Uhler, common in eastern and central United States, occurs on many species of Compositæ and has been reported as a pest on the tender leaves of apple and other fruits. It came to lights almost continuously from June 20th to July 15th with only two nights showing no catches. From July 15th to August 20th the catches were small and irregular. From August 20th to September 10th the catches were again almost continuous.

The captures of the meadow plant bug *Trigonostylus ruficornis* Geoff. were very sporadic from June 3rd to July 27th but from July 28th to August 5th they were almost continuous with only one night showing an absence. From August 6th to September 10th the catches were small and irregular again.

It is quite evident that the largest catches were made in light traps that were located in open areas.

JACOB CHRISTIAN SCHÄFFER, 1718–1790 CLERGYMAN, ENTOMOLOGIST, PAPERMAKER, SCHOLAR

By Harry B. Weiss

Biographical references to Jacob C. Schäffer in entomological literature are apparently rare and as a rule they are bibliographical rather than biographical so that little is learned of the man himself. In order to correct this situation, so far as I am able, the following notes have been gathered together and are here presented so as to provide another example of the versatility of our early naturalists. Living, as he did, in Germany during the eighteenth century, when entomology in America was in its infancy, his entomological papers were unknown to American entomologists and even today are rarely referred to except by an occasional lepidopterist. However, James Wilson in his article on entomology in the seventh edition of the Encyclopædia Britannica, London, 1835, included Schäffer in his ''Notices regarding the principal authors in entomology, and their works.''

What apparently is a complete list of Schäffer's writings on entomology may be found in volume three of ''Index Litteraturæ Entomologicæ'' by Walther Horn and Sigm. Schenkling (Berlin-Dahlem, 1928). From this list it is apparent that his insect publications appeared first in 1752 when he was about 34 years of age and continued more or less evenly for a period of 28 years. In all there are 18 titles in his bibliography. He wrote of a caterpillar that was doing much damage in Saxony, of the ''saddle fly,'' of new information on caterpillars and butterfiies, of the transformation of the ''root house caterpillars,'' of the flying Uferas that he had observed on the Danube and on the stone bridge at Regensburg, of various butterflies and horned beetles, of the ''white shell crown and club beetle'' [probably ''long horn''], of the masonry bee, of the doubt and adversity that still prevailed in the study of insects, and of the ''May worm beetle'' as a reliable remedy against the bite of a mad dog, etc.

In addition his more important works included "Abhandlungen von Insecten," Regensburg, in three volumes, two in 1764 and the third in 1779; "Icones Insectorum circa Ratisbonam indigenorum," Regensburg, in three volumes, 1766–1779, text in Latin and German, this being a large collection of colored plates of the insects of his own neighborhood, with the names of Linnæus. James Wilson referred to this in 1835, as being well executed and presenting "a careful development of the most important characters." And finally there was his volume "Elementa Entomologica," Regensburg, 1766, with its 135 colored plates. To this Schäffer added a supplement in 1777, containing new genera. Of this work, Wilson wrote, "Although the names of his classes are different, yet the classes themselves coincide with those of Geoffroy."

This is a very brief and inadequate summary of Schäffer's entomological work. Much more could be written were his writings available. Dr. F. S. Bodenheimer in his "Material zur Geschichte der Entomologie bis Linné" (2 vols., Berlin, 1928, 1929) refers to him several times and reproduces some of the illustrations in his books, showing collecting apparatus, forceps, specimen boxes and cases, nets, umbrella, beating stick, breeding jar and cabinet.

The above was the extent of my information about Schäffer until I happened to see a copy of "The Paper Maker," vol. 21, No. 2, 1952, published by the Paper Makers Chemical Department of the Hercules Powder Company, which carried an informative and highly interesting paper entitled "In Search for New Raw Materials, Being the narration of the many efforts of papermakers, clergymen, and scholars to make paper from materials other than rags, and of the curious books they left us," by Henk Voorn, editor and owner of the only paper trade journal in Holland, "De Papierwereld." Mr. Voorn's article (p. 1–14) among other matters contains more information about Schäffer's life in general than is available in entomological journals. Although neglected by entomologists who are mostly not historically minded, Schäffer receives full credit, for his experiments in the utilization of plants for the manufacture of paper, by historians of papermaking.

Linen rags were scarce during the eighteenth century and this induced a search for new raw materials from which paper could be made. Schäffer was one of those who engaged in research upon this subject. Although not a papermaker himself he intended his experiments to be useful to papermakers and to facilitate and extend the art of papermaking. Mr. Voorn records and evaluates Schäffer's contributions, discusses the beliefs of Schäffer's critics, and the results of an analysis of 114 of Schäffer's samples, made many years after Schäffer's death, in which rags turned up in samples that were not supposed to contain any, thus posing a problem for solution, long after the event. Mr. Voorn's account includes a bibliography of Schäffer's books on papermaking that were published in Regensburg from 1765 to 1772, and illustrations from Schäffer's works depicting his equipment, two title pages of one of his treatises, and several other engravings. There is also included a portrait of Schäffer from a painting by G. V. Mansinger in 1774.

Of most interest to entomologists however is the general account of Schäffer's life which is quoted below, from Mr. Voorn's article, with the kind permission of Bronson B. Tufts, editor of "The Paper Maker."

"Jacob Christian Schäffer was born at Querfurt, May 30, 1718, and died seventy-two years later, January 5, 1790 at Regensburg, the town where he had worked nearly all his life. He is the hero and the center in the search for new raw materials for papermaking. Schäffer was a clever, ingenious man who possessed fabulous knowledge. At eighteen and as a poor boy, he went to the University at Halle. Two years later, financial difficulties forced him to accept a position with a merchant in Regensburg. When the merchant died, Schäffer was ready to return to Halle, but in 1741, he was offered a pastorate in Regensburg. As a clergyman, he was much loved by his parishioners. He continued his studies and in 1763 he succeeded in getting his doctor's degree in theology in Tübingen.

"Schäffer's many books show him to be an honest, devout soul possessing a great thirst for scientific knowledge. So, with his customary energy, he acquired a profound understanding of natural science. He gathered together a private museum of natural history, which became well-known in Germany and abroad and which became a mecca for famous scholars from all parts of the world. The extent of his knowledge can be seen by examining the books he wrote, both in his own tongue and in Latin, on insects and fish. Many of the books have been translated into Dutch. Widely acclaimed was his work on the fungi of Bavaria, and it remained the standard book on the subject until far into the nineteenth century.

"It would be wrong to think of Schäffer as a man devoted exclusively to theory and having little interest in putting his theories to practical use. With foresight and clarity, he wrote about a new sawing machine. For the ladies, he wrote of a new-model oven, and his booklet on a practical washing machine was reprinted three times and was translated into Dutch. Schäffer was typical of the eighteenth century: minister and scholar, artisan and large-scale author who published books on a variety of subjects every year. This man, famous and honored throughout Europe, was awarded medals, premiums, and honorary titles by kings in Germany and elsewhere. A correspondent and an honorary professor of many universities, he wrote about new materials for making paper in the only way we would expect from such a man—thoroughly and scientifically. His books on papermaking are written in fluent language and are illustrated by numerous plates and examples."

RECORDS AND DESCRIPTIONS OF NEOTROPICAL CRANE-FLIES (TIPULIDÆ, DIPTERA), XXVI

By Charles P. Alexander
Amherst, Massachusetts

The preceding article under this general title was published in the Journal of the New York Entomological Society, 59: 99–110; 1951. The materials discussed at this time are from Grenada, taken by Noël L. H. Krauss; Venezuela, by Jenaro Maldonado Capriles; Ecuador, by Segundo Velastegui; Peru, by José M. Schunke; and especially in Bolivia and Chile, taken by Luis E. Peña. I am greatly indebted to the various collectors for the privilege of retaining the types of the various novelties.

Genus *Hexatoma* Latreille

Hexatoma (Eriocera) maldonadoi new species

General coloration brownish gray, the præscutum with four darker brown stripes; antennæ (male) very long, approximately three times the wing; wings with a weak brownish tinge, the stigma darker; vein R_2 at or before the fork of R_{3+4}; cell *1st* M_2 small, subrectangular; valves of ovipositor elongate.

Male. Length about 8–9 mm.; wing 9.5–11 mm.; antenna about 29–31 mm.

Female. Length about 10–11 mm.; wing 8.5–10 mm.; antenna about 1.5–1.6 mm.

Mouthparts very reduced, black. Antennæ (male) very long, approximately three times the wing; basal segments brown, the outer ones black; flagellar segments very long-cylindrical, provided with small scattered emergence bristles, these lacking on the even more attenuated outer segments. In female, antennæ 9-segmented, the segments gradually decreasing in length outwardly; flagellar segments four to six, inclusive, more nearly equal. Head brownish gray, the vertex in male very bulbous, entire, in female less developed.

Pronotum brown. Mesonotum brownish gray, the præscutum with four darker brown stripes; interspaces with long erect pale setæ; scutum weakly darkened. Pleura brownish gray. Halteres dark brown, the base of stem restrictedly brightened. Legs with the coxæ brown, sparsely pruinose; trochanters brown; remainder of legs brown, the femoral tips vaguely brightened. Wings with a weak brownish tinge, cells C and Sc a trifle more infuscated; stigma oval, still darker brown; veins brown. Veins unusually glabrous, with a series of trichia over most of the length of distal section of vein R_5. Venation: Sc_1 ending shortly beyond level of *r-m*, Sc_2 a short distance from its tip; R_{1+2} and R_2 subequal, the latter at or before the fork of R_{3+4}, in some specimens just beyond this fork; veins beyond cell *1st* M_2 pale to subevanescent, the cell small, short-subrectangular; *m-cu* longer than the distal section of Cu_1; vein *2nd A* nearly straight.

Abdomen brown, the outer segments, including the hypopygium, darker brown; posterior borders of the more proximal segments narrowly darkened. Valves of ovipositor elongate.

Habitat. Venezuela.

Holotype, ♂, Camp Benitez, Marahuaca Region, foot of Pacaraima Mountains, May 1950 (Jenaro Maldonado Capriles). Allotopotype, ♀. Paratopotypes, 16♂♀.

I am very pleased to name this distinct fly for the collector, Mr. Jenaro Maldonado Capriles, to whom I am indebted for specimens of Tipulidæ from Puerto Rico and Venezuela. The species is quite distinct from all other regional members of the subgenus, including *Hexatoma (Eriocera) antennata* (Alexander) and *H. (E.) macrocera* (Alexander), in the details of venation.

Genus *Teucholabis* Osten Sacken

Teucholabis (Teucholabis) xantha new species

General coloration pale reddish yellow, the præscutum in cases with a weak median darkening on extreme cephalic portion; halteres and legs yellow; no modifications of posterior tibiæ of male; wings with *Sc* relatively long, cell R_4 at margin more extensive than cell R_2, cell M_2 open by the atrophy of the basal section of M_3; male hypopygium with the inner dististyle appearing as a large triangular darkened blade, without setæ; ædeagus large, its apex obtuse.

Male. Length about 4.8–5 mm.; wing 5.3–5.5 mm.

Female. Length about 5 mm.; wing 5–5.1 mm.

Rostrum and palpi yellow. Antennæ with the scape and pedicel brown, the latter a trifle darker; flagellum light brown, the segments oval with very long verticils. Head yellow.

Pronotum and pretergites uniformly yellow. Mesonotum pale reddish yellow, unmarked or with a weak median infuscation on extreme cephalic portion of præscutum. Pleura and pleurotergite more yellowed. Halteres yellow. Legs yellow, the terminal tarsal segments more darkened; posterior leg of male unmodified, lacking in glandular area on the basitarsus. Wings yellow, including the veins; stigma very small, pale brown. Venation: *Sc* relatively long, Sc_1 ending at about two-fifths the length of *Rs*, Sc_2 a short distance from its tip; vein R_4 nearly straight, R_5 on apical half bent very strongly caudad to the wing-tip, cell R_4 at margin more extensive than cell R_2; cell M_2 open by atrophy of basal section of M_3; *m-cu* nearly one-third to one-half its length beyond the fork of M.

Abdomen obscure yellow, including the hypopygium; in the female, tergites indistinctly bicolored, the bases of the segments weakly darkened, a little less extensive than the yellow apices. Abdomen of male without modified sternal pockets. Male hypopygium with the appendage of basistyle subapical, pale, the entire inner margin fringed with long pale setæ; on mesal face of style near base with a much stouter and only slightly shorter fleshy lobe that is provided with scattered strong setæ. Outer dististyle a long slender rod that is gently curved and narrowed to the tip. Inner dististyle of distinctive shape, appearing as a large triangular darkened blade, without setæ. Aedeagus large and pale, its apex obtuse, both the upper and lower margins of the apical portion with rather numerous pale setæ.

Habitat. Bolivia.

Holotype, ♂, Rio Yapacani, Buena Vista, Santa Cruz, August 10, 1950 (L. E. Peña). Allotopotype, ♀, pinned with the type. Paratypes, 1 ♂, 1 ♀, Ichilo, Puerto Greether, August 20, 1950 (L. E. Peña).

Teucholabis (*Teucholabis*) *xantha* is quite distinct from the most similar species, including *Teucholabis* (*T.*) *omissinervis* Alexander, in the very distinct male hypopygium.

Genus *Molophilus* Curtis

Molophilus melanoleucus new species

General coloration of thorax pale buffy yellow, abdomen abruptly brownish black, the genital segment yellow; legs brown to black, the proximal two tarsal segments white with darkened tips; no modified setal brushes on tibiæ; wings with a strong blackish tinge, cells M and M_4 more evidently whitened; Rs relatively short, about twice the unusually long basal section of R_{4+5}; vein R_2 lying unusually basad, about two-thirds R_{2+3+4}.

Female. Length about 3.5 mm.; wing 4 mm.

Rostrum and palpi brown. Antennæ dark brown; flagellar segments oval, well-constricted, with very long conspicuous verticils. Head brown.

Thorax uniformly pale buffy yellow. Halteres black. Legs with the coxæ and trochanters yellow; femora brown, the tips narrowly yellow; tibiæ brown, the bases narrowly yellow; basitarsi white, the tips blackened, on some legs including more than the outer half; second tarsal segment white, the tip and remaining segments black; legs with abundant long coarse setæ that conform in color to the part of the leg where found; no modified brushes on tibiæ. Wings with a strong blackish tinge, cells M and M_4, more evidently whitened; veins brown, macrotrichia dark brown. Venation: Rs relatively short, about twice the unusually long basal section of R_{4+5} and in alignment with it; R_2 unusually basad, about two-thirds R_{2+3+4}; petiole of cell M_3 approximately four times *m-cu*; cell *2nd A* relatively narrow.

Abdomen brownish black, the genital segment yellow. Ovipositor evidently broken, the cerci lost.

Habitat. Grenada.

Holotype, ♀, Grand Etang, November 1950 (Noël L. H. Krauss).

This very distinct fly apparently belongs to the subgenus *Eumolophilus* Alexander and would seem to be most nearly allied to *Molophilus* (*Eumolophilus*) *thaumastopodus* Alexander, despite the lack of modified setal brushes on the tibiæ, as found in other known species of the subgenus. The discovery of the male sex will determine the subgeneric position. Additional to the character above discussed, the fly is very different from all regional members of the genus in the coloration, venation, and pattern of the legs.

Molophilus (Molophilus) avitus new species

Belongs to the *plagiatus* group; mesonotum reddish brown, the præscutum restrictedly darkened medially in front; antennæ (male) elongate, exceeding one-third the length of wing; flagellar segments with a dense erect white pubescence and long unilaterally arranged verticils; wings tinged with brown; vein *2nd A* long, sinuous, ending beyond midlength of the petiole of cell M_3; male hypopygium with the basal dististyle a long gently curved to nearly straight rod, the outer end feebly dilated, set with numerous slender spines.

Male. Length about 4.5 mm.; wing 4.8 mm.; antenna about 1.8 mm.

Rostrum brown; palpi black. Antennæ (male) elongate, exceeding one-third the wing, brown throughout; flagellar segments long-oval, with a dense erect white pubescence and very long unilaterally arranged verticils, the latter on the more proximal segments exceeding twice the length of the latter. Head dark brown, sparsely pruinose.

Pronotum pale brown, the pretergites testaceous yellow. Mesonotum reddish brown, the præscutum restrictedly darkened medially in front. Pleura medium brown, the dorsopleural region a little darker. Halteres with stem dusky, knob slightly yellowed. Legs with the coxæ and trochanters yellow; femora and tibiæ obscure brownish yellow, brighter basally; tarsi darker brown. Wings tinged with brown, the stigmal region diffusely more darkened; veins and macrotrichia darker brown. Venation: R_2 nearly in alignment with *r-m*; *m-cu* about one-half the petiole of cell M_3; vein *2nd A* long, sinuous, ending beyond midlength of the petiole of cell M_3.

Abdomen, including hypopygium, brown. Male hypopygium with the beak of the basistyle slender. Outer dististyle unequally bilobed, the longest or inner arm slender, the outer one with the margin microscopically toothed.

Basal dististyle a long gently curved to nearly straight rod, narrowest beyond the base, gently widened outwardly, the feebly dilated outer end set with numerous slender black spines; outer margin of style almost to the base with microscopic appressed denticles; outer margin near the beginning of the spinous head with a small lobule, not indicated on one style of the holotype and presumably broken. Phallosome glabrous, the apex broadly obtuse to truncate.

Habitat. Ecuador (Tungurahua).

Holotype, ♂, Upper Rio Topo, altitude 1500 meters, February 1949 (Segundo Velastegui, through Macintyre).

The present fly is most similar to species such as *Molophilus* (*Molophilus*) *lictor* Alexander, *M.* (*M.*) *sublictor* Alexander, and *M.* (*M.*) *panchrestus* Alexander, differing especially in the structure of the male hypopygium, particularly the basal dististyle.

Molophilus (Molophilus) planitas new species

Belongs to the *plagiatus* group; general coloration brownish gray, pleura plumbeous; antennæ moderately long, flagellar segments fusiform, with an abundant dense white pubescence; male hypopygium with the basal dististyle a long gently curved rod, terminating abruptly in an acute spine, the lower margin for virtually the whole length with a dense row of appressed spines and long black setæ.

Male. Length about 4 mm.; wing 4.5 mm.; antenna about 1.2 mm.

Rostrum brown; palpi brownish black. Antennæ with scape testaceous, remaining segments dark brown; antennæ (male) moderately elongate flagellate segments fusiform, with an abundant dense white pubescence and somewhat longer black verticils. Anterior part of head brown, the posterior vertex grayish.

Pronotum brownish gray. Mesonotum chiefly brownish gray, the pretergites and restricted humeral region more whitened. Pleura dark plumbeous. Halteres broken. Legs with the coxæ and trochanters obscure yellow, the fore coxæ darker; remainder of legs brown, the tarsi black. Wings tinged with brown, the prearcular and costal fields more yellowed; veins brownish yellow; macrotrichia brown. Venation: R_2 opposite *r-m;* petiole of cell M_3 about twice *m-cu;* vein *2nd A* moderately sinuous, terminating nearly opposite the posterior end of *m-cu.*

Abdomen dark brown, the hypopygium more yellowed. Male hypopygium with the beak of the basistyle relatively slender, blackened. Outer dististyle with the arms unequal, the inner more slender and a little longer. Basal dististyle appearing as a long, gently curved rod that terminates abruptly in an acute spine, the lower margin for virtually the entire length with dense appressed blackened spines, interspersed with longer black setæ, the latter more conspicuous on the basal part. Phallosome glabrous, its apex very obtuse.

Habitat. Bolivia.

Holotype, ♂, Cristal Mayu, altitude 1200 meters, August 24, 1949 (L. E. Peña).

There are rather numerous species in Tropical America that have the male hypopygium of the general type of the present fly yet are quite distinct in all details. Such allied species include *Molophilus* (*Molophilus*) *brownianus* Alexander, *M.* (*M.*) *capricornis* Alexander, *M.* (*M.*) *carpishensis* Alexander, *M.* (*M.*) *flemingi* Alexander, *M.* (*M.*) *illectus* Alexander, *M.* (*M.*) *luxuriosus* Alexander, *M.* (*M.*) *pennatus* Alexander, and *M.* (*M.*) *remiger* Alexander.

Molophilus (Molophilus) pertenuis new species

Belongs to the *plagiatus* group; size relatively small (wing, male, about 4 mm.); antennæ short; general coloration dark gray, the pretergites restrictedly pale yellow; wings with a strong brownish tinge; petiole of cell M_3 relatively short, a little longer than *m-cu;* abdomen, including hypopygium, brownish black; male hypopygium with the beak of the basistyle slender; basal dististyle an unusually long and slender rod, bearing a conspicuous spine on the outer margin at near the basal fifth; approximately the outer half of lower margin of style with a row of closely applied spines or teeth.

Male. Length about 3.5–3.6 mm.; wing 4–4.2 mm.; antenna about 1.2–1.3 mm.

Rostrum and palpi black. Antennæ relatively short; scape and pedicel brownish yellow, flagellum brown; flagellar segments subcylindrical, less than one-half as long as the verticils. Head gray.

General coloration dark gray, the pretergites restrictedly pale yellow. Halteres yellow. Legs with the coxæ brownish testaceous; trochanters obscure yellow; remainder of legs brown, the outer tarsal segments darker brown. Wings with a strong brownish tinge, the prearcular field restrictedly more yellowed; veins brown, trichia darker brown. Venation: R_2 about in transverse alignment with *r-m;* petiole of cell M_3 relatively short, a little longer than *m-cu;* vein *2nd A* only gently sinuous, ending about opposite the posterior end of *m-cu.*

Abdomen, including the hypopygium, brownish black. Male hypopygium with the beak of the basistyle slender, blackened. Outer dististyle with the arms unequal, the outer shorter and broader, the inner arm slightly expanded at near midlength. Basal dististyle an unusually long and slender gently curved rod, the tip a strong spinous point; outer margin at near the basal fifth with a strong acute spine; about the outer half of style along the lower margin with a row of closely applied spines or teeth, extending to the base of the apical point. Phallosome glabrous, very obtuse at apex. Aedeagus long and slender.

Habitat. Peru.

Holotype, ♂, Chanchamayo, Junin, altitude 1100 meters, February 12, 1949 (José M. Schunke). Paratopotypes, 2♂♂, pinned with the type.

The closest allies of the present fly are species such as *Molophilus* (*Molophilus*) *flexistylus* Alexander and *M.* (*M.*) *sicarius* Alexander, which differ in all details of coloration and in the structure of the male hypopygium.

Molophilus (Molophilus) setosistylus new species

Belongs to the *plagiatus* group, *flavidus* subgroup; general coloration dark brown; head gray; male hypopygium with the outer arm of the basal dististyle slender, the outer third dilated, terminating in a long spine; inner margin of the expanded portion with a dense brush of dark setæ but without spines; inner arm slender, its outer margin at near midlength with about five or six spines, the outermost longest.

Male. Length about 4.5 mm.; wing 5 mm.; antenna about 1.5 mm.

Rostrum brown; palpi brownish black. Antennæ brownish black, the scape and pedicel a little paler; flagellar segments long-oval, with long, unilaterally arranged verticils on the more proximal segments, additional to a long outspreading pubescence. Head gray.

Pronotum brown, the pretergites more yellowed. Mesonotum dark brown, sparsely pruinose, the humeral region of the præscutum slightly more brightened. Pleura dark brown, sparsely pruinose; dorsopleural membrane yellow. Halteres yellow. Legs with the coxæ and trochanters testaceous yellow; remainder of legs brownish yellow, the tarsi darker brown; dilated darkened ring on base of fore tibia of male conspicuous. Wings with a weak brownish tinge, the prearcular field a very little brightened; veins brown, the macrotrichia darker brown. Venation: R_2 lying slightly distad of the level of *r-m;* petiole of cell M_3 relatively short, only a little longer than the oblique, feebly sinuous *m-cu;* vein *2nd A* long, sinuous, ending a short distance beyond the level of *m-cu.*

Abdomen, including hypopygium, dark brown. Male hypopygium with the beak of the basistyle long and slender, blackened, curved to the acute tip. Outer dististyle with the arms very unequal in shape, the inner a gently curved fingerlike rod. Basal dististyle profoundly bifid, as in the subgroup; outer arm slender basally, with about the outer third or more dilated, thence narrowed to a long straight apical spine; inner margin of the dilated portion with abundant delicate blackened setæ, forming a dense brush; inner arm about two-thirds as long, appearing as a slender rod that terminates in a long acute spine, the outer margin at near midlength with five or six spines, the outermost longest.

Habitat. Chile.

Holotype, ♂, Termas Rio Blanco, Malleco, altitude 1050 meters, March 5–27, 1951 (L. E. Peña).

By my key to the Chilean species of *Molophilus* (Diptera of Patagonia and South Chile, Part 1: 200–202; 1929), the present fly runs to *Molophilus* (*Molophilus*) *inflexibilis* Alexander, which has the details of the male hypopygium quite distinct.

Molophilus (Molophilus) sparsispinus new species

Belongs to the *plagiatus* group, *flavidus* subgroup; general coloration of mesonotum brownish yellow; head orange-yellow; thoracic pleura with a broad dusky dorsal stripe, the ventral pleurites obscure yellow; male hypopygium with the beak of the basistyle long and slender, its tip decurved; basal dististyle profoundly bifid, the outer arm provided with unusually few spines, those of the outer third about ten in number, all on the outer face; inner arm with about two small spinules on outer face beyond midlength; style without setæ.

Male. Length about 5 mm.; wing 5.8 mm.; antenna about 1.5 mm.

Rostrum testaceous brown; palpi black. Antennæ with scape and pedicel yellow, flagellum passing through brown to black; flagellar segments long-oval, with long white pubescence and very long verticils on the more proximal segments. Head orange yellow.

Pronotum chiefly yellow; pretergites whitish yellow. Mesonotum brownish yellow, the humeral region of præscutum more brightened; posterior half of mediotergite infuscated. Pleura with a broad dusky dorsal stripe extending from the cervical region to the postnotum, as described; ventral pleurites obscure yellow. Halteres yellow. Legs with the coxæ and trochanters yellow; femora yellow basally, more infuscated on outer portion, the extreme tip again brightened; tibiæ yellow, the tips narrowly infuscated; subbasal darkened ring of fore tibia of male conspicuous; tarsi brown. Wings tinged with brownish yellow, the prearcular and costal fields clearer yellow; veins brownish yellow, macrotrichia brown. Venation: R_2 lying shortly distad of level of *r-m*; petiole of cell M_3 short, about one-third longer than *m-cu*; vein *2nd A* ending shortly beyond *m-cu*.

Abdomen brown, the hypopygium a trifle more brightened. Male hypopygium with the beak of the basistyle unusually long and slender, blackened, the outer third decurved to the acute tip. Outer dististyle relatively short, its outer arm a gently curved black spine. Basal dististyle profoundly bifid, as in the subgroup; outer arm longest, provided with unusually few spines, those of the outer third about ten in number, all restricted to the outer face, the outer spines larger; basal half of arm with smaller spiculose points or roughenings; inner face of arm entirely glabrous; inner arm about two-thirds as long, terminating in a long simple spine, with about two smaller spinules on outer face beyond midlength; no setæ on style.

Habitat. Chile.

Holotype, ♂, Termas Curacautin, Malleco, altitude 400 meters, December 6–25, 1950 (L. E. Peña).

In the nature of the basal dististyle of the male hypopygium, the present fly is most similar to *Molophilus* (*Molophilus*) *breviramus* Alexander and *M.* (*M.*) *serrulatus* Alexander, differing in the details of armature of the style.

Molophilus (Molophilus) isolatus new species

Belongs to the *plagiatus* group; general coloration of thorax brown, including the disk of the præscutum; male hypopygium with the beak of the basistyle unusually stout, its apex blunt to subtruncate; basal dististyle a heavily blackened structure that narrows gradually into a long apical spine, the outer margin provided with about five spinous points, the two subbasal ones stoutest, the subapical pair small and slender; phallosome setiferous, conspicuously emarginate.

Male. Length about 4.8 mm.; wing 5.4 mm.; antenna about 1.3 mm.

Rostrum dark brown; palpi black. Antennæ (male) relatively long, approximately one-fourth the body length; basal segments obscure yellow, the flagellum dark brown, with unusually long erect white pubescence; verticils of the more proximal segments elongate. Head gray.

Pronotum dark brown, more yellowed behind; pretergites light yellow. Mesonotal præscutum with the disk brown, the humeral and lateral portions yellow; posterior sclerites of notum chiefly brown, the posterior angles of scutal lobes, caudal border of scutellum and sutures of the postnotum more yellowed. Pleura brown. Halteres weakly infuscated, the base of stem narrowly pale. Legs with the coxæ and trochanters yellow, fore coxæ a little darker; remainder of legs brownish yellow, the outer tarsal segments brownish black. Wings with a weak brownish yellow tinge, the prearcular and costal fields clearer yellow; veins brownish yellow, trichia brown. Venation: R_3 lying a short distance beyond the level of *r-m;* petiole of cell M_3 less than twice *m-cu;* vein *2nd A* ending about opposite one-fourth the length of petiole of cell M_3.

Abdomen, including hypopygium, dark brown. Male hypopygium with the beak of the basistyle unusually stout, its apex blunt to subtruncate. Outer dististyle with the arms very unequal, the outer a slender rod, the inner twisted at apex. Basal dististyle distinctive, appearing as a blackened structure that narrows gradually to a long apical spine, the outer margin provided with about five spinous points, the two subbasal ones stoutest, the subapical pair small and slender. Phallosome conspicuously setiferous, emarginate, the notch broad, the lobes correspondingly narrow.

Habitat. Chile.

Holotype, ♂, Termas Rio Blanco, Malleco, altitude 1050 meters, March 5–27, 1951 (L. E. Peña).

The most similar described species is *Molophilus* (*Molophilus*) *perfidus* Alexander, which has the male hypopygium quite different in structure.

Molophilus (Molophilus) echo new species

Belongs to the *plagiatus* group; general coloration dark brown, more or less pruinose; male hypopygium with the beak of the basistyle slender; basal dististyle appearing as a blackened rod, beyond midlength forking into two unequal spines, the outer or axial arm stouter, the lateral or inner spine shorter and more slender; phallosome hairy, its apex shallowly emarginate.

Male. Length about 4 mm.; wing 4.5 mm.; antenna about 1.2 mm.

Female. Length about 5 mm.; wing 5.5 mm.

Rostrum and palpi black. Antennæ brownish black, the scape a little paler; flagellar segments suboval, narrowed at outer end; verticils of the more proximal segments very long. Head brownish gray.

Pronotum dark brown, the scutellum and pretergites obscure yellow. Mesonotum chiefly dark brown, more or less pruinose; humeral region of præscutum and posterior border of scutellum more reddened. The paratype has the body coloration much clearer brown, without the marked gray pruinosity of the type. Pleura more heavily pruinose. Halteres yellow. Legs with the coxæ testaceous; trochanters yellow; remainder of legs brown, the outer segments darker; modified subbasal ring of fore tibia of male conspicuous but scarcely differentiated in color. Wings tinged with brownish yellow, the prearcular and costal regions clearer yellow; veins pale brown, clearer yellow in the brightened fields; macrotrichia brown. Venation: R_2 lying a short distance beyond the level of *r-m;* petiole of cell M_3 about one-third longer than *m-cu;* vein *2nd A* long and sinuous, ending a short distance beyond *m-cu.*

Abdomen dark brown, the hypopygium a trifle brighter. Male hypopygium with the beak of the basistyle slender, on one style of the paratype abnormal, distinctly split to form two points. Outer dististyle with the outer arm flattened, its inner apical angle produced into a small point. Basal dististyle appearing as a blackened rod, beyond midlength forking into two unequal spines, the outer or axial arm stouter, the lateral one shorter and more slender. Phallosome hairy, the apex shallowly emarginate.

Habitat. Chile.

Holotype, ♂, Termas Rio Blanco, Malleco, March 5–27, 1951 (L. E. Peña). Allotype, ♀, Termas Curacautin, Malleco, altitude 400 meters, December 10, 1950 (L. E. Peña). Paratype, 1 ♂, with the allotype.

In the structure of the male hypopygium, the present fly is most like *Molophilus* (*Molophilus*) *diceros* Alexander and *M.* (*M.*) *furcus* Alexander, differing conspicuously in the shape of the basal dististyle.

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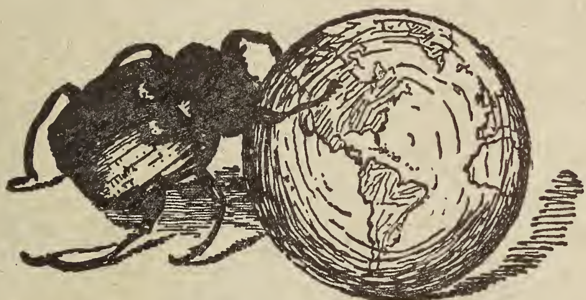

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Prepared by
Harry B. Weiss

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1953

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Andrew J. Mutchler

ANDREW J. MUTCHLER, 1869–1952

An Appreciation

We, of the older entomological group of the New York Entomological Society are in grief over the passing of our dear and eminent entomologist, Andrew J. Mutchler. Personally I have a great deal of praise for his grand personality and his rare faculty of love and insight of entomology as a whole and his helpfulness towards entomological students, both old and young workers in this field.

When I started in the service of the American Museum of Natural History, over 36 years ago, as preparator of the Marine Invertebrate Department, I carried on the study of Hemiptera as a hobby. It was wonderful to discover here a congenial and helpful entomologist, one who had the faculty of tracing and ferreting out references which the librarians found troublesome. Mutchler was primarily a coleopterist but he knew a great deal about literature in all other orders. To have a complying friend at the Museum, one who knew its library so well, was a great advantage to the pursuit of my hobby. Mutchler was never too busy to assist anyone with his problems. He was always willing and happy to be of service in any way, entomologically or otherwise. In fact, Mutchler was most delighted if he could do something for you that you were not able to do for yourself. This was not just my special privilege for he was that same nonchalant good fellow to any entomologist with whom he came in contact. It was a delight to work and be associated with him. Every entomologist who knew A. J., as he was often called, had nothing but good words to bespeak his praise.

To our household A. J. was always a welcome guest. Both Mrs. Olsen and I and in fact the whole family, were very fond of the unassuming, quiet, yet jovial "Uncle Andy" who would always greet you with a kind but raspy basso voice and a very pleasant smile—always pleasant, always polite, always decent in speech and action. He was very fond of a good joke and of throwing in a pun whenever the occasion permitted. We all loved him very much. He was of the same caliber and school as were our late entomological friends, Wm. T. Davis and Charles Leng. Among these three there existed a great bond of friendship and all were lovable characters.

Ethel, our youngest daughter, grew very fond of Mr. Mutchler during the ten years she was secretary to the Department of Entomology. When he decided to marry she helped him plan for his wedding which took place at our home in West Nyack, N. Y. It was not an imposing affair but nevertheless an unforgettable event for us. We know that A. J. and Sadie lived very happily together in their modest little cottage at South Harwich on Cape Cod until he passed away.—Chris E. Olsen.

My sorrow is deep but each and every memory of A. J. is a pleasant and happy one. When I was secretary to the Department of Entomology I never forgot for a moment that A. J. was my superior but I also knew that he was my friend and as time went on our relationship was more that of a father and daughter. A. J. was always willing to hold out his hand in comfort and guidance and many a time I've grasped that hand and been so thankful.—Ethel (Olsen) Ross.

As a Co-worker

Andrew J. Mutchler, who died in the Hyannis Hospital, Hyannis, Massachusetts, on August 31, 1952, was born in Phillipsburg, New Jersey, on October 10, 1869. From early manhood he had been connected with the American Museum of Natural History, with which he first became associated in 1895. Always conscientious in the discharge of his duties and giving evidence of innate capacity beyond the tasks that were initially assigned to him, Mutchler attracted the attention of Frank E. Lutz, who had joined the Museum's Department of Invertebrate Zoology in 1909. It was on Dr. Lutz's recommendation that Mutchler was appointed an assistant in that Department in 1913. Mutchler served the Department with rare fidelity and high efficiency until his voluntary retirement a quarter of a century later on May 19, 1938. In 1920, when the Department of Invertebrate Zoology was reconstituted into a Department of Lower Invertebrates and a Department of Insects, Mutchler was assigned to the latter unit with the rank of Assistant in Coleoptera, subsequently changed, February 6, 1922, to Assistant Curator in Coleoptera. On January 3, 1927 he was elevated to Associate Curator of Coleoptera and this title he bore at the time of his retirement eleven years later. At that time the Executive Committee of the Board of Trustees elected him a Life Member of the American Museum of Natural History "in recognition of more than forty-three years of faithful and effective service."

Mutchler's role as a coördinator of work within the Department was so indispensable that he could be spared for only relatively few field trips. These included an entomological collecting trip to Florida in 1914 and a trip with similar objectives to Puerto Rico in the following year (1915). At that time the New York Academy of Sciences was actively engaged in compiling material and preparing reports for its Scientific Survey of Puerto Rico and the Virgin Islands and it is a tribute to the high standing enjoyed by Mutchler as a coleopterist that to him was assigned the monumental task of writing the account of the beetles of the area in question. Unfortunately, notwithstanding exacting efforts on his part, the complications of museum work so encroached upon his time that he did not succeed in completing the contemplated monograph.

However, he made other notable contributions to his science. He is perhaps best remembered as a member of that scientific partnership that produced the Leng and Mutchler *Catalogue of Coleoptera of America, North of Mexico*—remembered with admiration for the magnitude and accuracy of the task and with gratitude for easing the investigations of others. This work, revised and brought up to date by R. E. Blackwelder, continues to be a standard work of reference for students of the beetles.

His connection with the New York Entomological Society was particularly close. In those days the Society had both a library and an insect collection, since disbanded. Mutchler was appointed Librarian in 1914 and served the Society as Curator from 1914 to 1928. He was Vice-President of our Society from 1929 to 1930, and he guided its destiny as President during 1931 and 1932,—critical years when the nation was in the depths of the depression. The esteem and affection in which he was held by the members of the Society and others were manifested in a spontaneous outburst of goodwill at a farewell party given him on his retirement in 1938. It was then that Dr. Howard C. Curran, who was master of ceremonies, called attention to the phrase "Ask Mutchler," which had become a commonplace saying throughout the Museum and, indeed, in other meeting places as well. It was a phrase that expressed not only a well placed confidence that Mutchler would have the answer to many a problem, but also reflected the assumed belief that he would co-operate fully in providing a right answer if a search for such an answer had to be made. He was a master of the techniques of his office and frequently he knew the contents of the offices of others more thoroughly than did the occupants themselves. His memory was photographic and he often could put his finger on some missing volume amid a litter of books after others had vainly tried to discover its whereabouts. At such times a little throaty chuckle of satisfaction would escape his lips. Mutchler worked hard and enjoyed it but equally he enjoyed his retirement on Cape Cod, tending his place, which he named Mariposa, and joining with his wife in many occupations of mutual interest. On his visits—in later years altogether too infrequent—to New York, he never failed to get in touch with old friends, especially those belonging to the New York Entomological Society, and his presence was a cheery one always.—Herbert F. Schwarz.

As a Friend

Andrew J. Mutchler was a grand person, always modest and unassuming, always cheerful, enthusiastic—and very capable too. One felt entirely at home and glad to be with him in his office at the Museum—and in other places, whether at the famous outings of the Society with the Olsens in West Nyack; at the teas in the Museum Library; or at the dinners before our meetings—at the Hotel Berkley in West 74th Street where he lived for some years. It was great to have him as a guest in your home, and to visit him and his wife at "The Mariposa" in South Harwich on Cape Cod where they lived after his retirement from the Museum in 1938, and to play "Canasta" with them. He also played a good game of "Bridge."

Above all, he took keen delight in encouraging and helping his entomological friends, young and old, in collecting and classifying beetles and studying the books about them. Especially, he enjoyed ferreting out rare and unusual entomological books and papers.

Charles W. Leng in the preface to his Catalogue of the Coleoptera of America, North of Mexico, following a long list of the customary acknowledgments, added "Still more, however, we owe to Andrew J. Mutchler of the American Museum of Natural History, who has followed the entire work, aiding its completion in every possible way."—John D. Sherman, Jr.

As a Co-author

I first became acquainted with Andrew J. Mutchler around 1915, when I visited the American Museum of Natural History with a butterfly that I wanted identified. I was referred to Mr. Mutchler who pulled out several cases of butterflies and finally identified my specimen as *Gonepteryx rhamni* L. He asked me where I found it and when I said New Jersey he looked at me searchingly and said "Like hell you did." I was so amazed that I hardly knew what to say and I immediately concluded that Andy Mutchler was a tough, outspoken guy whom I was not going to like. However when I explained that the specimen in question, a European species, had been bred from a pupa collected on nursery stock imported from Europe, he understood that I was not engaged in "nature faking" and his voice finally became friendly.

After that Andy Mutchler and I got on very well for many years and our friendship continued. After he retired from the Museum and moved to Cape Cod our paths diverged and we no longer kept in touch with each other.

From 1916 until his retirement I was a frequent visitor to his office. For many years I used to call at his office around three or four in the afternoon on the days when the New York Entomological Society met at the Museum in the evening. Other members did the same thing and much entomological gossip passed back and forth between Andy and C. W. Leng, W. T.

Davis, E. L. Dickerson, John D. Sherman, Jr. and a few others who made a practice of such visits. When the Museum closed for the day, the group would go out to eat supper at some nearby restaurant where they were usually joined by other members of the Society. After the meal all would return together for the meeting. This custom continued for many years.

From 1922 to 1929, Mr. Mutchler and I prepared seven papers on certain groups of Coleoptera. These were published by the New Jersey Department of Agriculture, and both of us had a lot of pleasure in putting our papers together, deciding upon illustrations, etc., and talking over disputed points.

I was always greatly impressed by Mr. Mutchler's knowledge of the Coleoptera and of entomological literature. He was a very friendly, even-tempered man who was anxious to help everyone even though his own work was frequently delayed by such interruptions. He had free run of the Museum Library and on numerous times when I had a lot of things to look up, if he knew what I wanted, he would get the books together in advance of my arrival, and have them waiting for me in some quiet corner, where I could work during the short time at my disposal. I am sure others received the same kind of helpful consideration.

I always enjoyed greatly the talk that went on between Mutchler and C. W. Leng, W. T. Davis, John D. Sherman, Jr., Frank E. Lutz and others about the peculiarities of some old-time entomologists and their work and some that were not so old-time. Frequently they were very amusing. However when Mutchler and Leng entered into a discussion of the validity of some species before deciding whether or not it would go into their Catalogue of Coleoptera, all general conversation ceased.

Andy was very faithful in attending the meetings of the New York Entomological Society—many of which were held in Dr. Lutz's office around several large tables that were pushed together. At various times he reported upon some group in which he was interested. Here we heard Chas. F. Schaeffer read description after description of new species of Coleoptera—a practice capable of driving most listeners mad—and watched Robert Percy Dow smoke endless cigarettes and then build a little fire, of partly burned matchsticks, in his ash tray.—Harry B. Weiss.

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1922. The Lycidæ, Lampyridæ and Cantharidæ (Telephoridæ) of the West Indies. (With Charles W. Leng.) Bull. AMNH., 46. p. 413–499. 65 figs.

1922. Wood-boring beetles of the genus Agrilus known to occur in New Jersey. (With Harry B. Weiss.) Circular 48, N. J. Dept. Agric., 20 p. 9 figs. 1 pl.

1923. Beetles of the genera Saperda and Oberea known to occur in New Jersey. (With Harry B. Weiss.) Circular 58, N. J. Dept. Agric., 26 p. 10 figs.

1923. Notes on West Indian Lycidæ & Lampyridæ with descriptions of new forms. AMNH. Novitates, No. 60. 13 p.

1923. Notes on West Indian Lampyridæ & Cantharidæ with descriptions of new forms. AMNH. Novitates, No. 63. 9 p.

1924. A new species of Cincindelidæ from Cuba. AMNH. Novitates, No. 106. 3 p.

1924. The oil and blister beetles of New Jersey. (With Harry B. Weiss.) Circular 76, N. J. Dept. Agric., 19 p. 6 figs.

1925. Beetles of the genus Conotrachelus known to occur in New Jersey. (With Harry B. Weiss.) Circular 87, N. J. Dept. Agric., 22 p. 6 figs.

1925. Coleoptera from the Williams Galapagos Expedition. Zoologica, 5. No. 20. p. 219–240.

1926. Leaf beetles of the genus Galerucella known to inhabit New Jersey. (With Harry B. Weiss.) Circular 98, N. J. Dept. Agric., 16 p. 5 figs.

1927. The dermestid beetles of New Jersey, including the carpet beetle and those which feed upon animal products. (With Harry B. Weiss.) Circular 108, N. J. Dept. Agric., 31 p. 4 pl.

1927. Supplement 1919–1924 inclusive to catalogue of the Coleoptera of America, north of Mexico. (With Charles W. Leng.) Mount Vernon, N. Y. John D. Sherman, Jr. 78 p.

1929. The Ostomidæ of New Jersey. (With Harry B. Weiss.) Circular 158, N. J. Dept. Agric., 17 p.

1930. A Japanese weevil, Calomycterus setarius, which may become a pest in the U. S. AMNH. Novitates, No. 418. 3 p.

* Prepared by Dr. Mont A. Cazier.

1931. Genotype designations of the genera Hydrophilus and Hydrochara. AMNH. Novitates, No. 507. 3 p.
1933. Second and third supplements 1925 to 1932 (inclusive) to catalogue of the Coleoptera of America, north of Mexico. (With Charles W. Leng.) Mount Vernon, N. Y. John D. Sherman, Jr. 112 p.
1934. New species of Carabidæ from Puerto Rica. AMNH. Novitates, No. 686. 5 p.
1934. Saprinus dimidiatipennis. (With Charles W. Leng.) Jour. N. Y. Ent. Soc., 42. p. 86.
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1938. Coleoptera from the Galapagos Islands. AMNH. Novitates, No. 981. 19 p.

SEXUAL DIMORPHISM WITH A NEW SPECIES OF PHILYA WALKER (HOMOPTERA: MEMBRACIDÆ)

By Z. P. Metcalf

North Carolina State College of Agriculture and Engineering of the University of North Carolina, Raleigh, North Carolina

Sexual dimorphism has long been of interest to entomologists, and many interesting and unusual examples of this phenomenon have been recorded. Capener (1951a) has recently described several examples from South Africa. Dr. Mont Cazier of the American Museum of Natural History has sent me an interesting pair of *Umbonia crassicornis* Amyot and Serville (1843a: 543) from Ft. Lauderdale, Florida. It is not surprising that Amyot and Serville should have thought that the male of this species constituted a new genus; nor is it strange that the male and female have been described as distinct species. Even a cursory examination of the illustrations (Pl. II, Figs. 1–6) will show the remarkable differences between the two sexes of this species, which has a wide distribution, having been described originally from Mexico and recorded subsequently from Central America through Colombia, Ecuador, and Brazil. In the United States it has been recorded from Florida by Amyot and Serville and from Ohio and South Carolina by Van Duzee (1917b: 557).

This interesting case of sexual dimorphism called my attention to another case involving a new species of the genus *Philya* as indicated below.

Philya Walker

(Walker 1858b: 126)

Haplotype *Philya bicolor* Walker

This is a genus of moderate sized species of membracids belonging to the subfamily MEMBRACINÆ and tribe NOTOCERINI. Superficially they resemble the genus *Guayaquila* Goding of the NOTOCERINI and the genera *Enchophyllum*

Amyot and Serville, *Enchenopa* Amyot and Serville, and *Campylenchia* Stal of the tribe MEMBRACINI. They also have a superficial resemblance to the genus *Aconophora* Fairmaire of the subfamily DARNINÆ. The genus *Philya* may be readily distinguished from the genus *Aconophora* by the fact that the anterior tibiæ are strongly foliate in *Philya*. From the other genera in the MEMBRACINI they may be readily distinguished by the fact that the pronotum is broadly arched and flat and not strongly compressed. The frontal horn of the pronotum has a strong median carina in *Philya* but usually lacks conspicuous lateral carinæ which are generally conspicuous in the other genera mentioned. Goding (1928e: 225) recognizes four species of this genus while Funkhouser (1951a: 54) records twelve species. For the present my catalogue contains thirteen species as I consider *curvicornis* Stal (1869c: 279) a valid species. The addition of the new species indicated below will make a total of fourteen species in this genus, all from the Western Hemisphere. These species range southward from the western United States across Mexico and Central America to Colombia, Ecuador, and Brazil.

Head subquadrate, foliaceous ventrally and laterally; median carina of the vertex distinct, with a v-shaped suture separating the frons from the vertex; postclypeus small, almost concealed by the foliaceous ventral margin of the frons. Pronotum rather slender with an elongate porrect frontal process which is more or less expanded and bidentate at the apex; median carina percurrent; dorsal area of the posterior process broadly rounded, rather flat, with usually indefinite lateral carinæ toward the apex; the posterior lateral margins broadly incised from the short humeral angles, halfway to the apex of the process. Tibiæ of all three pairs of legs broadly flattened. Tegmina semiopaque, minutely punctulate, the cells at the apex irregularly reticulate. Hind wings transparent; subcosta and radius united to beyond the middle then separating and forming a large first apical cell, reunited before the apex of the wing to form a common vein which is continuous with the subapical vein; media unbranched, united to the first apical cell by a short cross vein and to cubitus one-a by an elongate vein; cubitous one with two main branches.

Male genitalia with the pygofer broadly triangular, the genital plates somewhat clavate, genital styles elongate, obtuse apically; the ædeagus tubular, somewhat inflated apically with a strongly curved acute process internally.

Philya inflata n. sp.

Pl. III, Figs. 1–9

Face nearly quadrangular, slightly longer than broad, the ventral margin broadly obtusely rounded, the dorsal margin rounded; the ocelli nearly twice as far from each other as from the compound eyes. Pronotum elongate, slender, median carina percurrent, whole surface densely and rather coarsely punctate, the punctures each with a short, minute, hair-like spine; frontal process elongate, differing decidedly in the male from the female; in the male the horn is strongly inflated on the apical third, laterally with a distinct vertical carina, dorsally the inflated part is more or less quadrangular with distinct lateral teeth; lateral margins usually more or less rugulose. Frontal horn in the female elongate, somewhat more slender than in the male, dorsal margin nearly straight to the apical fifth; ventral margin slightly expanded on the apical third; apex of the frontal horn slightly expanded when viewed dorsally with short obtuse teeth laterally. Humeral angles short, obtusely produced; lateral margins distinctly incised posteriorly to the humeral angles; the apical area strongly produced laterally with at least one distinct carina. Tegmina with the basal two-thirds strongly punctulate, each puncture provided with a short, hair-like seta; the apical third semiopaque, apical venation rather irregular. Anterior tibiæ strongly, triangularly foliaceous; intermediate tibiæ not so strongly inflated, posterior tibiæ rather strongly inflated with the anterior margin with several stout teeth before the apex and ciliate with elongate, slender hairs.

Male genitalia with the genital plates elongate, more than twice as long as broad; apex obtuse; pygofer triangular, nearly equilateral; genital plates when viewed laterally strongly clavate; genital styles elongate, the apex recurved with a slender tooth directed cephalad; ædeagus broad and short, tubular, with the internal process elongate, recurved; tenth segment elongate, tubular; anal style short, slender, when viewed laterally rather obtuse at the apex. Female with the last ventral segment deeply, triangularly incised almost to the anterior margin.

General color ochraceous tawny with the face strongly clouded with blackish fuscous; the frontal horn is clouded with blackish fuscous on the apical two-thirds leaving smaller areas of ochraceous tawny; basal third of the frontal horn and the posterior process of the pronotum tawny with a few irregular fuscous markings, especially on the apical third; tegmina sometimes entirely ochraceous tawny, sometimes with the basal area and a rather broad fascia before the apical cells blackish fuscous; beneath with the thorax chiefly blackish fuscous, the abdomen ochraceous orange; femora chiefly blackish fuscous, the tibia and tarsi chiefly ochraceous tawny.

Length apex of frontal horn to apex of pronotum 8.2 mm. to 9.0 mm. Length from apex of frontal horn to humeral angles 4.25 mm.

Holotype ♂: Nova Teutonia, Santa Catarina, Brazil; October 23, 1945; F. Plaumann. Allotype ♀: Nova Teutonia, Santa

Catarina, Brazil; October 23, 1945; F. Plaumann. Paratypes 9 ♂♂ and 1 ♀: Nova Teutonia, Santa Catarina, Brazil; October 23, 1945; F. Plaumann.

Bibliographical references are as cited in Metcalf 1944a and 1944b except for the following:

CAPENER, A. L.—1951a—Sexually dimorphic Membracidæ from Southern Africa. Jour. Ent. Soc. South Africa 14: 152–164; Figs. 1–50.

FUNKHOUSER, W. D., 1951a—Homoptera, Fam. Membracidæ—Genera Insectorum 208: 1–383; Pls. I–XIV; Text figs. 1–9.

PLATE II

Umbonia crassicornis Amyot and Serville

Fig. 1. Lateral view of ♂
Fig. 2. Frontal view of ♂
Fig. 3. Lateral view of ♀
Fig. 4. Frontal view of ♀
Fig. 5. Lateral view of ♂ genitalia
Fig. 6. Ventral view of ♂ genitalia

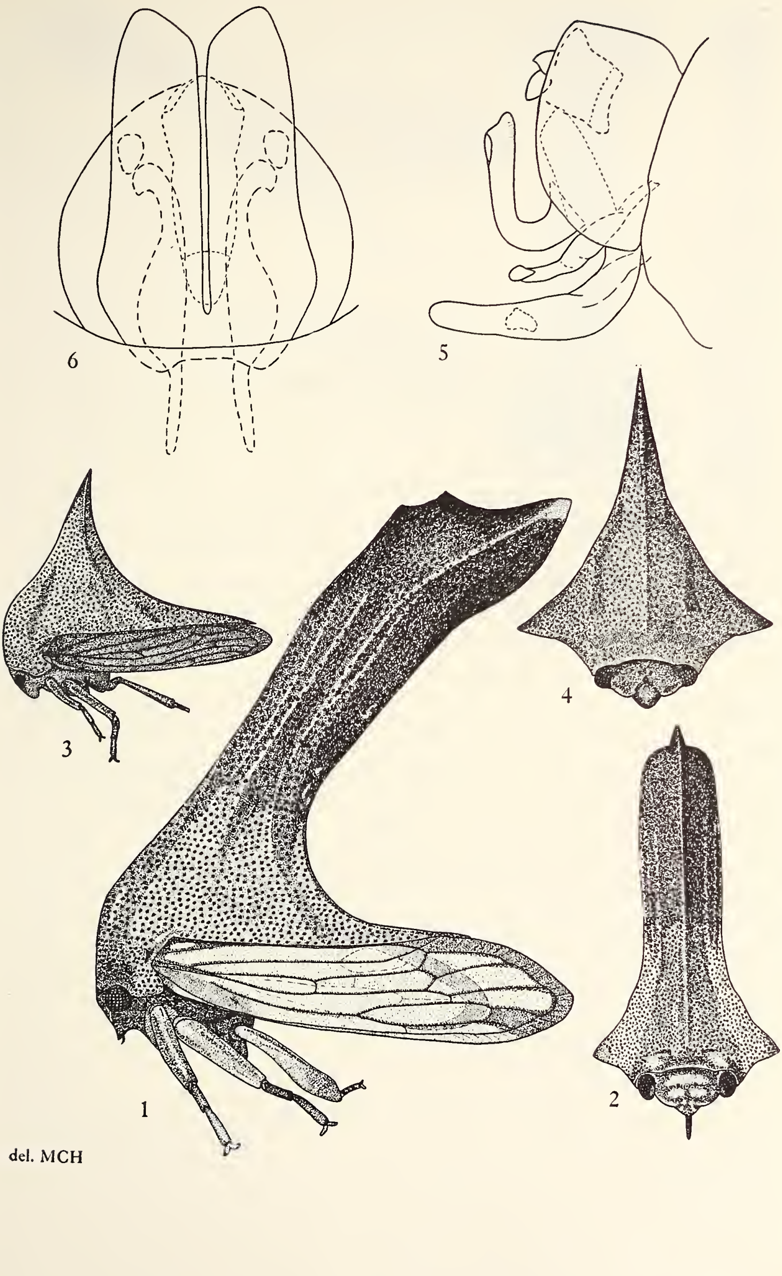
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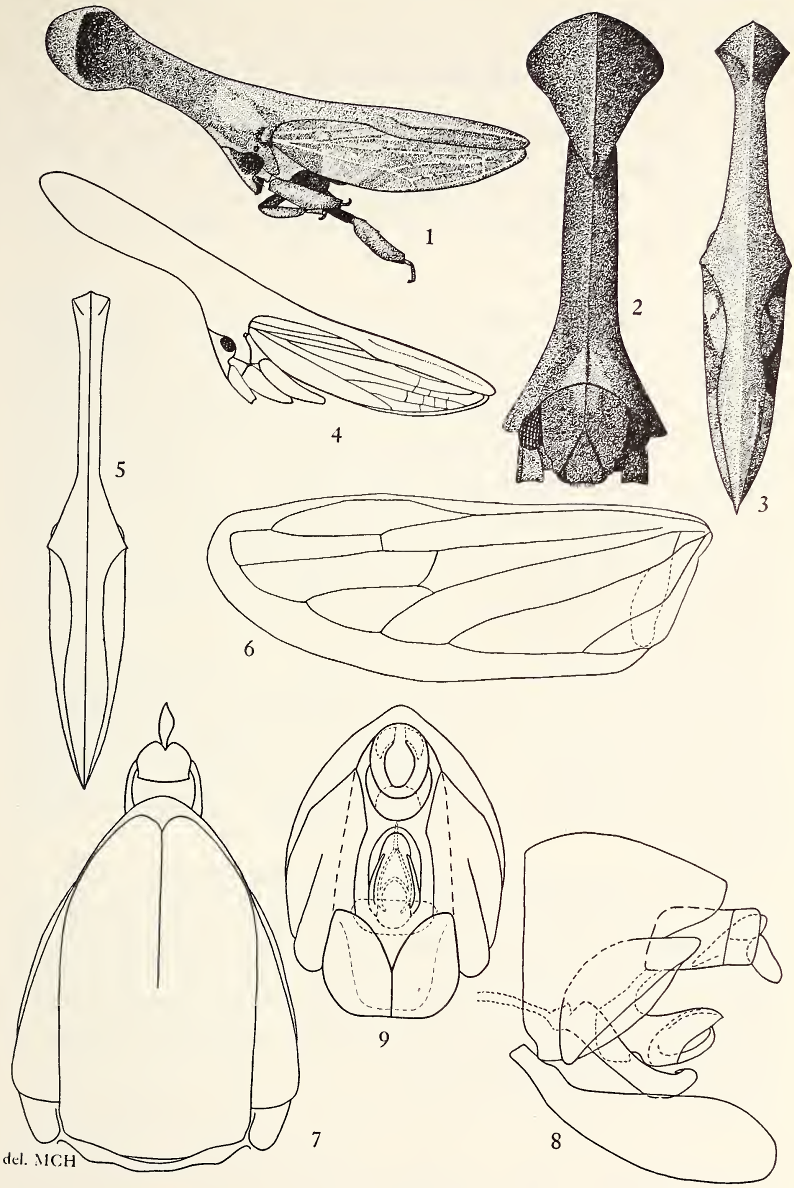
PLATE III

Philya inflata n. sp.

Fig. 1. Lateral view of ♂
Fig. 2. Frontal view of ♂
Fig. 3. Dorsal view of ♂
Fig. 4. Lateral view of ♀
Fig. 5. Dorsal view of ♀
Fig. 6. Hind wing of ♂
Fig. 7. Ventral view of ♀ genitalia
Fig. 8. Lateral view of ♂ genitalia
Fig. 9. Posterior view of ♂ genitalia.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BOOK NOTICE

The Wonderful World of Insects, by Albro T. Gaul. Rinehart & Company, Inc., 232 Madison Avenue, New York 16, N. Y. Feb. 1953. Published simultaneously in Canada by Clarke, Irwin & Co., Ltd. Toronto. $8\frac{1}{4} \times 5\frac{1}{2}$ inches. 290 pp. 47 plates. $4.00.

This is a nice book by one of the more active and enthusiastic members of the New York Entomological Society. The whole world of entomology is surveyed extensively in this volume and Mr. Gaul picks out for his readers and investigates with them, some of the phenomena that have intrigued him and many more entomologists for long years. This is done in good style. The reader is introduced to insects and some of their more interesting behavior is explained. Their economic importance is given good coverage and even the future of the Insecta is forecast, for Mr. Gaul gives a ''NO'' to the question ''Will the insects ever rule the earth?''

This book should provide an excellent introduction to the field of entomology. Mr. Gaul's photography is well displayed and while it might be a little difficult by means of his photographs to distinguish a kidney bean from a kidney, the photographs do provide an interesting example of modern photographic art.

The book has added significance because of the manner in which it was composed. It is the first volume composed with the Higonnet-Moyroud photographic type-composing machine. No type, in the conventional sense, was used in the preparation of this book. We like the printing job and if it represents a step in reducing printing costs, the JOURNAL is extremely happy to welcome the publication.—F.A.S.

THE NEOTROPICAL SPECIES OF THE ANT GENUS STRUMIGENYS FR. SMITH: GROUP OF MANDIBULARIS FR. SMITH

BY WILLIAM L. BROWN, JR.

MUSEUM OF COMPARATIVE ZOOLOGY, HARVARD UNIVERSITY

Below are offered results of studies on *Strumigenys mandibularis* and a few related New World species. Other groups will be treated in separate papers, to be followed by a key to the genus as found in our hemisphere. In citing measurements and proportions, I have used the abbreviations standard in my works on the dacetines: TL, total outstretched length of insect, including mandibles, as measured by separate tagmata; HL, maximum measurable length of head from dorsal view, including all of clypeus and occipital lobes; ML, distance to which closed mandibles extend beyond most anterior point of clypeal margin; WL, length of alitrunk measured along a diagonal in side view. Otherwise, "L" denotes length of part referred to, while "W" refers to maximum measurable width. All measurements are in millimeters, and, except for TL and WL, are subject to an error not exceeding $\pm$ .01 mm. The indices are given as percentages of HL: the cephalic index, or CI, being the maximum measurable head width/HL $\times$ 100, while the mandibulo-cephalic index, or MI, equals ML/HL $\times$ 100.

Strumigenys mandibularis Fr. Smith

Strumigenys mandibularis Fr. Smith, 1860, Jour. Ent. 1: 72, pl. 4, figs. 6, 8, 10, female *nec* worker (original description). Mayr, 1887, Verh. zool.-bot. Ges. Wien, 37: 574, (restriction of type to female of Smith). (*Nec* Forel, 1911, Sitzb. Bayer. Akad. Wiss., p. 263, worker.) Wheeler, 1908, Bull. Amer. Mus. Nat. Hist. 24: 146. Donisthorpe, 1948, Psyche 55: 78–80 (redescription of type female).

Strumigenys batesi Forel, 1911, Sitzb. Bayer. Akad. Wiss., p. 264, worker. NEW SYNONYMY.

I have been able to examine briefly the holotype of this species in the British Museum. It is easily the largest member of the genus known from the New World, and is one of the largest anywhere. Smith first described under this name a female of one species and workers of another, much smaller species, the latter to be called correctly *S. prospiciens* Emery. In 1887, Mayr realized Smith's error, and in effect restricted the type to the large female as *S. mandibularis.*

The *mandibularis* type has been redescribed by Donisthorpe, but rather vaguely and with doubtful measurements. Another set of measurements sent by Mr. Donisthorpe in a letter do not agree with those he published. Mr. G. E. J. Nixon had the type measured for me separately, and, while his methods are somewhat different from mine, the dimensions may be regarded as approximately comparable to those I have given for other species. He gives the head of the type as 1.31 mm. long, 1.34 mm. wide, and the length of the mandibles measured from the *center* of the anterior clypeal border as 0.51 mm. Indices on this basis would be CI 102 $\pm$ and MI 37 to 39. There can be no doubt that the head is slightly broader than long, a condition unique among American *Strumigenys.* Otherwise, *mandibularis* can be readily distinguished by its very short, thick, strongly arcuate mandibles, which are relatively considerably shorter and thicker than are those of *S. godmani.* Furthermore, the entire first gastric tergite of *mandibularis* is densely and finely longitudinally striolate. Other characters were not noted in detail during the short time available to me in London.

In 1911, Forel published on *Strumigenys* material evidently sent earlier by Smith to the Munich Museum; among this material was part of the original type series of *mandibularis* with both species Smith had confused under the name *mandibularis.* These specimens were labelled as having been taken by H. W. Bates in Amazonas, Brazil, whereas Smith gave "St. Paul" as the type locality in his paper. I believe that the nature of the two included species, backed by a review of Bates' collecting localities and the fact that neither species has since been taken again in the São Paulo region, indicates that the Amazonian locality is the correct one for Smith's original series. That

Smith was in error in citing the *mandibularis* type locality is no novelty to those familiar with his entomological works.

Forel rightly realized that the smaller workers described by Smith were the same as Emery's *prospiciens,* but overlooked Mayr's restriction of the type to the large female of Smith, which caused him wrongly to place *prospiciens* in the synonymy of *mandibularis.* At the same time, Forel found with the smaller workers a large worker which he described as *S. batesi* new species. From his description, it is obvious that *batesi* is the worker of the true *mandibularis* as limited by Mayr, and it seems probable that the Munich worker and the type of *mandibularis* in the British Museum are actually part of the same collection and possibly of the same nest series.

S. mandibularis is the genotype of the (monobasic) genus *Strumigenys.* It is apparently an Amazonian rainforest species, and it has not been taken a second time to my knowledge. A whole series of related forms graduated in ever-decreasing size (correlated with decreasing head width and lengthening, narrowing and straightening of the mandibles) begins with *mandibularis,* the largest, and culminates in *S. smithii* Forel. These species, with variants in other directions, are grouped as the *mandibularis* series, characterized by having two strong preapical teeth on the inner mandibular border; most species in this series also have a single well-developed intercalary tooth between the two larger teeth of the apical fork of the mandible.

Strumigenys godmani Forel

Strumigenys godmani Forel, 1899, Biol. Centr.-Amer., Hym. 3: 42, pl. 3, fig. 5, female (original description). Wheeler, 1908, Bull. Amer. Mus. Nat. Hist. 24: 147, female.

Strumigenys ferox Weber, 1934, Revista Ent., Rio de Janeiro, 4: 41–43, fig. 4, worker. NEW SYNONYMY.

Worker, measurements based on 8 specimens from British Guiana and Costa Rica, including 3 cotypes of *ferox:* TL 4.84–5.42, HL 1.06–1.20, ML 0.51–0.55, WL 1.09–1.22 mm.; CI 87–93, MI 46–48.

Weber gives a fairly good likeness with his characterization of *S. ferox,* showing the head and mandibles. The head is massive, with convexly raised vertex and depressed occipital lobe dorsa; posterior excision very deep; median longitudinal sulcus present but weak. Eyes large, convex, protruding, oriented obliquely outward and forward; preocular regions moderately deeply concave, but these gentle hollows not interrupting the antennal scrobe or terminating the preocular laminæ. Mandibles very robust, arcuate, thickest at about midlength. Basal tooth or process reduced, flat and truncate, continuing the inner mandibular border beneath the clypeus. Apical fork of two large teeth, the ventral longer than the dorsal, with a smaller intercalary tooth. Two stout preapical teeth, slightly variable in size, shape and position, but the proximal one much the shorter and more triangular of the two and usually placed at or near the mandibular midlength. This proximal tooth may or may not trail an indistinct lamellate ridge which diminishes proximally toward the condyle; this ridge, the absence of which Weber accepted as a distinguishing character for *ferox,* is best developed in the (female) type of *godmani,* but even here is far from conspicuous. The few available specimens show all intergradient conditions between its presence and absence without regard to locality series.

The petiolar and postpetiolar nodes are relatively large, particularly the latter, which is very large, longer than broad (in an average-sized specimen L 0.44 mm., W about 0.38 mm.) in the free portion of its densely punctulate, evenly convex dorsal surface or disc. The base of the gaster bears short longitudinal costulæ, but the gastric surface is otherwise smooth and shining. The postpetiole and gaster especially bear rather coarse, stiffly erect hairs.

In the brief time available to me for examining the female type, which rests in the British Museum (Natural History), I was able merely to satisfy myself of the identity of this specimen with those available to me from Costa Rica: Hamburg Farm, 3 workers (F. Nevermann) [Museum of Comparative Zoology, U. S. National Museum, Borgmeier Coll.] and British Guiana: Kartabo, 3 worker cotypes of *ferox* (W. M. Wheeler) and two stray workers (R. Wheeler), deposited in the same collections and in Weber Coll. The type locality is Volcan de Chiriqui, Panama (Champion).

Strumigenys planeti new species

Worker, holotype: TL 3.76, HL 0.89, ML 0.47, WL 0.90 mm.; CI 81, MI 53. Paratypes, 39 workers from at least 5 nest series from all of the localities listed below: TL 3.45–4.00, HL 0.80–0.89, ML 0.45–0.50, WL 0.80–0.90 mm.; CI 80–86, MI 52–57. A species intermediate between *S. godmani* and *S. smithii* in total size, structure and sculpture of petiole and postpetiole, proportions of head and mandibles and mandibular dentition, yet perfectly distinct from both species. The new species has in the past been confused with *S. smithii,* which is perhaps its closest ally, and agreement with *smithii* is close except in the following characters:

1. Head similar, but larger and relatively broader, with deeper and broader posterior excision and more broadly expanded occipital lobes.

2. Mandibles heavier, broader and more strongly bowed (less so than in *mandibularis* or *godmani*), and with longer, more widely spaced and more acute teeth. Apical fork of two long spiniform teeth, the ventral slightly the longest and with a weakly deflected tip; small acute intercalary tooth present. Preapical teeth at about the apical fifth and again at about the second apical fifth of the shaft, the distance between the apical fork and distal preapical tooth usually very slightly greater than that separating the distal from the proximal preapical teeth. Distal preapical tooth about $\frac{3}{5}$ the length of the dorsal tooth of the apical fork, proximal preapical tooth $\frac{3}{4}$ to $\frac{4}{5}$ the length of the distal.

3. Fifth funicular segment very slightly shorter than I–IV taken together, or rarely about equal to I–IV. In holotype, scape L 0.58, funiculus L 0.78 mm.

4. Alitrunk as in *smithii,* but more robust. Propodeal lamellæ each forming upper and lower subequal triangular teeth, acutely angular, but with extreme apices usually more or less blunt; portion of lamella separating the upper and lower teeth deeply excavated as a subangular or sharply rounded excision. Metanotal groove well marked.

5. Anterior slope of petiolar node distinctly and evenly convex in both directions, summit gently rounded and disappearing

without interruption beneath its thick posterodorsal spongiform collar.

6. Postpetiolar disc approximately as broad as long, varying very slightly among my series in favor of length or width in different specimens; anterior border truncate, disc itself subcircular and weakly convex in both directions, its surface evenly and densely reticulo-punctate and opaque, with some short weak longitudinal rugæ ranged along its anterior border and varying in distinctness in different specimens; posterior border subtruncate.

7. Threadlike costulæ at base of first gastric segment short and weak (much as in *godmani*), about half as numerous as those of the *smithii* cotypes and much more widely spaced, shorter.

8. Pilosity as in *smithii* cotypes, except that the shorter reclinate and subreclinate hairs of head and scapes are perhaps a trifle longer and more conspicuous.

Color yellowish- to medium ferrugineous; gaster reddish-brown to deep piceous or near-black; appendages somewhat paler in many specimens.

Variation among the paratypes other than that already mentioned is seen in slight differences in the length, acuteness and position of the preapical teeth and in the shape of the propodeal lamellæ. A few specimens show rudimentary development of a trailing lamella from the proximal side of the proximal preapical tooth, recalling the condition in the type of *S. godmani,* but less extreme. The two Trinidad specimens have slightly the longest mandibles (MI 57), while in the specimen from Pará, the MI is 56; the Bolivian series show a range of MI from 52–56, with an average of about 54. This variation, considering the numbers of series involved and the ± 1 error for MI determination, is not significant.

Strumigenys planeti appears to be widespread and probably rather common in the Amazon-Orinoco Basins, with an extension to Trinidad. It appears to be a rainforest species, as are also *S. mandibularis* and *S. godmani* in all probability. The holotype [U. S. National Museum, Mann Collection] was taken at Huachi, Rio Beni, Bolivia (W. M. Mann) together with a group of fourteen paratype workers and a dealate female. The female is similar to the workers, with only the usual differences, and the proportions of head and mandibles, as well as the absolute measurements for these parts, is well within the variation shown by the workers from the same nest (HL 0.86, ML 0.45, CI 85, MI 52).

Additional paratypes were seen from Bolivia: Tumupasa, twenty workers; Covendo, two workers (W. M. Mann). Brazil: Pará, now Belém, one worker (W. M. Mann). Trinidad: Maracas Valley, two workers (N. A. Weber, No. 454). Paratypes in Museum of Comparative Zoology, U. S. National Museum, Borgmeier Coll., and, by exchange, in other collections.

This species can be distinguished readily from all members of its group by means of the dimensions and proportions of head and mandibles, by the shape and dentition of the mandibles, and by the shape of the petiolar and postpetiolar nodes.

COUNT JOSEPH DORFEUILLE, NATURAL SCIENTIST

Joseph Dorfeuille (1790 to July 23, 1840), was a cultured French aristocrat who traveled extensively in Europe, the Orient and America before settling in Cincinnati around 1820 where he invested his money in the Western Museum, wherein was shown the ''best natural history collection on the continent''. Dorfeuille was of course interested in entomology along with his interest in music, art, languages, books, etc. One of his museum exhibits consisted of colored drawings of parasitical insects. Thomas Say corresponded with him and there are other indications of his interest in entomology especially his scrapbook wherein are drawings and tables relating to insect classification. In 1834 he apparently ran a type foundry in Cincinnati because Thomas Say ordered type from him. As science was not sufficient to attract enough paying citizens to his museum Dorfeuille with the help of others arranged for a tableau representing the Inferno, Purgatory and Paradise. This was known to the public as the ''Infernal Regions'' or ''Dorfeuille's Hell''. In the Cincinnati papers it was advertised as ''Dante's Hell''. Joseph moved to New York City around 1838 and established his ''Infernal Regions'' in the City Saloon (formerly Hanington's Diorama) and next door to the American Museum, according to an advertisement in the ''Morning Courier and New York Enquirer'' of May 29, 1839. The City Saloon, 218 Broadway was a large exhibition room at the same address as John Scudder's American Museum. The most complete and interesting account of Joseph Dorfeuille and his activities was written by Elizabeth R. Kellogg under the title ''Joseph Dorfeuille and the Western Museum''. This appeared in volume 22, No. 4 of ''The Journal of the Cincinnati Society of Natural History'' for April 1945.—H.B.W.

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New York Entomological Society

Organized June 29, 1892—Incorporated February 25, 1893

Reincorporated February 17, 1943

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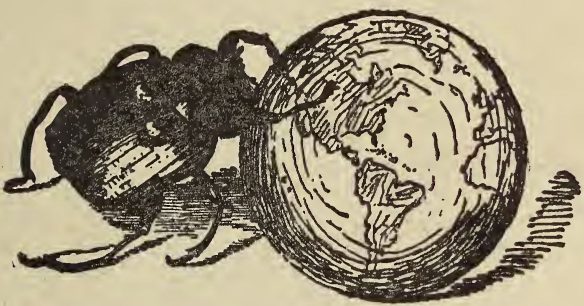

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A BIOLOGICAL STUDY OF ANOPLIUS APICULATUS AUTUMNALIS (BANKS) AND ITS PARASITE, EVAGETES MOHAVE (BANKS) (HYMENOPTERA, POMPILIDÆ)[1]

By Howard E. Evans, Cheng Shan Lin, and Carl M. Yoshimoto

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Information on the biology of North American pompilid wasps is for the most part fragmentary and based on observations of single specimens or at most a few specimens. This is perhaps inevitable in a group of solitary insects which are rarely abundant enough for detailed field studies. In the summer of 1952, the authors were fortunate enough to be doing field work in a locality where one species, *Anoplius* (*Arachnophroctonus*) *apiculatus autumnalis* (Banks), was abundant enough to permit us to make a relatively detailed study of its biology. By observing many individuals, we believe that we were able to arrive at some understanding of the basic core of inherited behavior in this species, as well as of some aspects of its variability. Our notes cover thirty individuals in more or less detail; many others were observed briefly in various phases of their behavior but were not studied in detail since they showed no departure from the usual scheme. A number of observations were also made on a cleptoparasitic pompilid belonging to a closely related genus, *Evagetes mohave* (Banks).

Nothing has previously been reported on the biology of *Anop-*

[1] This study was undertaken as part of a project on the comparative behavior of solitary wasps, supported by the National Science Foundation, grant NSF G-248.

lius apiculatus autumnalis. However, Krombein[2] has recently made observations on *A. apiculatus pretiosus* (Banks), an east-coast subspecies. His observations agree with ours in most essentials and confirm the ethological discreteness of this species. *Evagetes mohave* has been studied briefly by the senior author[3] (under the name *hyacinthinus*) who found it parasitizing *Anoplius* (*Arachnophroctonus*) *americanus juxtus* (Cresson).

All the studies reported on here, except where otherwise noted, were made at Blackjack Creek, Pottawatomie Co., Kansas. This is seven miles east of Kansas State College, Manhattan, where the authors were located at the time. Blackjack Creek runs a relatively short course, arising from several springs amid a group of loess hills a mile or two north of the Kansas River and emptying into the river near the town of St. George. The stream has a relatively constant flow of water at all seasons. The stream bottom is composed of sand which is sufficiently firm to support humans and cattle. The banks of the stream are composed of light but firm pale-colored sand, and at many of the curves in the stream there are broad, flat areas of sand which are relatively free of vegetation. The stream valley as a whole is rather heavily wooded, chiefly with oaks and catalpas. The valley supports a rich insect fauna, including an abundance of psammophilous wasps and bees. Thirty-four species of Pompilidæ were collected here, and sixteen of these were found nesting during the course of the summer. Next to the species considered below, the most abundant pompilid was the small black pepsine, *Priocnemis cornica* (Say), which hunted and nested in close proximity to *autumnalis,* frequently using the same species of spider as prey.

GENERAL HABITS OF ADULTS

The first specimen of *Anoplius apiculatus autumnalis* seen was on May 31, when a male was taken on sand along the stream. On June 6 the first female was seen, and this specimen had cap-

[2] Krombein, Karl V. Biological and Taxonomic Observations on the Wasps in a Coastal Area of North Carolina. Wasmann Jour. Biol. **10**: 275–341. Feb., 1953.

[3] Evans, Howard E. A Taxonomic Study of the Nearctic Spider Wasps Belonging to the Tribe Pompilini. Trans. Amer. Ent. Soc. **75**: 181. June, 1950.

tured a spider and was nesting. Both sexes were present constantly throughout the summer, and the population appeared to increase gradually until early September, when the species was extremely abundant. We did not visit the area after Sept. 9, but female specimens have been taken in the Manhattan area as late as October 28. No specimens of either sex were taken on flowers or honeydew during the entire season; there are in fact no records whatever of this species ever feeding on nectar or honeydew in the manner of many other wasps. Adult females apparently obtain their food from captured spiders. As mentioned below, females nearly always feed briefly on the blood of the spider which exudes from the wound following stinging. In addition, females may occasionally capture spiders merely for their own feeding. A female was seen on July 25 to capture a spider (probably *Arctosa littoralis* Hentz) of extremely small size, smaller than was ever used to stock the nest. After stinging, the spider was not moved at all, but merely consumed by the wasp. After fifteen minutes the wasp left, and we were unable to find any traces of the spider, although these could easily have been missed due to the small size and concealing coloration of this spider. The males were not observed to feed at all and may live only a few days. We have no data on the length of life of adults of either sex.

The male *autumnalis* is always found close to the ground in open sandy places; specimens often alight on the sand and remain motionless for a few moments, but most of the time is spent flying erratically from place to place, particularly where there are females. Males were seen to dart upon females on several occasions, but to the best of our knowledge, none of these were successful matings. Females engaged in their activities generally moved away when approached by a male, or actually drove the male away. It is possible that mating is successful only with virgin females which have recently emerged from the cocoon.

On clear, hot days the activity of *autumnalis* was at its peak during the morning hours (8 to 11 A.M.) with a second and lesser peak in the late afternoon (4 to 7 P.M.). Virtually all nesting occurred during these hours except on cool and cloudy days, when there was a single peak of activity at mid-day. Even on days of intermittent rain a few active specimens could usually be found. If disturbed by man during hunting activities, this species will usually fly away a short distance, but during the nesting process it is possible to make observations very close to it without disturbing it in any way.

HUNTING ACTIVITIES

The female *autumnalis* appears to spend a high percentage of her time searching for prey. In this area only one species of spider was employed as prey, the very common *Arctosa littoralis* (Hentz) [det. W. J. Gertsch]. Fourteen specimens were actually collected and identified; many others were observed in the field or used for rearing, and all appeared to represent this same species. A single *autumnalis* was also taken in Kearny Co., in western Kansas, with the same species of spider. Without exception the spiders were immature. Krombein found *apiculatus pretiosus* using *Arctosa littoralis* apparently exclusively in North Carolina, and again all were immature.

Arctosa littoralis lives in shallow burrows in the sand, particularly in slightly moist sand close to the water. The female *autumnalis* searches in these places by walking rapidly over the sand with the wings vibrating and the antennæ constantly tapping the sand. Small depressions and openings in the sand are examined, and not infrequently the wasp digs a little with the tarsal comb of the front legs. The apparent object of this is to flush the spider from its hole; in all cases observed spiders which were encountered would leap from the hole and bound rapidly over the sand. When this happened the wasp would pursue rapidly but in a haphazard manner, apparently only dimly aware of the exact whereabouts of the spider. Nevertheless the wasp usually succeeded in crossing paths with the spider, whereupon the sting would be applied several times rapidly to any convenient part of the body, usually the abdomen. If this action was successful, the spider would then slow down or stop; the wasp would then straddle the spider, extend the abdomen beneath the cephalothorax and move the tip over the body until a suitable spot was found, when the sting would be inserted. This action lasted several seconds and had the effect of completely paralyzing the spider. Usually the wasp would then pause for a few moments and clean itself, rubbing the hind legs over the wings and the front legs through the mouthparts. The wasp would then malaxate the spider in the vicinity of the puncture, near the anterior part of the cephalothorax ventrally. This activity would usually take several minutes.

This phase of the behavior was observed in its complete form only twice, but in part several times. On the basis of these observations, we are inclined to analyze the hunting and stinging activities as follows: (1) appetitive behavior directed at contacting the host spider, *Arctosa littoralis,* apparently employing short-range visual, chemical, and perhaps tactile stimuli; (2) on contact with the spider, release of the stinging response in the form of several quick thrusts on any part of the spider; (3) on perceiving the inactivation of the spider, application of the *"coup de grâce"* to the vicinity of the central nervous system; (4) reduction in the pace of activity and more "leisurely" feeding upon the spider's blood at the puncture. This analysis is a tentative one and needs confirmation by other workers.

In order to study the duration of paralysis, on three occasions spiders were taken away from the wasps immediately after being stung and kept alive, on two occasions spiders were dug from the nest after two days had elapsed, and on ten occasions spiders were taken from the nest after oviposition and used for rearing. In every instance the spider recovered fully from the effects of the sting. Recovery was usually apparent within one or two hours and complete within twenty-four hours.

TRANSPORTATION

Anoplius apiculatus autumnalis has no need to transport its prey any great distances, since it nests in essentially the same habitat as that in which the host occurs. However, the prey is generally carried from the somewhat moist sand along the stream, where *Arctosa littoralis* occurs, up onto the drier sand away from the stream. It was a very common sight to see *autumnalis* females proceeding away from the stream-bed with their spiders. In all of the innumerable instances observed, the spider was seized by the base of the hind legs, close to the abdominal pedicel, and carried anterior end up (fig. 3). Most commonly the wasp walked backward, the legs and abdomen of the spider dragging on the ground. On several occasions individuals were seen carrying small spiders which dragged on the ground slightly or not at all. Invariably the wasp would start out backward even with a small spider, but on several occasions individuals were seen to reverse themselves abruptly and proceed rapidly forward, the head held high to prevent the spider from dragging on the ground. On three occasions specimens were seen to fly with the spider, retaining the same grasp. One was seen to fly about twenty-five feet across the sand with a small spider. The manner of progression thus seems plastic, depending upon the size of the spider, although the manner in which the spider is held seems to be fixed.

Once in a suitable area, the wasp deposits the spider on the sand while it seeks for a place to dig. Not infrequently the spider is placed close to the base of a plant, where it is shaded; however, we never observed it to be placed in the crotch of a plant or to be hidden in any way. The behavior of *autumnalis* seeking a nesting site is very similar to that when seeking prey: the wasp walks rapidly over the sand, investigating depressions and crevices, with the antennæ constantly being applied to the surface of the sand. A little digging is done occasionally, seemingly to test the quality of the sand. The sides of depressions (foot-prints, for example) are favored as places to dig. The wasp may move about considerably and may move the spider several times before digging in earnest in a specific spot. Always the same grasp on the spider is employed. After the hole is a centimeter or two deep, the wasp ordinarily gets the spider and places it just outside or just inside the entrance, where it remains during the remainder of the digging, often becoming covered with sand. This highly characteristic trait was also noted for *apiculatus pretiosus* in North Carolina by Krombein. It is possible that this habit of hiding the spider during digging may have adaptive value either in preventing the attacks of small parasitic flies (see below under "Parasites") or in preventing robbery by other wasps of the same species. We observed one instance of robbery where a spider had been left on the sand during the search for a place to dig; the spider was accidentally encountered there by another *autumnalis,* stung (although already well paralyzed), and carried away and used in nesting. Considering the abundance of this species in its rather restricted habitat, robbery may well be of common occurrence.

In all movements prior to the completion of the nest-cell, the spider is grasped in the manner already described. Once the cell has been prepared, however, the spider is grasped by the spinnerets and drawn into the nest backwards, the legs extending anteriorly and upward.

NESTING

The nest is dug with the fore legs, which possess a strong "tarsal comb"; the sand is thrown back beneath the body in the usual manner of digger wasps. In the beginning stages, the sand is cleared away from the entrance. Later it is allowed to pile up in the burrow and may fill the entrance; now and then the wasp backs out, pushing the load of sand behind it, and then clears it away from the entrance. The mandibles are undoubtedly used to some extent in loosening the sand, and occasionally they assist in removing the sand from the burrow.

Not uncommonly a nest is abandoned after having been well started. Sometimes cave-ins appear to cause the wasp to seek another site; at other times the reason is not evident. In one exceptional instance an *autumnalis* was observed over a period of $2\frac{1}{2}$ hours to construct and abandon thirteen different holes, varying from one to four centimeters deep, before finally completing and using the fourteenth. Possibly a stimulus indicating a certain moisture content of the soil is necessary for the wasp to complete the nest and store the spider.

A. apiculatus autumnalis works rapidly and almost without interruption until the nest is completed. Records were kept in nine instances of the amount of time taken to dig the nest; the average was nineteen minutes, the variation from nine to thirty-five minutes. As mentioned earlier, the spider is generally placed inside or just outside the burrow entrance as soon as the burrow has been well started. On completion of the nest, it is dragged into the cell; after a very brief pause for oviposition, filling begins. Filling is accomplished by scraping sand from the walls of the burrow and packing it firmly with the tip of the abdomen, which is used to pound the sand rather gently while describing more or less of a circle. The entire act of filling requires only from three to eight minutes. Only when the burrow is nearly full does the wasp rake in sand from the outside by orienting itself away from the opening and throwing sand beneath the body with the fore legs. Commonly the wasp describes a circle about the opening with a radius of about two centimeters, digging a series of shallow holes and throwing the sand toward the center, where it forms a small pile. The next step is the complete concealment of the filled nest; this is accomplished by kicking sand in various directions over an area of several square inches until the surface is completely level. This final concealment usually requires a longer time than the filling of the burrow, and the wasp may remain in the general area for ten or twenty minutes, returning occasionally to the nesting site and kicking a little more sand here and there.

Measurements were taken on fourteen nests. The length of the burrow, including the cell, varied from 5 to 17 cm. (average 10 cm.). The depth of the cell beneath the surface vertically varied from 4.5 to 14 cm. (average 9 cm.). The average angle of the burrow with the surface was about 60°. The average width of the burrow near the middle was about 5 mm., the width of the cell about 7 mm. The more or less vertical cell averaged about 15 mm. in length. Profiles of nests are shown in figures 5 through 9.

The position of the spider in the cell was essentially the same in all cases observed (fig. 4). The legs are drawn upward and serve as more or less of a plug against which sand is packed. The spider fits so snugly into the cell that no movement is possible. Since *Arctosa littoralis* is itself a burrower, it would certainly dig its way out after recovering from paralysis were it not so packed. Spiders brought into the laboratory and placed in artificial cells moved about freely in these cells and lined them with silk. However, the eggs of the wasp generally hatched and the larvæ developed normally in spite of the activity of the hosts.

The position in which the egg is laid on the spider is subject to little variation (figs. 1 and 4). In fifteen observed cases, the egg was without exception laid dorsolaterally in an oblique position a little in front of the middle of the abdomen. It may be laid on the left or the right side of the abdomen and may be tilted in either direction. The egg is fastened very securely, especially at the top, which is the anterior end of the larva.

IMMATURE STAGES

The egg is whitish, slightly curved, about 1.5 mm. in length. Approximately forty-eight hours are required for hatching both in the field and in the laboratory.[4] On one occasion two wasps were seen nesting simultaneously side by side in the field. These nests were both dug out exactly forty-eight hours later. One contained a small larva, the other an egg which hatched within a few hours. Thus the hatching time appears to vary somewhat under apparently identical conditions.

Larvæ reared in the laboratory fed at the point of attachment of the egg for about four days, having by then devoured the entire abdomen; they then turned to the cephalothorax, the last instar apparently having more powerful mandibles. The larva is fully grown five or six days after hatching. The mature larva measures about 13 mm. in length and about 4 mm. in greatest diameter (near the posterior end). It is whitish, the tips of the mandibles conspicuously darker. A detailed description of the larva will be presented at a later date.

The cocoon is brown, parchment-like, and is attached to the walls of the cell on all sides by a network of fine silken threads. Its position in the cell is vertical; the slightly narrower lower end becomes blackened by the meconium; the adult emerges by cutting a circular lid from the upper, wider end. Three females reared in the laboratory spent 20, 22, and 23 days in the cocoon; the single male reared spent 16 days in the cocoon. The total life cycle thus required slightly less than one month (see table). Considering the long active season of this species, it is probable that three or four overlapping generations occur each year.

[4] Laboratory rearings were carried on at a constant temperature of 80° F., which approximated that in the field at the depth of the cells.

No.	Date egg laid	Days in egg	Days in larval st.	Days in cocoon	Date of emergence	Total days egg-adult
1	June 27	2	6	(full-grown larva preserved)		
2	July 4	2	5	20	July 31 (♀)	27
3	July 14	2	6	22	Aug. 13 (♀)	30
4	July 17	2	6	(full-grown larva preserved)		
5	July 29	2	6	23	Aug. 29 (♀)	31
6	Aug. 4	2	5	(full-grown larva preserved)		
7	Aug. 9	2	5	16	Sept. 2 (♂)	24

Table showing rearing data (80° F.) on seven specimens of *Anoplius apiculatus autumnalis* (Banks)

GENERAL REMARKS ON BEHAVIOR

The writers were much impressed by the uniformity of behavior in this species. The method of hunting, the manner of holding the prey, the activities during the search for a nesting-site, the construction of the nest, filling and concealing: all of these activities appeared highly stereotyped. While the carrying out of these innate activities is, of course, directed in its details by stimuli received from the environment, it must be remembered that *autumnalis* is confined to a restricted ecological niche within which the environment is highly uniform. Although this species would seem to be host-specific, it is probable that innate tendencies to respond in certain ways to certain stimuli merely lead it to *Arctosa littoralis*. It seems improbable that *autumnalis* would reject a lycosid of another species if it should be encountered in an *Arctosa littoralis* hole. This point might well be clarified by experimentation. It is noteworthy that one detail of the behavior, the manner of carrying the spider (i.e., backward, forward, or in flight) is highly modifiable depending upon the size of the host spider.

The most unusual aspect of the behavior of this species is its habit of placing the spider inside or just outside the entrance of the burrow while it is digging; as the sand is thrown up it covers the spider or hides it by filling the entrance. Our notes describe three instances in which the spider was left just outside the entrance (up to 3 inches away) and eight instances in which the spider was placed inside the burrow. There were many other instances of this type of behavior which were not specifically recorded. We observed one exceptional case in which the spider was left several feet away during the entire digging process, then retrieved and taken directly into the nest after the cell had been completed. This is the more usual type of behavior for an *Anoplius* and probably represents the original behavior of *autumnalis*. Is the spider-hiding trait recently acquired and not yet completely fixed, or does it merely occur as a response to certain stimuli (e.g., the presence of parasitic flies)?

PARASITES

The sand flats where *autumnalis* nested teemed with small flies of the family Sarcophagidæ, subfamily Miltogramminæ. These flies were commonly seen hovering behind female wasps which were carrying their spider or in the early stages of nesting. After the hole had been well started, they would commonly alight on the sand an inch or two away, their heads oriented toward the burrow. Ten of these flies were captured as they followed *autumnalis* or perched at the side of the burrow; nine of them proved to be *Senotainia litoralis* Allen and one *S. trilineata* Wulp [determinations by C. W. Sabrosky]. The latter species was reared in numbers from the nests of *Bembix carolina* Fabricius which was nesting nearby. *S. litoralis* was reared from the nest of *Anoplius* (*Lophopompilus*) *cleora* (Banks) in this same area.

Neither species of *Senotainia* was observed to successfully parasitize *A. autumnalis* despite many apparent opportunities, a fact which suggested to us the idea that the spider-hiding habit of *autumnalis* might be a successful adaptation for escaping parasitism by these flies. Krombein[5] found *Senotainia litoralis* perching beside the nesting sites of *A. apiculatus pretiosus* in North Carolina. One was seen to dart in and possibly deposit a larva on the spider, which was lying half an inch from the burrow entrance partially covered with sand. A few moments later another fly was observed to larviposit on the spider. When the nest was dug out, a *Senotainia* maggot was found crawling on the spider. As pointed out by Krom-

[5] *Op. cit.*, p. 274.

bein, it appears that in certain instances miltogrammine maggots actively seek out and destroy the wasp egg before starting to feed on the wasp's prey, while in other cases the egg of the wasp hatches and the larva later dies either because of predation by the maggots or rapid decomposition of the prey. The exact relationship of *Senotainia litoralis* with *Anoplius apiculatus* in this regard is not known.

A somewhat less abundant but apparently more successful parasite of *autumnalis* was the pompilid wasp *Evagetes mohave* (Banks). This species has been reported as a parasite of *Anoplius americanus juxtus* (Cresson) by the senior author,[6] but the observations reported here are considerably more complete.

HABITS OF *Evagetes Mohave*

This species was rather common in the nesting area of *A. autumnalis,* and it was suspected very early that it might be a cleptoparasite of this species. Females were found walking over the sand in the usual manner of wasps of this genus, with the antennæ being applied constantly to the surface of the sand, occasionally entering holes or doing a little digging. Males were found visiting honeydew on willows growing in the sand, and would occasionally rest on the sand near the females and dart after them. Both sexes were present in the field from May until September.

The first detailed observations of *E. mohave* were made on July 11. On that date the authors were watching an *Anoplius autumnalis* digging its burrow, when an *Evagetes* walked along the sand and, seemingly at random, entered the partially completed burrow. (The spider had already been placed inside the entrance.) The *Evagetes* came out immediately, walked

[6] *Op cit.,* p. 181. The specimen on which these observations were based was identified as *E. hyacinthinus* (Cresson), of which *mohave* was listed as a synonym. It now seems very probable that these two forms are separate species, and this specimen falls in *mohave.* Incidentally, the rearings described on the following pages were instrumental in convincing us of the discreteness of *mohave,* and it seems possible that techniques such as these may eventually be of much help in properly defining the species of *Evagetes,* a most difficult group taxonomically.

about two feet away, and then rested quietly on the sand, even the antennæ and wings entirely motionless. The *Anoplius* did not appear to have been disturbed in any way and proceeded with its digging. In the next ten minutes the *Evagetes* moved several times (being bothered by a male) but stayed in the same general area, remaining motionless between moves. Finally the *Evagetes* approached the hole very slowly, its antennæ vibrating rapidly. The *Anoplius* had just finished its digging and was inside the burrow in the act of placing the spider in the cell and laying its egg upon it, though whether the *Evagetes* was aware of this it is impossible to say. In any case the *Evagetes* entered the burrow and was in for fully five minutes with the *Anoplius*. Suddenly the *Anoplius* leaped out quickly and, after a moment of seeming confusion, began filling the burrow, leaving the *Evagetes* inside. Five minutes later the filling of the burrow had been completed and the surface had been leveled, when suddenly the *Evagetes* pushed its way out through the sand and flew off, landing on the sand about twenty feet away and being captured for identification. No effort was made by the *Evagetes* to smooth over the sand where she emerged, though no noticeable hole was left except for a slight irregularity of the surface.

This nest was dug out and found to be of the usual *autumnalis* type, with the spider in the typical position in the cell. However, the spider bore an egg obviously not that of *autumnalis:* it was small, only about one millimeter in length, slightly thicker, and more cream-colored. Furthermore, the egg had been laid transversely on the extreme front of the dorsum of the abdomen (fig. 2). This spider and the egg were brought into the laboratory. The egg hatched in about 48 hours; the larva was decidedly pinkish in color and quite robust, but otherwise not dissimilar in its gross appearance and manner of feeding to that of the *Anoplius.* The spider recovered promptly from paralysis in the usual manner, but this did not effect the development of the larva. Five days after hatching, the larva was 12 millimeters long and began spinning its cocoon. Nineteen days later an adult female *Evagetes mohave* emerged from this cocoon (total life cycle: 26 days).

During the next month, a careful watch was maintained for further activity on the part of *Evagetes,* but although these wasps were common, none were seen to enter *Anoplius* nests. Recalling the success of Adlerz[7] in observing the European *E. crassicornis* (Shuckard) in a glass tube attacking the egg of *Pompilus unguicularis* Thomson, we decided to attempt this approach. Consequently we marked an *Anoplius autumnalis* nest and dug it out after the wasp had finished, obtaining a spider with the egg of the *Anoplius* in the usual position. This was placed in a small cell beneath the surface of the sand in a jar, next to the glass. An *Evagetes mohave* was then captured and placed in the top of the jar. For about ten minutes the *Evagetes* walked, flew, and dug around the walls trying to escape. Suddenly she discovered the cell and immediately ceased her attempts to escape. For about half a minute she quietly ran her antennæ over the spider; then she grasped the egg of the *Anoplius* firmly in her mandibles and worked it back and forth until it came loose. Then, still holding the egg in her mandibles, she straddled the spider's cephalothorax dorsally and slowly rubbed the tip of the abdomen in a zig-zag motion over the spider's abdomen, starting posteriorly and working forward. Having reached a point just behind the cephalothorax, movement stopped and the egg was deposited transversely in the same position as in the preceding example. Then the *Evagetes* left the cell promptly and once again attempted to escape from the jar. The spider bearing the egg was brought into the laboratory and an adult male *Evagetes mohave* was produced 22 days later.

This experiment was repeated a few days later with similar but not identical results. In this instance the *Evagetes,* after initial attempts to escape from the jar, seemed definitely attracted to the spot directly over the cell, and returned repeatedly to this spot and attemped to dig. Finally, after 15 minutes of unsuccessful digging, the wasp located the cell and entered with the antennæ vibrating rapidly in contact with the spider. This spider had, however, already begun to re-

[7] Adlerz, G., 1910, K. Svensk. Vet.-Akad. Handl., v. 45, no. 12, pp. 13–26 (under the name *Pompilus campestris*).

cover from the effects of the sting. We were most interested to observe that the *Evagetes* straddled the spider and felt with the tip of the abdomen on the ventral side of the cephalothorax, finally stinging it there. The spider ceased its activity immediataely, and the *Evagetes* then turned to the *Anoplius* egg and devoured it *in situ.* The egg of *Evagetes* was deposited in the same manner and in the same place as before.

We then repeated this experiment using the spider bearing the *Evagetes* egg. Another specimen of *Evagetes mohave* was captured and released in the same jar as previously. It seemed definitely attracted to that part of the jar above the cell (presumably by odor) and without great delay entered the cell and consumed the egg on the spider—which was, of course, the egg of another *Evagetes mohave!* The wasp then rubbed the tip of her abdomen over the back of the spider in the usual manner. However, the spider was already recovering from the effects of the sting of the preceding *Evagetes* and lurched to one side. The *Evagetes* slipped off and remained quietly in the cell for ten minutes, but finally left without laying an egg.

Several additional experiments were tried as follows: (1) An *Evagetes* was introduced into a jar containing an active *Arctosa littoralis* on top of the sand. The wasp merely avoided the spider. (2) An *Evagetes* was placed in a jar containing a cell in which there was a spider which had been stung by *Anoplius autumnalis* but which did not bear an egg. The reaction was the same up to the point where the *Evagetes* entered the cell and examined the spider with the antennæ. Not finding an egg, she then left the cell promptly and did not return. (3) An *Evagetes* was introduced into a jar containing a spider on which a small *autumnalis* larva was feeding. The *Evagetes* was attracted to the cell and dug into it. However, the spider was active enough to run out of the cell and over the surface of the sand. The *Evagetes* ignored it thereafter.

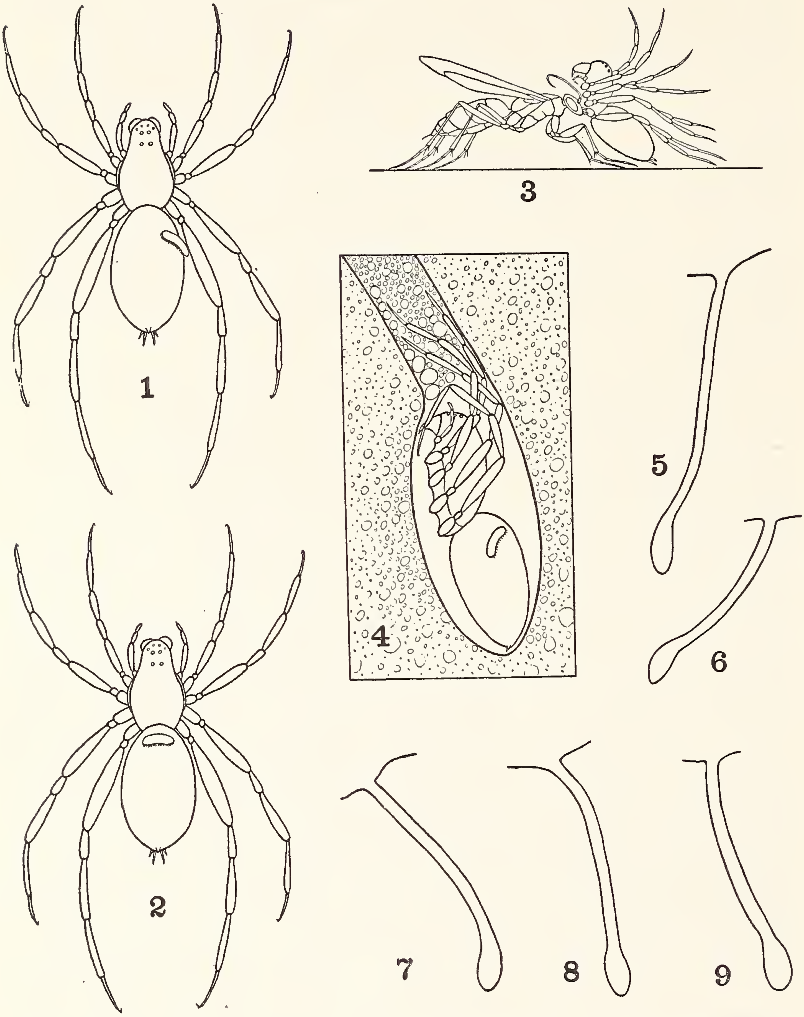
The original experiment was repeated again on Sept. 9, and the resulting *Evagetes* larva spun its cocoon Sept. 17 and remained in the cocoon through the winter. Many more possible experiments suggested themselves, but could not be performed because of lack of time and of lack of the right material at the right time. For example, it would have been most interesting to try *Evagetes mohave* on other hosts to determine which it would attack. It would also have been of much interest to try other species of *Evagetes* on *Anoplius autumnalis.* Although *E. parvus* and *E. padrinus* occurred in this area, we were unable to obtain specimens at the time they were needed. In all probability host differences account for some of the intraspecific variation which occurs in *Evagetes* and which in part renders the genus so difficult taxonomically. Experiments of this kind might assist in understanding the range of hosts of different species and in determining what differences in size and structure, if any, result from development on different hosts.

We may summarize the activities of *Evagetes mohave* as follows. The females walk over the sand, the antennæ vibrating, inspecting depressions and holes. By means of stimuli which must certainly be largely olfactory, they detect the nests of *Anoplius autumnalis* in the sand. If it is a completed nest, they dig into the cell directly. If it is a nest on which the *Anoplius* is still working, they wait quietly on the sand nearby until the spider has been placed in the cell and the egg laid upon it. They are then able to enter the nest without materially upsetting the *Anoplius,* which fills the nest in the usual manner. Once in the cell, the *Evagetes* appears to employ the antennæ to determine the state of paralysis of the spider and the presence of the host egg. If the spider is somewhat active, it may be stung beneath the cephalothorax. (It should be remembered that *Evagetes* ignores free-running spiders and makes no use of the sting in the manner of other spider wasps. However, the ability to sting a spider has not been lost.)

The presence of the host egg on the spider apparently acts as a releaser for the steps which follow. In any case if the spider does not bear an egg the *Evagetes* leaves the cell without further ado. If an egg is present it is grasped in the mandibles and masticated. The *Evagetes* then straddles the spider, its head toward the anterior end, and runs the tip of the abdomen in a zig-zag fashion over the back of the spider's abdomen, finally depositing the egg transversely near the anterior end. The egg of another *Evagetes* is treated in the same manner. After oviposition, the wasp digs its way out of the cell, pushing the sand behind it and more or less filling the tunnel as it progresses.

It is noteworthy that all the *Evagetes* used in our experiments were ready to oviposit, other conditions being favorable. The idea often expressed that the pressure of the developing egg in the female reproductive system is instrumental in producing the "drive" in the activities of a wasp thus seems not wholly satisfactory. At least it would seem likely that some of these specimens would not have found a suitable host for some time, perhaps several days, had they not been captured and used in these experiments.

It is to be hoped that workers in other areas will study both *Anoplius apiculatus autumnalis* and *Evagetes mohave* further. A great deal remains to be learned from an observational standpoint on the amount of individual variation and plasticity of behavior, as well as on many of the finer details of behavior. Both species seem amenable to experimentation in the field, and it is entirely possible that they could be reared through more than one generation in the laboratory. Although our interest has been mainly from the standpoint of comparative ethology as an adjunct to taxonomy, much can perhaps be learned from work of this kind about the underlying principles of innate behavior. From a taxonomic point of view, a species such as *autumnalis* appears to present an array of ethological characters just as it does of morphological characters; it exhibits the behavioral features of the genus *Anoplius* and possesses certain specific behavioral characteristics. The genus *Evagetes* presents quite a different array of characters, and yet leaves reason to believe that it may have been derived from an ancestor not greatly dissimilar to *Anoplius*. Behavioral traits have undoubtedly played a major role in the evolution of these wasps, as they must have in all groups of insects. That behavioral characteristics are much more difficult to discover and enumerate than morphological ones is unfortunate but irrelevant. If the taxonomist be true to his ideals, he must root out by all means available the essence of his science, which is the pattern of evolution.



Explanation of figures.—Fig. 1, Egg of *Anoplius apiculatus autumnalis* in position on abdomen of *Arctosa littoralis.* Fig. 2, Egg of *Evagetes mohave* in position on same spider. Fig. 3, *Anoplius apiculatus autumnalis* dragging its spider prey backward over sand. Fig. 4, Cell of *autumnalis* containing spider and egg in typical position. Figs. 5, 6, 7, 8, 9, Profiles of several nests of *A. apiculatus autumnalis.*

COLLECTING IN SONORA, MEXICO, INCLUDING TIBURON ISLAND

By Patricia and Charles Vaurie

In the summer of 1952 (July 1 to August 16) the authors were sent by the Department of Insects and Spiders of the American Museum of Natural History to collect in the coastal region of the state of Sonora, including the rarely visited island of Tiburon. The main purpose was to gather further data on the distribution of tiger beetles (*Cicindela*) and to make a collection of other insects and spiders from this western region that is so little known entomologically, especially from Tiburon. Our collecting did, in fact, fill in the distributional gaps of a number of species of *Cicindela* and extended the ranges of others. Four new subspecies of *Cicindela* were discovered in this material by Dr. Mont A. Cazier, chairman of the Department of Insects and Spiders, who is describing them in a paper on the tiger beetles of Mexico to be published shortly in the bulletin of the American Museum of Natural History. Identifications of the other tiger beetles mentioned in this paper were checked by Dr. Cazier, whose assistance is greatly appreciated.

We are grateful to the United States Consuls at Nogales and Guaymas for the information and help given by them, and to Mr. William N. Smith, who has spent a number of years living with the Seri Indians on Tiburon and vicinity. We are particularly thankful for the cordial cooperation extended to us by Professor Manuel Quiroz Martinez, Rector of the University of Sonora at Hermosillo, and to his colleagues, without whom we could not have reached some of the places we wanted to visit.

Our equipment consisted of a Jeep and Bantam trailer, the latter being essential in enabling us to carry extra gasoline and water in the coastal area away from the highway and to the island of Tiburon. The highway, which is modern and in excellent condition, extends from Nogales south to Hermosillo and Guaymas, then east through Obregon and Navojoa; it ends at present about 27 miles south of Navojoa, but will eventually reach Mexico City. A paved spur extends from Navojoa to Huatabampo and others are under construction from Navojoa to Alamos and from Hermosillo to Puerto Kino. With the exception of another paved road from Sonoyta to Punta Peñasco, all other roads are either coarse gravel, stones and dirt, or pure sandy wheel tracks, most of them becoming impassable once the summer rains begin (on July 19 in 1952). Travel on these unpaved roads and tracks is often hazardous even during the dry season because many are very poorly indicated, and it is surprisingly easy to lose one's way even after local inquiry or with the services of a guide. The roads shift as often as fancy dictates, but generally speaking most of the choices offered lead eventually to the same place. In addition to extra water and gas, one should be equipped with ropes, a shovel, and old burlap bags.

Collecting localities are indicated by name or number on figure 1, but for the purpose of description they are separated below into coastal localities, islands, inland localities, and localities in the foothills.

COASTAL LOCALITIES

The gulf coast is exceedingly dry and arid, and in places is very rugged, with steep capes or rocky promontories shelving abruptly to the sea. In other places it is low lying, with beautiful curving beaches, and is indented more or less deeply by shallow bays or inlets called "esteros." These esteros, a typical feature of the coast, usually end in tidal marshes with extensive mud flats, ideal situations for many tiger beetles.

At La Cholla, reached by a sandy road through low cholla cacti wastes from Punta Peñasco, a fishing town, four species of *Cicindela* were taken on August 16, *C. gabbi, beneshi* and *californica mojavi* on the outer beach, and *digueti* (a new subspecies) at the edges of the tidal marsh behind the beach. In June, Drs. M. A. Cazier, W. Gertsch, and Mr. R. Schrammel had collected three additional species at this same spot (*C. latesignata parkeri, C. nevadica,* and a new species), and also had found the beetles far more numerous. At their visit the *beneshi* were so thick along the beach that twenty or thirty were caught in each few sweeps of the net and a total of over 1900 specimens were collected in a few hours whereas we found only one specimen of this species.

FIGURE 1

A small white roach, some green stink bugs (*Thyanta*), two *Tetracha* (Cicindelidæ), and a few other insects were collected at night at Pozo Coyote (7) about 150 miles south of La Cholla. This place, which is now but a semi-abandoned ranch, appears on the millionth map of the Americas whereas the much more important Desemboque, about nine miles to the west, the main all year round settlement of the Seri Indians, does not appear on any map. It took us all day of July 5th to make the hundred mile trip through the desert from Pitiquito, about sixty miles west of Santa Ana, to Pozo Coyote and Desemboque.

The beach of Desemboque is flat at its northern end and lined with Indian shelters; the southern end, as it curves towards the big bare headland of Cape Tepopa, has high dunes with clumps of coarse vegetation. The shore consists mostly of smooth stones and large pebbles which did not prove a very good habitat for tiger beetles. We collected only a few specimens of *C. carthagena colossea,* a subspecies which we later took in great numbers on the north end of the island of Tiburon, 30 miles to the south. Probably owing to the dead fish and other debris thrown on the beach by the Seri Indians, scavenger pill bugs (Arthropods) were annoyingly numerous along the water line, and their presence may have been another reason for the scarcity of tiger beetles. At night many œdemerid beetles came to light, some Pentatomidæ, one cerambycid, one buprestid, one clerid, and various small Lepidoptera. Collecting was definitely not good.

About 40 miles southward, at Puerto Kino, a small fishing community about 75 miles west of the city of Hermosillo, collecting was much better. Here, on July 12, 14, and 15, on the beautiful stretch of hard sandy beach (no stones as at Desemboque), about 200 specimens were taken of a new subspecies of *macrocnema,* a species not previously known to occur north of Sinaloa. At night by the light of Coleman lanterns, an additional hundred of this subspecies were taken, also numerous *digueti* (a new subspecies), *californica brevihamata* (rare in collections), and *gabbi.* The two latter species we were unable to find by day, but they undoubtedly came from the extensive marshy inlets behind the dunes. Blister beetles, scarabs, stink bugs, grasshoppers, moths, and other insects were also abundant at night.

Another thirty miles or so southward, at Tastiota, where we stayed July 17 and 18, collecting was also excellent. Four of the species of tiger beetles were the same as those of Kino, and and there were two additional ones, *carthagena* and *trifasciata*. Only three specimens of the latter were collected by us in Sonora although it is a widespread and common species throughout the United States and much of Mexico. Most of the *Cicindela* at Tastiota were not found on the outer beach, which is as beautiful as that of Kino, but within the large, shallow, marshy bay, either in the short grass by the water's edge or on a bare spit at the mouth of the bay, a favorite roost of hundreds of pelicans. There is no settlement at Tastiota, just a modern house situated not far from the bay under a low ridge of organ cactus, giant cactus (*Pachycereus pringlei*), creosote bush (*Larrea tridentata*), and elephant trees (*Pachycormus*). Here at night some Lamiinæ of the Cerambycidæ were taken, along with scarabs, tenebrionids, and other insects.

Eight miles inland from Tastiota is a large irrigated cultivated area called La Floresta (12), so named, no doubt, because of its screen of tall trees enclosing fields, mostly of alfalfa. Here we picked up a few beetles (Malachidæ, Anthicidæ), and Hymenoptera, and saw a specimen of *Cicindela lemniscata*. On our way back to Hermosillo by way of El Zapo we got lost a couple of times through the maze of desert tracks and abandoned, fenced in former fields, now a swirl of fine, floury dust.

Two species of *Cicindela* were taken July 25 at San Carlos Bay (13), about forty miles south of Tastiota and sixteen miles north of the well known fishing port and resort of Guaymas. San Carlos is an unusually lovely and sheltered bay enclosed in sheer rocky walls with a few tiny sandy beaches. On one of these, not more than sixty feet long, we took 116 *carthagena* and about fifty *digueti,* the same subspecies as taken at Kino and Tastiota.

Several days at the end of July and in the middle of August were spent in the vicinity of Guaymas and the nearby railroad junction of Empalme (14). In general this region, with the exception of Cochore Beach a few miles south of Empalme, was not very good for tiger beetles because the many mud or alkaline flats, inlets, and beaches that seemed so promising at first sight yielded very few specimens. The beach at Miramar, where we camped, is crowded with bathers and is much built up, but on a small strip of sand inside the inlet at the northern end of the beach we found *C. carthagena* in good numbers both by day and night, also a few *digueti*, and a single *trifasciata*. Two specimens of *gabbi* were finally found on a large tidal flat across the inlet after a search of a couple of hours. At night *C. wickhami* came to lights in the town.

On our two visits to Cochore Beach we took good series of *macrocnema*, also a few *carthagena*, *digueti*, and *tenuisignata*, the latter usually being a river species. The long legged *macrocnema*, as we had already noted at Kino and Tastiota, were difficult to collect because they usually spread themselves out flat on the moist sand and were missed by the scoop of the net. At Cochore they were even more difficult to capture because of the strong breeze that springs up in the forenoon. A specimen of the weevil *Calendra phœniciensis*, a billbug common in Arizona, was found in the low sand dunes, but insects in general were not plentiful.

The coast can be reached also by way of Potam (15), about forty-five miles south of Guaymas, and at Las Bocas (21), about thirty miles southwest of Navojoa (19). At Potam, an interesting Yaqui community where we arrived August 10, the rains which had begun at the end of July made further progress impossible. At Las Bocas we saw but one tiger beetle, a *macrocnema* that we failed to collect, and, although the shores of an estuary at this locality looked ideal for tiger beetles, no others were found despite long search. A specimen of a buprestid, *Polycesta* sp., however, was found.

The southernmost coastal locality visited, in addition to Las Bocas, was Yavaros, close to the border of Sinaloa and reached by way of Huatabampo. It is a picturesque but forsaken little fishing village at the end of a long narrow spit of land projecting into a huge bay, sheltered in the lee of a large sand dune which cuts off any breeze. At the end of July it was a good locality for night collecting, the few lights of the village attracting *C. lemniscata*, *gabbi*, and *californica brevihamata*, and more cerambycids than were taken at any other place on the coast. On the tidal flats of the bay in the daytime about 150 *gabbi* were collected in a short time and on another immense flat a few miles north of Yavaros a large series of *californica brevihamata.* On this flat, however, the wind was even stronger than it was at Cochore and made collecting very arduous.

ISLANDS

We collected on three islands, all uninhabited, on Tiburon, on Patos (10), a few miles to the north of Tiburon, and Alcatraz or Tassne Island (11) in Kino Bay. Patos lacks suitable habitat for tiger beetles but one lone specimen of *digueti* was captured. On Alcatraz a long sand spit seemed suitable, but we found only one specimen of *carthagena.*

Although Tiburon, which is thirty miles long from north to south by fifteen miles wide, is separated from the Sonoran coast by a narrow channel only a few miles wide, it can only be reached by way of either Desemboque or Kino, which are both about thirty miles distant, respectively, from the north and south ends of the island. In character Tiburon is very similar to the bare headlands of the coast and consists of two rugged, barren mountain ranges separated by a central valley, the mountains on the west coast rising abruptly from the water. The island is exceedingly arid, and there is virtually no drinking water except for a small hole of strongly brackish and debris-filled water near the Seri Indian camp of Tecomate at the north end (the Fresh Water Bay or Bahia de Agua Dulce of maps). A few other water holes and springs are said to exist elsewhere, in the mountains, but are known only by the Indians. The scrubby and scanty vegetation gives no shade, and the thermometer reaches 150 to 160 degrees Fahrenheit.

We spent July 8 to 10 at Tecomate, and July 13 to 14 at Ensenada del Perro, a large bay at the southern end. An 18-foot rowboat with a five horse power engine, handled by three Indians, took us and all our equipment over thirty miles of water from Desemboque to Tecomate. Here, when the tide is out it exposes large rocky flats interspersed with sandy, gravelly patches. The dry part of the beach is narrow, with high clay banks and shell mounds rising steeply from the high water mark. The women and children of a couple of families of Seris had built their open shelters on the shelf of sand cliff, but the usual summer influx of Seris from Desemboque to Tiburon had not yet begun. The first night, while we were waiting on the sand cliff for the Seris to cook the big pot of rice which was to be mixed with some of our assorted canned food, the Coleman lanterns attracted some small green pentatomids, Orthoptera, miscellaneous Coleoptera, and 11 specimens of *C. digueti.* The next night we took some tenebrionids (*Eleodes*), sand spiders on the beach, and assorted scarabs, œdemerids, tenebrionids, curculionids, and more pentatomids in the dry wash near the water hole. By day, at low tide, beyond the belt of rocks, good series of *digueti* were taken on the moist sandy spots and near shallow pools, also many specimens of the large subspecies of *carthagena* (*colossea*).

At the southern end of the island, which we reached via Kino with some Mexican fishermen, we did not find *carthagena,* but took some *digueti* which were found later by Dr. Cazier to belong to the same subspecies that occurs in Baja California. The tigers here were not found on the hard sandy part of the beach, but to one side of the bay, on and among large rocks and hard clay-like outcroppings; they were often confused with some small brown, shiny marine arthropods that scuttled over the rocks.

INLAND LOCALITIES

Our first collecting stop in Sonora, on July 1, was at a large cattle tank at Agua Zarca (1), about twelve miles south of Nogales. Here *C. sedecimpunctata* was swarming by the thousands at the edge of the water, and was equally abundant a little farther south a Cibuta (2) and Imuris (4), and was also collected near the towns of Magdalena (5) and Santa Ana. Near Magdalena some fig beetles (*Cotinus*), elaters, and other insects were swept from mesquite. The highway from Imuris to Santa Ana follows along the Magdalena River which comes down from the Sierra through the canyon of Cocospera and flows west at Santa Ana, passing through Pitiquito. At the time of our visit the river had only a very scant flow of water or was dry for long stretches, the wet places always having good numbers of *sedecimpunctata* which is most abundant in this region.

At Santa Ana the character of the country changes rather abruptly. To the north the land is high, varying between 2000 and 3800 feet, and is relatively well watered, but to the south it is much lower and becomes very arid. From Santa Ana a rough road swings westward via Altar and Pitiquito, and this is the only road from the highway to the coast in the 150 miles between Santa Ana and Hermosillo.

Pitiquito, a small town about sixty-five miles west of Santa Ana, proved to be an excellent collecting locality. Along a small canal dug in the otherwise dry bed of the Rio Magdalena, five species of *Cicindela* were taken, as follows: rather large numbers of *fera, sommeri* and *sedecimpunctata* and considerably less numbers of *flavopunctata* and *sperata.* The first named species was not known to occur so far north, and the last, which was found by Dr. Cazier to represent a new subspecies, had not been reported from Sonora. On the arid mesa above the river bed the first bumble bees of the trip were collected, also some large and small bugs (Coreidæ, Pentatomidæ), elaters and coccinellids in Coleoptera, and at night, on the feathery stalks of a river plant, a hundred or more specimens of the big grey-brown, mottled weevil, *Cleonus saginatus* or *dentatus?.* We spent three days at Pitiquito and on the 5th of July left for Desemboque, passing through La Cienaga (6), about thirty miles south where, on the banks of some large ponds fed by springs, we collected more *C. sedecimpunctata,* as well as some Hymenoptera, Diptera, and Neuroptera. From the small community of La Cienaga on through the desert, the ''road'' becomes a few vague sets of tracks through an immense uninhabited region in which the Sonoran desert is at its most varied and beautiful.

Hermosillo, the capital of Sonora, is a very modern and attractive city, but being low (693 feet) is very hot. We stopped there on several occasions and collected at night on store fronts. Orthoptera, especially crickets, Scarabæidæ (gold bugs), and Meloidæ, were especially numerous one night, and Malachidæ, Pentatomidæ, Reduviidæ, small scarabs, and tenebrionids could always be found. Series of *C. lemniscata* and *wickhami* were also taken. By day on the shores of the large dam at the edge of the city we took four of the same species of *Cicindela* as at Pitiquito, El Gavilan, and north of Navojoa: *fera, sommeri,* *sedecimpunctata,* and *sperata.* On our last visit, on August 12, the rains had filled the dam to overflowing, destroying the habitat of the tiger beetles.

The Sonoran desert south of Guaymas is poor, with little variation in its vegetation, and it ends finally at the Yaqui River. From there on, the low lying land is under intensive irrigation, the waters being derived from the permanent Yaqui and Mayo rivers through a series of modern dams and canals some of which are still under construction. The centers of this rich agricultural region are the thriving cities of Obregon and Navojoa (19). At the end of July we collected on both sides of the Yaqui River north of Obregon near the little Yaqui Indian town of Cocorit (16). The fording place was not too deep for trucks and even where the ferries operated the water was not more than three feet deep. Thus quite a large area of sand and mud flats was exposed, and *C. sedecimpunctata, flavopunctata, tenuisignata,* and *fera,* also a member of the cicindelid genus *Tetracha,* were caught near small pools on the flats, or at the river's edge. On the high sandy banks among the vegetation many specimens of the small grey weevil, *Trichobaris,* were collected, also cinch bugs, chrysomelids (*Chrysochus*), coccinellids and Hymenoptera and Diptera.

In Obregon itself, where we collected at night only, at the lights of a motel and on store fronts, we took *C. tenuisignata* again, also *lemniscata* and *wickhami.* The night of July 29, after a terrific rain and thunder storm the day before, proved about the best night we had for all insects. Among those collected were *Eburia* and *Hippopsis* in the Cerambycidæ, *Trox* and other Scarabæidæ, Bostrichidæ, Meloidæ (*Pyrota akhurstiana* and others), Hydrophilidæ, Curculionidæ, Reduviidæ, and others.

A few more specimens of *C. tenuisignata,* also of *sedecimpunctata,* were collected on a short excursion of about 13 miles from Esperanza (near Obregon), past the village of Los Hornos, to Agua Caliente (17), a hot sulphur spring and lake in the hills. Hydrophilids and some Hymenoptera were also taken on the lake shores.

Navojoa is about an hour's drive south of Obregon and is situated on the far side of the Rio Mayo. But on August 1 and 3 the river was so high that there was no habitat for *Cicindela*. At the ranch of J. J. Dow, off the highway between Navojoa and Huatabampo, two species of buprestids (*Acmæodera*) were taken from within the yellow flowers of the cotton plants, also some chrysomelids (*Diabrotica*), and curculionids (*Anthonomus*). Northwest of Navojoa and of the village of Tesia, at the Santa Rosa Ranch (18), the Rio Mayo makes a wide bend and here on one side there were low sandy banks exposed on which were taken *C. sedecimpunctata, fera,* and *sommeri,* the great majority being *fera,* and at night *wickhami* and *lemniscata.* There was some rain at this time (August 1 and 2), and the area was very moist, hot, humid, and very good for insects. The large *Cleonus* weevil taken at Pitiquito on the Magdalena and later at Pesqueira on the Rio Sonora, was present here also in good numbers, also another weevil, equally large, a variety of *Cratosomus punctulatus,* white with variable black transverse markings, which was picked from two mesquite trees in the river bed. Although this weevil is said to be common throughout Mexico, we encountered it once only. Other insects taken at night included some *Monilema* taken on cholla and beaver tail cacti, also other smaller Cerambycidæ, *Diplotaxis* and other Scarabæidæ, some Cleridæ, Elateridæ, Bostrichidæ, and many Neuroptera and Lepidoptera.

LOCALITIES IN THE FOOTHILLS

In some places the foothills of the Sierra Madre Occidental come very close to the highway, and the Sierra itself is always in sight. We first penetrated into the foothills on the evening of July 1 when we went part way to Cananea, camping in Cocospera Canyon (3) a few miles above the village of Puerta del Cajon. Here along the Magdalena River we took the ubiquitous *C. sedecimpunctata,* and some chrysomelids, curculionids, malachids, coccinellids, and Diptera.

Another canyon, about forty-five or fifty miles northeast of Hermosillo and through which flows the San Miguel, an affluent of the Rio Sonora, was visited at a very beautiful spot called El Gavilan (9), on the road to Ures. Here, at the fording of the river we managed to collect a few specimens of *C. fera, sommeri,* and *sedecimpunctata* and see a *sperata* before the first heavy raindrops of the season chased us and the tiger beetles off the sandbanks (July 19). El Gavilan will always remain vivid in our memory as one of the wildest nights we ever spent in the open. The torrential rain which began at 6 p. m. as we attempted to leave the canyon kept up until 3 a. m. with constant lightning, thunder, and driving gusts of wind, while we sat shivering and soaked in the open jeep, marooned on the side of a fast flowing wash. The next day we woke to a grey dawn and a wet motor, but were eventually rescued by some truck drivers who, like us, had been caught by the storm in the mountains. The trucks and ourselves continued laboriously through a number of minor washes to find our way finally cut off by the impassable Rio Sonora which, though bone dry the evening before, was now a swiftly running, handsome river some 200 to 300 yards wide.

Near the village of Pesqueira (8) on the shore of the Sonora, while we were waiting for the river to go down, we picked up about sixty cicadas, one hundred *Cleonus,* elaters, coccinellids, the spectacular orange and black cerambycid, *Dendrobias,* and other insects. We were finally pulled across the river by a team of four mules, whose owner was making a good business with the vehicles waiting on both sides of the river at ten pesos a crossing.

Quite different country was encountered at the southern end of Sonora at Minas Nuevas (20), 1700 feet high in the Sierra de Alamos, and at Alamos itself which is somewhat lower at 1200 feet, and not far from the border of the state of Chihuahua. Around Minas Nuevas and Alamos the vegetation is semi-tropical and more varied, with morning glory trees and wild figs, although quite a few of the typical Sonoran desert plants still persist. At the time of our stay (August 4 to 8) it rained nearly every day. Hundreds of butterflies, not seen before on the trip, clustered about the pools and moist mud along the paths and roads. The first Lycidæ and Lampyridæ of the trip were also taken at Minas Nuevas, and on a flowering tree hordes of small cerambycids (*Rhopalophora,* etc.), clerids (*Enoclerus, Cymatodera*), Hymenoptera, and the large black cerambycid (*Stenaspis*). Two inch long, spiny legged Coreidæ were mating everywhere on the mesquite, and small black and red Chrysomelidæ were taken from a mesquite in flower. At night *Monilema* cerambycids were picked from the beavertail and cholla cacti and many insects came to light. Small dung beetles rolled their pills on the paths, and on the vegetation large green elaters were taken, brilliant green and golden buprestids (*Agœocera*), curculionids (*Trichobaris*) on *Solanum,* and the large *Cactophagus.* Other beetles included *Trox, Diplotaxis, Bolboceras, Acmœodera, Eburia, Epicauta* and members of the Cucujidæ, Lucanidæ, Carabidæ, and Anthribidæ.

Minas Nuevas is a silver mine no longer under operation where we were the guests of Mrs. Clara Yaeger, the owner of the mines. On a wooded, gravelly, and shady path at one side of the mine, the small tiger beetles *lemniscata* and *wickhami* were collected by day and night, also a few *sedecimpunctata,* and six specimens of *hydrophoba taretana,* a subspecies known previously only from farther south in Mexico. Alamos, six miles east of Minas Nuevas, is a sleepy colonial town with fine old buildings and arcaded streets where time has stood still. Once the capital of all northwestern Mexico with a population of 25,000, it has now only about 1000 inhabitants, many of them retired Americans. In the arroyo at the entrance to town bumble bees and a cetonid beetle were collected from the white flowers of a tall bush, and other Hymenoptera in nearby poppy fields.

A NOTE ON GIBBIUM PSYLLOIDES CZEMP. (PTINIDÆ, COL.)

This species was collected June 2, 1953 in an apartment house in Trenton, N. J., on carpets. It appeared only during the night and was mildly annoying rather than troublesome. William M. Boyd of Trenton, N. J., has specimens in his collection labelled, "New Brunswick, N. J., in flower seeds from California," and Dr. Mont A. Cazier has advised me that the specimens in the collection of The American Museum of Natural History are labelled "New York City" and "Puerto Rico."

Although this "hump beetle" has a world-wide distribution and is seldom of economic importance it is very poorly recorded in the literature of American entomology, in spite of the fact that it occurs in houses and warehouses, in cereals, cake, yeast, cotton and other seeds, hay, drugs, casein, food products, etc. In the literature of American economic entomology from 1860 to 1947, as compiled by Henshaw, Banks, Colcord and Hawes, there are only six references to it, one in 1886 by Riley recording the species in old hay, one in the index for 1915–1919, three in the index for 1935–1939 and one in the 1945–1947 index. Blatchley and Leng, each record it as occurring from Virginia to California. Even though it is a cosmopolitan species it seems desirable to have some definite locality records in the literature.

In Loding's "Catalogue of the Beetles of Alabama" (1945) it is recorded from Mobile County in drugs; in Leonard's "Insects of New York," from the Produce Exchange, New York City; and in Brimley's "Insects of North Carolina" from Raleigh, in grain, casein and other food products, January to May, and September.

The species may be represented more abundantly in various private and public collections than in entomological literature. Its small size and nocturnal habits may have saved it from publicity.—Harry B. Weiss.

THE SCHENDYLIDÆ OF NORTHEASTERN NORTH AMERICA (CHILOPODA: GEOPHILOMORPHA: SCHENDYLIDÆ)

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The members of this interesting family may be found in all of the faunal realms of the earth. The Schendylidæ embrace at least twenty-seven genera, over half of which are represented in the New World, chiefly in the tropics. Mainly tropical, this family is known from the more temperate regions of the Western Hemisphere by relatively few species, four of which are known to inhabit the northeastern United States.

Schendylidæ

Schendylidæ Cook, Proc. U. S. Nat. Mus., XVIII, p. 70, (1895).
Ballophilidæ Cook, Proc. U. S. Nat. Mus., XVIII, p. 70, (1895).
Schendylini Verhoeff [tribe of subfamily Geophilinæ], Nov. Acta Leop. Acad., LXXVII, p. 414, (1901).
Schendylidæ Verhoeff, Bronn Kl. u. Ordn., V, p. 275, (1908).
Schendylinæ Brolemann, Arch. Zool. Expér., (5) III, p. 312, (1909).

The mandible which possesses both a dentate lamella and a row of simple teeth will identify the members of the family.

FAMILY DIAGNOSIS.[1]—Antennæ: filiform, weakly attenuate distally. Cephalic plate: slightly longer than wide. Labrum: unipartite, usually separated at least laterally from clypeus; usually medially concave and dentate. Mandible: with a dentate lamella and with a row of simple teeth. First maxillæ: coxites completely fused; with or without well-developed telopodital and coxosternal lappets. Second maxillæ: coxites completely fused medially; telopodital apical claw either simple or pectinate dorsally and ventrally. Prehensorial segment: telopodites not surpassing anterior margin of cephalic plate, lateral telopodite surfaces generally largely concealed from above; prosternum with or without chitin lines. Tergites: preparatergites and

[1] The familial and generic diagnoses presented here apply to their groups primarily as they are represented in eastern North America.

paratergites lacking. Sternites: with or without ventral pore fields. Ultimate pedal segment: each coxopleuron either with freely opening pores or with depressed pits into which pores open; tarsus entire or bipartite; pretarsus present or absent, when present appearing as a sclerotized claw.

Key to the Genera

——— Ultimate pretarsus absent. Ventral pore fields present
Schendyla Bergsöe and Meinert

——— Ultimate pretarsus present. Ventral pore fields absent
Escaryus Cook and Collins

Schendyla Bergsöe and Meinert

Schendyla Bergsöe and Meinert, Naturh. Tidsskr., (3) IV, p. 103, (1866). TYPE: *Geophilus nemorensis* C. L. Koch, 1836 [= *Schendyla* (*S.*) *nemorensis* (C. L. Koch)]. (Monobasic.)

The absence of an ultimate pretarsus will readily distinguish *Schendyla*.

Generic Diagnosis.—First maxillæ: coxosternum without lappets; telapodites with tiny lappets. Second maxillæ: apical claw simple, its ventral and dorsal edges non-pectinate. Ventral pore fields: each consisting of a small number of slightly pigmented pores and occurring upon a variable number of anterior sternites; each usually in the form of a small elliptical and centrally situated group of pores. Ultimate pedal segment: each coxopleuron with two large sunken pits which do not open directly onto the coxopleural surface; second tarsus only about a third the diameter of the first tarsus; pretarsus absent; male and female ultimate legs greatly swollen, those of the male but slightly more inflated than those of the female.

Component Species.—this genus, which consists of some seven species, a few of which are polytypic, is represented in Europe, Asia, North and South America. It has been divided into two subgenera, *Echinoschendyla* and *Schendyla,* but only the latter is known from the northeast and only by a single species that has undoubtedly been introduced from Europe.

Schendyla nemorensis (C. L. Koch)

Geophilus nemorensis C. L. Koch, Deutsch. Crust. Myr. Arach., (1836).

Poabius bistriatus C. L. Koch, Koch-Panzer, Krit. Revis., III, p. 183, (1847).

Linotænia nemorensis (C. L. Koch), Myr., II, p. 26, (1863).

Geophilus tyrolensis Bergsöe and Meinert, Naturh. Tidsskr., (3) IV, p. 73, (1866).
Schendyla nemorensis (C. L. Koch),—Bergsöe and Meinert, Naturh. Tidsskr., (3) IV, p. 105, (1866).
Geophilus gracilis Harger, Amer. Journ. Sci. Arts, (3) IV, p. 18, (1872).
Schendyla (*S.*) *nemorensis* (C. L. Koch),—Brolemann and Ribaut, Arch. Mus. Paris, (5) IV, p. 154, (1912).

Specific Diagnosis.—Length: to 28 mm. Color: pale yellowish-white. Labrum: with about fifteen weakly sclerotized teeth. Mandible: dentate lamella with 5–7 teeth. Ventral pore fields: present on sternite two through about fifteen, eventually dividing into two paramedian fields; each field consisting of some twenty-five pores. Pairs of legs: 39–55. Ultimate pedal segment: second tarsus much thinner and shorter than the first, being about a third as long and wide.

Ethology.—This tiny species is usually discovered in humus and debris or infrequently beneath rocks. By means of a Berlese funnel it may be collected in large numbers in most of its localities. I have taken it most commonly in the Ithaca region between late March and early June oftentimes while the temperature (F.) was hovering in the low fifties.

Distribution.—Apart from the northeastern localities listed below, *nemorensis* is known only from Utah. NEW HAMPSHIRE: Laconia. MASSACHUSETTS: Hough's Neck; Blue Hills; Mattapan; Forest Hills. CONNECTICUT: Mt. Higby Reservoir; New Haven. NEW YORK: Taughannock Falls State Park; Ithaca; Clyde; Albany; Baiting Hollow; Hunter Mountain; Staten Island; Kenwood. OHIO: Delaware County. ILLINOIS: Chicago Ridge; Chicago; Urbana; Champaign. MICHIGAN: Detroit; Willow Run.

Escaryus Cook and Collins

Escaryus Cook and Collins, Proc. U. S. Nat. Mus., XIII, p. 391, (1891). TYPE: *Escaryus phyllophilus* Cook and Collins, 1891 [= *Geophilus urbicus* Meinert = *Escaryus urbicus* (Meinert)]. Subsequent designation of Cook, Proc. U. S. Nat. Mus., XVIII, p. 71, (1895).

The absence of ventral pore fields will identify *Escaryus*.

GENERIC DIAGNOSIS.—First maxillæ: coxosternum with or without rudimentary lappets; telopodite with long or short lappets. Second maxillæ: apical claw pectinate along dorsal and ventral edges. Ventral pore fields: absent. Ultimate pedal segment: each coxopleuron with numerous singly and freely opening pores; second tarsus but slightly narrower than the first; pretarsus present, unguiform; male ultimate legs greatly swollen, those of female conspicuously thinner.

COMPONENT SPECIES.—The genus includes at least eleven forms which are known from central and eastern Asia, the Behring Island, Alaska, and the United States. Three well-defined species are known from the northeast.

KEY TO THE SPECIES

1. 57–59 pairs of legs. Ultimate pretergite laterally suturate. First maxillary telopodite lappets long, at least half as long as the second telopodite article.[2] Coxopleural pores small and numerous .... *missouriensis* Chamberlin
— 41–49 pairs of legs. Ultimate pedal pretergite laterally with or without sutures. First maxillary telopodite lappets short, at most (and rarely) half as long as the second telopodite article. Coxopleural pores large and small, numbering about 18–35 2
2. 47–49 pairs of legs. Ultimate pedal pretergite non-suturate laterally. Prehensorial telopodite without a femoral denticle. Cephalic plate much longer than wide (37: 27). Labral teeth 10–13. Coxopleural pores 18–25 .... *liber* Cook and Collins
— 41 pairs of legs in both sexes. Ultimate pedal pretergite laterally suturate. Prehensorial telopodite with a distinct femoral denticle. Cephalic plate slightly longer than wide (26: 25). Labral teeth 13–18. Coxopleural pores 25–35 .... *urbicus* (Meinert)

Escaryus missouriensis Chamberlin

Escaryus missouriensis Chamberlin, Ent. News, LIII, p. 185, (1942). [St. Louis, Missouri.]

The numerous pairs of legs will readily identify this species.

SPECIFIC DIAGNOSIS.—Length: to 65 mm. Color: yellowish-brown. Cephalic plate: much longer than wide (47: 38). Labrum: with some 16 teeth. First maxillæ: telopodite lappets relatively long, the apex of each attaining at least half the length of the associated telopodite second article; coxosternal

[2] The telopodite apparently consists of two articles, the basal one of which gives rise to the telopodital lappet. The distal article is divided into two regions, a proximal sclerotized part and a distal membranous portion.

lappets tiny, each represented by a low setose mound.[3] Prehensorial telopodite: femoral denticle present, approximately as large as that of the tibia. Pairs of legs: 59 in the male holotype, 57 in the only female known; legs relatively densely hirsute. Ultimate pedal segment: each coxopleuron with some 70–80 tiny pores; pretergite suturate laterally.

DISTRIBUTION.—The species is known from but two localities, the environs of St. Louis, Missouri, and Dallon's Spring Cave, Indiana. I have examined the Indiana female.

Escaryus liber Cook and Collins

Escaryus liber Cook and Collins, Proc. U. S. Nat. Mus., XIII, p. 394, (1891). [Kirkville, New York.]

The number of pairs of legs and the non-suturate ultimate pedal pretergite are especially characteristic of this species.

SPECIFIC DIAGNOSIS.—Length: to 29 mm. Color: typically waxy-white. Cephalic plate: distinctly much longer than wide (37: 27). Labrum: with about 10–13 teeth. First maxillæ: telopodital lappets tiny, the apex of each at most half as long as the second article of the telopodite; coxosternal lappets absent or at most represented by obscure and sparsely setose mounds. Prehensorial telopodite: femoral denticle absent, denticles of remaining articles tiny. Pairs of legs: 47 or 49 (usually 47) in the male, 47 or 49 (usually 49) in the female; legs almost glabrous. Ultimate pedal segment: coxopleuron with some 18–25 large and small pores: pretergite non-suturate laterally.

DISTRIBUTION.—The species is known only from the following northeastern localities: NEW YORK: Ithaca, Taughannock Falls State Park; Varna; Kirkville. MARYLAND: Lanham. DISTRICT OF COLUMBIA: Washington. OHIO: Cleveland.

Escaryus urbicus (Meinert)

Geophilus urbicus Meinert, Proc. Amer. Phil. Soc., XXIII, p. 218, (1886). [Cambridge, Massachusetts.]

Escaryus phyllophilus Cook and Collins, Proc. U. S. Nat. Mus., XIII, p. 392, (1891).

[3] In his original description Chamberlin states that the first maxillæ lack lappets. Because the lappets of the telopodites are often bent back under the telopodite on microscopic preparations, it may appear that they are absent. Similarly the coxosternal lappets may escape detection owing to their minute size.

Escaryus urbicus (Meinert),—Bailey, Bull. N. Y. State Mus., no. 276, p. 44, (1928).

The characteristic number of pairs of legs and the presence of lateral sutures upon the ultimate pedal pretergite will identify *urbicus*.

Specific Diagnosis.—Length: to 29 mm. Color: light yellowish-brown. Cephalic plate: slightly longer than wide (26: 25). Labrum: with about 13–17 teeth. First maxillæ: telopodital lappets tiny, the apex of each attaining less than a third the length of the second telopodite article; coxosternal lappets absent. Prehensorial telopodite: femoral denticle relatively large, about as large as that of the tibia. Pairs of legs: in both sexes 41; legs relatively hirsute. Ultimate pedal segment: each coxopleuron with some 25–35 large and small pores; pretergite suturate laterally.

Distribution.—Outside of the northeast the species has been recorded only from Minnesota. MASSACHUSETTS: Cambridge. NEW YORK: Ithaca; Syracuse. VIRGINIA: Clifton Forge; Calf Mountain; Mountain Lake. OHIO: (locality ?).

AN UNNAMED LYCÆNID FROM TRINIDAD (LEPIDOPTERA)

BY FREDERICK H. RINDGE AND WILLIAM P. COMSTOCK
THE AMERICAN MUSEUM OF NATURAL HISTORY

Echinargus huntingtoni, new species

Echinargus n. sp., Nabokov, 1945, Psyche, vol. 52, pp. 27, 29–31, pl. 5, N. SP. 1, 2, 3 (male genitalia), pl. 7, N. SP. 1, 1a, 2, 4 (female genitalia), pl. 8 (under surface of wings).

In his ''Notes on Neotropical Plebejinæ'' (1945, Psyche, vol. 52, pp. 1–61), Nabokov recognized this species as being undescribed and he included a careful diagnosis of the maculation and the genitalia of both sexes. He refrained from applying a name to this species, as Mr. Comstock had already applied a manuscript name to the series in the collection of the American Museum of Natural History, and was preparing to publish it. However, illness prevented a completion of this project and so it is being done now.

Male, Upper Surface of Wings: Blue, with a faint purple tint, lighter blue along costa and on veins of primaries and along anal margin of secondaries; veins of both wings becoming dull black distally; terminal margin of primaries dull black, approximately 0.5 mm. wide, decreasing in width posteriorly, and with a narrow black terminal line; fringes gray-black in basal half, grayish white distally. Hind wings gray-black along costal margin, with a narrow dull black line near the terminal margin, becoming obsolescent posteriorly, followed by a narrow white band, interrupted by the veins, and with a narrow black terminal line; a black circular spot in cell Cu_1; fringes as on primaries.

Female, Upper Surface of Wings: Brownish black, the basal portion of the primaries shaded with blue; outer part of forewing with a few lighter scales, and with a very faint, narrow gray line just basad of black terminal line. Hind wings concolorous with forewings, slightly more heavily dusted with lighter scales, the area below the cell lightly dusted with scattered blue scales; spot in cell Cu_1 slightly larger than in male, bordered basally by a crescentiform pure white band, this latter extending in the cells from cell M_1 to cell Cu_2 setting off semilunate patches of ground color; the cells basad of the crescentiform white band lighter in color than the adjoining veins; a narrow pure white line just basad of black terminal line, the former interrupted by the veins; fringes of both wings as in male.

Expanse: Males, 13 to 18 mm., holotype 16 mm.; females, 15 to 20 mm., allotype 18 mm.

The under side has been described and figured by Nabokov, as have the male and female genitalia.

Types: Holotype, male, Hololo Mountain Road, St. Ann's, Trinidad, B. W. I., March 21–31, 1929 (E. I. Huntingdon); allotype, female, same data and collector. Paratypes, 8 males and 9 females, all from Trinidad: 4 males and 2 females, same data as holotype; 3 males and 6 females, Chancellor Road, Port of Spain, March 21–31, 1929, April 1–9, 1929 (E. I. Huntington); 1 male and 1 female, near Botanical Gardens, Port of Spain, March 21–31, 1929 (E. I. Huntington). The entire type series is in the American Museum of Natural History. Another male and female are stated to be in the Museum of Comparative Zoology, Nabokov, *op. cit.*).

This species can be separated from *Echinargus isola* (Reakirt) by lacking the row of enlarged spots on the under side of the primaries. The females are very distinctive in having the white maculation on the upper surface of the secondaries. For comparative notes on the genitalia, see the article by Nabokov.

It is with great pleasure that we name this species in honor of our friend, Mr. E. Irving Huntington, who, with the aid of his wife, captured the type series.

THE NEOTROPICAL SPECIES OF THE ANT GENUS STRUMIGENYS FR. SMITH: GROUP OF SMITHII FOREL

By William L. Brown, Jr.

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Below are offered results of studies on *Strumigenys smithii* Forel and a few related species. Other groups are treated in separate papers, to be followed by a key to the genus as found in the Western Hemisphere. In citing measurements and proportions, I have used the abbreviations standard in my works on the dacetines: TL, total outstretched length of insect, including mandibles, as measured by separate tagmata; HL, maximum measurable length of head from dorsal view, including all of clypeus and occipital lobes; ML, distance from anteriormost point of the anterior clypeal border to which the apices of the closed mandibles extend; WL (when given), diagonal length of visible alitrunk as seen from the side. Otherwise, ''L'' denotes length of part referred to, while ''W'' is maximum measurable width. All measurements are in millimeters, and, except for TL and WL, are subject to an error not exceeding $\pm$ .01 mm. The indices are given as percentages of HL, the cephalic index (CI) being HW/HL $\times$ 100, while the mandibulo-cephalic index (MI) equals ML/HL $\times$ 100.

Strumigenys biolleyi Forel

Strumigenys biolleyi Forel, 1908, Bull. Soc. Vaud. Sci. Nat. (5) 44: 43–44, worker (original description).

Strumigenys tridens Weber, 1934, Revista Ent., Rio de Janeiro, 4: 29–31, fig. 3, worker. NEW SYNONYMY.

Strumigenys luctuosa Menozzi, 1936, Arb. Morph. Tax. Ent. 3: 81–82, fig. 1, worker. NEW SYNONYMY.

Worker: TL 2.6–3.6, HL 0.60–0.81, ML 0.35–0.51, WL of largest specimen 0.86 mm.; CI 78–85, MI 58–66. Measurements from 51 specimens representing at least 10 nest series from the localities as listed below, except that in Chiapas, Mexico.

This species, like *S. smithii, S. prospiciens* and other members of the *mandibularis* series, possesses a small but distinct and acute intercalary tooth between the largest teeth of the apical mandibular fork, and two strong spiniform preapical teeth. In size, general proportions and facies, *biolleyi* closely resembles *smithii* and *prospiciens,* but differs from both in the shape of the propodeal lamellæ and, less strikingly, in having relatively slightly more slender mandibular shafts. In closely related species, each propodeal lamella forms an upper and a lower tooth or distinct angles separated by an excision or concavity (except in *hemidisca* sp. nov.; see below). In *S. biolleyi,* however, the upper (dorsal) of these angles is obsolete, represented by at most a feeble convexity, while the lower angle remains well-developed as a salient triangular tooth, acute but with a usually blunt extremity. In the more distantly-related *S. cordovensis* Mayr, a similar condition occurs as an inconstant variation, but in *biolleyi* the propodeal form varies only within very narrow limits and appears to be characteristic.

S. biolleyi lacks entirely the basal costulæ of the gastric dorsum, in this being even more extreme than is *S. prospiciens.* In a few specimens, in good light at magnification of 80× or more, rudiments of costulæ can be seen in the intersegmental groove, but these never extend onto the principal tergital surface; the latter is smooth and shining. *S. smithii* always has numerous distinct, fine basal costulæ. The petiole of *biolleyi* is like that of *smithii,* but in some specimens is very slightly more convex across the anterior nodal slope. The postpetiolar disc is very slightly broader than long to distinctly so, without longitudinal costulæ, finely punctulate, sometimes with the sculpture effaced in the center, so that the middle may be either opaque or shining.

Variation in this species is considerable, extending chiefly to size, color, proportions of head and mandibles (see quantitative data above), spacing and size of preapical mandibular teeth (distal tooth equal to or very slightly larger or smaller than the proximal), and presence or absence and abundance of the sparse, long, weak flagelliform hairs of the gastric dorsum. All of these characters seem to vary in random recombinations, relatively constant within nest series, but completely intergradient between series and without discernible territorial regularity of the sort that marks geographical races.

The largest, darkest form, represented by the *luctuosa* type series, is ferrugineous-blackish, and agrees well with Forel's description of *biolleyi* from a similar, not-too-distant locality. It seems significant that Menozzi compared *luctuosa* to *smithii* and *prospiciens,* but not to *biolleyi.* Another extreme of variation lies with certain smaller, lighter ferrugineous or even yellowish series with brownish gaster, in which cotypes of *tridens* fall. In making comparison, Weber overlooked *biolleyi* and related species completely and went to an entirely different group to choose *S. rogeri* Emery, an Old World migrant species only superficially resembling his supposed novelty. Menozzi's figure is a more accurate representation than is Weber's.

The female of *biolleyi* differs in the usual ways from its worker. The CI of three females from different nests was 87 in each case, but other dimensions and proportions of head and mandibles were within the range of variation of the accompanying worker series. No males of this species were seen.

Forel based this species upon a single worker, presumably now in the Museum d'Histoire Naturelle, Geneva. The type locality is La Palma, Costa Rica, at 1600 meters altitude (P. Biolley). I have not seen the type specimen.

Material examined for the present study: Mexico: Finca Guatemoc, Chiapas, 3500 feet, one worker (C. and M. Goodnight). Guatemala: Mixco, one nest series (W. M. Mann). Honduras: Lombardia, one nest series, and San Juan Pueblo, one series (W. M. Mann). Costa Rica: Hamburg Farm, Sta. Clara, two series, and Parismina Br., Sta. Clara, one series (F. Nevermann). San José, one series at 4000 feet alt. (L. Hare). La Caja, 8 km. west of San José, four cotype workers of *S. luctuosa* (H. Schmidt), courtesy of Sig. M. Consani. Panama: El Volcan, Chiriqui, 4200 feet alt., one series (L. Hare). Barro Colorado Island, Canal Zone, cotype series of *S. tridens,* of which five workers were measured (W. M. Wheeler).

Cotypes of both *luctuosa* and *tridens* are preserved in the Museum of Comparative Zoology and in other collections.

The distribution of *biolleyi* is wide within Central America from Chiapas to Panama, and it appears to do well in both lowland and higher elevations. It is a forest species; most of the collections were noted as having been made in or beneath rotten logs.

Strumigenys smithii Forel

Strumigenys smithii Forel, 1886, Mitt. Schweiz. Ent. Ges. 7: 215–216, worker (original description). Mayr, 1887, Verh. zool.-bot. Ges. Wien 37: 569, worker. Emery, 1890, Bull. Soc. Ent. Ital. 22: pl. 7, fig. 2, worker. Forel, 1893, Trans. Ent. Soc. London, p. 375, female, male, biology. Wheeler, 1908, Bull. Amer. Mus. Nat. Hist. 24: 147, worker, in key. Some spellings omit final "i."

Strumigenys smithi var. *inæqualis* Emery, 1890, Bull. Soc. Ent. Ital. 22: 67, pl. 7, fig. 3, worker. NEW SYNONYMY.

Worker: Combined measurement-proportions ranges for all series studied are TL 3.0–3.3, HL 0.67–0.76, ML 0.36–0.42, WL 0.70–0.78 mm.; CI 80–87, MI 52–61; broken down by nest series below.

The head and mandibles of this species are much as shown by Emery in his figures 2 and 3 (1890, *loc. cit.*), which express the variation pretty well. The mandibles are intermediate in thickness and dentition between those of *S. planeti* Brown and *S. biolleyi* Forel, the distal preapical tooth being equal to, very slightly longer than, or distinctly shorter than the proximal; the latter situated at or near the apical third of the shaft of the mandible. The shafts are straight along most of the inner borders and gently convex along the external borders. The teeth of the apical fork are subequal, with an acute intercalary tooth between.

Head rather thick dorsoventrally, convex above. Alitrunk compact, with distinctly impressed metanotal groove, the propodeum curving into its declivity through a very broadly obtuse angle and in its entirety subequal in length to the promesothorax. Humeri bluntly angulo-tuberculate, trailing fine dorsolateral pronotal margins. Propodeal lamellæ forming distinct, usually blunt-tipped upper and lower teeth with a concavity between, the lower tooth usually the more prominent. Petiolar node obliquely depressed from in front and above, so that the anterior slope is nearly plane and the summit appears narrowly subangular in profile, disappearing almost immediately beneath the voluminous posterodorsal spongiform collar. Postpetiole distinctly (averaging about 1.3×) broader than long, with transverse anterior and posterior borders, only very feebly convex and margined all the way around; surface with sculpture more or less effaced, except for a row of fine longitudinal costulæ along the anterior margin, shining; spongiform appendages of both nodes voluminous.

Pilosity typical for this and most related species. Ground pilosity of head consisting of short, inconspicuous spatulate hairs, reclining anteriad and appearing subappressed. Anterior clypeal border with longer spatulate hairs, five or six on each side of the center, the median pair about twice as long as the rest. Anterior scape borders each with eight or nine spatulate hairs, one or two near the base broader and directed basad, the remainder very slender, directed obliquely apicad. Alitrunk with a few scattered, very inconspicuous, short spatulate hairs. Several pairs of longer, conspicuous, stiffly erect hairs, truncate or narrowly spatulate apically, placed as follows: one medium pair on the center of the occiput and another placed one hair on the dorsolateral border of each occipital lobe. A large hair on each humeral tubercle, and one on each side of the mesonotum. A few serially arranged fine small hairs, usually reclinate posteriad, on each side of the dorsal propodeal face. Petiolar and postpetiolar nodes each with a very few long, fine, subflagellate hairs, curved posteriad. Gaster with a transverse row of four long upright subflagellate hairs springing from the anterior costulate portion; rest of gastric tergite I naked except for very sparse, very fine and minute appressed hairs, not ordinarily visible under magnifications of less than 60×. Apical gastric segments and venter with a sparse growth of weak, straggling flagellate hairs. Legs, antennæ and mandibles covered moderately densely with short, subappressed, linear-spatulate and pointed hairs. Mandibles with a row of strong, pointed, oblique hairs, few in number, directed anteromesad from their inner borders; these are especially characteristic of the entire *mandibularis* series of species.

Color in the medium ferrugineous range; gaster medium brown to dark reddish-brown. Basal gastric costulæ distinct, fine, numerous.

The above description was taken mostly from three cotype workers in the Museum d'Histoire Naturelle, Geneva and the Museum of Comparative Zoology at Harvard, stemming from the type locality, Itajahy, Santa Catarina, Brazil (W. Müller). HL 0.70–0.75, ML 0.36–0.38, WL 0.73–0.75; CI 84–85, MI 52–53. Five additional nest samples were examined from widely-spaced localities; since these samples all differ to some degree from the types and from each other, details of variation are cited for each case below. In view of the scanty material available, it is impossible to determine the taxonomic status of these samples satisfactorily at this time. The nature of the recombinations of characters, taken together with the width of range and quantitative departure of measurable features as related to their geographical apportionment, makes it as easy to distinguish all these samples (and Emery's *inæqualis*) as separate species or races as it is to consider them merely units of one variable and widespread population. The latter course is chosen here because I believe that lack of more positive evidence of separateness of populations should be expressed in a conservative nomenclature, if only to prevent burdening the literature with names of highly hypothetical entities. It is a fact that the vast majority of ant "subspecies," even of those recently analyzed in the light of modern population-systematical principles, rests on unsatisfactory data.

San José, Costa Rica (H. Schmidt), 13 workers from two colonies: HL 0.67–0.71 mm.; CI 80–82, MI 57–61. Proximal preapical tooth slightly longer than distal. Lower propodeal teeth more prominent and acute than in types. Postpetiole weakly shining, finely costulate anteriorly.

St. Vincent, B. W. I. (H. H. Smith), one worker: HL 0.70 mm.; CI 85, MI 55. Propodeal lamellæ with both teeth forming low, blunt angles; concavity between correspondingly shallow.

Barro Colorado Island, Canal Zone (J. Zetek), one worker: TL 3.0, HL 0.67, ML 0.36, WL 0.70 mm.; CI 87, MI 54. Proximal preapical tooth slightly longer than distal. Propodeal lamellæ with lower teeth larger and more acute than uppers. Postpetiolar disc L 0.60, W 0.95 mm., weakly shining, with about eight feeble costulæ running its length.

Campinas, Goyáz, Brazil (Schwarzmaier), six workers: HL 0.71–0.75 mm.; CI 81–83, MI 54–56. Proximal preapical tooth slightly longer than distal. Postpetiolar disc subopaque, but only very indistinctly costulate.

Covendo, Bolivia (W. M. Mann), two workers: HL 0.72–0.76 mm.; CI 80–83, MI 54–56. Proximal preapical tooth slightly longer than distal. Postpetiolar disc costulate its length, interspaces punctulo-granulose, opaque. Both upper and lower, especially the lower teeth of the propodeal lamellæ distinctly longer and more acute than in any of the other series of this species.

Emery's var. *inæqualis* appears to be yet another variant in this series, with a notably reduced distal preapical tooth. Variation among these series also includes greater or lesser convexity of the eyes. The basal gastric costulæ are rather constant in all series, being fine, numerous, and extending $\frac{1}{8}$ to $\frac{1}{7}$ the length of the otherwise smooth, very long basal segment.

The type of *inæqualis,* possibly in the Museo Civico di Storia Naturale, was taken in "Matto Grosso" by an unknown collector.

I have not seen the sexual forms of *S. smithii,* which were described by Forel in the 1893 reference cited in the synonymy. It should be born in mind that Forel's measurements are usually considerably less than those employed here for the same insects. In this same reference, Forel quotes H. H. Smith's notes on this species as it lives on St. Vincent, where it nests in rotten logs, or, more rarely, in sod. Workers were taken in fungi. The nest chambers were often found lined with a black fungus-like material, which induced Forel to speculate that it was a fungus-feeder; it is more probable that *smithii,* like some other members of the genus, feeds on collembolans and possibly other small arthropods. In Central America (Barro Colorado and San José) this species is found sympatrically with *S. biolleyi,* but is there not so common as on St. Vincent. No *biolleyi-smithii* intergrades have been seen.

Strumigenys hemidisca new species

Holotype worker: TL 2.78, HL 0.60, ML 0.39, WL 0.64 mm.; CI 82, MI 65. Closely similar to *S. smithii,* but smaller and with slightly longer mandibles relative to head size, also the following differences:

1. Preapical teeth of mandible farther apart and farther from the apical teeth; distal preapical tooth distant from the apical fork by about its own length, slightly longer than the proximal tooth; the latter situated at or very near the midlength of the mandible.
2. Eyes a little larger and more convex.
3. Alitrunk slightly more strongly depressed; propodeal dorsum virtually continuous with the very gradually sloping declivity.
4. Propodeal lamellæ modified into the form of low, nearly perfectly semicircular discs, only very feebly approaching straightness along one small portion of the generally rounded free edge and without traces of either upper or lower angles or teeth. These discs are feebly convex over their mesial and lateral surfaces and are densely punctate, continuing the sculpture of the adjacent lateral surfaces of the alitrunk.

5. Petiole and postpetiole as in *smithii,* disc of the latter very slightly more convex, shining, with a few very fine, short costulæ along the anterior border. Posterodorsal spongiform collar of petiolar node not so well developed.

6. Gastric basal costulæ vestigial, fewer than in *smithii* and not half so long, scarcely longer than the distances separating them.

7. Ground hairs of head slightly more conspicuous, but this may be due to darker integumental background color. Sparse appressed fine hairs of gastric dorsum extremely small and inconspicuous.

8. Color deep ferrugineous; gaster blackish-mahogany; mandibles and appendages lighter and more yellowish.

Holotype and the two accompanying paratypes taken in U. S. Plant Quarantine from orchid plants originating at an unknown locality in Venezuela (E. Q. No. A-42465; USNM Lot No. 37-20988), to be deposited in the U. S. National Museum; one paratype in the Museum of Comparative Zoology. The two paratypes are very similar to the holotype, scarcely differing in the usual measurements by more than the expected errors. One specimen has the gaster a bit lighter and more reddish in color than the holotype, and there is very slight variation in the degree of convexity of the propodeal lamellæ.

This species, the smallest member of the *mandibularis* series so far discovered, is apparently a member of the large and varied dacetine fauna inhabiting the epiphytes of the mountain rainforests of Colombia and Venezuela, scarcely known except through Plant Quarantine interceptions at U. S. ports of entry. Many species of this fauna remain undescribed, and quite a few of them possess significantly larger eyes than have their closest ground-living relatives. *S. hemdiisca* can be distinguished from all other species of *Strumigenys* known at present anywhere by the form of its propodeal lamellæ.

Strumigenys prospiciens Emery new status

Strumigenys smithi subsp. *prospiciens* Emery, 1906, Bull. Soc. Ent. Ital. 37: 167–168, fig. 26, worker (original description). Wheeler, 1908, Bull. Amer. Mus. Nat. Hist. 24: 147, worker (in key).

Strumigenys mandibularis Fr. Smith (*partim*), 1860, Jour. Ent. 1: 73, pl. 4, figs. 7, 9, 11, worker, *nec* female. Forel, 1911, Sitzb. Bayer. Akad. Wiss., pp. 263–264, worker only. Emery, 1922, Gen. Ins. 174: 322.

Worker: TL 3.22–3.51, HL 0.74–0.80, ML 0.41–0.46, WL 0.75–0.82 mm.; CI 79–83, MI 56–60. Measurements from eight workers representing three different nest series from two Bolivian and one Brazilian localities.

Very similar to *S. smithii,* but a little larger and more slender. Mandibles slender, the preapical teeth a bit farther apart, the distal slightly longer than the proximal. Eyes fairly large, convex, protruding somewhat anteriorly as well as laterally, but not quite so strikingly so as in Emery's figure of 1906. Alitrunk a bit more slender and more depressed than in *smithii;* propodeal lamellæ lower, with more obtuse upper and lower angles and only weakly concave between. Petiole with a slender peduncle rising gradually to its node; anterior face and summit of node convex in both directions (depressed in *smithii*). Postpetiole about as broad as long, length or width favored slightly in different series, its disc weakly convex, evenly and densely punctulate and opaque, often with a few very fine, short longitudinal costulæ along the anterior margin. The basal costulæ of the gaster are vestigial, in many cases hardly perceptible, and are not or scarcely longer than their intervals. The gaster is smooth and shining, with rather long flagellate hairs, some of which may loop back to the integumental surface; these hairs, while sparse, are considerably more numerous and generally distributed than in *smithii.* Color approximately as in *smithii,* but a little more variable; gaster sometimes approaching black.

The female (Rurrenabaque series, see below) differs in the usual ways from the accompanying workers: TL 3.7, HL 0.78, ML 0.42, WL 0.90 mm.; CI 82, MI 54. Eyes very large. Ocellar area blackened; mesopleura bright yellow, largely smooth and shining. Propodeal lamellæ more prominent, with the upper tooth slightly more acute than in worker. Postpetiolar disc more convex and with longer, stronger costulation. Medium ferrugineous, gaster darker.

When Smith described *S. mandibularis,* he included two very different species. In 1887, Mayr restricted the female of *mandibularis* as the type of that species, leaving the workers described by Smith without a name, although Mayr thought his *S. saliens* might correspond to these. In view of Mayr's restriction, Forel's synonymization of *prospiciens* with *mandibularis* must be rejected. On the other hand, the workers found by Forel in the Munich Museum in 1911, and which he realized were the same as Emery's *prospiciens,* really were a part of Smith's original *mandibularis* type series, taken by Bates in Amazonas, probably at Ega (Tefe), and almost certainly not at "St. Paul," as Smith gave in his 1860 paper. That Smith's small *mandibularis* workers and Emery's *prospiciens* represent the same species seems certain, especially in view of the correspondence between two workers sent from the British Museum with Emery's brief but relevant description and his figure. The British Museum specimens bear only a small circular label reading "59 [or 5g] 10" and without direct locality statement, but I believe them to be part of Smith's *mandibularis* small worker series, if only because no other workers among the *Strumigenys* series can be the right ones; I have been able to confirm this during a recent visit to the British Museum. In addition to these presumed types of worker *mandibularis,* supposedly taken by H. W. Bates in Amazonas, I have seen a small series of workers with a dealate female from Rurrenabaque, Rio Beni, and a single worker from Sta. Helena, both localities in Bolivia (W. M. Mann), which are referable to *S. prospiciens.* Specimens are in the U. S. National Museum, Museum of Comparative Zoology and elsewhere. I have not seen the type of *prospiciens,* in the Museo Civico di Storia Naturale, Genoa. Type locality: Puerto Piray, Misiones, Argentina (F. Silvestri).

It should be noted that *prospiciens* and *biolleyi,* which are separable on the basis of the shape of the propodeal lamellæ and some other slight differences of mandibular proportions, etc., are nevertheless very closely related. The fact that they are, so far as is known, completely allopatric might indicate that they are geographical races of one species if one chooses to interpret such slender evidence as a case of polytypy. *S. prospiciens* cannot, however, be logically regarded as a subspecies of *S. smithii,* since the two forms apparently occur together over a wide part of South America without producing intergrades. We have no biological information concerning *S. prospiciens,* but it is most probably a rainforest species.

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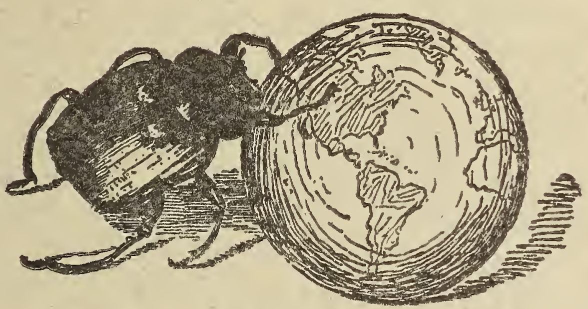

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THE EFFECT OF DDT ON THE COMPOSITION OF LARVAL BLOOD OF THE JAPANESE BEETLE (POPILLIA JAPONICA NEWMAN)

By Daniel Ludwig and Anthony J. Bartolotta

Department of Biology, Fordham University

Ludwig (1946) found that following exposure to DDT, Japanese beetle larvæ showed an increase in muscular activity, increased oxygen consumption, and a loss of glycogen, glucose, and fat. He suggested that death may be the result of a depletion of the readily available energy reserves. On the other hand, Merrill, Savit, and Tobias (1946) observed that in the cockroach, *Periplaneta americana,* carbohydrate depletion is not a factor in the death of the insect poisoned by DDT. Cockroaches are not saved by glucose administration, nor by anesthesia sufficient to suppress symptoms and prevent carbohydrate depletion. Buck and Keister (1947) studied the effects of DDT on the metabolism of the blowfly, *Phormia regina.* They showed that DDT enhances both the water and substrate loss but stated that death is not primarily due to either water loss or exhaustion of respirable reserves. In 1949, they found that those flies which died from DDT had more respirable substrate left than starved controls.

Ludwig and Wugmeister (1953) made analyses of the larval blood of the Japanese beetle during a starvation period of 4 weeks. They found no change in protein nitrogen, an increase in nonprotein and amino nitrogen, and an increase in reducing compounds. The nonprotein nitrogen increased from a normal average of 619 to a final average of 1210 milligrams per cent, at the end of 28 days of starvation. During the same period, corresponding values for amino nitrogen were 236 and 438; and for reducing compounds, 248 and 327. Cullen (1953) observed that during a starvation period of four weeks, the blood of the Japanese beetle larva showed an increase in urea nitrogen, but a slight decrease in uric acid content.

The present experiments were undertaken to determine whether changes in the blood of Japanese beetle larvæ following exposure to DDT are similar to those previously observed in larvæ as a result of starvation. These observations should provide information regarding the importance of starvation in the death of larvæ following exposure to DDT.

MATERIAL AND METHODS

Third instar Japanese beetle larvæ were used throughout these experiments. They were collected in the field during the fall and winter months, brought into the laboratory and reared in moist soil contained in individual one-ounce metal salve boxes at a temperature of 25° C. They were examined every four or five days and kept plentifully supplied with water and wheat grains. All determinations were made on larvæ which had been fed at least two weeks.

Determinations were made on normal larvæ and on others poisoned with a 5 per cent solution of pure DDT crystals in peanut oil. The larvæ were poisoned by allowing them to crawl on a piece of filter paper soaked with the DDT solution for a period of five to ten minutes. They were then blotted with clean filter paper, returned to the salve boxes, and allowed to remain at 25° C. for three days. Determinations were then made on the blood for protein, nonprotein, amino, uric acid, and urea nitrogen, as well as for reducing substances. The procedures employed for obtaining blood and for making all analyses, except for uric acid and urea nitrogen, are given by Ludwig (1951).

Uric acid was determined by the method of Brown (1945). The procedure, outlined by Hawk, Oser, and Summerson, 1947, p. 516, was followed except that only 0.2 ml. of the tungstic blood filtrate was used for each determination, and the amount of the other reagents adjusted accordingly. Since nitrogen is one-third of the total weight of the uric acid molecule, values for uric acid nitrogen (in milligrams per cent) were obtained by multiplying the milligrams of uric acid in 100 ml. of blood by 0.33.

Urea nitrogen was determined by the following modification of the method of Keller (1931–32). One-tenth of a milliliter of blood was added to 4.9 ml. of the tungstic acid reagent. It was then centrifuged and 1 ml. of the supernatant fluid was placed in a 15 ml. graduated centrifuge tube and diluted to 4 ml. with distilled water. A second tube was prepared with 1 ml. of a standard solution (containing 0.015 mg. urea nitrogen) and the solution diluted to 4 ml. with distilled water. A third tube, to serve as a blank for color comparison, was also prepared containing 4 ml. of distilled water. To each tube were added 3 drops of urease solution and 3 drops of the phosphate buffer. They were then incubated at 50° C. for 10 minutes and cooled in ice-water for 10 minutes. After cooling, the solutions were diluted to 9 ml. with distilled water and 1 ml. of Nessler's reagent was added to each. The solutions were then allowed to stand for 30 minutes. Readings were made in a Beckman DU spectrophotometer at 430 $m\mu$. The concentration of urea nitrogen was determined from the following formula:

$$\frac{\text{Density of unknown}}{\text{Density of standard}} \times 0.015 \times \frac{100}{0.02} = \text{milligrams per cent urea nitrogen.}$$

RESULTS

The results of the analyses on the blood of normal Japanese beetle larvæ and of others 3 days after they had been exposed to DDT are shown in Table 1. Exposure to DDT does not pro-

TABLE 1. CHANGES IN THE COMPOSITION OF THE BLOOD DURING DDT POISONING.
(Values in Milligrams Per Cent)

Condition of larva	Protein N	Non-protein N	Amino N	Uric Acid N	Urea N	Reducing Compounds
Normal						
No. of tests	5	5	5	7	6	6[1]
Minimum values	630	574	225	3.3	21.0	220
Maximum values	700	686	255	6.6	40.5	284
Average values	666	620	241	4.9	26.6	248
DDT poisoned						
No. of tests	10	10	10	10	11	8
Minimum values	490	854	330	3.1	41.8	250
Maximum values	700	1,067	460	4.6	60.0	360
Average values	593	967	420	4.0	47.3	314

[1] Figures for reducing compounds in the blood of normal larvæ were taken from Ludwig and Wugmeister (1953).

duce a change in protein nitrogen. All of the values obtained for poisoned larvæ fall within the range of values previously reported for normal larvæ (Ludwig and Wugmeister, 1953). However, exposure to DDT results in an increase in nonprotein nitrogen from a normal average of 620 to an average of 967 milligrams per cent. Corresponding increases in other constituents are: amino nitrogen from 241 to 420, urea nitrogen from 26.6 to 47.3, and reducing compounds from 248 to 314. Uric acid nitrogen appears to decrease slightly as a result of DDT poisoning.

DISCUSSION

The results of these analyses on the nitrogen content of normal Japanese beetle larval blood are in excellent agreement with the observations of Ludwig (1951) on the larval blood of this insect; and of Florkin (1937) on the blood of the silkworm, *Bombyx mori.* Ludwig and Wugmeister (1953) found that the protein nitrogen of the blood of normal Japanese beetle larvæ averaged 356 mg. per cent. This value is considerably less than the figure given by Ludwig (1951) and the figure given in the present paper. This discrepancy may be explained by unpublished work by the senior author which indicates that the protein nitrogen of the blood of this species varies with the stage of larval development, and that its concentration increases considerably on the approach of metamorphosis. The value reported by Ludwig and Wugmeister was obtained on larvæ which had been fed for only two weeks, while the larvæ used in the present experiment had been fed for approximately one mouth. They were, therefore, ready to undergo metamorphosis.

The changes which occur in the blood of larvæ three days after exposure to DDT are similar to those reported by Ludwig and Wugmeister (1953) following four weeks of starvation. They include an increase of nonprotein and amino nitrogen, and of reducing substances. They are also in agreement with the results of Cullen (1953) on changes in urea and uric acid nitrogen following four weeks of inanition. In both cases (DDT poisoning and starvation) there was a slight decrease in uric acid and an increase in urea nitrogen. This similarity of results indicates that comparable changes occur in the insect during starvation and DDT poisoning. They add evidence to the suggestion by Ludwig (1946), that in the Japanese beetle larva, starvation may be the cause of death following exposure to DDT.

Buck and Keister (1949) found that in *Phormia regina* when death from DDT occurred, the flies had more respirable substrate left than starved controls. A similar comparison can now be made for changes in the concentration of various food materials in the Japanese beetle larva. Ludwig (1946, p. 501) presented a table showing the changes in glycogen, glucose, and fat following exposure of the larvæ to DDT. The data in this table show that, at the time of death, the larvæ had used 85.5 per cent of the original supply of glycogen, 40.4 per cent of the glucose, and 32.8 per cent of the fat. Newton (1953) observed that during four weeks of starvation, Japanese beetle larvæ use 80.0 per cent of their glycogen, 28.6 per cent of their glucose, and 71.7 per cent of their fat. Hence, more of the available carbohydrate reserve is utilized following exposure to DDT than during four weeks of starvation. However, a much larger percentage of fat remained in the larva at the time of death from DDT than following complete inanition. These observations agree with those of Buck and Keister (1949) only in regard to the utilization of fat reserves, and thus suggest the possibility that DDT may interfere with an enzyme system needed for the utilization of fat. An inability to utilize fat might explain the greater use of carbohydrate as an energy source following exposure to DDT. However, the difference in the amount of glucose used during complete starvation (28.6 per cent) and that used by DDT poisoned larvæ (40.4 per cent) might be associated with the fact that the glucose determinations during starvation were performed on diapause larvæ which are already in a state of partial starvation. Presumably, they have a smaller supply of available glucose and would lose less during complete starvation than would post-diapause larvæ (Newton 1953).

SUMMARY

1. Analyses were made on the blood of normal Japanese beetle larvæ and of others three days after exposure to DDT. This study included determinations of protein, nonprotein, amino

acid, uric acid, and urea nitrogen, as well as of reducing compounds.

2. There was no change in the protein nitrogen of the blood following DDT poisoning. However, nonprotein nitrogen increased from an average of 620 to 967 milligrams per cent. Comparable increases in other constituents were: amino acid nitrogen from 241 to 420 milligrams per cent; urea nitrogen from 26.6 to 47.3 milligrams per cent; reducing compounds from 248 to 314 milligrams per cent. The uric acid of the blood decreased slightly following exposure to DDT.

3. These results are similar to those previously determined on the blood of Japanese beetle larvæ during four weeks of starvation. They add evidence to the suggestion that starvation may be a factor causing the death of larvæ following DDT poisoning.

4. Glycogen and glucose appear to be used to a greater extent during DDT poisoning than during complete inanition. However, the utilization of fat occurs to a much greater degree during four weeks of starvation. This observation suggests the possibility that DDT may interfere with an enzyme required for the utilization of fat.

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THE CABINET OF THE LINNÆAN ASSOCIATION OF PENNSYLVANIA COLLEGE

Linnæan Associations are no longer as numerous as they were at one time. However the one at the Pennsylvania College, Gettysburg, Pennsylvania, around 1845 published a "Literary Record" that carried a series of papers on entomology. At that time the "Cabinet" of the Linnæan Association over a period of six months had accumulated 63 native and foreign birds, 92 reptiles stuffed and in spirits, 97 fishes and Crustacea, 10 mammals, 900 shells, 40 dried plants, 2,100 minerals, 60 fossils, 13 anatomical preparations, 35 paintings and engravings, 70 plaster casts, and 1,100 insects. This "Cabinet" was located in the college library.—H. B. W.

BOOK NOTICE

A Manual of Entomological Techniques, by Alvah Peterson. Published by the author. Ohio State University, Columbus, Ohio. $11\frac{1}{4} \times 8\frac{3}{4}$ inches. vi + 367 p. 182 plates. $7.50.

This book is the seventh revised edition of Dr. Petersen's well-known and appreciated "Manual of Entomological Equipment and Methods," with a new title, twenty-two new plates, and much new text. The text preceding the plates discusses the determination of ecological factors, including temperature, humidity, air velocity, evaporation and light; cage microclimates, which are frequently neglected by students; various products entering into the structure of cages, etc.; the location and construction of a field insectary; general information on the rearing of insects and mites; specific information on the mass rearing of some forty-one species; the marking, collecting and preservation of insects; killing, fixing, clearing, staining and mounting of insect tissue; and drawing suggestions. Following the plates are useful tables for temperature conversions, for determining relative humidity; aqueous vapor pressures at different temperatures; metric and other measures and weights; percentage tables, etc.; author and subject indexes. The numerous plates with their hundreds of carefully drawn and labelled figures and their explanations are models of accuracy and simplicity. The plates illustrate behavior equipment, cabinets, incubators, cages, collecting, sampling and sorting devices, suggestions for drawings, weather instruments, and other ecological equipment, feeding cages, insectaries, killing, mounting and preserving tools, traps, tree bands, containers for transporting and feeding insects, cages for holding small mammals, museum devices, automatic soil irrigators, a cockroach maternity ward, a humidifier for cabinets which also serves for cooking eggs or warming baby bottles, etc., etc., etc. Everything is free. You just dip into this authentic, encyclopaedic book and if you fail to find something to suit your need, which is unlikely, then you are bound to come away with new ideas suggested by the illustrations. This satisfying and informative work which is excellently lithoprinted and bound in red cloth and which is unique in its field is pleasing to browse through even though you have no immediate need for a particular piece of equipment.—Harry B. Weiss.

A NEW SPECIES OF PROBOLOMYRMEX, AND THE FIRST DESCRIPTION OF A PROBOLOMYRMEX MALE (HYMENOPTERA, FORMICIDÆ)

BY MARION R. SMITH

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE, AGRICULTURAL RESEARCH ADMINISTRATION, UNITED STATES DEPARTMENT OF AGRICULTURE

Among the Micronesian ants sent me for determination by the Pacific Science Board, through J. L. Gressitt, Honolulu, Hawaii, there is a single male (unassociated with workers or females) of a *Probolomyrmex* which I am describing below as a new species. However, I realize that the male may eventually prove to be that of a previously described species. The male of *Probolomyrmex* can be readily distinguished from those of other genera by the placement of the antenna at the extreme anterior border of the clypeus, by its unusually small size and slender body and by the characteristically shaped petiole. Even though Mayr described the monobasic genus (genotype, *filiformis*) over half a century ago from worker individuals collected at Port Elizabeth, Cape Colony, Africa, no one has seen or described the male of *Probolomyrmex*. In 1949 (Proc. Ent. Soc. Wash. 51: 38–40) I listed the then five known species including one that I was describing from Barro Colorado Island, Panama. In that paper I gave the original references, castes, and type localities for the five species. Shortly afterward, Weber described a sixth species, *parvus* from Busnia, Uganda, Africa (1949, Amer. Mus. Novitates No. 1398: 3, 9). The present new species represents the seventh. Brown (1952, Harvard Univ., Mus. Comp. Zool. Breviora No. 6, p. 6) reports that he has seen an apparently undescribed species from the Canberra Region of eastern Australia. In the same paper he also suggests that the genus *Probolomyrmex* be removed from the tribe Proceratiini and be placed in the tribe Platythyreini and gives his reasons for the change. After studying the male described here I am unable either to confirm or to disprove Brown's new tribal placement of the genus. I would certainly agree with him that this group of ants is most highly specialized, as is evidenced by the shape of the body, lack of eyes (in the worker), position of the antennæ, type of wing venation (male) and possibly other characters. Although species are now recorded from such distant parts of the World as Africa, Java, Micronesian Islands, Australia, Panama and South America, paradoxically we know almost nothing of these ants except that their colonies are extremely small and the individuals of a cryptobiotic nature.

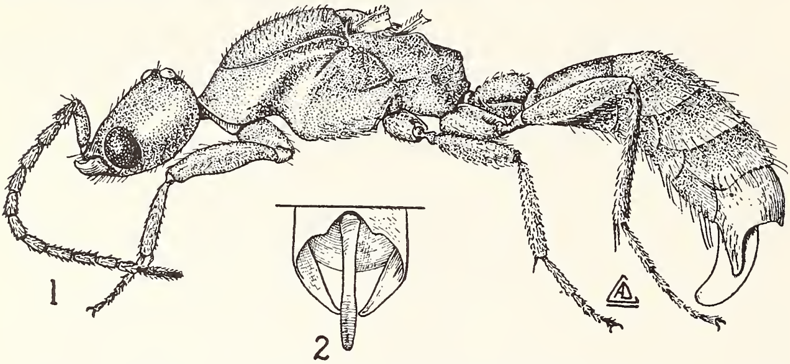

FIG. 1. Profile view of male of **Probolomyrmex palauensis** n. sp.; fig. 2, posterior view of genital appendages. Wings not shown. (Illustrations by Arthur D. Cushman.)

Probolomyrmex palauensis n. s.

MALE: Length 1.8 mm.

Unusually small and slender. Head oblong; measured at its greatest breadth and length (including the eyes but not the mandibles) 1.2 times as long as broad, with subtruncate front, rounded posterior corners and posterior border and weakly convex sides. Ocelli of about normal size, not strongly protruding above the general surface of the head, 0.15 mm. in front at their greatest width. Eye on the anterior half of the head, exceedingly close to the base of the mandible, not unusually large or convex, approximately 0.10 mm. in its greatest diameter. Antenna inserted at the extreme anterior border of the clypeus; 13-segmented; scape curved, broader than the basal funicular segments, (excluding the pedicel) not quite as long as the combined lengths of the first two funicular segments; funiculus filiform, the last segment as long as, or longer than, the combined lengths of the two preceding segments. Median region of the clypeus subtriangular, very small, with the apex extending some distance posteriorly between the insertions of the antennæ. No visible frontal area or frontal carinæ. Head, in profile, higher in the posterior than the anterior half.

Mandible vestigial, very short, stubby, edentate. Pronotum sloping anteroventrally, not concealed by the mesonotum. Mesonotum, from above, 0.4 mm. in length, narrowest anteriorly, where it is subtruncate. Mayrian furrows and parapsidal sutures lacking. Legs moderately long, without noticeably enlarged femora and tibiæ; each anterior and middle tibia with a single spur, the posterior tibia with two spurs. Tarsal claws simple. Anterior wing without any apparent stigma or veins, especially in the apical half of the wing. Petiole with a very short, scarcely noticeable peduncle; the node, from above, longer than broad, compressed, narrowest anteriorly, subtruncate posteriorly. Gaster, from above, slender and elongate, much narrowed and constricted at its junction with the petiole; apex of gaster with unusually large genitalia; viewed from behind and somewhat above, the dorsal surface of the sagitta appearing as a long, flattened, strap-like process (almost equally broad throughout) which is curved posteroventrally near the apex. Volsellæ almost entirely hidden from view, at least not visible enough for adequate description. Basal portion of stipes curved, the convexity of the curve being external (that is, lateral to the axis of the body), the apical portion of the stipes tapering rapidly to a rather acute point which is directed medioposteriorly toward the sagittæ Penicilli apparently lacking.

Body, in some lights, rather shining although bearing a rather dense vestiture of suberect to erect grayish hairs, those on the gaster being the longest. Antennæ and legs densely clothed with rather short, suberect hairs.

Body brownish; mandibles, antennæ and legs lighter.

Type locality—A wooded peak, SW. of Ulimang, Babelthuap I., Palau Islands; Dec. 12, 1947, H. S. Dybas, Pacific Sci. Board, Ent. Survey of Micronesia.

Described from a single holotype, a winged male, which has been placed in the United States National Museum under U. S. N. M. No. 62,200.

BOOK NOTICE

How To Know The Spiders, by B. J. Kaston. Wm. C. Brown Company, Dubuque, Iowa, July, 1953. Offset printed. $8\frac{1}{2} \times 5\frac{1}{2}$ inches. vi + 200 pages. Paper cover, spiral binding, price $2.25. Cloth binding $3.00.

This excellent book is the latest in the Pictured-Key Nature Series and is certainly one of the best. The apparent objective of this series, of presenting the forms of life in such manner that the student with a bare background of natural science can grasp a good understanding of the forms, is very well accomplished in this book. A non-specialist can become very familiar with the spiders, with the aid of this book. This is not a manual in the common sense of the word, but rather the key to the world of spiders. This book can easily become the missing link between the naturalist and Comstock's Spider Book (and Gertsch's excellent revision), which will probably continue to be the standard reference. The myriad of line drawings, all by Mrs. Kaston, provide a most impressive feature of this work, leading one to conclude that children are not the only worthwhile products of a successful marriage.

If a recommendation were needed, it should be that the naturalist purchase the cloth bound volume. The slight additional investment will assume permanency of a well of information that will never run dry.—F. A. S.

THE SPERMATHECA IN THE FLOUR BEETLE (TRIBOLIUM CASTANEUM HERBST)[1]

By Ranendra Nath Sinha
Department of Entomology, University of Kansas, Lawrence

The histology of the spermatheca of the Tenebrionid beetles has been very poorly studied. The structure of the spermatheca of *Tribolium castaneum* Herbst differs greatly from the Coleopteran spermathecæ described by previous authors (see Snodgrass, 1935; Imms, 1934). It is characterized by being unrecognizable in gross anatomcial dissection. The descriptive terms used in this paper are those employed by Snodgrass (1935).

MATERIALS AND METHODS

Adult females of *Tribolium castaneum* Herbst were fixed in Mukerji's fluid (Mukerji, 1937; Sinha, 1953, in press) and serial sections of the entire body, 8 micra in thickness, were made in transverse and longitudinal planes. The technique employed for sectioning the sclerotized beetles was that of Mukerji with the author's modification. Some dissections of the organ were also made in normal saline solution and later sectioned by the ordinary paraffin method. Sets of the serial sections of the insects were stained in Mallory's triple stain and Delafield's Hematoxylin and Eosin, whereas the sets from the dissected organs were stained only in the latter.

DESCRIPTION

The spermatheca of the *Tribolium castaneum* Herbst is a blunt, apical, anterior swelling of the vagina which is totally unrecognizable from outside. It is 0.08 mm. long and 0.13 mm. in diameter and is located 0.13 mm. above the junction of the fifth and the sixth abdominal sterna (third and fourth visible sterna) in natural position. A study of the serial sections reveals that the organ is a rectangular muscular chamber composed of four long

[1] Studies carried out in the Entomology Laboratory, Department of Zoology, University of Calcutta, India.

and convoluted pouches, extending almost throughout the organ. Of these pouches, one is unusually broad having a maximum diameter of 0.02 mm. Its position is slightly dorsal to the center of the organ. The other three pouches which are 0.01 mm. in diameter open into this relatively larger pouch immediately above the dorso-lateral margin of the vagina. The muscular wall of the vagina is broken obliquely at this point making a connection between the main cavity of the vagina and the lumen of the larger pouch. As seen in figure 1, this narrow passage which is less than 8 micra in diameter at its narrowest portion is the connection between the store of sperms and the vagina. In sections of fertilized females the pouches are observed to be packed with sperms (figure 1). The heads of the clusters of the

FIGURE 1: A longtiudinal section through the posterior part of the abdomen of a female *Tribolium castaneum* Herbst showing vagina, spermatheca, and the accessory gland in natural position; a. spermatheca, b. mass of sperms in the vagina, and c. accessory gland.

sperms are directed toward the blind ends of the pouches. As the sperms are extremely minute, it was difficult to be certain of their presence in the pouches. It was confirmed by comparing the staining with Orange G (Mallory's mixture) of sperms in the pouches with those in the vagina and by detecting sperm cells themselves under the oil immersion. Each pouch is lined inside by a thin cuticular intima. The epithelial cells are hardly visible, and have a thick layer of circular muscle coating. The entire organ is also superficially covered by circular muscles.

DISCUSSION

Good (1933) stated that the adult females of the genus *Tribolium* continue to lay fertilized eggs after a mating for nearly three months. They lay eggs on an average of 2–3 eggs per individual per day in favorable food medium (Mukerji & Sinha, 1953, in press). In view of this information regarding the biology of these beetles, the above described modifications of the spermatheca may provide for the storage of large numbers of sperms for day to day consumption. It seems possible that at the time of escape from the spermatophore, the sperms enter the spermatheca through the vagina, completely filling the pouches. As the pouches are convoluted and bound by muscular lining, they can easily accommodate a huge quantity of sperms which are released as the mature ova drop into the vagina one after another. Another possible explanation is that the anterior end of the vagina serves to contain many of the sperm cells under ordinary condition (figure 1b) and that the spermatheca provides only for long time storage or serves some other functions.

ACKNOWLEDGMENTS

The author wishes to express his indebtedness to Professor D. Mukerji, Department of Zoology, University of Calcutta for his guidance during this work; to Dr. C. D. Michener, Chairman, Department of Entomology, University of Kansas, Lawrence, for his helpful suggestions and checking the manuscript, and to Mr. E. B. Wittlake, Department of Botany, University of Kansas, for taking the photomicrograph.

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A NEW METAPONE FROM THE MICRONESIAN ISLANDS (HYMENOPTERA, FORMICIDÆ)

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U. S. Department of Agriculture,
Washington, D. C.

Among the numerous Micronesian ants sent me for study by the Pacific Science Board, there is a new species of *Metapone* from Moen Island, Truk, which is described below. So far as I am aware, it is the first species of the genus to be recorded from the Micronesian Islands, although all the other previously described species are from the Oriental and Australian faunal realms. Since Truk was highly fortified by the Japanese before the Second World War, there must have been a great amount of imports then and it is quite likely that this new species may have been introduced. Certainly, one must be cautious in accepting the form as strictly indigenous. The 12 previously described species are *bakeri* Whlr. (1916) and *gracilis* Whlr. (1935), the Philippines; *greeni* Forel (1911) the genotype, and *johni* Karawajew (1933), Ceylon; *hewitti* Whlr. (1919), Borneo; *jacobsoni* Craw. (1924), Sumatra; *sauteri* Forel (1912), Formosa; *krombeini* M. R. Sm. (1947), New Guinea; *leæ* Whlr. (1919), *mjœbergi* Forel, (1915), *tillyardi* Whlr. (1919) and *tricolor* MacAreavey (1949) Australia.

These very interesting and highly aberrant ants undoubtedly belong to the subfamily Myrmicinæ, but their exact phylogenetic status and relationships have not yet been determined. The ants are believed to nest in small colonies within the cavities of plants and to feed on termites.

Metapone truki new species

Worker.—Length 5 mm.

Head subrectangular, 1.5 times as long as broad (measured from the anterior border of the clypeal lobe to the posterior border of the head, and across the greatest width of the head), with anteriorly converging sides and emarginate posterior border. Width approximately 0.7 mm. at the insertion of the mandibles. Clypeus extended forward as a prominent, subrectangular lobe, the anterior border of which is transversely truncated and the anterolateral angles sharply defined. Distance from the fronto-clypeal suture to the anterior border of the clypeal lobe (measured through its greatest length) approximately 0.5 mm. Frontal area lacking. Fronto-clypeal suture present but not clearly defined in all lights. Mandible inwardly curved, the dorsal and ventral borders somewhat subparallel, the masticatory margin oblique and bearing 2 well-defined apical teeth and 3 or 4 smaller and less regular basal teeth. Antenna 11-segmented, with a prominent 3-segmented club; all funcicular segments except the last clearly broader than long and with a flattened appearance, the last funicular segment longer than the combined lengths of the 2 preceding segments. Eye with 7 or 8 ommatidia in its greatest width and about 6 in its shortest width. Ocelli and ocellar pits absent.

Thorax, in profile, subrectangular, with flattened, weakly arched (anteroposteriorly) dorsum. Prosternum on each side projecting ventrally as a rather wide but bluntly angular process. Thorax, from above, measured through its greatest length (from the anterior border of the pronotal collar to the posterior border of the epinotum) 1.7 mm., narrowest at the posterior border of the epinotum where it measures scarcely over 0.3 mm. Thorax submarginate, with prominent but somewhat rounded humeri. Promesonotal suture lacking, mesoepinotal suture represented by a distinct dark line, which is approximately 1 mm. from the anterior border of the pronotal collar and approximately 0.7 mm. from the posterior border of the epinotum.

Legs short, the femora greatly expanded, especially the femora of the hind legs. Each tibia with a spur, that of the anterior tibia the largest. Apices of the tibiæ and metatarsi toothed. In profile, anterior surface of the petiolar node concave, the dorsal surface convex, the node bearing a distinct posterolateral tooth; ventral surface of the petiole with a prominent tooth, which is followed after a short space by a slight angle much smaller than the tooth. Ventral surface of postpetiole with 2 distinct, tooth-like convexities. Petiolar node, from above, distinctly longer than broad, measured through its greatest length and breadth it is approximately 0.43 mm. by 0.35 mm., narrowest anteriorly and widening posteriorly, and forming on each side an acute, well-defined posterolateral tooth; anterior border of the node truncate, the posterior border concave, and the sides straight or very weakly concave. Postpetiolar node, from above, somewhat subrectangular in appearance but in reality with the sides diverging posteriorly, approximately 1.3 times as broad as long.

Gaster, from above, oblong-triangular, broadest at the base and acute at the apex, with the first segment approximately twice the length of the postpetiolar node.

Mandible finely and longitudinally striated. Cheeks and antennal scrobes coarsely, longitudinally striated. Dorsal surface of head and thorax very distinctly striated longitudinally, the former also bearing coarse, scattered, hair-bearing punctures. Dorsal surface of petiolar and postpetiolar nodes smooth but with scattered hair-bearing punctures. Sides of thorax (excluding the epinotum) rather finely, obliquely striated, sides of postpetiolar node largely punctulate.

Pubescence most apparent on the gaster, where it is composed of sparse, rather closely appressed, yellowish hairs. Pilosity fairly abundant on body and consisting of yellowish hairs of variable length, which are mostly erect; those near the apex of the gaster unusually long. Under surface of the head also with erect hairs.

Type locality.—Truk: North Basin of Mount Chukumong, Moen, 2-10-49, R. W. L. Potts, from rotten breadfruit.

Described from a holotype and two paratype workers. The holotype has been deposited in the United States National Museum under U.S.N.M. No. 61855. A single paratype each has been placed in the California Academy of Sciences and the Bishop Museum. The paratypes are very similar to the holotype, differing mainly in their slightly smaller size, 4.3 and 4.5 mm. respectively.

In W. M. Wheeler's article entitled The Ants of the Genus *Metapone* Forel (1919, Ann. Ent. Soc. Amer. 12: 173–191, 7 figs.), specimens would key down to couplet 4 because of the projecting, subrectangular clypeal lobe, which is transversely truncated in front and with sharply defined anterolateral angles, and also because of the shape of the petiole, which is distinctly longer than broad and with the posterior corners produced as distinct teeth rather than as blunt lobes. Couplet 4 contains two species, *leæ* of Australia and *sauteri* of Formosa. The worker of *truki* differs from that of *leæ* in its less flattened body, different mandibular dentition, less developed clypeal lobe, larger eyes, different shaped epinotum, more expanded hind femora, and numerous other characters. Since *sauteri* is known only from the female type, it is difficult to compare the worker of *truki* with that caste; *truki,* however, differs from *sauteri* in not having the petiole and postpetiole striated, in lacking the lobe at the base of the mandible, and in the different configuration of the ventral side of the petiole and postpetiole.

POISONOUS HONEY IN 1802

In 1802, Dr. Benjamin Smith Barton, one of the leading American botanists of that period, was the author of a paper on "Some account of the poisonous and injurious honey of North America." This was published in the Transactions of the American Philosophical Society (Vol. 5, No. 7, p. 51–70, 1802). This poisonous honey, supposedly due to the nectar of poisonous flowers which the bees had visited, produced, when eaten by humans, vertigo or dimness of vision at first and then a delirium that was sometimes mild and pleasant and sometimes "ferocious." This was followed by stomach and intestinal pains, profuse perspiration, foaming at the mouth, purging, and in some cases death. Barton, in his paper also mentioned that bees feeding in the flowers, *Kalmia angustifolia,* produced a honey that was intoxicating. Although he did not so state, I am of the opinion that this honey had been allowed to ferment.

Although primarily a botanist Barton wrote a few papers on insects. For one of these entitled, "Memoir on a Number of Pernicious Insects of the United States" and which appeared in the Philadelphia Medical and Physical Journal, (Vol. 1, pt. 2, Art. 20, p. 127–31, 1805) he was honored with the Magellanic Medal of the American Philosophical Society. When only twenty-four he was appointed to the chair of natural history and botany in the College of Philadelphia and thus became the first natural history instructor in Philadelphia.—H. B. W.

NOTES ON SOME SIPHONAPTERA OF FULTON COUNTY, NEW YORK

BY ROBERT STURM

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During April and May, 1953, 22 small mammals were collected near the village of Gloversville, Fulton County, New York. From these mammals, 77 fleas were collected, representing seven species of two families. Nomenclature follows Holland, Siphonaptera of Canada, 1949.

I am grateful to Dr. Allen H. Benton and Edward Cummings of New York State College for Teachers, Albany, for aid in preparation and identification of specimens.

Notes on species collected:

Family Hystrichopsyllidæ

Tamiophila grandis (Rothschild): Twelve females of this species were taken from two chipmunks, *Tamias striatus lysteri.*

Ctenophthalmus pseudagyrtes Baker: This non-specific parasite is represented by 11 specimens. Five females and two males were taken from 4 short-tailed shrews, *Blarina brevicauda,* while four females were taken from two chipmunks.

Corrodopsylla c. curvata (Rothschild): Four females of this highly host-specific flea were taken from three short-tailed shrews.

Orchopeas leucopus (Baker): Nine females and seven males of this common flea were taken from nine deer mice, *Peromyscus leucopus noveboracensis.*

Family Ceratophyllidæ

Ceratophyllus gallinæ (Schrank): One female of this species, normally a parasite of domestic fowl, was taken from a Norway rat, *Rattus norvegicus.* A nearby turkey farm was its probable source.

Megabothris acerbus (Jordan) : This chipmunk flea was taken from every chipmunk collected. Eighteen females and thirteen males were collected from three chipmunks.

Peromyscopsylla h. hesperomys (Baker) : Two males of this species were taken from a deer mouse.

DISCUSSION

The area trapped, in and around an extensive dump, was heavily infested with fleas. The average of somewhat more than three fleas per animal, with almost every one taken infested to some degree, is unusual. One chipmunk was host to 27 fleas of three species.

The tremendous preponderance of females, 53 to 24 or about two to one, seems too great to be the result of chance. This is especially true of *Tamiophila grandis,* of which twelve females and no males were taken. Some difference in behavior of the sexes, at least during this season, may be indicated.

SYNONYMIC NOTES ON NORTH AMERICAN GEOMETRIDÆ (LEPIDOPTERA)

By Frederick H. Rindge
The American Museum of Natural History

Gueneria similaria (Walker) new combination.

Acidalia similaria Walker, 1860, Canadian Nat. and Geol., vol. 5, p. 261; 1862, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 26, p. 1592. Hulst, 1895, Ent. News, vol. 6, p. 72. Barnes and McDunnough, 1916, Contributions to the natural history of the Lepidoptera of North America, vol. 3, p. 36.

Ellopia basiaria Walker, 1862, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 26, p. 1508 (new synonymy).

Gueneria basiata (sic!), Packard, 1876, A monograph of the geometrid moths . . . of the United States, p. 308.

Gueneria basiaria, Rupert, 1949, Proc. Ent. Soc. Washington, vol. 51, p. 141 (synonymy).

Dr. Eugene Munroe of the Division of Entomology, Department of Agriculture, Ottawa, has examined the type specimen of *similaria* Walker in the Canadian National Collection. This was done at the author's request, as he is embarking upon a revision of the North American species of *Deilinia* Hübner (= *Cabera* Treitschke). Walker's species was placed as a probable synonym of *Scopula quadrilineata* Packard by Hulst (1895, p. 72). Later, Barnes and McDunnough (1916, p. 36) examined the type specimen, and considered it "a poor ♀ specimen of what appears to be *Cabera erythemaria* Gn." However, a careful reexamination of the antennæ, wing venation, and frenulum of this specimen shows that it is undoubtedly the species heretofore known as *Gueneria basiaria* Walker. The abdomen of the type is missing, so the genitalia cannot be examined. As *similaria* was published two years before *basiaria,* the former must take precedence and, as *basiaria* is the type species of *Gueneria,* the type of the genus must now be known as *similaria* Walker.

Syrrhodia cruentaria (Hübner)

Geometra cruentaria Hübner, "1796" [1796–1799], Sammlung Europäischer Schmetterlinge, Horde 5, pl. 10, fig. 48.

Crochiphora coloraria var. *sphæromacharia* Harvey, 1875, Bull. Buffalo Soc. Nat. Sci., vol. 2, p. 284 (new synonymy).

Syrrhodia sphæromacharia, Rindge, 1950, Amer. Mus. Novitates, no. 1469, p. 19, figs. 3 (distribution), 5B (male genitalia), 6D (female genitalia).

Since the appearance of "A Revision of the North American Species of the Genus *Syrrhodia* (Lepidoptera, Geometridæ)" (Rindge, 1950, Amer. Mus. Novitates, no. 1469, pp. 1–26, 6 figs.) more material has come to hand and has been critically examined. At the suggestion of Dr. J. G. Franclemont of the Department of Entomology, Cornell University, the status of *cruentaria* Hübner has been reexamined. In the light of our present knowledge, it seem relatively certain that this name of Hübner's should be applied to, and take priority over, the species called *sphæromacharia* Harvey in the above-mentioned revision.

To the species erroneously called *cruentaria* by the author, the well-known name *coloraria* Fabricius may be once again applied (*op. cit.,* p. 13, figs. 2 (distribution), 5A (male genitalia), 6C (female genitalia)).

A NEW PHEIDOLE (SUBG. CERATOPHEIDOLE) FROM UTAH (HYMENOPTERA: FORMICIDÆ)

BY MARION R. SMITH
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Ants of the subgenus *Ceratopheidole* are similar to those of the typical subgenus *Pheidole*, differing mainly in the possession of a 4-segmented instead of a 3-segmented antennal club in the worker, soldier, and female castes. The groups are alike in having dimorphic and polymorphic forms. Although *Ceratopheidole* has been reported from most of the faunal realms, the species composing it are apparently not so numerous as those of *Pheidole*.

Only two species of *Ceratopheidole* have been found in North America, *granulata* Pergande and *clydei* Gregg. The type locality of *granulata* is Tepic, Mexico; that of *clydei* is the vicinity of the lava beds of the Tularosa Basin near Carrizozo, New Mexico. Pergande described *granulata,* the genotype, from two specimens which he thought, but was not quite sure, were soldiers. I have carefully examined them and believe them to be soldiers. So far as I am aware, the species is known only from the type specimens which are now in the collections of the United States National Museum.

On the other hand, *clydei* has recently been taken in two additional localities. L. F. Byars found some foraging workers of this species at Windy Point, altitude 7,100 ft., in the Santa Catalina Mountains of Arizona. According to him, they were collected from a rocky roadside park at the upper edge of the Xeric-Evergreen forest (oak-juniper, with some pines). W. S. Creighton was fortunate enough to find a colony containing both workers and soldiers in Split Mountain, altitude 500 ft., in the Anza Desert of southern California near Borego. This is the first North American species of *Ceratopheidole* in which associated workers and soldiers have been found. Robert E. Gregg has prepared an article describing and figuring the soldier caste.

Recently I was much surprised to receive fourteen workers of another *Ceratopheidole* from A. W. Grundmann, of the University of Utah. He wrote that they "were collected near the creek at the mouth of Ashley Canyon a few hundred yards below Merkeley Park. The specimens came from the wooded area along the creek and were found under a stone beneath a narrowleaf cottonwood tree." In a previous letter he had stated that this locality is near Vernal, Utah, at an altitude of 6,000 ft. Robert E. Gregg and I agree that the form, which is described below, is a new species. The exact status and relationship of each of our North American species of *Ceratopheidole* is difficult to evaluate, since the worker caste is unknown for *granulata* and the soldier caste for this new form and until recently for *clydei*. The Utah individuals have many characters in common with *clydei* and may eventually prove to be only a subspecies. The main distinctions between the two are discussed elsewhere in this article.

Pheidole (Ceratopheidole) grundmanni n. sp.

WORKER. Length 2.3 mm.

Head subrectangular, 1.08 times as long as broad, with weakly convex sides, rounded posterior corners and almost imperceptibly emarginate posterior borders. Scape slender, curved at the base, enlarged apically, extending approximately one fourth its length (not including the pedicel) beyond the posterior border of the head; all funicular segments longer than broad, the last four segments forming a club, which is distinctly longer than the rest of the funiculus. Eye oblong, moderately large and prominent, with 10–12 ommatidia in its greatest diameter, which is less than 0.2 mm. Frontal carinæ subparallel, with weakly developed lobes. Clypeus at least twice as broad as long, the middle of the anterior border with a distinct emargination. Mandible subtriangular, the masticatory border with 2 rather large apical teeth and 6 to 8 much smaller and irregular basal teeth. Thorax slender, widest through the pronotum, which is 0.5 mm., with obsolescent promesonotal suture but very distinct mesoepinotal impression. Epinotal spine well developed, 0.143 mm. in length, tapering from base to apex, and with acute tip. In profile, the pronotum is convex and the mesonotal outline forms an almost unbroken slope into the mesoepinotal impression; base of epinotum 0.2 mm. in length, sloping posteriorly. Legs rather long and slender but with incrassated femora and tibiæ. Petiole pedunculate; in profile, with concave anterior surface and angular node. Petiolar node, from above, with rather sharp and transversely rounded superior border. Postpetiolar node, from above, with convergent sides on its anterior half, and subparallel sides on the posterior half, the two halves meeting on each side to form rather small but distinct angles. Gaster with subangular humeri.

Mandibles, dorsum of thorax, petiole and postpetiole, and gaster somewhat shining; remainder of body subopaque. Cheeks, and regions between the eyes and front, longitudinally rugulose with punctulate interspaces. Sides of thorax and also lower surface of petiole and postpetiole punctulate.

Pubescence lacking on body. Pilosity not abundant, rather widely spaced, and consisting of suberect to erect, light yellowish or grayish hairs, many of which are noticeably long on the dorsal surface of the body. Hairs on the scapes short and rather appressed, those on the legs longer and more suberect.

Dorsal surface of head, and much of the gaster, infuscated. Eyes and mandibular teeth dark; remainder of body, especially in some lights, reddish brown.

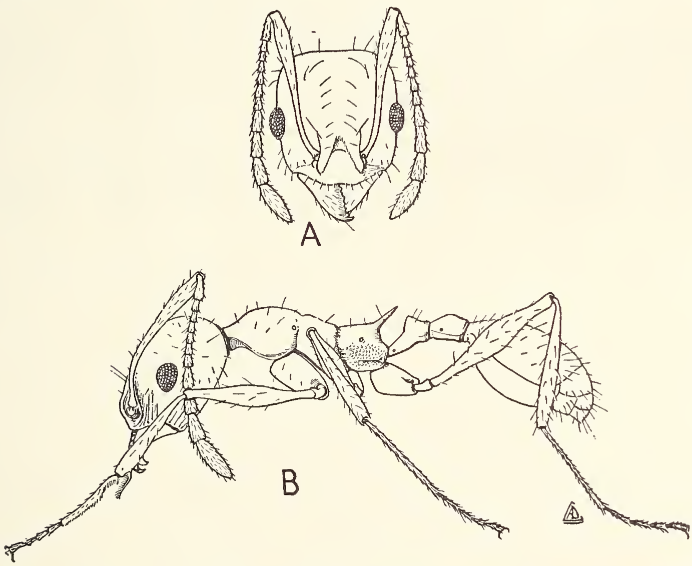

Fig. 1 — Worker of **Pheidole (Ceratopheidole) grundmanni** n. sp. *A*, Frontal view of head; *B*, body in profile. Drawn from a paratype. (Illustrations by Arthur D. Cushman.)

Type locality—Ashley Creek near Vernal, Utah, 6,000 ft., May 28, 1946, A. W. Grundmann.

Described from a holotype and thirteen paratype workers. The holotype and ten paratype workers have been placed in the United States National Museum under U. S. N. M. No. 61792.

The three remaining paratypes are in the collection of A. W. Grundmann. The species is named for Mr. Grundmann, who has made some important contributions to the knowledge of the ants of Utah.

Paratypes range from 2.3 to 2.7 mm. in length. Some of them differ from the holotype in having the posterior border of the head straight, the superior border of the petiolar node transversely truncate, and the base of the epinotum horizontal or even slightly ascending posteriorly. They also differ in having the front or much of the dorsal surface of the head shining. The coloring of the head and gaster, although variable, is apparently always darker than that of the thorax, petiole, and postpetiole.

This species appears to be closest to *clydei*. It differs from *clydei* mainly in stature, color and sculpture. The worker of *grundmanni* has a more robust body, a more subquadrate head, more ommatidia (10–12 against 8–10) in the greatest diameter of the eye, and a distinctly lighter body (the body of *clydei* is black); and the dorsal portion of the body, especially of the thorax, is less heavily sculptured and therefore more shining.

RECORDS AND DESCRIPTIONS OF NEOTROPICAL CRANE-FLIES (TIPULIDÆ, DIPTERA), XXVII

By Charles P. Alexander
Amherst, Massachusetts

The preceding article under this general title appeared in the Journal of the New York Entomological Society, **60**: 245–254; 1952. The materials considered herewith come from a variety of sources that are discussed under the various species. The types are preserved in my personal collection of World Tipulidæ.

Genus *Longurio* Loew

Longurio (Tanypremnella) maldonadoi new species

Mesonotal præscutum orange, with three slightly darker pale brown stripes, the central one with a vague darker capillary vitta; pleura yellow, with a broad transverse band on the mesepisternum; femora brownish yellow, the tips dark brown; tarsi and tips of tibiæ white; wings crystal clear, the large oval stigma dark brown; cell M_4 at margin wide, the distance a little greater than the outer section of Cu_1.

Female. Length about 8 mm.; wing 11.5 mm.

Mouthparts broken. Antennæ short; scape brownish yellow, pedicel clear light yellow, flagellum dark brown, the first segment more brightened on proximal half; flagellar segments elongate-cylindrical, much longer than the verticils. Head orange; vertical tubercle low and obtuse.

Pronotum darkened medially above, the sides, together with the pleura, pale yellow. Mesonotal præscutum with the restricted ground orange, the dorsum with three slightly darker pale brown stripes, with indications of a slightly darker capillary median line; posterior sclerites of notum light brown, the scutellum and mediotergite slightly more pruinose. Pleura with the mesepisternum chiefly darkened, forming a transverse girdle, the mesepimeron and meron more yellowed; pleurotergite weakly darkened. Halteres with the stem brown, restrictedly yellowed at the base, the knob brownish black. Legs with the coxæ and trochanters obscure yellow; femora brownish yellow, the tips rather narrowly but distinctly dark brown; tibiæ pale brown, the tips, together with the tarsi, white. Wings crystal white, the large oval stigma dark brown; veins dark brown, conspicuous. Venation: *Rs* short and straight, less than half R_{2+3}, the latter subequal to R_3; cell *1st* M_2 less pointed at outer end than in *gentilis;* cell M_4 broad at margin, the distance a little greater than the distal section of Cu_1.

Abdomen conspicuously bicolored, the segments yellow with broad black posterior borders, the amount of the latter greater on the intermediate segments where it much exceeds the pale bases; on the sternites the yellow is considerably more extensive than the darkened apices; outer segments brownish yellow. Ovipositor with the valves short and blunt, as in the subgenus.

Habitat. Venezuela.

Holotype, ♀, Camp Benitez, near foot of Mount Marahuaca, Pacaraima Mountains, May 1950 (Jenaro Maldonado Capriles).

I take pleasure in naming this fly for the collector, Mr. Jenaro Maldonado Capriles. The species is very closely allied to *Longurio* (*Tanypremnella*) *gentilis* (Alexander), differing in slight details of coloration and venation.

Longurio (Tanypremnella) segnipes new species

General coloration of thorax yellowish brown, the pleura unpatterned; antennæ short, scape and pedicel testaceous yellow, flagellum black; legs uniformly dark brown; wings subhyaline, the stigma and cell *Sc* brown; cell *1st* M_2 long, its inner end arcuated, lying almost opposite the origin of *Rs;* petiole of cell M_1 shorter than *m;* cell *2nd A* relatively narrow.

Female. Length about 9 mm.; wing 11 mm.

Frontal prolongation of head relatively long, orange; nasus short and very broad, more infuscated; palpi brownish black. Antennæ (female) 10-segmented; scape and pedicel testaceous yellow, flagellum black; flagellar segments cylindrical, gradually decreasing in length outwardly, the terminal one about one-third longer than the penultimate; verticils much shorter than the segments. Head yellow.

Thorax almost uniformly yellowish brown, unpatterned, the pleurotergite and pleura more yellowed. Halteres with stem brownish yellow, knob darkened. Legs with the coxæ and trochanters yellow; femora yellowish brown, brighter basally; remainder of legs uniformly dark brown. Wings subhyaline, variegated by the brown stigma; cell *Sc* brown; veins dark brown. Venation: Sc_1 present, ending shortly beyond the fork of *Rs*, the latter shorter than R_{2+3}; cell *1st* M_2 long, its inner end arcuated, lying almost opposite the origin of *Rs;* petiole of cell M_1 shorter than *m;* cell *2nd A* relatively narrow.

Abdomen dark brown, the color probably intensified by internal discoloration; ovipositor fulvous, the long-triangular cerci more infuscated; hypovalvæ slender.

Habitat. Bolivia.

Holotype, ♀, Cristal Mayu, altitude 1200 meters, August 24, 1949 (L. E. Pena).

When compared with the various species of the subgenus that have unvariegated legs, including *Longurio* (*Tanypremnella*) *mediocornis* (Alexander), *L.* (*T.*) *megacera* (Alexander), and

L. (*T.*) *microcera* (Alexander), the present fly differs especially in the venation, particularly of the medial field.

Genus *Nephrotoma* Meigen

Nephrotoma durangensis new species

Size large (wing, male, 15 mm.); mesonotal præscutum light yellow with three brownish stripes that are very narrowly bordered by blackish; antennal flagellum black; femora and tibiæ yellow, the tips very narrowly brownish black; wings whitish subhyline, veins beyond cord very narrowly seamed with brown; abdominal tergites with a narrowly interrupted median stripe; male hypopygium with the caudal border of tergite produced into two conspicuous triangular lobes; inner dististyle with the beak slender, lower beak spinous, outer basal lobe a powerful curved arm that narrows into a long spine, on outer margin beyond midlength with a small acute spine; eighth sternite at midline produced into a small pale fingerlike lobe.

Male. Length about 16 mm.; wing 15 mm.; antenna about 5.5 mm.

Frontal prolongation of head yellow, polished chestnut above, including the nasus; palpi pale brown, the outer end of the terminal segment somewhat paler. Antennæ with scape yellow, pedicel obscure yellow, flagellum black, the proximal half of the basal segment more reddened; flagellar segments moderately incised, longer than the verticils. Front whitened, with a pale brown triangular area before and between the antennal bases; posterior part of head orange, the vertical tubercle and adjacent region more yellowed; vertical tubercle high, with a capillary median impressed line; occipital brand brown, pointed anteriorly.

Pronotum light yellow, infuscated on sides. Mesonotal præscutum light yellow with three brownish black stripes, the central area of the median vitta more reddened; all stripes very narrowly bordered by blackish; lateral stripes outcurved to margin, the lateral spot dark reddish brown, polished; lateral ends of suture velvety black; scutum yellow, each lobe extensively polished chestnut brown; scutellum brown, parascutella pale yellow; mediotergite pale yellow, the mid-central third more reddened, the posterior third more evidently so. Pleura and pleurotergite whitish yellow, variegated with more reddened areas, especially on the ventral sternopleurite, ventral anepisternum and dorsal pleurotergite. Halteres weakly infuscated, base of stem and apex of knob paler. Legs with the coxæ reddish yellow; trochanters testaceous yellow; femora and tibiæ yellow, their tips very narrowly brownish black, the amount subequal on all legs; tarsi dark brown to brownish black; claws (male) toothed. Wings whitish subhyaline; veins beyond cord narrowly and vaguely seamed with brown; stigma medium brown, with numerous trichia; area above the stigma more yellowed; prearcular field brownish yellow; veins dark brown or brownish black. Venation: *Rs* gently arcuated, nearly twice the basal section of R_{4+5}; petiole of cell M_1 more than one-half *m*; *m–cu* just before the fork of *M*.

Abdomen with basal tergites yellow, beyond the second more orange; a broken median dark brown stripe, interrupted at the posterior borders of the segments; outer segments, including the hypopygium, more extensively infuscated; basal sternites yellow. Male hypopygium with the caudal margin of the ninth tergite produced into two conspicuous triangular lobes, the margins and surface with small blackened spicules; outer lateral part with a flange of coarser teeth; a second oblique ridge on either side of the deep median notch between the major lobes. Outer dististyle dilated on basal half, the outer part long and narrow. Inner dististyle with the beak slender, lower beak long and spinous, black; dorsal crest very low and inconspicuous, posterior crest undeveloped; outer basal lobe a powerful curved arm that narrows into a long acute spine, on outer margin beyond midlength with a small acute spine. Gonapophysis appearing as a long slender rod, its tip acute. Eighth sternite extensive, narrowed posteriorly, the median area farther produced into a narrow tonguelike lobe, the rounded apex on either side with sparse setæ.

Habitat. Mexico.

Holotype, ♂, 10 miles east of El Salto, Durango, August 9, 1947 (Mont Cazier).

By existing keys to the regional species of the genus, the present fly runs to *Nephrotoma affinis* (Bellardi) or *N. usta* (Osten Sacken), both of which are much smaller species that differ in the details of coloration. The present form may be the unnamed species of *Nephrotoma* discussed by Williston (Biol. Centr. Amer., Diptera, 1, suppl., p. 228; 1900) from Mount Orizaba, Guerrero, since it agrees in the unusually large size and in most of the colorational features indicated by Williston.

Genus *Limonia* Meigen

Limonia (Peripheroptera) euryptera new species

General coloration of body, antennæ, halteres and legs intensely black; wings unusually broad, the ground color light brown, variegated by darker brown and light yellow areas, the latter especially evident on either side of the cord; darker brown pattern restricted but conspicuous; vein Sc_1 about one-fifth longer than *Rs;* inner ends of cells R_3, R_5 and *1st* M_2 in approximate transverse alignment.

Male. Length about 7 mm.; wing 8 mm.

Rostrum and palpi black. Antennæ black throughout; flagellar segments passing through subglobular to oval; verticils short. Head black.

Entire thorax, halteres and legs black, only the extreme base of the stem of the haltere a trifle brightened. Wings unusually broad, the ground chiefly light brown, the disk on either side of the cord much paler, light yellow; a restricted but conspicuous dark brown pattern, as follows: A postarcular spot in bases of cells *R* and *M* and relatively broad seams over cord and outer end of cell *1st* M_2; stigma somewhat paler brown; free tip of Sc_2 and R_2 slightly seamed with darker; prearcular and costal fields brighter yellow; veins obscure yellow, darker in the patterned portions. Venation: Sc_1 ending opposite origin of *Rs*, Sc_2 some distance from its tip, Sc_1 alone about one-fifth longer than *Rs*; free tip of Sc_2 about its own length before R_2; inner ends of cells R_3, R_5 and *1st* M_2 in approximate transverse alignment; cell *1st* M_2 elongate, gently widened outwardly, the second section or M_{1+2} about one-fourth longer than the distal section; *m–cu* oblique, approximately one-half its length beyond the fork of *M*; basal third of cell *2nd A* very narrow, vein *2nd A* gently arcuated at the level of the arculus.

Abdomen, including hypopygium, black.

Habitat. Peru.

Holotype, ♂, Chinchao, Huanuco, altitude 2500 meters, September 15, 1947 (Woytkowski).

The most similar described species is *Limonia* (*Peripheroptera*) *dis* Alexander, which differs in the shape of the wings, the slightly longer prearcular field, and in the coloration and venation of the wings.

Limonia (Peripheroptera) fulvistigma new species

Size large (wing, male, to 12.5 mm.); general coloration of thorax reddish, the præscutum more brownish gray, with three highly polished dark brown to black stripes; femora yellow, the tips narrowly blackened; wings whitish subhyaline, the expanded stigmal region of male strongly fulvous; free tip of Sc_2 far before R_2, R_{1+2} persisting as a strong spur; inner ends of cells R_3, R_5 and *1st* M_2 in transverse alignment; cell *1st* M_2 relatively wide, *2nd A* narrow; abdomen reddish fulvous, the large ventral dististyle of the male hypopygium dark brown.

Male. Length about 6–7.5 mm.; wing 8.5–12.5 mm.

Rostrum yellowish brown; palpi black. Antennæ black throughout; flagellar segments long-oval to elongate, shorter than their verticils. Head above brown, gray pruinose, more sparsely so behind, more yellowish beneath; anterior vertex relatively narrow, about two and one-half times the diameter of the scape.

Pronotum brown. Mesonotal præscutum brownish gray, with three highly polished dark brown to black stripes, the lateral pair varying in intensity; posterior sclerites of notum reddish, somewhat pruinose, the centers of the scutal lobes polished red with a smaller black ventral area. Pleura and pleurotergite reddish. Halteres with stem yellow, knob black. Legs with all coxæ reddish; trochanters obscure yellow; femora yellow, the tips narrowly infuscated to blackened; tibiæ brownish yellow, the tips more gradually darkened; tarsi black. Wings whitish subhyaline, the expanded stigmal region in male strongly fulvous, cell *C* and base of *Sc* less conspicuously so; a very narrow and inconspicuous darker brown seam over the cord, most evident as a deepening in color of the veins; arculus darkened; wing tip more or less distinctly infuscated; veins brownish yellow to light brown, deeper in the heavily patterned areas. Venation: Sc_1 ending opposite origin of *Rs;* free tips of Sc_2 far before R_2, R_1 alone being more than three times either of the two latter elements; junction of R_1 and R_2 angulated and usually with a strong spur of R_{1+2} persisting; inner ends of cells R_3, R_5 and *1st* M_2 in transverse alignment; cell *1st* M_2, relatively broad, about equal in length to the distal section of vein M_{1+2}; cell *2nd A* narrow.

Abdomen reddish fulvous, the large ventral dististyles of the male hypopygium dark brown.

Habitat. Peru.

Holotype, ♂, Utcuyacu, Tarma, March 2, 1948 (Woytkowski). Paratopotypes, 5 ♂♂.

The most similar species is *Limonia* (*Peripheroptera*) *cochabambæ* Alexander, of Bolivia, which differs in the details of coloration of the body and wings, and in slight venational points, especially of the outer radial field and cell *1st* M_2.

Limonia (Peripheroptera) machupichuana new species

Allied to *ordinaria;* general coloration black, in places heavily gray pruinose; mesonotal præscutum with three polished black stripes; legs black, the extreme femoral bases vaguely more brightened; wings with the ground grayish, the prearcular field light yellow; cord narrowly seamed with brown, more evident on the anterior cord; *Rs* strongly arcuated; cell *2nd A* elongate.

Female. Length about 6 mm.; wing 6.5 mm.

Rostrum and palpi black. Antennæ black throughout; flagellar segments oval, the outer ones progressively smaller. Head black; anterior vertex relatively broad, exceeding three times the diameter of the scape.

Pronotum brownish black. Mesonotal præscutum with the interspaces light brown, with three polished black stripes, the central one broader and more conspicuous; scutal lobes with polished black areas; posterior sclerites of notum, including the midregion of the scutum, heavily pruinose. Pleura and pleurotergite with a very heavy gray pruinosity. Halteres with stem yellow, knob brownish black. Legs with the coxæ and trochanters black, sparsely pruinose; remainder of legs black, the extreme femoral bases vaguely more brightened. Wings with the ground color grayish, the prearcular field light yellow, including the veins; stigma small, medium brown; cord narrowly seamed wtih brown, more evident and slightly darker on the anterior cord, best evidenced by the darkened veins; remaining veins brown. Venation: *Rs* strongly arcuated, much more so than in *ordinaria;* vein R_2 more oblique, cell *2nd A* considerably longer.

Abdomen black, the intermediate tergites very vaguely pruinose; valves of ovipositor horn yellow, the hypovalvæ more infuscated basally.

Habitat. Peru.

Holotype, ♀, Machupichu, Cuzco, February 25, 1950 (L. E. Peña).

The nearest relative and most similar species is *Limonia* (*Peripheroptera*) *ordinaria* Alexander, which differs chiefly in slight details of coloration of the body and wings, and in the venation.

Genus *Helius* St. Fargeau

Helius (Helius) pervenustus new species

Belongs to the *albitarsis* group; general coloration of head and thorax dark brown to black; antennæ (male) relatively long, flagellar segments elongate, with a dense erect pubescence; femora black, the tips abruptly snowy white; tibiæ black, the tips more broadly white; tarsi white with the proximal ends of the basitarsi broadly black; wings with a weak brownish tinge; vein R_{4+5} extensively fused with vein M_{1+2}, the distance subequal to the basal section of M_{1+2}; cell *1st* M_2 large, with *m-cu* lying far distad; male hypopygium with the tergite conspicuously emarginate by a shallow V-shaped notch, the margins of the lobes very densely set with short black setæ to form continuous cushions; dististyles slightly subterminal in position, the outer style small and slender.

Male. Length about 5.5 mm.; wing 5.5 mm.

Rostrum black, subequal to or a trifle longer than the remainder of head; palpi black. Antennæ black throughout, unusually long for a member of this group, if bent backward extending nearly to the wing root; flagellar segments elongate, with a dense erect pubescence. Head black, sparsely pruinose; anterior vertex reduced to a narrow strip.

Pronotum dark brown. Mesonotum chiefly dark brown, restricted variegated with yellow, including the broad lateral parts of the præscutum and the very narrow median region of the scutum, with the adjacent posterior part of the præscutum. Pleura and pleurotergite chiefly yellow; dorsopleural region vaguely more infuscated. Halteres elongate, stem dusky, restrictedly more brightened at base, knob dark brown. Legs with the coxæ and trochanters yellow, the fore coxæ a trifle darker; femora black, the tips abruptly snowy white, involving about the outer twelfth; tibiæ black, the tips more broadly white, including nearly the distal fourth; tarsi snowy white, the proximal part of the basitarsi black, the amount subequal to or only a trifle less than the white tibial tips and involving about one-fifth the segment; setæ of legs conforming in color to the part that bears them. Wings with a weak brownish tinge, the prearcular field more whitened; costal border, including cells *C* and *Sc*, as far as the wing tip, slightly more infuscated; stigma long-oval, scarcely darker than the costal border; veins brown. Venation: Sc_1 ending just before the level of fork of *Rs*, Sc_2 at its tip and stronger; branches of *Rs* extending generally parallel to one another, diverging near tips so cells R_2 and R_4 at margin are subequal in extent; vein R_{4+5} very extensively fused with M_{1+2}, the union subequal to the basal section of M_{1+2}; cell *1st* M_2 large; *m-cu* subequal in length to outer section of M_{3+4}, the basal section of the latter lacking; *m-cu* lying far distad, about three-fourths as long as the distal section of Cu_1.

Abdominal tergites brownish black; basal sternites obscure yellow; outer segments more uniformly blackened. Male hypopygium with the tergite conspicuously emarginate by a shallow V-shaped notch, the margins of the lobes very densely set with short coarse black setæ to form a continuous cushion. Basistyle produced slightly beyond the point of insertion of the dististyles, the obtuse apex with a concentration of coarse black setæ; mesal face, especially at and near base with very long yellow setæ. Outer dististyle small and slender, the axial spine strongly decurved, the lateral one with a smaller blunt point in its axis; inner style longer and stouter, its tip obtuse, with two major setæ. Gonapophyses elongate.

Habitat. Costa Rica.

Holotype, ♂, La Suiza, without further data (Schild); through kindness of Melander.

The only described regional species having this somewhat peculiar type of venation is *Helius* (*Helius*) *quadrifidus* Alexander, which differs very conspicuously in all details of structure of the male hypopygium. The black and white banded pattern of the legs is likewise quite unique in the group.

Helius (Helius) angustalbus new species

Allied to *productellus;* mesonotal præscutum light brownish yellow, with a single median pale brown stripe; rostrum and antennæ black throughout; legs brownish black, the tips of the tarsi narrowly whitened, involving about the outer ninth of the basitarsi; wings with a strong blackish tinge; vein R_3 not deflected strongly caudad, cell R_2 at margin approximately twice as extensive as cell R_3; *r-m* elongate.

Female. Length about 9 mm.; wing 9.8 mm.

Rostrum black, moderately long, about one-half longer than the remainder of head; palpi black. Antennæ black throughout; flagellar segments oval, the verticils much exceeding the segments. Head black.

Pronotum brown. Mesonotal præscutum light brownish yellow, with a single median pale brown stripe, this not quite reaching the suture; lateral præscutal borders vaguely darkened; scutal lobes weakly darkened; central part of suture more yellowed; scutellum infuscated, its posterior border yellow; mediotergite dark brown, the pleurotergite more brightened. Pleura with the dorsal half, including the membrane, more infuscated than the ventral part, including the sternopleurite. Halteres infuscated. Legs with the coxæ brownish yellow, the fore pair darker; trochanters testaceous yellow; femora and tibiæ brownish black; basitarsi black, with about the outer ninth white; remainder of tarsi whitened. Wings with a strong blackish tinge, cells *C* and *Sc*, with the long-oval stigma, darker brown; vague dark seams along certain of the veins, especially *M* and *Cu;* veins dark brown. Venation: Sc_2 ending just beyond the level of *r-m;* branches of *Rs* generally parallel to one another, diverging very gradually, R_3 not deflected strongly caudad, cell R_2 at margin being approximately twice as extensive as cell R_3; *r-m* long, approximately two-thirds the basal section of R_{4+5}; cell *1st* M_2 relatively long, its inner end pointed; *m-cu* at near two-thirds the length of cell *1st* M_2 or about its own length before the fork of M_{3+4}.

Abdomen dark brown; genital shield a trifle brightened.

Habitat. Peru.

Holotype, ♀, Chinchao, Huanuco, altitude 2500 meters, September 22, 1947 (Woytkowski).

Helius (*Helius*) *angustalbus* is almost intermediate in size and venational characters between *H.* (*H.*) *productellus* Alexander and *H.* (*H.*) *regius* Alexander, differing from both species in the details of coloration and venation.

Genus *Orimarga* Osten Sacken

Orimarga (Orimarga) speciosa new species

Allied to *multipunctata;* thoracic notum gray; pleura yellow, with a conspicuous dark brown longitudinal stripe; femora brown, the tips paling to yellow; tibiæ brown, the extreme base yellowed; wings with a weak yellow ground, heavily patterned with dark brown; vein R_{1+2} elongate, subequal to *Rs; m-cu* about its own length before the fork of *M.*

Male. Length about 9 mm.; wing 7.5 mm.

Rostrum and palpi brownish black. Antennæ with the scape dark brown; pedicel brownish yellow; basal flagellar segments weakly bicolored, brown, the bases yellow, the outer ones passing into brownish black; flagellar segments oval. Head brownish gray; anterior vertex approximately twice the diameter of the scape.

Pronotum and mesonotum gray, the præscutum somewhat more yellowish gray, with very vague indications of darker stripes, the intermediate pair very delicate; scutellum more pruinose; pleura and pleurotergite more yellowed, the former with a conspicuous dark brown longitudinal stripe extending from the cervical region to the base of abdomen, broadest in front and on the anepisternum; ventral sternopleurite less evidently darkened, slightly pruinose. Halteres with stem white, knob pale yellow. Legs with the coxæ testaceous yellow, the fore pair darker; trochanters yellow, the apices narrowly blackened; femora brown, the bases obscure yellow, the tips more narrowly of the same color; tibiæ brown, the extreme bases narrowly yellowed; proximal three tarsal segments yellow, the outer two brownish black; claws (male) with an appressed tooth. Wings with a weak yellow ground, conspicuously patterned with dark brown, as follows: Arculus, origin of *Rs*, fork of *Sc*, stigma, cord, ends of veins R_{1+2} and R_3, fork of M_{3+4}; other darkened marginal areas at ends of veins M_3, M_4, Cu_1 and the Anal veins, the last three larger; axillary border narrowly darkened; veins yellow, darkened in the patterned areas. Venation: Sc_1 ending just before fork of *Rs*, Sc_2 near its tip; free tip of Sc_2 just basad of level of R_2, about twice as long as the short vein R_1 beyond it; R_{1+2} elongate, subequal to *Rs*; inner end of cell R_5 lying slightly distad of cells R_3 and M_2, the two latter about on a level; M_{3+4} subequal to or a trifle longer than vein M_4; *m-cu* about its own length before fork of *M*; cell *2nd A* relatively broad.

Abdomen brown, the extreme bases of the segments slightly yellowed; subterminal segments darker in color; basistyles of hypopygium obscure yellow. Male hypopygium with the basistyle simple, approximately as long as the slender simple outer dististyle. Inner dististyle a trifle shorter than the outer style. Inner gonapophyses of the phallosome with the membranous apices relatively large.

Habitat. Peru.

Holotype, ♂, Chinchao, Huanuco, on wooded hills, altitude 2500 meters, September 22, 1947 (Woytkowski). Allotopotype, ♀. Paratopotypes, ♂♀.

Most similar in its venation, wing pattern and hypopygial characters to *Orimarga* (*Orimarga*) *multipunctata* Alexander, differing in the heavier wing pattern and in other details of coloration.

Genus *Dicranoptycha* Osten Sacken

Dicranoptycha leucopoda new species

General coloration medium brown; head dark brown; legs brown, the tips of the tibiæ and the tarsi whitened; wings with a strong dusky tinge, strongly narrowed at base, restricting the prearcular field and narrowing cell *2nd A*; cell *1st* M_2 closed; male hypopygium with the outer dististyle long and slender, at apex narrowed into a straight black spine, the remaining outer surface with appressed pale spinous setæ; phallosome terminating in two glabrous obtuse lobes.

Male. Length about 8.5 mm.; wing 8.7 mm.

Rostrum brown; palpi brownish black. Antennæ short, dark brown, the pedicel testaceous yellow; flagellar segments oval, with long pale verticils that are more than twice the length of the segments. Head above dark brown.

Pronotum brown. Mesonotum chiefly medium brown, the humeral region of the præscutum extensively more yellowed; scutellum more testaceous.

Ventral region of pleura obscure whitish, the dorsal part somewhat darker, especially a narrow line on the ventral anepisternum to form an incomplete stripe. Halteres with stem pale, knob more infuscated. Legs with all coxæ and trochanters whitened; femora brown, the fore pair restrictedly paler at base; tibiæ brown, paling to white at tips, the tarsi uniformly whitened. Wings with a strong dusky tinge, the extreme base more yellowed; veins and macrotrichia dark brown. Wing strongly narrowed at base, restricting the prearcular field and narrowing cell *2nd A*. Costal fringe relatively short; Anal fringe long and delicate. Venation: Sc_1 ending just beyond the level of *r-m*; *Rs* somewhat longer than cell *1st* M_2; basal section of R_{4+5} weakly angulated and spurred before midlength; *m-cu* at near one-fourth the length of cell *1st* M_2; cell *2nd A* very narrow.

Abdominal tergites brownish black, the basal sternites obscure yellow. Male hypopygium with the outer dististyle long and slender, at apex farther narrowed into a long straight black spine, the surface back from this point with appressed pale spinous setæ; inner dististyle subequal in length but broader, obtuse at tip, provided with strong scattered setæ. Phallosome relatively inconspicuous, terminating in two glabrous lobes with obtuse tips.

Habitat. Guatemala.

Holotype, ♂, El Naranjo, Chicacao, altitude 5500 feet, July 17, 1949 (T. H. Farr).

Dicranoptycha leucopoda is entirely distinct from all known species in the conspicuously whitened legs. All of the regional forms, both in Middle America and the western United States, have the male hypopygium quite distinct, such species including *D. costaricensis* Alexander and *D. harpyia* Alexander.

REORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

Late in October, 1953, Secretary of Agriculture Ezra T. Benson, announced a plan to reorganize the Department. A summary of the changes proposed, follows:

The regulatory work would be separated from the research work and each would be grouped with similar functions in the new Agricultural Research Service "to provide two main activities with clear lines of authority—the research work in one group and the inspection and control work in another."

The administration of the Insecticide Act would be assigned to the Agricultural Research Service and presumably grouped with other regulatory work affecting plant pest control activities.

The forest disease and pest research and control work—including blister rust activities—would be transferred to the Forest Service.

One of the activities apparently included would be the transfer of the research on insects affecting stored products of the Agricultural Marketing Service.

The plan will have far reaching effect upon official entomology and the passing of the "Bureau" will be regretted by all those who have been privileged to work with it.—F. A. S.

THE PERIODICAL CICADA IN NEW JERSEY IN 1953

By Harry B. Weiss

The following notes represent an effort to keep track of the localities in New Jersey where *Magicicada septendecim* (Linn.) and its form *cassinii* (Fisher) made their appearance during the spring of 1953. This emergence was part of Brood X, which extends over a large part of the northeastern fourth of the United States.

In central New Jersey, specifically in Lawrence Road, Lawrence Township, (Mercer County) a cicada was observed on May 11. On May 16, cicadas were seen near Milford, along the Delaware River in Hunterdon County, which is also in the central part of the state. At Princeton, (Mercer County) nymphs were still emerging from the ground from May 20 to June 4. By June 16, emergence was all over in the Princeton area. Adults were disappearing and oviposition injury was beginning to appear on the oaks. In the vicinity of Bloomsbury, (Hunterdon County) the males were still singing, and ovipositing, on June 29, but in most areas in central New Jersey the cicadas were well on the wane by that date.

Magicicada septendecim form *cassinii,* with its darker colored ventral abdominal surface and its clicking song, whch occurs with *septendecim* was extremely abundant in Princeton and vicinity (Mercer County), in the Sourland Mountain (Hunterdon County), and along the road between Montgomery and Zion over the Sourland Mountain (Somerset County), where it occurred in very large colonies and where its song almost completely overwhelmed that of *septendecim. Cassinii* may have been as abundant elsewhere but the above areas were the only ones to come under my direct observation while the singing was going on.

The following cicada locality records for Mercer, Hunterdon, Somerset, and Warren counties are mostly the results of my own observations. I also covered Monmouth and Middlesex counties rather completely and found no signs of cicadas. The western parts of Burlington and Camden counties were also devoid of cicada colonies. Locality records outside of these areas were supplied by interested observers.

Atlantic County. Near Buena.

Burlington County. For a mile and a half between Indian Mills and Tabernacle.

Gloucester County. Along U. S. Route 40, west of Malaga.

Hunterdon County. Vicinity of Milford. Sourland Mountain between Amwell and Wertsville. Vicinity of Rocktown. Vicinity of Croton. Along N. J. Route 12 between Baptistown and Croton and between Croton and Flemington. Clinton to Baptistown. Pittstown to Bloomsbury (Musconetcong Mtn.). In Musconetcong Mountain between West Portal, Pattenburg and Bloomsbury. Vicinity of Jutland. Pittstown to Milford. Around Pattenburg. Northwest of Little York. Vicinity of Mount Pleasant. Along road from Cherryville to Clinton Reformatory. A mile northwest of Sergeantsville. Near Stanton. Four miles east of Lambertville. Along Mt. Airy-Harbourton Road about one and one-half miles from Mt. Airy.

Mercer County. In wooded areas on both sides of U. S. Route 206 in Princeton Township. Along Harbourton-Woodsville Road. Between Pennington and Harbourton. In a few wooded areas near Ackors Corner and also north of Pennington. Along both sides of N. J. Route 27 for a mile southwest of Princeton and extending into Princeton to the vicinity of the Princeton Battle Monument. In Princeton along Mercer Road, Library Place, Elm Road, on the old Hun School grounds and vicinity in Princeton. In the vicinity of the new Hun School. A few individuals in Lawrence Township.

Ocean County. Vicinity of Lakewood and Toms River.

Salem County. In an area from Portertown west to the Salem-Woodstown highway, known as "Bushtown."

Somerset County. On both sides of the road over the Sourland Mountain between Montgomery and Zion.

Warren County. Colonies in the Stewartsville (Pohatcong Mtn.) and Riegelsville (Musconetcong Mtn.) areas. In the vicinity of Carpentersville (Musconetcong Mtn.) entire mountainside infested.

An attempt was made through correspondence to obtain infestation records from all counties in the state. No records were forthcoming from Essex, Bergen, Union, Passaic, Cape May, Morris, Camden and Sussex counties. Definite locality records are not readily obtainable unless one actually surveys the likely places in a county or unless the cicadas are numerous and of course noisy enough to force their attention upon people. In the absence of information one never knows usually whether the cicadas have been eliminated from an area or simply overlooked because of their distance from well-traveled roads. Although Brood X has, during its past five appearances since 1868, been recorded from nearly all counties of the state, its absence in 1953 from such counties as Essex, Bergen, Union, Passaic, Camden, Middlesex and parts of Monmouth and Morris is not unexpected because of the advance of ''civilization'' in such areas. For the most part humans and cicadas do not exist side by side, and in areas where the human population is high, the ''seventeen-year locust'' has vanished. There are of course some exceptions to this. For example in the Princeton Battle Monument area and over an extensive part of its surroundings Brood X of the periodical cicada has been doing very well every seventeen years since 1885 which is as far back as my records extend. And it also did very well previous to 1885. This has been due to the comparatively unchanged residential areas in that locality, which for many years have supported numerous fine old trees and patches of dense woods. I doubt if there is another residential area in New Jersey where, during a periodical cicada emergence, the sidewalks, trees, fences, and shrubbery would overflow with these amazing and interesting insects. For many years to come, the best areas in New Jersey for observing Brood X, will be found in Mercer and Hunterdon counties and in parts of Somerset and Warren counties, until land clearance and building operations eliminate them from the wooded areas.

EARLY ADVICE TO COLLECTORS

In 1831 the "American Journal of Science and Arts" printed a paper by Theodore Roger on "Instructions for the benefit of those who are engaged in collecting insects for cabinets of natural history." This had been translated from the French by Dr. Jacob Porter of Plainfield, Massachusetts. At that time the collector was supposed to carry a net of gauze, rackets in gauze (these being flat cup-like nets operated like large pairs of scissors), umbrella, trowel, a bownet of horse hair or canvas for water collecting, tin box, wooden box lined with cork, paper triangles, pins, bottles with large necks.

In 1829 the Franklin Society of Providence, Rhode Island, published an eight page pamphlet entitled "General directions for collecting and preserving articles in the various departments of natural history: respectfully submitted by the Franklin Society of Providence, Rhode Island, to the attention of travellers, sea-faring men, and all lovers of nature and of nature's handy works, who are willing to lend their aid in promoting the cause of science, and advancing the progress of the arts."—H. B. W.

A NEW ROMBLONELLA FROM PALAU, AND THE FIRST DESCRIPTION OF A ROMBLONELLA MALE (HYMENOPTERA, FORMICIDÆ)

BY MARION R. SMITH

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Since publishing a revisionary paper on the genus *Romblonella* (Smith 1953), I have received some specimens from Palau (Micronesian Islands) which represent a new species. The material sent through the Pacific Science Board, Honolulu, Hawaii, contained, in addition to the new species, the males of several other species of *Romblonella* from the islands of Palau, Yap, and Ponape. Five of the male specimens I feel confident are of the new species, although they do not come from the same locality on Palau as the workers. I am describing them as the male of the new species but am not including them in the type series.

The males are of more than usual interest, since they enable more certain placement of the genus in the proper tribe and represent the first individuals of this sex to be recorded. A study of the male has convinced me that the genus *Romblonella* does not belong in the tribe Meranoplini, as previously placed by Wheeler (1935) and myself (Smith 1953), but to the tribe Myrmecinini, subtribe Podomyrmina, in the sense of Emery, 1922 (Genera Insectorum, pages 230, 236). The anterior wing differs from that of most myrmicine ants in lacking a discoidal cell and in the possession of a single closed cubital cell and a single closed radial cell, the latter being appendiculate and bearing on its ventral border a spur of a vein which originates before the middle of the cell. Other peculiarities are the form of the antennæ and the shape of the thorax, all of which are described below.

It is regrettable that the material from Palau and the other islands does not add to our knowledge of the biology of the various species of *Romblonella*. In my revisionary article I stated that the genus seems to be confined to the Oriental and Australian regions. It now seems that the genus is especially well represented on the islands in the general vicinity of the Philippines.

Romblonella palauensis n. sp.

Worker: Length 4.6 mm.

Head subrectangular, measured through its greatest breadth and width approximately as wide as long, with rounded posterior corners, weakly emarginate posterior border and weakly convex sides. No ocelli. Eye moderately large, oval, convex, placed closer to the posterior than the anterior border of the head. Mandible of about normal size, subtriangular, the masticatory border with 6 teeth. Clypeus extended posteriorly between the frontal carinæ, the anterior border sinuate laterally but in the middle forming a broad projecting lobe, which is almost straight in a transverse direction. Antenna short, 12-segmented, the scape lacking approximately 0.2 mm. of reaching the posterior border of the head, lying in a weak scrobe, the mesal border of which is formed by the posteriorly diverging frontal carina which is approximately the length of the scape, exterior border of the scrobe without a carina; funiculus with a distinct 3-segmented club which is clearly longer than the remainder of the funiculus, the second through the seventh funicular segments clearly broader than long. Frontal area not well defined. Thorax dorsally without promesonotal and mesoepinotal sutures, widest at the pronotum which is sharply marginate both anteriorly and laterally and with the anterolateral and posterolateral angles well defined; narrowest somewhat anterior to the base of the epinotal spines where it is approximately 0.5 mm. in width. Epinotal spines unusually long (0.5 mm. or slightly more in length) and directed posteroventrally; from above, the spines appear subparallel. In profile, the thorax is flattened on the pronotum and weakly arched on the mesoepinotum, there is also a precipitous incline from the anterior border of the pronotum to the pronotal collar. Legs with incrassated femora, the middle and posterior legs without tibial spurs, the tarsal claws simple. Petiole non-pedunculate, the node from above subrectangular, very distinctly longer than broad (0.4 mm. in width and 0.6 mm. in length). Postpetiole voluminous, transversely elliptical (approximately 0.5 mm. in length and 0.7 mm. in width); ventral surface of postpetiole with a conspicuous clump of erect hairs anteriorly, such as have also been observed in other species of this genus. Gaster, from above, longitudinally elliptical, the base without humeri and the first segment occupying most of the surface.

Mandible longitudinally striate and also sparsely punctate. Clypeus with six prominent, longitudinal carinæ, the interspaces and ground surface finely reticulate. Frontal area finely and longitudinally striated and with fine reticulate interspaces. Surface of head between the frontal carinæ with rather fine longitudinal rugulæ and reticulate interspaces, this type of sculpture extending from the frontal area to the occiput. Sides of head, especially the cheeks, coarsely and irregularly reticulate with fine reticulate interspaces. Thorax above, with coarse, longitudinal rugulæ and finely reticulate interspaces. Mesopleura and metapleura with a few oblique rugulæ, the interspaces as well as the rest of the areas finely reticulate.

Dorsal surface of petiole and postpetiole with coarse longitudinal rugulæ and reticulate interspaces. Dorsal surface of first gastric segment finely and densely reticulate. Body and appendages, except the legs and antennæ, subopaque. First gastric segment with a peculiar sheen or luster.

Head, legs excepting the tarsi, epinotal spines, and gaster blackish; remainder of body lighter; thorax, petiole and postpetiole light brown or reddish brown.

Hair moderately abundant, rather uniformly distributed on the body, white, short, coarse, erect, obtuse, and of nearly equal length except near the apex of the gaster. Apparently shorter and more oblique on the scapes and legs. Pubescence very sparse or lacking, most noticeable on the gaster.

Male: Length 4.6 mm.

Closely approximating the worker in length but more slender, with longer legs and antennæ. Head, including the eyes, but not the mandibles, almost one-fourth broader than long. Ocelli unusually large, placed prominently on the vertex, mostly above the posterior borders of the eyes; the longitudinal axis of the anterior ocellus running transversely across the head, the longitudinal axis of each posterior ocellus obliquely directed. Eye, viewed from the front, unusually large, convex, protuberant, occupying all of the side of the head except the cheek which is approximately 0.05 mm. in length. Antenna elongate, subfiliform, 13-segmented, with rather distinct constrictions between the segments; scape, not including the base, unusually short, approximately 0.2 mm. in length; first funicular segment extremely short, broader than long and shorter than the scape, second funicular segment unusually long (the longest of all the antennal segments), approximately 0.4 mm. in length. Clypeus apparently projecting more in the middle of its anterior border than elsewhere. Mandible well developed, subtriangular, the masticatory border with 6 or 7 very distinct teeth, the apical tooth the longest. Maxillary palpus 5-segmented, labial palpus 3-segmented. Thorax, in profile, highest through the mesonotum where it measures approximately 1 mm., lowest where the base and declivity of the epinotum meet; anteriorly a very sharp incline from the mesonotum to the pronotum and from the pronotum to the pronotal collar, these inclines being of such a nature that the pronotum projects below the mesonotum and the pronotal collar projects beneath the pronotum. Legs rather long and slender without noticeably enlarged femora and tibiæ. Spurs and claws as with the worker. Thorax, from above, with distinct parapsidal sutures but incompletely developed Mayrian furrow, the two anterior arms of the Mayrian furrow, although distinct, failing to meet posteriorly. Anterior wing without a discoidal cell but with a single closed cubital and a single closed radial cell, the radial cell being appendiculate and also bearing ventrally a spur of a vein which originates before the middle of the cell. Petiolar node from above, subcylindrical, elongate (about 0.6 mm. in length), postpetiolar node shorter than the petiolar node and widened posteriorly; each node bearing a pair of lateral spiracles near its base. Gaster, from above, elongate, subelliptical; in profile, the gaster impressed dorsoventrally. Genital appendages retracted, not visible.

Clypeus with several distinct longitudinal carinæ, the ground surface very finely reticulate. Head rather coarsely ruguloso-reticulate with finer reticulate interspaces; the rugulæ largely longitudinal in trend from the frontal area to the anterior ocellus. Dorsal surface of thorax with weak rugulæ borne on a ground surface of fine reticulæ. Epinotum transversely rugulose, with reticulate interspaces. Petiolar and postpetiolar nodes longitudinally rugulose with reticulate interspaces. First gastric segment with such weak reticulæ that they are not easily seen and do not cast the same luster or sheen as they do with the worker.

Hair light yellowish, suberect to erect, moderately abundant and scattered over the body, more reclinate on the appendages. Antenna clothed with dense, yellowish, reclinate pile, which seems to arise from punctures. Ventral surface of postpetiole with a clump or tuft of erect hairs.

Body brown to brownish black with lighter appendages. Wings brown, with an iridescence in some lights; the vein and stigma rather distinct.

Type locality: Auluptagel (Aurapushekaru) I., Palau; Sept. 1952; N. L. H. Krauss.

Other localities: N. E. Urukthapel I., 180 m., Palau, Ngerendin; Dec. 5, 1952; J. L. Gressitt; 1 worker. E. Ngatpang, 65 m., Babelthuap I., Palau; Dec. 6, 1952 (1 male), Dec. 9, 1952 (2 males), Dec. 10, 1952 (2 males); light trap; J. L. Gressitt.

Described from a holotype and seven paratype workers. These have been distributed as follows: The holotype and three paratype workers to the United States National Museum (U.S.N.M. No. 62024), two paratype workers to the Museum of Comparative Zoology, Cambridge, Massachusetts, and two paratype workers to the Bishop Museum, Honolulu, Hawaii. The specimens which are not types have been distributed in the following manner: One worker and one male to the Museum of Comparative Zoology, three males to the United States National Museum, and one male to the Bishop Museum. Paratypes differ from the holotype mainly in color, some specimens being blackish (but not black) except for the mandibles, funiculi and tarsi. One of the individuals is a callow which I shall not describe.

The males vary in length of body (4.3–4.7 mm.) dentition of mandibles (five to six teeth), and sculpture. The sculpture on the petiolar and postpetiolar nodes, for instance, is not as strong and well defined in some individuals as in others.

The worker of *palauensis* can be readily distinguished from the workers of all previously described forms by the peculiarly flattened and sharply marginate (both anteriorly and laterally) pronotum, the extraordinarily large epinotal spines which are approximately 0.5 mm. in length and directed posteroventrad, and the voluminous petiolar node, which from above is somewhat rectangular and very distinctly longer than broad.

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HOLLY SCALE, ASTEROLECANIUM PUTEANUM RUSSELL, IN NEW JERSEY

On August 28, 1953, several small scale-infested twigs of American Holly, *Ilex opaca* Ait. were submitted to the New Jersey Department of Agriculture by a resident of Cape May Point, N. J. There was complaint that the tree was seriously affected and apparently dying.

The specimens were sent to the Division of Insect Detection and Identification of the Federal Bureau of Entomology and Plant Quarantine and the scale was identified by Miss L. M. Russell as *Asterolecanium puteanum* Russell.

This pit-making scale has been recorded from the States of Delaware, Maryland, Virginia, North Carolina, Georgia, Florida and Alabama. It has been reported on *Ilex vomitoria, Ilex apaca, Ilex* sp., and *Bumelia parciflora.* G. B. Merrill in A Revision of the Scale-Insects of Florida, Bulletin 1, State Plant Board of Florida, Gainesville, January 1953, states ''Occasionally this is a very serious pest in Florida.''—Wm. M. Boyd.

TOXICITY OF SEVERAL NEW ORGANIC INSECTICIDES TO BODY LICE (PEDICULUS HUMANUS CORPORIS DeG.)

By Franklin S. Blanton, Lt. Col.
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Due to the length of the present paper it will appear in three parts[1], representing the three types of tests conducted. The first part will carry a review of the literature, but the references cited will appear in Part III.

All of the experimental phases of this work were conducted at the Orlando, Florida Laboratory, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture. The writer wishes to acknowledge the assistance rendered by this laboratory in lending all the available facilities and personnel needed to complete these studies.

It is not possible to name all that contributed, but the writer is especially grateful to Dr. W. V. King, in charge of the laboratory, to Dr. Carroll Smith and Mr. W. C. McDuffie. All three made helpful suggestions during the progress of this work. To Mr. George Culpepper the writer is also grateful for furnishing the many thousands of lice needed. To Miss Helen J. Fluno and Mr. Raymond W. Ihndries of the chemistry section the writer is especially grateful for the formulating of the thousands of chemical samples tested.

To David Lunsford, Richard Grovitt and Paul Schacht the writer is very grateful for the assistance rendered in testing the samples.

The writer is most grateful to Dr. B. V. Travis who directed this work. Acknowledgement is also made to Dr. W. V. King for reading the experimental phases of this paper and to Miss Helen Fluno for checking all the chemical names.

Acknowledgement is also made to Dr. E. F. Knipling, in charge, Division of Insects Affecting Man and Animals, Bureau of Ento-

[1] The three papers to appear under this title represent a portion of a thesis by the same title presented to the faculty of the Graduate School at Cornell University in partial fulfillment of the requirement for the degree of Doctor of Philosophy.

mology and Plant Quarantine, U. S. Department of Agriculture, and Drs. C. E. Palm and Henry Dietrich of the Department of Entomology at Cornell University, for helpful suggestions and encouragement.

The writer is also grateful to the U. S. Army for making it possible to pursue these studies.

PART I: BEAKER TESTS

The need for studies on the control of body lice, *Pediculus humanus corporis* deG. has been well brought out by historians who have dealt with the three important diseases transmitted by these insects—epidemic typhus, trench fever and relapsing fever.

The ravages of epidemic typhus and the role that lice have played in this disease has been dramatically portrayed by Zinsser (1944). This author pointed out that louse-borne typhus has been one of the epidemic diseases most feared by the military strategist and that battles and indeed even wars have been decided by it. One of the most noteworthy examples of the importance of lice and the diseases they carry is that of Napoleon's retreat from Russia even after the invasion of Moscow. The plight of his retreating soldiers is history, and Napoleon, one of the greatest generals, was defeated—not by the Russians—but by the louse and the death dealing organism it transmits.

Even at the outset of World War II epidemic typhus was one of the most dreaded diseases. Leading medical men and their scientific associates made careful plans for combatting this fatal disease. The development of DDT during the war and the accomplishment of typhus control in Italy, and other European countries, as well as Japan, will stand out in history as one of the high lights of scientific accomplishments.

One, however, should not forget that the control of louse-borne typhus might not have been possible had it not been for the brilliant work of several biologists, some of whom lost their lives to epidemic typhus.

Bayne-Jones (1948) states that the achievement at Naples, Italy, in 1943–1944 in the control of epidemic typhus stems from two fundamental discoveries made in 1909; one was the proof by Charles Nicolle (Nicolle 1909; Nicolle et al 1909) that body lice transmit typhus fever from man to man, the other by Ricketts (Ricketts, 1909, Ricketts and Wider, 1910, 1910a, 1910b, and 1910c), who discovered the causative organism of typhus, *Rickettsia prowazeki.* The discovery by Nicolle led Zinsser (1943–1944) to state that: "The strategic initiative passed into the hands of men, with the discovery in 1909 by Charles Nicolle, of the louse transmission of typhus from man to man. The victim was in a position to organize a rationally planned and strategically sound defense against his historic enemy". Further proof of the discovery was given by Strong et al (1920) and Walbach et al (1922) who confirmed that in the absence of lice, typhus is not contagious. As pointed out by Bayne-Jones (1948) typhus is associated with louse feces, and the occasional transmission of typhus by breathing dust infected with louse feces is still an association of man with lice. One may go still further and state that healthy lice cannot transmit the typhus organism and this knowledge led to the isolation of thousands of typhus cases in both Europe and Japan during World War II (Bayne-Jones, 1948; Gordon 1948; Scoville 1948; and Blanton 1951).

The other two diseases, trench fever and relapsing fever, which are transmitted by body lice are of much less importance than epidemic typhus. They, of course, are capable of causing great morbidity.

In this paper, data are presented on the relative toxicity of several organic insecticides to adult body lice, to determine if some would be even more useful than DDT louse powders.

At the time this research was being conducted it was thought that this information would be needed in case DDT resistance develops in louse populations, and subsequently resistance has been encountered in Japan and Korea, thus making necessary the use of alternate insecticides. Also the most probable large scale use of insecticides for louse control would come during and immediately following major national disasters. Substitute material should, therefore, be known to better insure an adequate supply of an effective chemical.

The experimental work for these papers was conducted at the Orlando, Florida, Laboratory of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture. The availability of a large louse colony and all chemicals needed made this location the most logical choice.

The chemicals used in these papers are listed according to the Chemical Abstracts System. For convenience they are arranged alphabetically. Common names, when known, are given after the name in parentheses. The thirteen chemicals used more often are as follows:

Camphene, chorinated (toxaphene)
Cyclohexane, 1,2,3,4,5,6, 95–100% gamma isomer (lindane)
Cyclohexane, 1,2,3,4,5,6-hexachloro-(10–12% gamma isomer)
1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-6,7-epoxy-l. 4,4a,5,6,7,8,8a-octahydro-(dieldrin)
1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a, 5,8,8a-hexahydro-(aldrin)
Ethane,1,1,1-trichloro-2,2-bis(*p* chorophenyl) (DDT)
Isobornyl sulfone, chlorinated, 70.5% Cl.
4,7-Methanoindene, 1(or 3a), 4,5,6,7,8-heptachlor-3a,4,7,7a-tetrahydro-(heptachlor)
4,7-Methanoindene,1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-(chlordane)
Pinene, chlorinated, 68.5% Cl.
Pinene, chlorinated, 68.8% Cl.
Sulfone, isobornyl phenyl, chorinated, 66.1% Cl
Thiophosphoric acid, O,O-diethyl-O-(p-nitrophenyl)ester (parathion)

HISTORY OF BODY LOUSE CONTROL SUBSEQUENT TO THE BEGINNING OF WORLD WAR II

A brief review of the literature is presented which brings together some of the more important titles on the subject of lice and their control that have been published since Grinnell and Hawes (1943). This publication covered the literature from 1758 through 1942.

During World War II modern methods of louse control replaced the cumbersome methods previously used. Methyl bromide was substituted for the steam method for treating clothing at most ports where German and Italian prisoners of war were being deloused. (Latta and Yeomans 1943, Latta 1944, Latta et al 1946, Stone and LaHue 1946, Richardson 1947, Blanton 1951). Individual bags were developed to fumigate soldiers' clothing, but these were seldom used A glass ampule holding 20 ml. of methyl bromide was developed for use with this bag. Although methyl bromide fumigation was an improvement over steam, the method still had many faults, being cumbersome, slow, and because of the extreme toxicity of the gas, dangerous for operating personnel (Houghton, 1946). Fumigation chambers were used at ports and to a limited extent in the field.

Fumigation with hydrocyanic acid gas was also used to some extent for disinfecting clothing and buildings (MacKenzie, 1941; Sherrard, 1942; David, 1944). Hot and cold air was used in some areas for control of lice in clothes (Busvine, 1944). In Germany one worker recommended placing clothing on ant nests (Hose, 1942).

While these methods were being used, laboratories were conducting research on the development of chemicals for louse control. Out of this work MYL and DDT louse powders and other DDT formulations were developed in the United States, AL63 in England and Lauseto Neu in Germany. The first official United States louse powder developed contained 0.2% pyrethrins, 2% dinitroanisol, 2% n-isobutylundecyleneamid and 1% phenol S(isopropyl cresols) in pyrophyllite. This product was known as MYL (Bushland, McAllister et al, 1944). MYL was later replaced by DDT, a product synthesized as early as 1874, but which lay dormant for many years without further development (Zeidler, O., 1874).

Bayne-Jones (1948) has reviewed the introduction of this material to the United States. Knipling (1948) states that: "In November 1942 a prepared insecticide called 'Gesarol Dust Insecticide' was received from the J. R. Geigy Company of New York, a subsidiary of the Geigy firm in Switzerland, where it was developed through the important research of Paul Mueller and his associates. A sample of the insecticide was obtained through the Division of Insecticide Investigations of the Bureau of Entomology and Plant Quarantine. This prepared insecticide contained as the active principle the material now known as DDT. . . ."

Other developments were being made by other laboratories on chemicals for lice control. Slade (1945) published on the new British insecticide, benzene hexachloride, and Gomez Ozamiz (1945) mentions using it in Spain for the control of various insects including lice.

A good deal of work was done in Russia with dixanthogen ($C_6H_{12}O_2S_4$) for louse control. This material was usually referred to as "K" or "SK" (Gorkina, 1942; Ivanova, 1942; Soboleva, 1942, 1942a).

Most of the chemicals mentioned above were developed for external use as powders. Jones et al (1945) published on impregnation of clothing and Jones and Fluno (1947) on xylene emulsions of DDT for louse control. Musgrave (1946) and Goodall et al (1946) also published on impregnation of clothing. Busvine (1945) describes a belt which was impregnated with "lasting insecticides" and worn for louse protection.

Another development during the war which should be continued was the protection of animals through internal medication, Knipling et al (1948). It is possible that a chemical could be found which would be compatible toxicologically, to the human and at the same time give protection against insects. This field of research needs a great deal more investigation yet is not within the scope of these studies.

All of these developments aided in louse control but the developments of louse powder at the Orlando Laboratory contributed more to the control of epidemic typhus than any other single development. In experimental and practical tests MYL proved to be very effective, (Bushland, McAllister et al, 1944; Bushland Schecter et al, 1944; Davis and Wheeler, 1944). This material was found to be completely effective for breaking an epidemic of typhus in a Mexican village (Davis et al, 1944).

MYL, however, was soon replaced with DDT which had been proven experimentally to be a very effective louse powder with long residual action (Bushland et al., 1944, 1945; Knipling, 1946; Stone, 1946). From these early discoveries the magic of DDT became the byword of at least all preventive medicine officers, accounting for the large number of publications on the control of insects which carry human disease. A review of this work is beyond the scope of this paper, but mention should be made of some of the outstanding work of a few of the individuals who contributed so much to the control of lice. As chief of the United States of America Typhus Commission, Stanhope Bayne-Jones (1943, 1948) contributed enormously. Numerous papers have appeared giving the excellent results of DDT for the control of lice (Bushland, 1948; Bushland et al., 1944; Eddy, 1944, 1946, 1948; Eddy and Carson, 1946, 1947, 1948; Eddy, Carson and Bushland, 1947; Knipling, 1946, 1948; Knipling et al., 1944; Buxton, 1945; Stowman, 1945; Simmons, 1945; Soper, 1945; Stone, W. S., 1946; Wheeler, 1946; Busvine, 1946, 1947; Canadel Vidal, 1946; Chalke, 1946, 1946a; Crauford-Benson, 1946; Goodall et al., 1946; Gordan, 1948; Scoville, 1948; Sergent, 1944; and Blanton, 1951, 1951a.

DDT powders were used at a strength of 10% toxicant and 90% pyrophyllite. The powder was furnished in 2 ounce cans for the individual soldier's use and also in bulk for group delousing.

According to Bayne-Jones (1948), Wheeler was the first to use dust-guns for applications of louse powders to humans without having the infested person disrobe. This method later proved to be a fast, efficient method for delousing large numbers of individuals. A power duster was later developed which was capable of dusting 600 persons per hour.

With the extraordinary results obtained with DDT for the control of lice, it is easy to overlook the phases of typhus control which are likely as important as the development of DDT for this particular disease. Typhus vaccine developed by the Cox method (Cox and Bell, 1940) was important in protecting soldiers from death. During the war there were 64 known cases of epidemic typhus in the US Army and although the symptoms were usually mild, they were sometimes severe. Nevertheless, there was a potential death with each case and without vaccine protection some deaths certainly would have occurred. The author was present in Osaka, Japan, for almost the duration of the epidemic, the largest experienced during the war (Scoville, 1948, Blanton, 1951a). Little has been published on that epidemic, but the death rate of the Japanese natives subsided several percent after the use of the vaccine.

In the experimental studies which were responsible for the development of louse control measures thousands of lice were needed daily. Mention should be made of the work of Culpepper (1944, 1946, 1946a, 1948) who worked out the technique for rearing lice on rabbits.

DESCRIPTION OF METHODS AND RESULTS OF TESTS

Three types of tests were employed in these studies: (1) beaker test, (2) dust test, and (3) fumigation test. The beaker tests were designed primarily to screen large numbers of chemicals, but the method was expanded to test the limits of dilution and the lasting properties of the chemical. The dust tests were used to test the practicability of any promising louse toxicant found in the beaker tests. The promising chemicals were tested at different concentrations to determine the lowest effective dilution. Since many of the compounds were found to be effective at extremely low dilutions the concentrations of toxicants are given in parts per million instead of in terms of percentages.

Beaker Tests

Methods used for screening compounds:—The beaker test method developed by Bushland et al. (1944b) and also Eddy and Carson (1946) was used in the screening tests for initial kill and lasting qualities of new compounds. In these tests circular woolen cloth pads $1\frac{1}{2}$ inches in diameter were dipped in 1% (10,000 p.p.m) solutions of the test materials, and then were suspended on pins to dry at room temperature. When thoroughly dry, individual pads were placed in 5 ml. beakers and ten young adult lice were added for each test. Most of the compounds were applied to the pads from acetone solutions. Those that were not soluble in this material were dissolved in other suitable volatile solvents such as chloroform, benzene, alcohol or water.

The initial kill of the compound was based on the mortality after 24 hours' exposure. The lasting qualities of the chemical were determined by adding ten new lice daily until normal lice survived. All materials which gave complete kill for ten days were subjected to additional tests.

Screening large series of chemical compounds to test effectiveness against adult lice:—During the war thousands of chemicals were tested as toxicants against the body louse. Up until September 1947 approximately 7,000 materials had been tested, Eddy, Carson, and Bushland (1947). Since that time over 3,000 new materials have been tested. As mentioned above, those chemicals which were effective for more than ten days in beaker tests were tested further.

Minimum concentration of compounds which were effective for 31 days or more:—The chemicals discussed in these papers were effective for 31 or more days in beaker tests. Dilution tests were made to eliminate the poorer lousicides from further consideration. In the preliminary tests the chemicals were diluted to 1,000, 100 and 50 parts per million. In each test ten lice were used.

A series of 106 chemicals had given 100% louse mortality for 31 days at 10,000 p.p.m. (1%). Further tests with these chemicals yielded the following results: at dilution of 1000 p.p.m., 40 compounds gave 100% kill; at 100 p.p.m. only 14 gave 100% kill; and at 50 p.p.m. only 8 gave 100% kill. DDT gave 100% kill only at 1000 p.p.m., 70% kill at 100 and 30% kill at 50 p.p.m. DDT, the standard lousicide was selected as the chemical with which to compare all other chemicals.

Prior to some of the preceding tests, preliminary tests were conducted with some new chemicals including chlordane and dieldrin. These showed remarkable toxicity to lice as well as to other insects.

The results of further dilutions of these chemicals are presented in Table I. Three additional dilutions, 100, 50 and 25 parts per million were not included in the table. At these dilutions dieldrin and chlordane gave 100% kill, compared to DDT which gave 100, 50 and 30% kills at the respective dilutions. Dieldrin gave 100% kill at a dilution of 6.25 parts per million in all seven tests and 100% kill in three of the seven tests at a dilution of 3.125 p.p.m. In six tests at a dilution of 0.1 p.p.m., 100% kill was had in four tests. Chlordane gave 100% kill at 6.25 p.p.m., 88% kill at 3.125

p.p.m., and 76% at 0.1 p.p.m. DDT had lost most of its toxicity at 12.5 p.p.m. giving only 10% kill.

TABLE 1. AVERAGE PERCENT MORTALITY OF ADULT LICE WITH VARIOUS CONCENTRATIONS OF DIELDRIN, CHLORDANE, AND DDT. EACH TEST WITH 10 LICE

Chemical	Parts Per Million				
	12.5	6.25	3.125	0.1	0.05
Dieldrin	100	100	88.6	71.6	0
Chlordane	100	100	88	76	
DDT	10				

In 10 check lots of 10 lice each there were 2 dead lice or 2% mortality.

Two samples of chlordane were tried at dilutions of 50, 25, 10, 5 and 2.5 p.p.m. All tests at 50 and 25 p.p.m. resulted in 100% kill in both samples. Over 90% was had at 10 p.p.m. and even at 5 p.p.m. over 50% kill resulted. At 2.5 p.p.m. there was almost 50% kill with both samples. In four checks of ten lice each there was one dead louse or 2.5% mortality.

Thirteen of the better chemicals were selected from the preliminary tests for trials at lower concentrations. These concentrations ranged from 100 to 1 part per million. A minimum of two tests were made, but in some cases twelve tests were made on different days.

The results of these dilution tests are presented in Table 2. At concentrations of 100 parts per million, DDT which gave an average kill of 88% in four tests was definitely inferior to all other chemicals. At 50 parts per million, DDT with an average of 63% mortality was superior both to toxaphene with an average of 48% for four tests and chlorinated pinene (68.5% Cl.) with an average of 53% mortality. It was slightly inferior to two other materials, chlorinated isobornyl phenyl sulfone (66.1% Cl.) and chlorinated pinene (68.8% Cl.) with 65 and 68% respective mortality. At a concentration of 25 parts per million DDT gave 15% kill which was superior to three other chemicals.

The next concentration, 12.5 parts per million completely eliminated DDT, benzene hexachloride (12% gamma), toxaphene, chlorinated isobornyl sulfone (63.3% Cl.), chlorinated isobornyl phenyl sulfone (66.1% Cl.), chlorinated pinene 68.8% Cl.), and chlorinated pinene (68.5% Cl.). There were still four chemicals, parathion, heptachlor, aldrin and dieldrin, which gave 100% kill at the 12.5 p.p.m. concentration.

At concentrations of 6.25 parts per million three chemicals, heptachlor, aldrin and dieldrin, still gave 100% kill. At the next dilution, 3.125 parts per million, only one chemical, aldrin gave 100% kill in all tests, however, heptachlor and dieldrin gave respective average kills of 90 and 85%.

TABLE 2. AVERAGE PERCENT OF LOUSE MORTALITY AFTER 24 HOURS EXPOSURE ON CLOTH PATCHES TREATED WITH LOW CONCENTRATIONS OF TOXICANTS. FOUR TO SIX TESTS OF 10 LICE EACH.

Chemical	Number of Tests	Concentration in Parts Per Million						
		100	50	25	12.5	6.25	3.125	1
Aldrin	6	100	100	100	100	100	100	0
Heptachlor	12	100	100	100	100	100	90	5
Dieldrin	4	100	100	100	100	100	85	0
Parathion	4	100	100	100	100	68	10	0
Lindane	6	100	100	100	93	82	52	0
Chlordane	10	100	100	100	86	29	8	0
Technical benzene hexachloride (12% gamma)	2	100	100	70	30	0	0	
Isobornyl sulfone, chlorinated (63.3% Cl.)	4	100	98	13	3	0	0	
Pinene, chlorinated (68.8% Cl.)	4	98	68	40	0	0	0	
Sulfone, isobornyl phenyl, chlorinated (66.1% Cl.)	4	100	65	30	3	0	0	
Pinene, chlorinated (68.5% Cl.)	4	100	53	5	0	8	0	
Toxaphene	4	100	48	8	3	0	5	
DDT	4	88	63	15	3	5	0	

There were 2 dead lice in 24 checks of 10 lice each or a mortality of 0.8%.

Durability of the better chemicals found in the initial screening: New chemicals were found which were a great deal more toxic to lice than the older chemicals including DDT. Many of these could be diluted more than DDT and still maintain a high level of louse control. Thirteen of the best chemicals were chosen for dilution-durability studies. Cloth patches were treated with each chemical in five concentrations, 50, 25, 12.5, 6.25, and 3.125 parts per million. After 24 hours the mortality was checked and new lice were placed on the patches that were still effective. This process was repeated daily until the chemical had definitely failed.

Concentrations of 50 parts per million DDT gave a 50% kill for one day and no kill thereafter. The remaining 12 chemicals were superior to DDT at 50 parts per million as they were effective for more than one day. The outstanding chemicals were parathion and dieldrin. With concentrations as low as 12.5 parts per million parathion gave 100% kill through the eighth day and dieldrin through the fifth day.

(*To Be Continued*)

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

Meeting of January 15, 1952

The Annual Meeting of the Society was held January 15, 1952, at the American Museum of Natural History; President Gaul in the chair. There were sixteen members and three guests present. The Treasurer and Secretary presented their annual reports to the Society. The Editor, in his informal report noted that he had a two-year backlog of papers for the Journal. The Secretary then read the report of the Auditing Committee.

The Nominating Committee report was read by Mr. Sam Harriot, as follows:

President: Albro T. Gaul
Vice-President: Dr. Lucy Clausen
Secretary: Louis S. Marks
Assistant Secretary: Dr. Frederick H. Rindge
Treasurer: Arthur Roensch
Assistant Treasurer: Mrs. Patricia Vaurie
Editor Emeritus: Harry B. Weiss
Editor: Frank A. Soraci
Associate Editor: Herbert F. Schwarz
Trustees: E. W. Teale, Dr. Mont A. Cazier, E. Irving Huntington, Dr. James Forbes
Publication Committee: Frank A. Soraci, E. W. Teale, Herbert F. Schwarz, John D. Sherman, Jr.
Delegate to New York Academy of Sciences: Herbert F. Schwarz

The nominations were closed and Dr. Mullen moved that the Secretary cast one ballot for the slate. This was seconded by Dr. Forbes, and carried.

Mr. Harriot announced that the Zoological Record committee still had obtained but $20.00. The Secretary then called the Society's attention to the death of Dr. G. C. Crampton. He also called attention to the announcements of the Society meeting in the New York papers and the issuance by the Department of Agriculture of a Catalog of the Hymenoptera North of Mexico. Mr. Teale called attention to some of Dr. Vishniac's recent work.

The speaker of the evening, Dr. Albert Hartzell of the Boyce Thompson Institute then gave a paper on entomological research in Europe. Dr. Hartzell visited laboratories in England, Holland, Belgium, Switzerland and attended the Ninth International Congress on Entomology held in Amsterdam in August where he was a Section Chairman. In connection with the Congress, he pointed out that 55% of the papers were given in English compared with 20% at the Fifth Congress, the last one he attended. He was most interested in the work on insecticides and physiology, and it was heartening to hear how well our European colleagues in Entomology have recovered since the war. The talk was illustrated by motion pictures and slides.

L. S. Marks, *Secretary*

Annual Report of the Secretary for 1951

Total membership—134—loss of 5.
  Honorary—9—gain of 1.
Number of meetings—14.
Average attendance—22.
Greatest attendance—46 at December 4 meeting (Petrunkevitch).
Major correspondence (notices)—4 local mailings.

1. Alpine Field Trip
2. Olsen picnic
3. Petrunkevitch meeting
4. Annual meeting

There were a total of 537 pieces of mail this year. The total cost to the Society was $9.27. Mr. Herriott of the Field Committee defrayed the expenses of his Committee by his $5.00 contribution. Total cost to Society, $4.27.

The Secretary also acknowledges certain supplies received through friends of the Society, at no cost to it.

L. S. MARKS, *Secretary*

Jan. 15, 1952

MEETING OF FEBRUARY 5, 1952

A regular meeting of the SOCIETY was held February 5, 1952 at the American Museum of Natural History; President Gaul in the chair. There were ten members and fifteen guests present.

The Secretary called the attention of the Society to the Harvey Lecture to be given at the New York Academy of Science on ''Metamorphoses in Lepidoptera'' on February 21. The President advised that the Brooklyn Entomological Society had certain numbers of ENTOMOLOGIA AMERICANA for sale.

The speaker of the evening was Mr. Edwin Way Teale who spoke on the trip for his new book, ''North with the Spring.'' To the surprise of the members, Mr. Teale reported that nature books without insects sell best. The trip started in Florida in February and ended in the White Mountains in June. It covered 23 states and in addition to very extensive notes, Mr. Teale took 2400 photographs, many in color. He not only followed Spring north in latitude but also watched its progress in altitude on several mountains. He was on the road a total of 130 days. Because of technical difficulties, Mr. Teale was unable to project his slides, but the Society invited him to show his pictures at a later meeting. The personal portrait of the immense labor involving in writing the book intrigued the members and their guests.

L. S. MARKS, *Secretary*

MEETING OF FEBRUARY 19, 1952

A regular meeting of the SOCIETY was held on February 19, 1952, at the American Museum of Natural History; Vice-President Clausen in the chair. There were thirteen members and seven guests present.

Mr. Jacob Fisher, 147–44 Barclay Street, Flushing, New York and Dr. John Rehn, First Army Area Medical Lab., 90 Church Street, New York, New York were proposed for membership.

There being no new or miscellaneous business, Dr. Vishniac then introduced the speaker of the evening, Dr. Louis Roth, who spoke on ''Hydroreceptors in Coleoptera.'' Dr. Roth worked with several species of *Tribolium*. He was interested in factors which attract insects to stored food products, in this case, flour. By a correlation of behavior toward experimental situations with selective surgery on the antennæ and palps of the insects, Dr. Roth was able to identify certain sensilla as hydroceptors in *Tribolium*. He pointed out, however, that in other insects where several types of sensilla occur in the same general location, the problem becomes very complicated. Dr. Roth illustrated his talk with lantern slides.

L. S. MARKS, *Secretary*

MEETING OF MARCH 4, 1952

A regular meeting of the SOCIETY was held March 4, 1952 at the American Museum of Natural History; President Gaul in the chair. There were twelve members and six guests present. Mr. Jacob Fisher and Dr. John Rehn were elected to membership.

The speaker of the evening was the President of the Society, Mr. Albro T. Gaul, who spoke on ''How Insects Fly.'' Mr. Gaul proposed a new theory of insect flight. His theory is that the wing muscles vibrate at a sub-harmonic of the wing beats. Each species (at least in the Hymenoptera) used by Mr. Gaul has a constant frequency. By means of an electronic device, the frequency of any portion of the insect thorax was measurable. Such measurements seem to indicate that portions of the thorax do vibrate at subharmonics of the wing frequency.

L. S. Marks, *Secretary*

Meeting of March 18, 1952

A regular meeting of the Society was held March 18, 1952 at the American Museum of Natural History; President Gaul in the chair. There were ten members and five guests present.

The President spoke of the need for a Publicity Committee. Dr. Forbes called the attention of the Society to the presentation of Philco Playhouse—a television program—of the life of one of the members of the Society, Mr. Charles Pomerantz.

Mr. Teale commented that the New York Board of Education had banned A. Hyatt Verrill's *Strange Insects and their Stories* because of disparaging remarks on the intelligence of certain groups of insects.

The Society felicitated Mr. Gaul on his recent marriage.

The speaker of the evening, Mr. John C. Pallister of the American Museum of Natural History then spoke on "The Coleoptera." He indicated the vastness of the subject and spoke especially on the function of the elytra in flight, and on the chief divisions of the Coleoptera.

L. S. Marks, *Secretary*

Meeting of April 1, 1952

A regular meeting of the Society was held April 1, 1952, at the American Museum of Natural History; President Gaul in the chair. There were fourteen members and one guest present.

Dr. Forbes called the attention of the Society to some of Dr. Vishniac's published pictures in a magazine called People Today. In connection with these pictures of a "waterstrider" some discussion arose as to whether a waterstrider ever swims below the surface film. Dr. Vishniac called this a legend and said that this error arose because of the popular confusion of backswimmers, Notonectidæ, with the waterstriders, Gerridæ. It was reported that Osmund Breland, another member of the Society, had an article in the May issue of Pageant (p. 76), "Let Your Children Play with Bugs."

The speaker of the evening, Dr. Herbert Ruckes, spoke on "Colorful Hemiptera." After briefly reviewing the major ordinal classification of the Hemiptera, Dr. Ruckes displayed and discussed different highly-specialized true bugs. Most fascinating were the members of the family Membracidæ which develop ornate crests, spines and other odd protuberances which may have no value to the organism. Dr. Ruckes also showed modifications in the forelimbs which are useful in swimming. Two of the most interesting bugs in this group were a very thin flat family and one in which cryptocoloration and form blended with the environment. Dr. Ruckes also explained the oarlike mechanism in the coxa of the Notonectidæ.

L. S. Marks, *Secretary*

Meeting of April 15, 1952

A regular meeting of the Society was held April 15, 1952, at the American Museum of Natural History; Vice-President Clausen in the chair. There were thirteen members and eight guests present. The Secretary reported on a survey made by Dr. Forbes and himself, of the back numbers of the Journal.

Dr. Vishniac then introduced the speaker of the evening, Dr. Herman T. Spieth of the College of the City of New York, who spoke on "The Insect Cuticle." The insect cuticle is a secreted non-cellular covering whose major function is protection rather than support. It prevents abrasion of the living tissue and penetration of chemical substance. The cuticle can be divided into an epicuticle, procuticle and epidermis. The procuticle can be further subdivided into an exocuticle and endocuticle. Dr. Spieth pointed out that the outstanding authority on this entire subject is Dr. A. G. Richards, Jr.

The chemical nature of the cuticle is one of extreme interest. The epicuticle contains lipids and protein, the procuticle chitin and protein. The epicuticle appears to defy the laws of physical chemistry and at present it is an unsolved problem.

Dr. Spieth paid tribute to the older insect anatomists who appear in certain cases to have had better insight into some of these problems than their successors.

L. S. MARKS, *Secretary*

MEETING OF MAY 6, 1952

A regular meeting of the SOCIETY was held May 6, 1952, at the American Museum of Natural History; President Gaul in the chair. There were fourteen members and twelve guests present.

The Secretary reported that he had represented the Society at the Beta Lambda Sigma dinner for Dr. Carroll Williams. Dr. Forbes, Dr. Mullen and Mr. Pallister also were present at the dinner.

The speaker of the evening was Dr. Roman Vishniac who spoke on ''Metamorphosis.'' He referred to his early (1916) work on the subject and then reviewed the work of Dr. Carroll Williams of Harvard and others. Dr. Vishniac pointed out that according to some authorities there are thirty-two kinds of metamorphosis. Dr. Vishniac explained the subimaginal state in Ephemeroptera as an adaptation from the carboniferous age.

Dr. Williams started his work 10 years ago at the age of 23. His contributions, which have been brilliantly illustrated in LIFE by the pictures of Dr. Vishniac, put the subject of metamorphosis on an endocrinal basis. Certain areas of the brain secrete a hormone which activates the prothoracic glands which in their turn, by hormonal activity, cause the phenomenon of metamorphosis.

L. S. MARKS, *Secretary*

MEETING OF MAY 20, 1952

A regular meeting of the SOCIETY was held at the American Museum of Natural History on May 20, 1952. The President asked Dr. Forbes to serve as secretary for the meeting in the absence of the Secretary, Mr. Marks. There were fourteen members and seven guests present.

Mr. Harriot, Chairman of the Field Committee, reminded the members of the field trip to Alpine, New Jersey, which was scheduled for Sunday, May 25.

The Chairman of the Program Committee, Dr. Vishniac, then introduced Mr. E. W. Teale who showed some of the Kodachromes taken during his trip while gathering material for his recent best-seller, ''North with the Spring.'' These were the pictures he was unable to show when he previously spoke to the Society about his trip. The members were very pleased to have the opportunity to see Mr. Teale's fine pictures.

At the conclusion of Mr. Teale's talk, an opportunity was given to other members to show pictures. Dr. Lucy Clausen showed pictures of insects on postage stamps and a tomato-worm carrying braconid cocoons. Dr. Vishniac showed pictures of waterstriders, amœba in division, and aquatic invertebrates.

The President asked Dr. Vishniac what the plans were for the first meeting in October. He reported that Dr. Collins, New York State Entomologist, will be the speaker at the October 7 meeting, and the second meeting in October will be devoted to the summer collecting activities of the members.

JAMES FORBES, *Secretary pro tem.*

The
New York Entomological Society

Organized June 29, 1892—Incorporated February 25, 1893

Reincorporated February 17, 1943

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 24, N. Y.

Annual dues for Active Members, $4.00; including subscription to the Journal, $6.00.

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

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President, DR. LUCY W. CLAUSEN .... American Museum of Natural History
Vice-President, DR. ROMAN VISHNIAC .... 219 W. 81st St., N. Y. 24, N. Y.
Secretary, LOUIS S. MARKS .... 74 Main St., Tuckahoe, N. Y.
Assistant Secretary, DR. FREDERICK H. RINDGE
American Museum of Natural History
Treasurer, ARTHUR ROENSCH .... American Museum of Natural History
Assistant Treasurer, MRS. PATRICIA VAURIE .... American Museum of Natural History
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Editor, FRANK A. SORACI .... Allentown, N. J.
Associate Editor, HERBERT F. SCHWARZ .... American Museum of Natural History

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RALPH BROWNLEE SWAIN, 1912–1953

Dr. Ralph B. Swain met his untimely death on October 2, 1953, while on his way to a "Point IV" assignment in Nicaragua. He had completed a two year stint in that country with spectacular success and was returning with his wife and two sons for a second assignment when he was stopped about 130 miles south of Mexico City by four bandits who were later apprehended. They demanded 2000 pesos ($230.00). Swain told them that he did not have that much in cash but would give them travelers checks in that amount whereupon they shot him. He died before Mrs. Swain could get him to the nearest town which was 20 miles distant.

Swain was born in Benton, Illinois, on Oct. 20, 1912. As a boy he was very active in nature clubs. At 12 he organized a bird club. In high school he was twice elected president of the botany club. At a nature club banquet at the age of 14, he sat next to A. F. Satterthwait who was later to have such a strong guiding influence in his development. Satterthwait suggested that he enter the Insect Collection Contest then being conducted by the Webster Grove Nature Study Club but Swain told him he was interested in birds, not insects. Satterthwait nevertheless interested him in charting the feeding range of selected birds, in connection with which he collected and exhibited an outstanding collection of inflated and mounted larvæ. During his high school days Swain's understanding parents, at Satterthwait's urging, permitted him to attend the sessions of the American Association for the Advancement of Science. He took in the meetings and saw a lot of New York before he returned. Later his parents permitted him to attend a Boy Scout

Jamboree in England, to which he took a collection of Missouri reptiles which attracted a lot of attention. These he left with the London Zoo for which the management of the zoo gave him a collection of European reptiles.

Swain's first pay job in entomology according to Satterthwait was as a helper to Francis X. Williams during June and July of 1928. He reared egg parasites of the corn billbug which Williams sent to Hawaii to try out on a closely related sugar cane pest. During the summers, Swain was subsequently employed by Satterthwait at the Webster Grove entomology laboratory until college work afforded more favorable employment. After graduation from high school he went to Iowa State College where he took his first degree in 1934. From there he went to Colorado A. and M. College on a teaching fellowship where he did a two year thesis problem on parasites of the fall webworm for his master's degree. In 1940 he took his doctorate at the University of Colorado majoring in entomology with botany as a strong minor.

In March 1940, Swain took a position with the Bureau of Entomology and Plant Quarantine at Gulfport, Miss. At that place he was in charge of a laboratory devoted to the search for and testing of natural enemies of the white-fringed beetle, particularly nematode and bacterial parasites. He was later transferred to the Inspection House of the bureau's Division of Foreign Plant Quarantines at Hoboken, N. J., as chief inspector. On July 24, 1952 he took a Point IV assignment for entomological work in Nicaragua.

Swain was more than an entomologist. He was a very ardent ornithologist and an excellent botanist. His interests, in fact, extended to the whole field of natural sciences as well as to the arts. His appetite for exploring the unknown was insatiable and led him at times to adventures not always consistent with human welfare and safety. At the Inspection House in Hoboken he was disposed to smell and taste every plant that was new to him. When eating out, he could be depended upon to look for gastronomic adventures by ordering the most exotic dish on the menu. For this reason, the little foreign restaurants in New York appealed to him. I recall receiving at the Inspection

House on one occasion some large fungus-infected lepidopterous larvæ. He learned that these were a delicacy in the Orient and wasted no time thereafter combing New York food shops in search of them.

Aside from his catholic interests, Swain was a tireless champion of the underprivileged which was without doubt the driving force behind his immediate success in Nicaragua. His faith in human beings was illustrated in an incident which he related to me before leaving for his ill-fated assignment. He had been told that in that country he would have to keep everything, including his refrigerator, under lock and key. He told me he put nothing under lock and lost nothing.

It had become obvious by the time he left for his second assignment that his interest in human welfare would take him beyond the restricted field of entomology into the broader aspects of the total well-being of under privileged Nicaraguans. At memorial services held for him at Newark, N. J., representatives of the Nicaraguan embassy and of our State Department spoke of his work with deep appreciation and great emotion. I understand from Mrs. Swain that the Nicaraguan government is participating in a memorial to him at their National School of Agriculture.

Those of us who knew the Swains thought of them as a team. At the Univ. of Colorado, Miss SuZan Noguchi, a very talented art student, was advised by one of her instructors to take a course in zoology and specialize in illustrating natural subjects. She took this course under Swain, then working for his doctorate, whom she later married. A fine example of their team work is their Insect Guide so superbly illustrated by Mrs. Swain. Mrs. Swain is more than a gifted artist in drawing, painting and sculpturing; she was a devoted wife and wonderful mother to her two well-mannered youngsters. To friends of the Swains, her warm friendliness made her a charming hostess. I have never known a family in which all shared so much together, on field trips and expeditions, as well as in the home. Dr. Swain is survived by his parents, two brothers, his wife and his two sons, Tomi Alfred aged 12 and Ralph A. aged 10.

In addition to his membership and active interest in our own society, Dr. Swain also held membership in the University of Kansas Entomological Society, the American Association of Economic Entomologists and the Entomological Society of America.—Geo. G. Becker.

Swain published as follows:

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THE NEOTROPICAL SPECIES OF THE ANT GENUS STRUMIGENYS FR. SMITH: GROUP OF ELONGATA ROGER

By William L. Brown, Jr.
Museum of Comparative Zoology, Harvard University

This is a continuation of my series on the species of *Strumigenys* Fr. Smith from the New World. Previous parts, containing introductory remarks and explanation of the abbreviations for the standard measurements and indices, may be found in Jour. N. Y. Ent. Soc. 61: 53–59 and 101–110 (1953).

The present group, after the reduction of three synonyms and the addition of two new species, comprises four known species: *S. elongata* Roger, *S. consanii* n. sp., *S. ludia* Mann and *S. precava* n. sp. The first three of these lack entirely any trace of preapical armament, a character which will separate them from the other groups of the genus found in the New World; *S. precava* does possess a single preapical tooth, but this is short and somewhat modified from the usual spiniform teeth of many other neogæic species. While the first three species form a tightly-knit group of apparently close relationship, the affinities of *S. precava* are as close with other groups as with this one. It therefore seems that *S. precava* may be close to the ancestral stock of the *elongata* group. If *S. precava* be included with the *elongata* group as an arbitrary measure, it becomes clear that it is the most generalized of the species, while *S. elongata* has undergone the most radical reduction of mandibular armament and is probably most specialized.

Strumigenys elongata Roger

Strumigenys elongata Roger, 1863, Berlin. ent. Zeitschr. 7: 212, worker (original description). Wheeler, 1908, Bull. Amer. Mus. Nat. Hist. 24: 146.

Strumigenys imitator Mayr, 1887, Verh. zool.-bot. Ges. Wien 37: 572, worker, male. Emery, 1890, Bull. Soc. ent. Ital. 22: pl. 7, fig. 7, worker. Forel, 1893, Trans. ent. Soc. London, p. 377. NEW SYNONYMY.

Strumigenys elongata subsp. *imitator,* Weber, 1934, Rev. Ent., Rio de Janeiro, 4: 32, worker.

Strumigenys (*s. str.*) *elongata* subsp. *nicaraguensis* Weber, 1934, Rev. Ent. Rio de Janeiro, 4: 31–32, worker. NEW SYNONYMY.

Worker (Measurements from 161 individuals from at least 31 separate nests, including cotypes of *imitator* Mayr and *nicaraguensis* Weber): TL 1.96–2.55 mm., HL 0.50–0.63 mm., ML 0.28–0.41 mm., WL 0.47–0.62 mm., CI 72–79, MI 56–67. About 70 percent of the individuals had head lengths of 0.54–0.61 mm. Workers of single nests often showed considerable variation in dimensions and proportions, but variation between different nests was greater in most cases. The overlap of values for different nest series was great and was not found to follow apportionate distribution characteristic of geographical races. Cotypes of the synonyms are well within the limits of variation of these quantitative characters. Two cotypes of *imitator* showed median promesonotal carinulæ to be as well developed as in *elongata;* thus, the last supposed distinguishing character of any account is removed.

Mandibles straight, slender, flattened, the inner borders becoming gently concave preapically; apical fork of two long spiniform teeth, the dorsal slightly longer, no intercalary teeth or denticles; preapical armature completely lacking. The shafts are set very close together at their insertions, and are gradually narrowed in this region; at full closure diverging toward apex.

Antennal scapes (mean L. 0.42 mm.) slender, nearly straight, gently incrassate in basal half. Funiculus (mean L. 0.52 mm.) slender; apical segment $1\frac{1}{2}$ times or slightly more the length of the 4 preceding segments; I and IV subequal in length, but IV thicker; II and III much reduced, together not equalling I or IV in length.

Humeri angulate and tuberculate. Propodeal spines long and acute, strongly elevated, averaging about as long as distance between centers of bases or slightly less; infradental lamellæ reduced to weak carinæ.

Petiole with long, slender peduncle; node distinct and fairly high, the summit rounded and slightly longer than broad. Postpetiolar node small, broader than long and a little broader than the petiolar node. Spongiform appendages moderately developed; ventral strip of petiole absent. Gaster small, with coarse basal costulæ extending $\frac{1}{3}$ to $\frac{2}{5}$ the length of the basal tergite, remainder smooth and shining.

Both nodes densely punctulate and opaque, as is rest of body except mandibles and lower mesopleura, which are more or less smooth and shining. Ground pilosity of alitrunk absent or nearly so; on dorsum of head consisting of fairly abundant narrowly spoon-shaped hairs, curved anteriorly and subreclinate; on clypeus and scapes more slender. A pair of short, erect weakly spatulate hairs on occiput; bilateral pairs on sides of occipital lobes, humeri and mesonotum long and finely flagelliform. Nodes and gastric dorsum with a few regularly-spaced, rather long flagelliform hairs of a rather wavy or loose subhelical conformation peculiar to this and one or two related species. Head and posterior half of gaster ventrally with a rather dense growth of short, fine simple hairs, but similar subappressed pilosity of legs not quite so dense as usual. Color light ferrugineous yellow to moderately deep ferrugineous red, gaster sometimes slightly darker.

Female (measurements from a single dealate specimen from Colombiana Farm, Costa Rica, though others seen): TL 2.61 mm., HL 0.59 mm., ML 0.36 mm., WL 0.61 mm., CI 81, MI 61. Ocelli small. Mesothoracic dorsum only weakly convex, feebly rugulose. Petiolar node short, transverse; anterolateral corners of summit each with a small, blunt tubercle. Postpetiole rugulose. Color medium ferrugineous. Otherwise differing from the worker only by full sexual features.

Male (primary description from one Barro Colorado specimen): TL 1.99 mm., length of head with insignificant mandibles 0.45 mm., WL 0.60 mm. Eyes about 0.20 mm. in greatest diameter, oval and strongly convex, distant from the mandibular insertions by a bit less than half their greatest diameter. Mandibles extremely reduced, bent-subfalcate, their apices acute and remote from each other at full closure, full length ca. 0.05 mm. Scape and pedicel of antenna subequal in length; apical funicular segment longest, about three times the length of the scape. Verticocciput in profile high and sharply rounded, with rather small ocelli. Clypeus small, convex, with arcuate anterior margin. Mesonotum strongly humped, anterior ''face'' subvertical, remainder convex dorsally, with a distinct anteromedian pit and notauli, the latter becoming indistinct at their confluence. Parapsidal furrows distinct. Scutellum dorsally convex. Propodeal teeth minute, acute; infradental lamellæ cariniform. Petiole with a distinct, rounded, transverse node, only slightly narrower than the transverse postpetiolar node. Spongiform appendages obsolescent, visible only as extremely fine cariniform remnants on the postpetiole.

Densely punctulate; mesopleura and most of metapleura, both nodes, and gaster smooth and shining. Gastric costulæ reduced to extremely minute basal vestiges. Pilosity sparse, long and short, mostly reclinate or subreclinate, fine simple hairs. Color brownish-yellow, dorsum of head and alitrunk deeply infuscated. Forewing L. ca. 1.6 mm.; venation as in *S. precava* n. sp. Volsellæ-laciniæ to be figured in a later part, not remarkably different from those of related species or even species of *Smithistruma.*

A male from the *imitator* type series is very slightly larger, the pilosity is slightly more abundant and more erect, and the basal gastric costulæ and ventral postpetiolar appendages a bit better developed. Such differences are to be expected in normal variation of strumigenite males, which are often quite unstable (compared to the workers of the same species) in relatively superficial details.

Distribution, etc.: Type locality: Panama, teste J. Roger.

Additional localities from which specimens have been examined during the course of the revision: Mexico: Acapulco (F. Bonet). Guatemala: Bobas (W. M. Mann). Lanquin, Alta Vera Paz (R. D. Mitchell). Honduras: Choloma; La Ceiba; Cecilia; Progreso (W. M. Mann). Nicaragua: Tuli Creek near San Miguel (E. K. Noble); types of *nicaraguensis* Weber. Costa Rica: Estrella Valley; Colombiana Farm (W. M. Mann). Hamburg Farm, Limon Prov. (F. Nevermann). Panama Canal Zone: Barro Colorado I., several series (J. Zetek; A. E. Emerson). Venezuela: Macuto (N. A. Weber, No. 638). Trinidad: Without precise localities, Nos. 19, 1622 and other collections (N. A. Weber). Maracas Valley, Nos. 75, 76 (N. A. Weber). Guianas: Dunoon, British G. (F. M. Gaige). Oronoque R., British G. (N. A. Weber, No. 586). Paramaribo, Dutch G. (Geijskes). Brasil: Santa Catarina (Hetschko); cotypes of *imitator*. Jussaral (S. Lopes and M. Lent). Bolivia: Covendo; Tumupasa; Ivon, R. Beni (W. M. Mann).

This is one of the commonest species of the genus in tropical America, and is found in many collections, usually under the name *imitator*. It nests in and under rotten logs, usually in rainforest areas; the males were collected in the nest in March in Costa Rica. It is definitely known to prey upon entomobryid Collembola.

Deposition of type material: *S. elongata* Roger, Zoologisches Museum der Universität, Berlin; *S. imitator* Mayr, Naturhistorisches Museum, Vienna; *S. elongata nicaraguensis* Weber, Museum of Comparative Zoology, Harvard University.

Strumigenys consanii new species.

Worker (Holotype): TL 3.09, HL 0.66, ML 0.41, WL 0.78 mm.; CI 79, MI 63. Very similar to *elongata*, especially in mandibular form, position, and dentition. The insertions are a bit farther apart, the shafts slightly more robust, the preapical region a little more gradually narrowed (inner preapical border very feebly convex), and the teeth of the apical fork relatively a little longer.

Additional characters, comparison with *S. elongata:*

1. Entire body decidedly larger and more robust, less depressed. Head more strongly convex dorsally (Index of cephalic depression about 54). Alitrunk similar; anterior pronotal border tending to blunt, rounded pointing in the middle; humeral angles very poorly marked, with low, inconspicuous tubercles. Promesonotum evenly convex; metanotal groove well-marked, with short longitudinal bridging costulæ. Pronotum lacking all but the most extremely faint indication of a median longitudinal carinula.

2. Antennal scape (length 0.45 mm.) more slender than in either *elongata* or *ludia,* bent slightly near the base, but not or scarcely perceptibly incrassate. Funiculus length 0.64 mm.; apical segment only slightly longer than the 4 preceding segments taken together; funicular I shorter than IV, but longer than II + III; II and III both slightly longer than broad, III longer than II.

3. Propodeal teeth shorter and broader, but still quite acute, as long or nearly as long as the distance between the centers of their bases, diverging; infradental lamellæ low, subcariniform.

4. Petiolar node globose above, very slightly longer than broad and slightly higher than the postpetiole; dorsolateral spongiform margins moderately well developed, compact and with clean edges; ventral appendages restricted to a small posterior mass. Postpetiolar disc subreniform, about half again as broad as the petiolar node, convex, smooth and shining. Dorsal spongiform isthmus narrowed medially, but continuous; ventral and ventrolateral lobes well-developed, as is also the pad of spongiform pilosity on the anteroventral gastric surface. Base of gastric dorsum with poorly-developed spongiform margin; basal costulæ vestigial, extremely short and indistinct, partially replaced by a very narrow basal band of minute superficial roughening which may be only a hardened secretion. Gaster in general smooth and shining.

5. Pilosity arrangement basically as in *elongata,* but ground hairs of upper cephalic dorsum, anterior borders of scapes and of alitrunk much finer and less conspicuous; alitrunk nearly nude. Erect hairs of nodes and gastric dorsum shorter, stiffer, and tending more to apical truncation, though a few have short attenuate tips. Two erect pairs on the verticocciput, and the mesonotal pair, are also of this ''broken-flagellate'' type. Lateral occipital and humeral pairs long, weak-flagelliform.

6. Head, alitrunk, and petiolar node densely punctulate, the punctulæ rather shallow on pronotum and petiole and with shining bottoms, so that these surfaces are subopaque in certain lights. Large lower portions of meso- and metapleura smooth and shining, as are the mandibular apices.

Remainder of mandibles, scapes, and most of legs densely and finely granulo-punctulate. The upper cephalic dorsum bears a few fine, indistinct, more or less longitudinal rugulæ.

7. Color deep ferrugineous, gaster mahogany; mandibles, funiculi and legs lighter, more yellowish.

Holotype selected from a series of 5 workers labelled "La Palma, C[osta] R[ica], 1500 M., (Tristan)." These were sent through the kindness of the late Sr. Mario Consani, of Florence, Italy, to whom the species is dedicated. This series had originally been determined by Menozzi as "*S. imitator.*" The holotype and two paratypes are in the Consani Collection, and a paratype each in the Museum of Comparative Zoology, Harvard University, and the U. S. National Museum.

Paratypes: The remaining 4 specimens, all from the type nest, show very little variation in any respect, though the weaker hairs are sometimes lacking through shedding. TL 3.01–3.13, HL 0.64–0.66, ML 0.41–0.42, WL 0.76–0.80 mm.; CI 78–80, MI 63–64.

This species may be immediately distinguished from other species lacking preapical dentition by the very convex head and postpetiole, the latter smooth and strongly shining, and by the extremely reduced basal gastric costulæ.

Strumigenys ludia Mann

Strumigenys (*Strumigenys*) *ludia* Mann, 1922, Proc. U. S. Nat. Mus. 61 (13): 35, fig. 17, worker (original description).

Strumigenys (*s. str.*) *ludia* subsp. *tenuis* Weber, 1934, Rev. Ent., Rio de Janeiro, 4: 31, worker. NEW SYNONYMY.

Worker: Nine specimens measured, including cotypes of *ludia* and two cotypes of the subsp. *tenuis* Weber plus a few additional strays from Mexico and Guatemala; at least five colonies represented. TL 2.94–3.33, HL 0.67–0.74, ML 0.49–0.56, WL 0.62–0.73 mm.; CI 81–84, MI 73–76. Though dimensions differ slightly from one nest series to another, the standard proportions are closely similar in all specimens seen. Contrary to the *tenuis* description, funicular segment V is equal or nearly equal to the remainder of the funiculus in length in all *ludia* and *tenuis* types seen by me. The differences between the *ludia* and *tenuis* types are so insignificant that it is difficult to see why the latter was ever described. Additional material now available shows that *tenuis* cannot be defended as a geographical race.

In general habitus, *ludia* appears like a larger *elongata,* but the apical fork of the mandibles bears a short, acute intercalary tooth and the antennal scapes are longer and very slender, virtually straight, with subbasal incrassation scarcely evident. Also the following differences from *elongata:*

1. Petiole long and claviform, with long, low node, only weakly differentiated from its peduncle. Pronotum depressed, with obtuse humeral angles and weakly marginate laterally.
2. Upper cephalic dorsum and promesonotum variably but distinctly and more or less longitudinally rugulose. Sides of alitrunk granulo-punctulate, opaque in clean specimens; postpetiole densely punctulo-striolate, opaque. Spongiform appendages absent or vestigial under petiole, only moderately developed elsewhere. Gaster finely and closely striolate in a longitudinal direction anteriorly, becoming densely and superficially subpunctulate posteriorly; surface generally opaque or subopaque.
3. Paired hairs of lateral occipital borders, humeri and mesonotum long, weakly flagelliform. Occiput with a pair of slender, erect spatulate hairs just anterior to the posterior excision. Hairs on nodes and gaster spaced, erect, distinctly but weakly clavo-spatulate.

Female (single dealate specimen from Villa Hermosa, Tabasco): TL 3.28, HL 0.72, ML 0.48, WL 0.74 mm.; CI 85, MI 67. Humeri distinctly angulate. Scutum rugulose; scutellum with a median longitudinal sulcus, posteriorly forming a narrowly rounded angle and projecting. Propodeal teeth long, stout, acute, as long as the distance between centers of their bases. Petiole differing from that of worker; node higher and more distinct, broader than long and shorter than peduncle; anterodorsal border transverse, continued on each side as a small but distinct and acute denticle which projects dorsolaterad and is curved slightly posteriad. Mesonotum with a few erect spatulate hairs. Gaster slightly more strongly sculptured and more completely opaque than in workers. Otherwise differing by the usual caste features from worker.

Distribution, material studied: Type locality: Cecilia, Honduras (W. M. Mann); 3 cotypes carefully studied, others more casually, deposited in Museum of Comparative Zoology and U. S. National Museum.

Mexico: Villa Hermosa, Tabasco, 1 female from Berlese funnel lot (F. Bonet). Peñuela, Vera Cruz, 2200 feet altitude, (H. S. Dybas). Palenque Ruins, Chiapas, sifting (C. J. Goodnight).

(Latter two collections are strays.) Guatemala: Los Amates, one worker (Kellermann). Nicaragua: Tuli Creek, near San Miguel (E. K. Noble); cotypes of subsp. *tenuis*, deposited in Museum of Comparative Zoology.

Strumigenys precava new species.

Worker (Holotype): TL 3.57, HL 0.88, ML 0.50, WL 0.81 mm.; CI 77, MI 57. Head large, somewhat depressed, with prominent occipital lobes and correspondingly very deep posterior excision; anterolateral borders of occipital lobes nearly straight, strongly converging anteriorly, each with a narrow lamellate border which extends from behind the level of the eyes to the small, convex scutes over the antennal insertions. There is no indication of supraocular concavity along this (dorsal scrobal) border. Sides of head immediately in front of eyes evenly and gently excavated, each excavation extending mesad on the ventral surface of the head as a broad, deep sulcus. Portion of head anterior to antennal insertions recovering part of the width, due partly to the shape of the short, weakly convex preocular laminæ; each of the laminæ disappears posteriorly in the excavated area and misses reaching the eye by a wide margin. Head dorsally gently convex, with a feeble median longitudinal sulcus; frontal area not defined by sutures, but impressed. Clypeus triangular, with thin lateral portions curving to meet the preocular laminæ; anterior border low and nearly imperceptibly concave, almost straight; posterior angle ill-defined. Eyes moderate in size and only moderately convex, with about 5 coarse facets in the greatest diameter. Owing to conformataion of periocular area, eyes placed in a slightly projecting position, with central axis of vision anterolateral, lying at about a 45° angle from the longitudinal axis of the head. Thus, vision is about as much anterior as lateral, and the eyes are distinctly visible from dorsal view.

Antennal scapes (L. 0.58 mm.) virtually straight, slender, formed much as in *elongata*, with a slight subbasal incrassation tapering apically, the broadest point at about the basal fifth of the length. Funiculus (L. 0.78 mm.) with a slender apical segment (V), this slightly longer than I–IV inclusive; IV more than half again as long as I, which in turn is slightly longer than II + III; II and III approximately as long as broad, with oblique, irregular margins.

Mandibles porrect, inserted very close together, the blades straight, stout and broad, weakly depressed, lying parallel and with most of their inner borders opposed directly (near base and apex) at full closure. Inner borders each with ventral and dorsal margins; seen from dorsal view, the borders are very feebly concave toward midlength, the concavity scarcely noticeable in an isolated mandible. Apical fifth of inner border more suddenly and strongly concave and set with a short, stout, blunt preapical tooth. Apical fork consisting of two stout spiniform teeth, slightly diverging and of equal length (0.11 mm.). Intercalary tooth represented by an inconspicuous but acute spur, fused most of its length with the dorsal face of the ventral apical tooth. Basal lamella present in the form of a bluntly digitiform continuation of the inner dorsal margin, not easily seen unless a mandible is completely removed. The mandible as a whole more similar to those of the East Indian species *S. feæ* Emery, *S. formosensis* Forel, *S. koningsbergeri*, etc. than to other Neotropical forms.

Alitrunk rather slender and elongate, with a gently convex promesonotum and a broad, gently and somewhat irregularly concave posterior dorsum; metanotal groove distinct. Anterior pronotal border with a thin, cultrate lamelliform margin, forming a bluntly rounded point in the center; humeral angles of themselves not well developed, but with conspicuously projecting, flattened-subconical piligerous tubercles. Pronotum submarginate dorsolaterally; promesonotal suture represented by a very indistinct sulcus; median promesonotal carinula sharply defined until concave portion of posterior mesonotum, where it becomes indistinct. Lateral mesonotal tubercles small, situated just above the spiracles; mesopleuron with a small, depressed half-basin just posterior to the spiracle. Propodeal teeth moderately long and slender, acute, elevated, divergent, about as long as the distance between centers of bases. Infradental lamellæ reduced to low carinæ; lamelliform ventral lobes rounded. Metapleural bulla fairly conspicuous, with a large posterior opening continued forward as a ventrolateral slit.

Petiole with slender peduncle slightly longer than bare part of node; summit of node semiglobose, with fine carinulate borders laterally and posteriorly; petiolar appendages very well developed, the lateral lobes large and extending halfway up the sides of the node; ventral strip broad, excised posteriorly. Postpetiolar disc subrectangular, a little broader than long and about half again as broad as the petiolar node, convex, its surface traversed longitudinally by about 10 strong, sharp costulæ, interspaces weakly shining; surrounded by a carinate margin and by luxuriantly developed appendages on all sides; ventral lobes particularly well developed.

Gaster moderate in size, more convex ventrally than dorsally, with an anterodorsal spongiform margin and an anteroventral pad of tangled spongiform pilosity. Basal costulæ sharp and strong, spaced, about twelve in number; several near the middle longer than the rest and extending about $\frac{1}{3}$ the length of the basal tergite. Remainder of gaster smooth and shining, with a few small, scattered piligerous punctulæ.

Body otherwise densely and regularly punctulate, opaque; only the mandibles and lower mesopleura more or less smooth and shining.

Ground pilosity sparse and inconspicuous, especially on alitrunk; on head consisting of short, appressed and subappressed spatulate hairs, curved anteriorly, and not forming a projecting fringe along lateral borders; very few reduced hairs on clypeus, except anterior border, where there are 6 on each side, the outermost very small, the median pair decidedly the largest. Hairs on anterior scape border forming a rather regular row, nos. 2 and 3 curved basad, the remainder inclined sharply toward the apex of scape. Lateral occipital, humeral and mesonotal paired flagelliform hairs long, weak and more or less recurved. A pair of moderately long (L. 0.10 mm.), stiffly erect subspatulate hairs in front of the occipital excision. Petiole with 4, postpetiole with about 6, gastric dorsum with about 40 long, fine flagelliform hairs, those on gaster longest (L. up to 0.35 mm., or longer than petiole); a few similar hairs on underside of gaster. Femora and tibiæ with sparse, short subappressed hairs, most of which have broadened tips. Mandibles, ventral side of head, tarsi and ventro-apical part of gaster with the usual short, fine simple pilosity. Long, crossing sense-hairs of inner mandibular borders 6 or 7. Labral trigger hairs quite long, diverging.

Color yellowish-ferrugineous; first gastric segment medium ferrugineous.

Holotype worker selected from a series taken at Kamakusa, British Guiana, November 7, 1922 (H. O. Lang, No. 64). [Museum of Comparative Zoology at Harvard University.]

Paratype workers: 92 specimens representing at least 12 separate colonies, including the type nest and collections from the additional localities cited below: TL 3.42–4.05, HL 0.87–1.01, ML 0.50–0.56, WL 0.81–0.97 mm.; CI 71–79, MI 54–61. The type nest (Kamakusa) shows nearly the entire range of variation in size and proportions, and furthermore shows a feeble tendency toward polymorphism, the larger workers having relatively shorter mandibles (ML relative to HL). This tendency is not or even more feebly evident in the other series. Most series show rather distinct rugulation of the upper cephalic dorsum, strongest in the Bolivian series and weakest in the type nest series. The Bolivian and some Canal Zone specimens show a more distinct, but still very weak, concavity of the anterior clypeal border. Characters which vary slightly in all series are the shape (acuteness) of the preapical mandibular tooth, presence or absence and strength of feeble rugulation on the alitruncal dorsum, length of propodeal teeth, number and strength of costulæ on postpetiole and base of gaster. The long hairs are very weak, and few specimens possess a full complement after much handling. Color yellowish- to medium brownish-ferrugineous, the first gastric segment usually perceptibly darker than rest of body. Color extremes and all intermediate grades occur on Barro Colorado Island. None of the variation cited appears to be on a basis of geographic apportionment into races.

This species is probably even more variable in the lower Amazon Basin, but we have no collections from this region. The present localities appear to be more or less peripheral. Paratype material in Museum of Comparative Zoology, U. S. National Museum, Coll. Borgmeier, Coll. Consani, Academy of Natural Sciences of Philadelphia, Coll. Weber and other collections.

Female (Gynetype, alate): TL 4.14, HL 0.92, ML 0.53, WL 1.00 mm.; CI 82, MI 58. Forewing L. ca. 2.70 mm.

Differs from the workers in the usual characters of full sexuality. Humeri strongly angulate; scutum and scutellum convex, strongly rugulose and with distinct median carinula. Scutellum pointed posteriorly. Propodeal teeth with broader bases and slightly better-developed infradental lamellæ than in worker. Propodeal dorsum rugulose. Node of petiole broader than long, with feebly subdentiform anterolateral corners; summit strongly rugulose. Basal gastric costulæ distinct, interspersed with fine, close striation which extends beyond them posteriorly to about the midlength of the basal tergite. Greater part of mesepisterna smooth and shining. Dorsum of head rather strongly and more or less longitudinally rugulose; the rugulation of the entire body decidedly stronger than in the worker from the same nest. Ocelli small, each with a small, black callus.

Wings clear, with long posterior fringing microtrichia; forewing with veins R + Sc, stigma and 2r well-defined and pigmented; M + Cu, ''basal'' and cubital pigmented, but not sharply defined; Rs f_4 virtually obsolete, not well-pigmented or defined.

Body color bright ferrugineous yellow, gaster reddish-ferrugineous.

Gynetype taken with a worker on Barro Colorado Island, Panama Canal Zone (N. A. Weber, 1938, No. 739) [Coll. Weber].

Male unknown.

Distribution, material studied: Type locality: Kamakusa, British Guiana (H. O. Lang). Panama Canal Zone: Barro Colorado Island: several nest series and strays (J. Zetek; W. M. Wheeler; N. A. Weber; L. Hare). Rio Chinillo (J. Zetek). ''Cooper's place,'' Rio Quejeta (I. Molino). British Guiana: Between R. Cuyuni and R. Mazaruni (N. A. Weber, No. 358). Mazaruni Forest Settlement (N. A. Weber). Bolivia: Cachuela Esperanza, Rio Beni (W. M. Mann).

It is quite astonishing that this large and very distinct species, repeatedly collected by myrmecologists, has gone so long undescribed. It is easily recognized by its size and by the broad, straight, closely adjacent mandibles with small, blunt preapical tooth, and by the preocular excavation, which is stronger than in most New World species. *S. hindenburgi* Forel is perhaps most similar in general habitus, but is much smaller than *precava* and has a more acute preapical tooth, an additional minute preapical denticle, filiform cephalic ground pilosity, and very much more abundant gastric pilosity. The other forms with preocular concavities have two spiniform preapical teeth, etc., etc. *S. precava* seems related, and possibly ancestral, to the *hindenburgi* and *elongata* groups, and perhaps through them to the other New World forms.

The preocular excavation is much more gentle than in forms belonging to the Old World *chyzeri, szalayi,* and *rogeri* groups, but it represents still another possibly ancient feature which has been lost by most New World forms.

COLLECTING IN NATIONAL PARKS

A recent action to simplify procedures governing the collection of scientific materials in areas administered by the National Park Service is of interest to entomologists. Formerly, in order to collect insects and arachnids, it has been necessary for entomologists, other than federal employees, to qualify, through appointment by the Department of the Interior, as collaborators without compensation. This involved considerable paper work and delay, both for the applicant and the Government.

The new procedure, authority for which is set forth in *The Federal Register* of May 15, 1953 (18 FR 2831, 2832), excepts the collection of insects and arachnids from the federal employment requirement. It will now be possible for qualified entomologists to submit a simple application form by mail or in person to the Superintendent of the national park or monument concerned who is empowered to issue permits to make collections for scientific purposes. The interests of science have been served well by regulations intended to preserve in the national parks and monuments a maximum of as nearly as possible undisturbed natural biological associations. Collection of specimens is limited to legitimate scientific collection of such nature as to have no measurable adverse effect upon the biological values involved. —Anon.

AN INTERVIEW WITH HERMAN STRECKER IN 1887

On October 25, 1942, the late Rudolf Hommel of Richlandtown, Pa., Oriental scholar, one time curator of the Historical Society of Montgomery County (Pa.) and author of the classic "China at Work," published in 1937 for The Bucks County Historical Society (Pa.), advised me in a letter about an account of Herman Strecker that had appeared in the Pennsylvania School Journal (Lancaster, Pa.) volume 36, pp. 257–261, January, 1888, and which had been reprinted from the New York Evening Sun. At the time the significance of the account escaped me and I had no easy way of determining whether or not it had been noticed in an entomological journal. When Mathilde M. Carpenter's excellent "Bibliography of Biographies of Entomologists" was published in 1945, I noted that the "Pennsylvania School Journal" reference was not included among those referring to Herman Strecker. Again I did nothing, being occupied with other matters. Recently however I came across Mr. Hommel's letter and decided that the 1887 account of Mr. Strecker might be worth looking into. Through the courtesy of Herbert B. Anstaett, librarian of Franklin and Marshall College I obtained a photostatic copy of the account which I think is worth preserving in an entomological journal, thereby making it more accessible to future historians of entomology.

Ferdinand Heinrich Herman Strecker, 1836–1901, was an architect, designer, sculptor and traveler, a student and collector of butterflies from all over the world, whose best known work "Lepidoptera, Rhopaloceres and Heteroceres, Indigenous and Exotic, with Descriptions and Colored Illustrations" is familiar to all lepidopterists. This was commenced in 1872 and was published and illustrated by the author. Between 1872 and 1878 fifteen parts were published. Three supplementary parts appeared in 1898, 1899 and 1900 and on April 21, 1900 a single sheet was published. In Catalogue 37 of Edward Morrill & Son, Inc., Cambridge, Mass., November, 1953, this work dated (1879) is listed for sale at $45.00, and an appended note states "Second edition. Inserted is a 22-page pamphlet by the author, Harrisburg, 1879, 'Butterflies and Moths in Their Connection with Agriculture and Horticulture'." Franklin and Marshall conferred upon him the degree Doctor of Philosophy and in 1908, seven years after his death, his extensive collection of Lepidoptera was purchased by the Field Museum of Natural History in Chicago. The interview by the unknown reporter of the "New York Sun" follows.—H. B. Weiss.

HERMAN STRECKER

A Visit to America's Most Famous and Learned Collector of Butterflies

Not long ago there passed through New York post office a package wrapped in brown canvas and covered with red seals and directions in a foreign language. The red seals bore the imperial arms of Russia, and the directions announced that the package was from the Grand Duke Nicholas of Russia, and that it was going to Herman Strecker, of Reading, Pa. It contained butterflies, of which the Duke is an enthusiastic collector, and about which he has written a book, a copy of which, with his autograph in an angular, delicate hand, also found its way to Mr. Strecker. The butterflies and book were a tribute from a royal personage to a man who works as a designer and stonecutter in a marble yard during the day, but who is the greatest collector of and writer about butterflies on this continent, and who is known to every collector in his line in the world.

Last week an "Evening Sun" reporter journeyed to Reading to visit Mr. Strecker and see the largest collection of butterflies in America. He found him in his studio on the upper floor of a marble-cutter's shop, drawing a design for a monument. He is a man of about 50 years old, of medium build, with silvered beard, a face denoting perfect health and good nature, a pleasant voice and gentle eyes. He talks in a pleasant, off-hand manner, and will converse hours with you about butterflies and never use a scientific term unless you too are a collector. He rather reluctantly promised to let his guest see his butterflies after working hours in the evening, and then left his drawing board to go down and carve away at a unique monument in the marble yard.

All about the place were specimens of his handiwork. One tombstone was in the form of a stump, with its roots entwining a rock and ferns springing about its base. With the true instinct of a lover of nature, the sculptor has ornamented his monuments with examples of plant growth and the like rather than with the impossible lambs and angels that certain marble-cutters give to the world as a means of adding terror to death and dissolution.

While awaiting the hour set for the visit to the naturalist's collection, the visitor wandered out to a beautiful cemetery near Reading. A large figure of Christ upon the cross was one of the most striking monuments there. The look and attitude of the figure of the Redeemer expressed agony more completely than almost any design of a similar subject extant. It was apparent that the sculptor possessed a remarkably accurate knowledge of anatomy. The design was made and the figure carved by this self-same modest Mr. Strecker. A large monument to the soldier dead in the same cemetery was his work, and a bas relief in marble of Poe's Raven, which is owned by Joseph Drexel, in this city, is another evidence of his genius.

The visitor's guide consented to tell him about the modest sculptor and naturalist. Many years ago there came to Reading from Philadelphia a lad who attended school there two years, adding to the fund of learning that he had acquired in Philadelphia. When he was still a mere boy he left school and went to work as a marble-cutter. That finished his studies under teachers, but not his acquirement of knowledge. One of his ancestors had been a sculptor, and from him he inherited his taste for art. On his mother's side were three naturalists—Benjamin, Richard and Edward Kern. There was a doleful similarity in their taking off, Benjamin having been slain by the Indians while a member of the Fremont expedition, Richard having perished while on the Gunnison expedition, and Edward meeting his death from exposure while with Perry's party. From this strain of relationship the boy inherited his desire to be a naturalist. He lacked the time and the means, however, to humor his taste to the desired extent. He had to work at marble-cutting ten hours a day. He devoted holidays to collecting insects, and his nights to mounting them and to study.

He made a curious collection of tarantulas from all parts of the world where they flourish and bite, the largest being a great brown fellow from Costa Rica, and the most forbidding in appearance a big gray one from Texas. Gradually he drifted from bugs to butterflies and moths, and for over forty years he has been studying them.

There was something almost pathetic in the naturalist's struggles to publish his first book. Of course it was about butterflies. A work on that subject is expensive, for it must be illustrated with colored plates. Mr. Strecker saved enough money to buy a lithographic stone, and then drew and engraved upon it the group of butterflies to appear on the first page of illustrations. He sent the stone to Philadelphia, and expended his last spare dollar in having 300 plates printed from it. Then the stone was returned, and he cleaned it and drew upon it another group of butterflies. By the time the work was completed, he had hoarded enough money to pay for the printing of 300 impressions from the stone. Thus the stone traveled back and forth between Reading and Philadelphia until the plates were all finished. Then the text was printed and the book issued. The 300 copies were soon sold, but the demand for the work increased. Alas, the poor artist had destroyed his lithographic work necessary for the illustrations, and he could not meet the demand. The book is, of course, now out of print, and worth a fabulous sum.

As the subject of butterflies grew upon the collector, he concluded to prepare a work on American butterflies and moths, giving lists of every work in which they are mentioned, a brief review of the author or collector, and other information invaluable to a naturalist. It was necessary to consult every book written on the subject. The naturalist had his own library, but it did not contain all the desired books of reference. He was compelled to visit the libraries of New York, leaving Reading after he had ceased work Saturday, and returning in time to resume his stone-cutting Monday morning. He spent Sundays in his researches here, and most of Saturday and Sunday nights traveling to and from the metropolis. He found when he had exhausted his sources of information, that there were still two books to be consulted that were not in this country, and he had to employ agents abroad to search them for him. When their task had been concluded, Mr. Strecker published his work, which is one of the most exhaustive in its province ever issued. One paragraph in the portion that deals with the personnel of butterfly collectors tells in terse form a story of devotion to science that happily finds no counterpart in Mr. Strecker's case. It makes allusion to the collection of Dru Drury, a goldsmith of London, who made an extensive collection and then became so impoverished by reason of his expenditures on his work, that he had to part with his specimens. Mr. Strecker's latter work proved profitable, and repaid him in a monetary sense for its preparation.

At 5:30 o'clock the visitor walked out to a fine brick house on Chestnut Street, almost at the base of one of the mountains of the blue range that flanks Reading, and waited for the coming of its master, the naturalist. A curious grotesque figure from China, carved from a great root and representing a terribly impossible animal with other smaller and more horrible animals crawling over it, stands in the hall of the savant's handsome residence. On the walls of the parlor is a wonderfully intricate drawing of a religious nature from Mr. Strecker's pen and pencil, as fine in handling as the line-work on a bank note, and a painting made from one of his own sketches of a forest scene in Central America, where he went some years ago in search of specimens for his collection.

Finally the butterfly man, as his neighbors call him, arrived and conducted his visitor to an upper story of his house, where his beloved treasures are stored. It is a big room full of what looked like wardrobes, with cases of books on one side, and pigeonholes full of letters, carefully classified, on another. These letters are from men in all parts of the world, who are eminent in Mr. Strecker's domain of research, and who in their line are greater than Daniel Webster was in his, among them being Prof. Westwood of the University of Oxford, Dr. Herman Burmeister (now in Buenos Ayres), Dr. Otto Standinger of Dresden, and Dr. Felder, Lord Mayor of Vienna, who has almost as many titles as butterfly specimens. A long, white table, with two gasburners on it, extends the length of the room. The naturalist has done all his work in arranging his specimens and making his drawings at night, after the completion of his day's work, and he still treasures the old burner by the light of which he made his lithographic drawings for his first book. When he had lighted his room, he sat down and asked: "Well, what do you want to know?"

"All about your collection," answered the visitor.

The Doctor of Philosophy, for at least one college has honored him with that title, looked surprised and said: "What, tell you in one evening about a collection that I have been forty years in getting together!" As he spoke, he opened with loving care a box that had just arrived from New Zealand. It was full of butterflies, each done up in a paper folded in a three-cornered envelope. He took the specimens out and laid them in a jar half full of moist sand. After they have remained there long enough to become thoroughly pliable, he places them on a block with a groove in the middle for the accommodation of the bodies. The wings are spread and then fastened down beneath pieces of pasteboard. Thus they are left until they become rigid, and are then mounted in the drawers of the cabinet by thrusting long, slender pins through them. Other boxes full of butterflies had been put up for shipment to distant quarters of the earth, in exchange for specimens that had been received from them. These boxes had little glass windows in the top, to enable the Custom House officers to examine the contents without opening them. The skull of an ancient Peruvian, with a bit of black drapery over it, gave a weird effect to the surroundings, and in a room up stairs the buckskin garments once worn by the Indian chief Red Jacket hung over a model.

"What is the most expensive butterfly in your collection?" asked the visitor.

The naturalist, who seemed to know where to find any one of his 70,000 treasures, drew forth a drawer in which rested a pinkish moth with tails to his hind wings that reached nearly across the large case. It came from Sierra Leone, Africa, is very rare, and the specimen on which the visitor gazed is the only example in the Western Hemisphere. It cost the collector \$107. Others that cost \$50 each are numerous.

Then Mr. Strecker exhibited a drawer containing a long-winged, yellow butterfly from Equatorial Africa. "There are," he said, "only a dozen specimens in existence. I have three of them." In the course of the conversation it developed that great collectors know the number of specimens of every important or rare butterfly, and can tell you where each is owned. Away up toward the North Pole there were found on the second Ross expedition some hardy butterflies, a dozen specimens of which were secured. Mr. Strecker knew in what collections these are. He was aware that the British Museum has two, Jules Lederer of Vienna one, and so on. When he read that Lederer's collection was to be sold, he sent off post-haste to his agent in Europe, instructing him to buy it. The purchase was made, and the beloved butterfly now rests in Mr. Strecker's collection.

"Yes, we find butterflies everywhere," said the collector, "except perhaps at the Antarctic circle." So saying he produced a case of delicate-looking small white butterflies, whose wings were flecked with pink spots. They had come from mountain regions, some from the Swiss and German Alps, others from the Himalayas, 15,000 feet above sea level, and more from the Rocky Mountains. Some specimens had come from regions where the natives never capture butterflies. The only foreigners there are Jesuit missionaries, and collectors have had to depend upon them to gather the rare varieties, like those from Tatsienlou. On the other hand, other specimens come from regions where the lower order of natives gather them with great assiduity, although not from any devotion to science. Mr. Strecker showed a big one, with a body as large as an ordinary jackknife, and great gray wings. It came from Australia, where the natives eat it.

In a box devoted to insects was what looked like a withered beech leaf, but it wasn't. It was a grasshopper. A case of rare butterflies contained apparently another fallen leaf. It was a dead leaf butterfly from China. When it flies its extended wings of grayish blue make it appear a very handsome butterfly, but the lower surface of its wings is a dull brown, and when it closes them and lights on a limb it cannot readily be distinguished from a brown leaf.

"Here's a very timely butterfly," said the naturalist. It looked like black velvet with shining green bands. The under side of the wings were a silvery white, and on each hind wing was a black marking forming a perfect "88."

Then there was a buff-colored moth with the figure of an anchor stamped on its back, and another moth which successfully passes itself off for a bee among all but insects and keen-eyed naturalists. He seems so anxious to pose as a bee that, though a moth, he flies in the daytime. A near relative of this masquerader is a moth that has assumed the disguise of a humming bird. The collector showed one light-complexioned moth from China, that is necessarily very abstemious, because he has no mouth. He manages to live awhile without eating, but it is hardly to be supposed that he has as good a time as the big-bodied black moth with a long bill which is curved up like a watch spring. When this moth reaches a flower to his taste he darts the long bill down in the depths of the blossom and sucks the nectar.

As a rule the male members of the moth and butterfly family put on all the style. This was observable in Mr. Strecker's collection, where the males were gorgeous in color and the females very plainly attired. The most meek and homely of all the females was a Mrs. Oiketicus. The male looks like a well-to-do fly, but the female is not a fly. She has no wings and no legs. She never goes out of the sack-like structure in which she was born. She never tastes food or sees the light, and the chances for domestic disturbance in their family are lowered by the fact that she and her partner never see each other.

The butterfly man handled one case with extra care. In it were specimens of a very ordinary looking species called Lycaena Xerxes, and hailing from California. The breed is now extinct. There was once a family of butterflies in Huntingdonshire, England, fire-colored fellows, but they too had their day and have been extinct since 1840. Of course Mr. Strecker has specimens of them. The loss of two races of butterflies has been more than amply made up by the discoveries that men like Mr. Strecker are continually making of new ones. Sometimes two naturalists will discover a new specimen at about the same time. Each will give it some unpronounceable name, and upon finding that they are rivals for priority of discovery, the collectors will devote as much correspondence to settling the dispute, as it would take to arrange a treaty of peace between nations. Sometimes a new variety is named after a person, but the plan does not admit of such fearful and wonderful orthographic combinations as the collector loves, and it is not popular. Mr. Strecker has named several new discoveries, but only one of them after a man, who was T. Glover of the Agricultural Department.

''Now, I suppose you would like to see some of the pretty fellows,'' said the naturalist, with the kindly but almost pitying tone that an expert employs in humoring a novice. He drew forth a case full of the most gorgeous specimens that nature ever turned out. There were some from Brazil which look like changeable silk. Held in one light they were green, and in another a brilliant blue. Another case contained the beautiful silver butterflies from Central Chili, and another brown velvet ones from Ashantee. The golden Croesus from Halmeheira made a fine showing.

''I suppose you know,'' said the natural historian, ''that the color of a butterfly's wings is made by a series of minute scales overlapping each other, and that the wings proper are colorless as glass. And, by the way, did you ever see a butterfly's wings grow? I have watched them emerge from the chrysalis. Their wings are little affairs, all out of proportion to their bodies; but they have every marking that is to appear on the enlarged wing. Suddenly those little wings begin to grow, and you can see them expand.''

Mr. Strecker next exhibited his largest specimen, an owl moth from Brazil, which measures a foot across its wings, and then, moving more rapidly among his treasures, for it was growing late, he showed a specimen which is half one sex and half another, and still another variety which sport the needless luxury of an extra wing.

It sometimes happens that one of the same brood of butterflies will differ from all the rest. Among the odd specimens in the collection is a swallow-tail butterfly whose right wings and the right side of the body was yellow, the color of the male; and the left half of the body and left wings black, the color of the female. It is when the male of one species that may be a deep blue falls in love with the female of another that may be copper-colored, that some butterflies of startling and often beautiful colors are born. The underside of the wings of the common painted lady butterfly are sometimes white. Mr. Strecker knows of but five specimens, and he told how he got one of them. He lighted on a foreign book in Philadelphia containing a plate of the variety, and was made despondent with the reflection that some one had succeeded in getting the treasure and that he was out in the cold. He walked over to the house of a friend who is a collector, and who remarked that some one had caught near the city a pale butterfly. Mr. Strecker saw it and was deeply agitated. It was one of the rare species of pale painted lady butterflies, exactly like that foreign one whose picture he had seen. Of course he got it and went home happy.

"Do we have any butterflies in winter?" asked the visitor.

The naturalist smiled and said, "Yes—under logs and stones. Sometimes a hardy fellow, ambitious to live, crawls under some object and hibernates. He comes out in the spring, makes a desperate effort to be gay, but soon flutters to the ground and dies."

The harvest moon, hanging over Neversink mountain in front of the naturalist's house, the lights in the valley and to the right, leading in double file down to the city, made a pretty picture as Mr. Strecker stepped to the door to bid his visitor good-bye. It had been a great visit. It is probable that his collection, which has no superior in the world, will, when he is done with his beloved labors, go into the possession of the Government, but there is hardly money enough in the nation to purchase it till he gets through with it.—New York Sun.

A NEW CAMPONOTUS IN CALIFORNIA APPARENTLY INHABITING LIVE OAK, QUERCUS SP. (HYMENOPTERA, FORMICIDÆ)

By Marion R. Smith

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Recently I received for determination from Thompson C. Lawrence, University of California, Berkeley, an unusually interesting, shiny black species of *Camponotus* which he found foraging on, and "dominating" live oaks at Tanbark Flat, Los Angeles County, California. Although unable to find colonies, he collected 79 workers of variable size from the trees. These represent a new species. Its taxonomic position and its relationship to other species are discussed below.

Camponotus (Camponotus) quercicola, n. sp.

Major (?) worker: Length 12 mm.

Head (not including the mandibles) as broad as long when measured at its greatest breadth and length, narrower anteriorly than posteriorly, with broadly but weakly emarginate posterior border, rounded posterior corners and convex cheeks; both the head and remainder of the body of a habitus somewhat similar to that of the North American forms of *herculeanus* (L.). Eye oblong, weakly convex, approximately 0.75 mm. in its greatest length, placed much closer to the posterior than the anterior border of the head. Frontal area small, subtriangular, poorly defined. Mandible rather small, subtriangular, with five coarse, distinct teeth. Clypeus subcarinate, broader anteriorly than posteriorly; middle of the anterior border of the clypeus slightly extended to produce a subtruncate lobe on each side of which there is a sinuosity or emargination. Clypeal fossæ distinct. Frontal carinæ opposing each other to form a lyre-shaped figure. Frontal groove extending from the frontal area at least as far posteriorly as the ends of the frontal carinæ. Antenna 12-segmented; scape elongate, attaining at least the posterior corner of the head, curved at the base and also slightly flattened in this region. Thorax, from above, widest at the pronotum, where it measures approximately 2 mm. In profile, the thorax arched anteroposteriorly and lowest where the base and declivity of the epinotum meet. Legs moderately long, each tibia with a single spur, the tibiæ of the middle and posterior legs with a double row of graduated bristles on their flexor surfaces. Petiole with convex anterior surface and flattened posterior surface, the dorsal border sharp and entire, highest in the middle. Gaster, from above, elongate subelliptical, broadest at the base, more acute apically.

Mandibles rather coarsely rugulose punctate. Body rather shining (especially in some lights) but not strongly so. The sculpture of the ground surface dense but weak, consisting of fine reticulæ; in some lights or aspects the boundaries of the various individual reticulæ seem to coalesce to form exceedingly fine rugulæ. Head, especially the clypeus, cheeks and sides with conspicuous, pubescense-bearing punctures. Clypeus and lower portions of the cheeks with large, coarse, scattered foveolæ which bear erect or suberect hairs and give these areas a bearded and somewhat roughened aspect.

Hairs on body rather sparse, deep yellowish or golden, moderately long to rather long, suberect to erect; rather well scattered over all parts of the head except the occiput, sides and corners, almost lacking on the thorax, being represented there by a single hair on the pronotum and a clump of nine erect hairs arranged in a transverse row at the junction of the base and declivity of the epinotum; dorsal border of petiole with ten erect hairs; dorsum of each gastric segment with two rows of suberect to erect hairs, one near the anterior border and another near the posterior border, both running transversely across the gaster, the hairs near the apex of the gaster apparently the longest. Gula, coxæ and trochanters with suberect hairs.

Body black. Last five or six funicular segments lighter than the preceding ones. Maxillary and labial palpi light brown, legs reddish brown; a fairly broad, yellowish band at the posterior border of each gastric segment where that segment overlaps the succeeding one.

Minor (?) worker: Length 9.5 mm.

Differing mainly from the major worker in size and in the proportions of the body, especially of the head. Head somewhat subrectangular in appearance, approximately 1.12 times as long as broad when measured at its greatest length and breadth, with rounded posterior corners, rounded posterior border and weakly convex sides. Eye oblong, weakly convex, approximately 0.65 mm. at its greatest length, placed closer to the posterior than to the anterior border of the head. Frontal area, mandibles, clypeus, clypeal fossæ, frontal carinæ, frontal furrow as in the major worker. Antenna as in the major worker but the scape proportionally longer, the scape extending past the posterior corner of the head by 0.9 mm. or approximately one-third the length of the scape. Thorax, from above, widest at the pronotum where it measures approximately 1.8 mm.; in profile, the thorax similar to that of the major worker. Legs, petiole, gaster, sculpture, pilosity, pubescence and color, also as in the major worker.

Type locality—Tanbark Flat, Los Angeles County, California; approximately 2,700 ft.

Described from a holotype, major (?) worker and 78 paratype workers of variable size which were collected July 15, 1952 by Thompson C. Lawrence from live oak, *Quercus* sp. The holotype and 60 paratype workers have been placed in the United States National Museum under U. S. N. M. No. 62025. Six paratypes each have also been distributed to the following: The Museum of Comparative Zoology, Cambridge, Massachusetts, The California Academy of Sciences, San Francisco, California, The American Museum of Natural History, New York, New York and T. C. Lawrence.

Mr. Lawrence noted the ants feeding on exudates on the trees but did not specify the nature of the exudates. Although he sought colonies and was unable to find them, he believes that the ants nest in the oaks, probably in dead branches. One of the peculiarities noted was that workers did not appear until very dark on days when workers of *C. vicinus* Mayr came out about sunset in the same area.

One of the most noticeable variations among the paratypes is in the pilosity. The pronotum is usually without erect hairs but it may occasionally have one or two hairs; the mesonotum usually has two erect hairs, but in some specimens has none, only one or as many as four; the cluster of hairs on the epinotum consists of from two to ten hairs, most commonly four to seven. Specimens have been seen without erect hairs on the epinotum but presumably these had been rubbed off. None of the individuals lacked piligerous foveolæ on the cheeks but the number and size of the foveolæ varied considerably.

After studying the new species at considerable length I have come to the conclusion that it belongs to the subgenus *Camponotus* and is in or very near to the *herculeanus* (L.) complex of North American ants (sense of Wheeler, 1910).

In the keys to *Camponotus* (Wheeler, 1910, Ann. N. Y. Acad. Sci. 20 (6): 295–354 and Creighton, 1950. Harvard Univ., Bul. Mus. Comp. Zool. 104: 585 pp., 57 pl.) the species would key out to *noveboracensis* (Fitch) but it is not this species at all, being readily distinguished from it by color, by the coarse piligerous foveolæ on the anterior part of the head and by other characters. I do not know any North American species which is even closely related to it, the new species being especially characterized by its black and rather shining body, piligerous foveolæ on the cheeks and clypeus, subcarinate clypeus, slender body and long antennal scapes. The species may be distinguished at once from *lævigatus* (F. Sm.) by the lack of suberect or erect hairs on the antennal scapes, color of body hairs and nature of the sculpturing.

BOOK NOTICE

Aphids of the Rocky Mountain Region, by Miriam A. Palmer, was recently published by the Thomas Say Foundation. It consists of 452 pages, 8 colored plates, and 455 figures of line drawings providing additional accuracy in identification. Keys are provided for the subfamilies, tribes, genera and species. Although the title indicates a restricted area, as a matter of fact, the volume includes practically all of the species in North America, north of Mexico. The volume is priced at $10.25 postpaid in the United States, and for other countries $10.50 postpaid. It can be obtained from J. J. Davis, Purdue University, Lafayette, Indiana. Checks should be made payable to the Thomas Say Foundation.—J. J. Davis.

CORRECTIONS TO LENG'S CATALOGUE AND GEBIEN'S COLEOPTERORUM CATOLOGUS: TENEBRIONIDÆ AND KATALOG DER TENEBRIONIDEN.

By T. J. Spilman

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Gebien (1910 and 1911), in the Coleopterorum Catalogus: Tenebrionidæ, cited incorrectly many of the new genera and species described by LeConte (1862), in his Classification of the Coleoptera. Leng (1920) obviously copied Gebien's errors, except in the part on *Rhipidandrus* prepared by H. S. Barber. Most of these errors were corrected by Gebien (1940 and 1941) in his new catalogue.

The following is a list of corrections to be made. The column following the newly described forms gives the correct pages of LeConte's descriptions. The column for each of the catalogues gives the pages of the catalogue on which errors occur, followed by ''y'' if an error of year and by ''p'' if an error of page.

	LeConte 1862 (page)	Gebien 1910–11	Leng 1920	Gebien 1940–41
Oochila	220	120 y	224 y	
Branchus	222	263 y	229 y	
B. floridanus	223	263 y p	229 y p	
Discodemus	223	264 y	229 y	
Conipinus	223	265 y	229 y	
Ephalus	228	611 p	232 p	
Merinus	230	436 y	235 y	
Pachyurgus	230	447 y		
Xylopinus	230	436 y	235 y	
Haplandrus	230	437 y	235 y	
Cynæus	233	393 y	234 y	
Tharsus	233	400 y	234 y	
T. seditiosus	233	400 y p	234 y p	772 (579) y p
Aphanotus	233	404 y	234 y	
Rhipidandrus	236	362 y		
Prateus	238	470 y	236 y	
P. fusculus	238	470 y p	236 y p	821 (676) y p
Dioecus	238	395 y	234 y	
D. punctatus	238	395 y p	234 y p	757 (564) y p

Two other errors of page citation were found in Leng (1920). On page 222, species 11591 should be 66-110, not 66-100, and on page 232, species 12288 should be 66-125, 126, not 66-125.

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TOXICITY OF SEVERAL NEW ORGANIC INSECTICIDES TO BODY LICE (PEDICULUS HUMANUS CORPORIS DE G.)[1]

By Franklin S. Blanton, Lt. Col.
Medical Service Corps, U. S. Army

Part II—dust tests

Methods used for testing various chemicals mixed with powder carriers:—All promising lousicides located in the beaker tests were tested in powder formulations. The technique was to dissolve the chemical in acetone and then impregnate this solution on the test powder diluent. One gram of powder was then spread on cloth patches approximately 4⅞ inches square. These patches were cut from winter-weight cotton underwear cloth. The treated patches were placed on paper-covered plywood boards and 25 young adult lice were confined on each patch beneath an inverted petri dish. Mortality counts were made after 24 hours. The lice were kept in direct contact with the treated cloth except for one series of tests in which they were exposed for only 30 minutes and then removed to clean cloths.

Effect of various dusts or diluents on adult body lice:—A series of preliminary tests were conducted to determine the effect of fifteen diluents on adult body lice.

Preliminary work had been done on this phase of testing and very erratic results were sometimes had, when insecticides were used with various diluents.

It was found that there was considerable day to day variation. The results of four tests on different days are given in Table 3. Of the fifteen diluents tested alone, eight showed definite toxicity to lice. Five of the diluents caused an average of over 90 percent mortality, and one, an average of 60 percent. Cohutta talc gave an average of 18 percent mortality, pyrophyllite 22 percent and the remainder were nontoxic. In subsequent tests pyrophyllite gave even greater kills of lice. Pyrophyllite, which was

[1] For first paper of this series, see Jour. N. Y. Ent. Soc. **61**: 169–180. 1953.

toxic, Gypsum, Dilroc, Frianite and Walnut Shell Flour, which were non-toxic were chosen for further comparative tests.

Effect of dust combinations with and without chemicals on adult body lice:—Since the preliminary tests showed large differences in toxicity additional tests were made with some that showed little or no toxicity and with some that showed rather high toxicity. Five of these diluents were selected for testing alone, in combinations containing equal parts of two diluents,

TABLE 3. PERCENT OF LOUSE MORTALITY AFTER 24-HOUR EXPOSURES TO VARIOUS DILUENTS CONTAINING NO INSECTICIDE. FOUR REPLICATIONS OF 25 LICE EACH

Diluent	Dates of Treatment				Average
	Jan. 5	Jan. 11	Jan. 12	Jan. 13	
Activated charcoal	100	100	100	100	100
Wood charcoal	100	100	96	100	99
Fossilite	100	100	96	100	99
Fuller's Earth	100	100	100	92	98
Secco Clay[1]	96	100	lice escaped	80	92
Phospho Dust	100	44	0	96	60
Chutta Talc	12	32	16	12	18
Pyrophyllite	20	60	0	8	22
Dilroc	0	16	0	0	4
Frianite M3X	0	8	4	0	3
Control[2]	0	2	4	0	2
Gypsum	0	0	4	0	1
Walnut Shell Flour	0	0	0	4	1
Cocoa Shell	4	0	0	0	1
Bentonite	0	0	0	4	1
Frianite	0	0	0	0	0

[1] Only three tests of 25 lice each.
[2] Eight tests of 25 lice each.

and these diluents with various concentrations of DDT, chlordane and toxaphene. The purpose of these tests was to determine the most suitable range of concentrations for evaluating them in various diluent combinations.

The results of these very preliminary tests are not tabulated. There was considerable variation in individual tests, but in general, chlordane appeared slightly more toxic than DDT or toxaphene. The latter two were about equal in toxicity.

From these tests it was possible to set up a series of tests using five diluents both alone and in combination with each other, and with various concentrations of three toxicants, DDT, toxaphene and chlordane.

The results in Table 4 (Series A), show that Pyrophyllite

TABLE 4. Average Percent of Louse Mortality after 24-Hour Exposures to Various Diluents, with and without DDT. Three Replications of 25 Lice Each

Diluent	Diluent without toxicant	Concentration in parts per 5000 million of DDT in dust	2500	250	100
		Series A			
Pyrophyllite	96	100	100	100	100
Pyrophyllite + Frianite	93	100	100	95	96
Pyrophyllite + Walnut Shell Flour	5	100	100	21	3
Gypsum	1	100	100	81	12
Gypsum + Frianite	7	100	100	73	12
Gypsum + Walnut Shell Flour	7	100	99	4	1
Dilroc	8	100	100	76	41
Dilroc + Frianite	7	100	100	83	49
Dilroc + Walnut Shell Flour	1	100	96	5	1
Frianite	8	100	100	65	63
Walnut Shell Flour	5	93	53	9	3
Control of (6 of 25 lice each)	3				
		Series B (Toxaphene)			
Pyrophyllite	100	100	100	100	100
Pyrophyllite + Frianite	91	100	100	100	96
Pyrophyllite + Walnut Shell Flour	15	100	100	12	11
Gypsum	7	100	100	93	25
Gypsum + Frianite	8	100	100	88	23
Gypsum + Walnut Shell Flour	7	100	100	12	13
Dilroc	21	100	100	96	63
Dilroc + Frianite	17	100	100	93	25
Dilroc + Walnut Shell Flour	9	100	100	3	3
Frianite	11	100	99	99	55
Walnut Shell Flour	3	100	95	13	9
Control (6 of 25 lice each)	3				
		Series C (Chlordane)			
Pyrophyllite	99	100	100	100	100
Pyrophyllite + Frianite	73	100	100	100	92
Pyrophyllite + Walnut Shell Flour	8	79	63	8	3
Gypsum	4	100	97	80	41
Gypsum + Frianite	1	100	100	83	43
Gypsum + Walnut Shell Flour	0	79	27	1	3
Dilroc	8	100	100	100	75
Dilroc + Frianite	3	100	100	77	27
Dilroc + Walnut Shell Flour	4	68	39	15	3
Frianite	0	......	......	......	......
Walnut Shell Flour	4	25	5	16	7
Control (6 of 25 lice each)	3				

alone was very toxic to lice, giving an average of 96 percent kill. In combination with DDT it killed 100 percent of the lice at all concentrations. Pyrophyllite and Frianite mixed in equal amounts were also toxic giving an average kill of 93 percent. DDT, when mixed with the Pyrophyllite-Frianite combination was less toxic than when mixed with Pyrophyllite alone. The Pyrophyllite Walnut shell flour mixture was almost non-toxic, giving an average kill of 5 percent. When mixed with DDT it was highly toxic only at concentrations of 5000 and 2500 parts per million. At 250 and 100 parts per million the average kill was 21 and 3 percent respectively.

Gypsum, Dilroc and walnut shell flour, when used alone were non-toxic, and Frianite was only slightly toxic. All diluent combinations with DDT gave 100 percent kill at a concentration of 5000 and 2500 parts per million, except when walnut shell flour was used. At concentrations of 250 and 100 parts per million pyrophyllite was the only dust that gave 100 percent kill. At these concentrations the pyrophyllite-Frianite DDT combinations gave 95 and 96 percent mortality. Although high kills were obtained in some of the treatments, pyrophyllite was shown to be the most practical dust to use with DDT.

The results in Table 4 (Series B) again show that pyrophyllite was very toxic to lice even when used alone. Complete kill was had in all tests where pyrophyllite was used alone. With the combination of pyrophyllite and Frianite there was an average kill of 91 percent. None of the combinations of dust were outstandingly toxic.

Toxaphene, when mixed with dusts gave 100 percent kill in all combinations at a concentration of 5000 parts per million. At 2500 parts per million, Frianite gave an average kill of 99 percent and walnut shell flour 95 percent. At a concentration of 250 parts per million of toxaphene and various dusts the kill was complete with only pyrophyllite and the pyrophyllite-Frianite mixture. The average for all others was almost 90 percent, except for walnut shell flour which failed to show much mortality. At 100 parts per million complete kill was had with pyrophyllite and 96 percent kill with the pyrophyllite-Frianite-Toxaphene mixture. All others gave poor results.

The results in Table 4 (Series C) show that pyrophyllite was again very toxic to lice when used alone or in combination with chlordane. It was quite toxic when used in combination with Frianite without chlordane and very toxic when used with chlordane. Chlordane when mixed with pyrophyllite gave 100 percent kill at all dilutions. With pyrophyllite and Frianite it gave 100 percent kill at 500, 250, and 100 parts per million. It gave 92 percent kill at 50 parts per million. When mixed with walnut shell flour and pyrophyllite, chlordane gave only 79 percent kill at 500 parts per million. At 500 parts per million, chlordane gave 100 percent kill with all dust combinations except when walnut shell flour was used. At 250 parts per million complete kill was had with chlordane and all dust combinations except with gypsum which averaged 97 percent kill and with walnut shell which failed. At 100 parts per million complete kills were had with pyrophyllite, pyrophyllite and Frianite and Dilroc. Unfortunately, there was not enough Frianite of this particular sample to test it in combination with chlordane alone.

In summary, the results with DDT, toxaphene and chlordane, Table 4 (Series A, B, and C) show that pyrophyllite alone caused 96 to 100 percent mortality of lice, and the combination of pyrophyllite and Frianite was also very toxic. Consequently, where these diluents were used no distinction could be made between either the toxicants or the different concentration of each toxicant, as nearly complete to complete kills occurred in all cases.

Gypsum and Dilroc, alone and in combination with Frianite, showed little toxicity to lice, and in most instances, uniform results were obtained for the same concentration of each toxicant, thus permitting some conclusions as to their relative toxicity. This was also true for Frianite alone, which was relatively nontoxic to lice. Results showed that Chlordane was considerably more toxic to lice than DDT and slightly more toxic than toxaphene, at low concentrations of 50, 100, and 250 parts per million.

The presence of walnut-shell flour in the various diluent combinations caused a marked diminution in the effectiveness of each toxicant, except in the highest test concentration. Walnut shell flour also neutralized the toxicity of pyrophyllite.

Effect of freshly mixed chemical contrasted with mixtures aged for approximately one year in sealed brown bottles: A series of sixteen chemicals mixed in gypsum at concentrations of 5000, 500, and 50 parts per million were tested against lice to determine the effect of storage in brown glass bottles. Comparative tests were made with two series of dusts, one of which had been

TABLE 5. AVERAGE PERCENT OF LOUSE MORTALITY AFTER 24-HOUR EXPOSURES ON CLOTH DUSTED WITH OLD AND NEW LOUSE POWDERS FORMULATED IN GYPSUM.[1] THREE REPLICATIONS OF 25 LICE EACH.

Chemical	Parts per million toxicant in indicated dusts					
	5000		500		50	
	Old	New	Old	New	Old	New
Ether, bis (chlorophenyl)	100	100	....	....	....	....
Phenol, 2-sec-butyl-4,6-dinitro	100	100	2	36	....	....
DDT	99	95	88	84	49	29
Pyrethrine with piperonyl butoxide	100	100	100	100	7	12
Ethane, 1,1,1-trichloro-2-(0-chlorophenyl)-2-(*p*-chlorophenyl)-	17	28	9	13	9	7
Ethane, 1,1,1-trichloro-2-2-bis(*p*-fluorophenyl)-	100	99	68	19	12	12
Biphenyl, 4-ethoxy-	92	80	8	8	7	4
Biphenyl, chloro derivative (Aroclor 1232)	48	64	13	12	17	11
Biphenyl, chloro derivative (Aroclor 1248)	16	19	9	5	7	1
Sulfone, chloromethyl *p*-chlorophenyl	92	97	63	17	38	24
Toxaphene	100	99	99	18	16	12
Chlordane	100	100	84	75	7	32
Lindane	100	100	100	100	77	78
Parathion	100	100	100	100	59	84
Heptachlor	100	100	100	99	25	81
Benzenethiol	100	100	47	79	4	8

[1] In nine tests of Gypsum alone there was 4 percent mortality whereas in eighteen tests with untreated cloth there was 2 percent mortality.

stored for approximately one year and the other for only two or three months. The tests were replicated on three different days.

The results of these tests are given in Table 5. At a concentration of 5000 parts per million there were no outstanding differences between the old and new mixtures. At 500 p.p.m., however, the year-old dusts of compounds 1,1,1-trichloro-2,2-bis-(*p*-fluorophenyl) ethane, chloromethyl, *p*-chlorophenyl sulfone, and toxaphene were markedly more effective than similar dusts that were only two or three months old. The reasons for these differences are not definitely known, but they may have been due to variations in the dust mixtures or in the test insects. The fresh mixtures of thiolbenzene and 2-*sec*-butyl-4,6-dinitrophenol were more effective than the older ones. With the latter, however, the old mixture, even when freshly prepared showed a low toxicity against lice. Other workers at the Orlando laboratory confirmed this observation with flea tests and the difference is, therefore not attributable to aging.

TABLE 6. AVERAGE PERCENT OF LOUSE MORTALITY AFTER 24-HOUR EXPOSURES TO VARIOUS CHEMICALS IMPREGNATED ON GYPSUM. THREE REPLICATIONS OF 25 LICE EACH.

Chemical	Concentration in parts per million		
	500	50	5
Lindane	100	100	12
Heptachlor	100	97	0.7
Aldrin	100	88	0
Dieldrin	100	71	1
Parathion	100	57	1
Chlordane	100	27	0.8
Benzene hexachloride (12% gamma)	100	47	1
DDT	97	13	1
Toxaphene	95	1	0
Pinene, chlorinated, 68.5% Cl.	92	0	0
Pinene, chlorinated, 68.8% Cl.	88	3	0
Isobornyl sulfone, chlorinated, 63.3% Cl.	87	0	0
Sulfone, isobornyl phenyl chlorinated, 66.1% Cl.	73	8	1

Controls—Three lots of 25 lice each on gypsum—no mortality.
Six lots of 25 lice each on cloth—1 percent mortality.

Minimum concentration of impregnated dusts:—A series of tests were made using three concentrations of fifteen chemicals impregnated on gypsum. A total of 25 lice was used in each test and each test was replicated three or more times.

The results, in Table 6, show that at concentrations of 500 parts per million, DDT gave an average kill of 97 percent. This is about equal to toxaphene with an average of 95 percent and to chlorinated pinene (68.5% Cl.) with an average of 92 percent. DDT at this concentration was superior to chlorinated isobornyl sulfone (63.3% Cl.) with an average kill of 87 per cent; chlorinated isobornyl phenyl sulfone (66.1% Cl.) with 73 percent, and to chlorinated pinene (68.8% Cl.) with 88 percent. DDT was, however, inferior to lindane, technical benzene hexachloride (12% gamma), chlordane, parathion, heptachlor, aldrin, and dieldrin, each of which gave 100 percent mortality at 500 parts per million. At a concentration of 50 parts per million, DDT gave an average kill of 13 percent which was better than some. Lindane was the only chemical that gave 100 percent kill at 50

TABLE 7. AVERAGE PERCENT OF LOUSE MORTALITY AFTER 24-HOUR EXPOSURES TO VARIOUS CONCENTRATIONS OF CHEMICALS IMPREGNATED ON GYPSUM SPREAD ON CLOTH PATCHES. THREE OR MORE REPLICATIONS OF 25 LICE EACH.

Chemical	Concentration in parts per million					
	500	250	125	50	25	12.5
Heptachlor	100	100	100	100	97	38
Dieldrin	100	100	100	100	93	32
Lindane	100	100	100	100	91	23
Parathion	100	100	100	97	83	11
Aldrin	100	100	100	95	87	41
Chlordan	100	100	100	70	11	0.7
Technical Benzene hexachloride (10–12 percent gamma)	100	100	93	63	15	3
Toxaphene	95	12	9	5	1	0
Pinene, chlorinated, 68.8% Cl.	40	0	0	1	0	0
Pinene, chlorinated, 68.5% Cl.	35	4	1	0	1	1
Isobornyl sulfone, chlorinated, 70.5% Cl.	33	7	0	0	0	0
Sulfone, isobornyl phenyl, chlorinated, 66.1% Cl.	27	3	0	1	1	0
DDT	12	3	0	0	1	1

In six lots of 25 lice each there was on cloth alone 0.6 percent dead.
In six lots of 25 lice each on cloth treated with gypsum dust there was 1.3 percent dead.

parts per million, although heptachlor did give an average kill of 97 percent at that dilution. The next concentration, 5 parts per million, gave little or no mortality for any of the chemicals.

Another series of tests, Table 7, was made which employed thirteen of the better chemicals. Six concentrations of each chemical were used and the tests were replicated three to six times. In these tests all chemicals were superior to DDT. Some were only slightly better but some were extremely toxic. At

500 parts per million DDT averaged only twelve percent kill. This is quite a contrast to the average of 97 percent kill for DDT at the same dilution for the treatment made in previous tests. With such variation it is very important to make all comparative tests at the same time. At a concentration of 125 parts per million, six chemicals gave 100 percent kill. The next concentration, 50 parts per million, eliminated three other chemicals from the outstanding group. At 25 parts per million there were only three chemicals that gave kills above 90 percent and at 12.5 parts per million, all chemicals showed little toxicity.

Part III—fumigation tests

Methods used for testing fumigation qualities:—Several methods were devised and tested in an effort to find a reliable technique for testing chemicals as fumigants against adult lice. Chlordane and dieldrin were used in comparing the different techniques. In the first tests a small vial containing the lice was suspended in a larger vial containing a small woolen pad that had been impregnated with a 10,000 p.p.m. (1 percent) acetone solution of the test chemical. The small vial was closed with screen wire or a cotton plug and the larger vial was tightly stoppered. Suspending the lice in small cloth sacks was also tried. Since the vapors might be lighter or heavier than air, tests were run with the larger vials in upright, inverted, and horizontal positions. Other tests were made in which the treated cloth patches were placed in the bottom or top of a pint jar and lice exposed in small open petri dishes placed on the bottom.

Results of fumigation tests:—It was found that the jar method was superior to the other test methods. It was also found that there was little or no difference in louse mortality if the chemical were placed above or below the lice. It was assumed that the jars were too shallow to demonstrate whether the fumigant was heavier or lighter than air. In final tests the fumigant was placed only in the bottom of the jars. With chlordane and dieldrin complete kill was had in all tests. The other three methods tried, vial in vial, vial in vial-screen caps, and cloth envelopes gave kills ranging from 2 to 35 percent.

Additional preliminary tests of the jar method were made with five compounds known to have some vapor toxicity. Four or five tests of 20 lice each with each chemical showed the following mortality:

CHEMICAL	PERCENTAGE KILL
Technical benzene hexachloride	100
Chlordane	90
Heptachlor	100
Aldrin	99
Dieldrin	67
Control	1

These results indicated that the jar method was an effective qualitative means for measuring the vapor toxicity of compounds. Dieldrin was the least effective of the materials.

The jar method was then used to test 107 of the better contact insecticides to determine their effectiveness as fumigants. These tests were run in pairs, with an impregnated patch in the top of one jar and in the bottom of the other. Only nine of the compounds showed fumigant properties, the data for which are presented in the following table. Seven of the nine materials, Table 8, gave 100 percent kill of lice at the dosage tested. The other two, 1, 2, 3, 4-tetra-hydro-quinaldine and dieldrin failed to give complete kills.

TABLE 8. Percent louse mortality after 24-hour exposures in fumigant chambers. Ten lice in each test.

Chemical	No. of Tests	Position of fumigant in jar	
		Bottom	Top
Ethyl dithiopyrophosphate, tetra-	4	100	100
Aldrin	6	100	100
Heptachlor	6	100	100
Chlordane	8	100	100
Lindane	4	100	100
Technical benzene hexachloride (10–12% gamma isomer)	4	100	100
Acetic acid thiocyanochloroisobornyl ester	1	100	100
Quinaldine, 1,2,3,4-tetra hydro	3	77	96
Dieldrin	3	53	70
Control, acetone treated patch	8	1	1
Untreated patch	8	1	0

Although tests were preliminary, it was clearly demonstrated that these nine chemicals did possess fumigant qualities.

Further tests were made with concentrations of 100, 50, 25, and 12.5 parts per million. The results, Table 9, show that tetra ethyl dithiopyrophosphate, gave respective kills of 100 and 93

TABLE 9. Average percent louse mortality after 24-hour exposures in fumigation chambers. Three or more replications of 10 lice each.

Chemical	Concentrations in parts per million			
	100	50	25	12.5
Ethyl dithiopyrophosphate, tetra	100	93	7	3
Aldrin	83	30	0	0
Heptachlor	80	30	0	3
Chlordane	50	5	0	0
Lindane	27	0	0	0
Dieldrin	17	0	0	0
Acetic acid thiocyano-chloroisbornyl ester	3	0	0	0
Technical benzene hexachloride (10–12% gamma isomer)	3	0	0	0
Quinaldine, 1,2,3,4-tetra hydro-	0	0	0	0
Control Acetone treated patch. No deaths in 6 lots of 10 lice each.				
Untreated patch. One death in 6 lots of 10 lice each.				

percent at concentrations of 100 and 50 p.p.m. At 100 p.p.m. tetra ethyl dithiopyrophosphate, aldrin, heptachlor, chlordane, lindane, dieldrin, acetic acid thiocyano-chloroisobornyl ester, technical benzene hexachloride, and quinaldane 1,2,3,4-tetrahydro all demonstrated fumigant qualities.

DISCUSSIÓN AND CONCLUSIONS

It should be noted that the discussion and conclusions made at this time are based upon this paper and the two preceding papers on the same subject.

This work was designed to explore the field of new organic insecticides and to test the toxicity of these materials to body lice. Whether any of these materials will ever be used as lousicides depends on the need for new lousicides and their toxicity to men. If lice, like flies, mosquitoes and other insects, have resistant strains or the ability to produce resistant strains to DDT and other insecticides, the present work will have been justified. It is common knowledge that for houseflies and some other insects continuous treatments with DDT will give rise to resistant strains that cannot be killed at normal exposures with DDT. The introduction of another unrelated insecticide has been resorted to in order to control these resistant pests.

Although a few chemicals were found to possess fumigant qualities this was believed to be only a minor factor and at weaker dilutions contributed little if any to louse mortality.

The data show that chemicals impregnated on cloth in acetone solution (beaker tests) are more toxic to lice than when impregnated on a dust. For example, at a concentration of 12.5 parts per million in the beaker tests, aldrin, heptachlor, dieldrin, parathion, lindane, and chlordane gave 86 to 100 percent kills, but when the same chemicals were impregnated on dusts at 12.5 p.p.m. aldrin gave 41, heptachlor 38, dieldrin 32, parathion 11, lindane 23, and chlordane 0.7 percent kill. Some or all of this may be caused by the unavailability of the chemical since some of it is absorbed by the dust particle. In short, it requires a higher concentration of chemical in dust form than when impregnated on cloth to give equal louse mortality.

The beaker method proved to be a rapid and reliable method for evaluating new insecticides against body lice, but as pointed out by Eddy et al (1947a) materials found to be effective in the beaker method would need practical tests to prove which were good lousicides. When tested in powder form, many of these effective materials proved ineffective. By the same test, however, DDT remained effective for months.

SUMMARY

Body lice, *Pediculus humanus corporis* DeG., which are important as vectors of epidemic typhus, trench fever and relapsing fever have been investigated intensively since 1943. Numerous papers on control methods and a few on biology have appeared since Grinnell and Hawes (1943) published their bibliography on lice and man.

Data are presented on the relative toxicity of 106 compounds which were selected as the most toxic of over 10,000 subjected to screening test.

In the beaker tests the 106 which had been found to be 100 percent effective on adult lice for 31 days or more at 10,000 parts per million were further diluted and better chemicals were again tested at still lower concentrations. Only 13 chemicals were found to be worthy of further study.

By dilution methods, DDT was shown to be inferior to the other twelve promising chemicals at a concentration of 100 p.p.m. and at 50 p.p.m. DDT was inferior to eight chemicals. Three chemicals, heptachlor, aldrin, and dieldrin were outstandingly better than DDT, all giving 100 percent kill at concentrations of 6.25 p.p.m. Aldrin gave 100 percent kill at concentrations of 3.125 p.p.m.

For comparison of these three chemicals with DDT the average percent mortality of lice are extracted from Table 2.

Chemical	Concentration, parts per million					
	100	50	25	12.5	6.25	3.125
Aldrin	100	100	100	100	100	100
Heptachlor	100	100	100	100	100	90
Dieldrin	100	100	100	100	100	85
DDT	88	63	15	3	5	0

Durability tests were made with all chemicals at concentrations of 10,000 parts per million. Durability tests with thirteen of the more promising materials were made at concentrations of 50, 25, 12.5, 6.25 and 3.125 p.p.m. At concentrations of 50 p.p.m., DDT gave a 50 percent kill for one day and none thereafter. The remaining twelve at this concentration were still effective after one day of aging. The most durable chemicals, parathion, and dieldrin, gave 100 percent mortality through the eighth and fifth day respectively at a concentration of 12.5 p.p.m.

In comparative tests, both pyrophyllite alone and the combination of pyrophyllite and Frianite were very toxic. Gypsum and Dilroc alone and in combination with Frianite showed little toxicity to lice. At low concentrations of toxicants, walnut shell flour combined with the diluents that were toxic to lice caused a marked decrease in effectiveness of each toxicant.

In storage tests with sixteen chemicals impregnated on gypsum, heptachlor deteriorated but the others did not.

In dust tests, with gypsum, at concentrations of 500 parts per million, there were twelve chemicals of thirteen tested which were superior to DDT. Several of these, however, were not effective at lower dilutions.

Six of the chemicals tested were outstanding as lousicides. For comparison of these with DDT the average percent mortality of lice are extracted from Table 7.

Chemical	Concentration in parts per million					
	500	250	125	50	25	12.5
Heptachlor	100	100	100	100	97	38
Dieldrin	100	100	100	100	93	32
Lindane	100	100	100	100	91	23
Parathion	100	100	100	97	83	11
Aldrin	100	100	100	95	87	41
Chlordane	100	100	100	70	11	0.7
DDT	12	3	0	0	1	1

Several chemicals demonstrated fumigant qualities. Those that showed fumigant qualities at a concentration of 10,000 parts per million were further diluted and tested again. Six chemicals, ethyl tetradiethiopyrophosphate, aldrin, heptachlor, chlordane, lindane, and dieldrin, at a concentration of 100 p.p.m., gave kills which varied from 100 percent to 17 percent in the order named. At 50 p.p.m., the kill varied from 93 to 0 percent kill. At 25 p.p.m., none of the chemicals showed fumigant action.

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BOOK NOTICE

Fresh-water Invertebrates of the United States. By Robert W. Pennak. The Ronald Press Company. New York, 1953. 6⅞ × 9½ inches. ix + 769 pp. 470 figs. 12 tables. $14.00.

This first comprehensive book on fresh-water invertebrates since 1918 brings the subject matter up to date. It took twelve years to cull the best from over 5000 references. The book contains two-column text, keys and over 2300 illustrations on all known invertebrates inhabiting fresh water. Appendices cover equipment and reagents. Naturally, the parasitic Platyhelminthes and Nemathelminthes are omitted. This large volume packs between its covers a vast amount of information. Crustacea, for example, has an introduction with four tables followed by nine chapters. The first, on Eubranchiopoda, includes: general characteristics; food, feeding; internal anatomy, physiology; reproduction; resting eggs; development, life cycle; ecology; geographical distribution; enemies; economic importance; collection, preparation; taxonomy; key to species; references. The insects take 179 pages. Even the rarely seen Tardigrada fill 15 pages with a key to genera and 34 illustrations. No one person could adequately deal with all the orders concerned and the author has wisely called in specialists for assistance with each group. Certain mechanical features greatly enhance the book's serviceability: the type is of comfortable size for reading with the book at one's elbow and specimens before him; dichotomous keys extend across the entire page for easy reading; figures are large and clear with no superfluous or confusing lines and all are significant; a three-column index reduces page turn-over fifty percent and the book lies flat when opened. The publisher has done an excellent job on format, paper and binding. Perhaps the author takes a dim view of the contemporary student's ability when he limits the book's usefulness to seniors, graduates, teachers and researchers. From my experience, a normal student having had a course in taxonomy or field zoology could work with any section of the book. Only the general introduction seems to require a broader basic background. This volume is essential to everyone wishing to study, collect or identify fresh-water invertebrates.—H. R. HAGAN.

INDEX TO NAMES OF INSECTS AND PLANTS IN VOLUME LXI

Generic names begin with capital letters. New genera, subgenera, species, varieties and new names are printed in italics.

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