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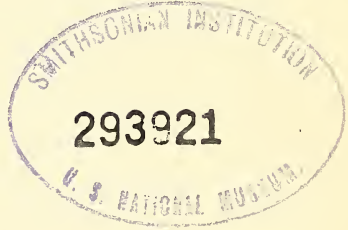
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VOL. XXXVI

MARCH, 1928

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NOTES ON THE HETEROPTERA OF EASTERN  
NORTH AMERICA WITH DESCRIPTIONS  
OF NEW SPECIES, I

BY W. S. BLATCHLEY

INDIANAPOLIS, INDIANA

This is the first of a series of supplements to my "Heteroptera of Eastern North America" which was issued October 18, 1926. During the year which has elapsed I have collected at Gainesville, Dunedin and Royal Palm Park, Florida, and at various points in Indiana, and have found several species which are evidently undescribed, and have identified others which were not included in that work. The known range of a number of species has also been extended by the published papers of several authors which have appeared during the year as well as by my own investigations. I also make brief mention of the new species of Heteroptera which have been described by others during the year from the territory covered by my work. From these "Notes and Descriptions," and from others which I hope to publish from time to time in the future, the student may keep informed as to the status of this interesting group of insects in eastern North America, and may the more readily identify his specimens and keep his collection up to date.

In the notes which follow the first number before each species mentioned is the serial number of that species in the "Heterop-

tera," and the one in parenthesis is the serial number of the species in Van Duzee's "Catalogue of the Hemiptera of America North of Mexico." A dash instead of a number denotes that the species was not included in one or the other or both of these works.

#### Family PODOPIDÆ

18 (—). *PODOPS PENINSULARIS* Blatchley.—A single male of this little turtle bug was taken February 21, 1927, at Gainesville, Fla., while sweeping along the margins of a pond. It was known before only from Dunedin and Royal Palm Park, that state.

#### Family CORIMELÆNIDÆ

31 (37). *CORIMELÆNA PULICARIA* (Germar).—This common northern negro bug is apparently very scarce in Florida. It was confused by both Van Duzee (1909) and Barber (1914) with *C. marginella* Dallas, the common species in that state. During sixteen years collecting in Florida I have taken not over half a dozen examples of *pulicaria* and these only at Dunedin and Royal Palm Park.

#### Family PENTATOMIDÆ

95 (143). *HYMENARCYS NERVOSA* (Say).—A single example of this species was taken by A. N. Tissot at Gainesville, Fla., November 29, by passing "Reindeer moss" through a Berlese funnel. Known in that state heretofore only from Sarasota and Ft. Myers.

96 (155). *MENECLUS INSERTUS* (Say).—This bug has recently been taken at Gainesville, Fla. It was not known from that state when the "Heteroptera" was written, the most southern station therein given being Raleigh, North Carolina.

115 (187). *BANASA PACKARDI* Stal.—Both this species and *B. euchlora* were beaten in numbers from red cedar near Dunedin during the winter of 1926-'27. Adults and nymphs in various stages occurred throughout the winter.

125b (207d). *STIRETRUS ANCHORAGO VIOLACEUS* (Say).—A single example was taken at Royal Palm Park, Fla., February 26, by F. M. Jones.

128 (210). *ALCÆORRHYNCHUS GRANDIS* (Dallas).—This large pentatomid was also taken at the Park, February 28, by Mr. Jones.

#### Family COREIDÆ

157 (249). *LEPTOGLOSSUS FULVICORNIS* (Westwood).—Two specimens were taken at Gainesville, Fla., February 21, 1927, while beating holly in low open oak woods. Known definitely heretofore from that state only from Dunedin.

163 (258). *PTHIA PICTA* (Drury).—Until February, 1927, I had not taken this species personally. I then began to find it on squash vines in my garden at Dunedin. Both young and adults occurred in small numbers until April. It is also in the Experiment Station collection at Gainesville, from Ft. Lauderdale and Gainesville.

— (280). *SEPHINA GUNDLACHI* (Guerin), 1857, 377.—This large and handsome coreid differs from *S. grayi* Van D., as described on page 237 of the "Heteroptera," in having the apex of hind pronotal angles and a large spot on middle of corium velvety black. It was described from the West Indies and was recorded by Banks (1910, 81) from "Fla." As no definite record of its occurrence in Florida could be found it was not included in the "Heteroptera." On March 28, 1927, I took at Royal Palm Park, Fla., several large nymphs, and, on April 15, a half dozen adults of *gundlachi*. These were all beaten from a large mass of slender stems of the climbing milkweed, *Metastelma scoparium* Nutt., on the margin of the hammock on Paradise Key. This milkweed is also the host plant of *S. grayi* Van D., and, aside from the difference in coloration above stated, the only appreciable difference between the two forms is that the scutellum is almost flat in *grayi* while in *gundlachi* there is a distinct transverse ridge with a furrow behind it; the punctures of both pronotum and elytra are also somewhat deeper and more numerous in the latter species. It is possible that a large series will show that *grayi* is only a race or color variety of *gundlachi*. Dr. Carl J. Drake informs me that a single specimen of *gundlachi* from Gulfport, Fla., is in his collection.

## Family CORISCIDÆ

189 (—). *PROTENOR AUSTRALIS* Hussey.—An adult and a last instar nymph of this recently described species were taken at Royal Palm Park, April 18, while sweeping herbage in a swale of the Caribbean pinelands. Like the northern *P. belfragei* Hagl., it is probably an inhabitant mainly of the marshlands.

## Family CORIZIDÆ

Mr. W. E. China has called my attention to the fact that *Corizus hyalinus* Fabr. differs from our other species in possessing "scent glands," and therefore osteolar openings. The first phrase of *aa* in the Key to Families of Coreoideæ on page 208 of the "Heteroptera" should therefore be changed to read: "Osteolar openings usually absent; *when present*, placed between the middle and hind coxæ near the median line and provided with two short, diverging furrows;" and in the 14th line on page 270 the words "except in *Corizus hyalinus* Fabr." should be placed after the word "obsolete."

## Family ARADIDÆ

268 (417). *ANEURUS FISKEI* Heidemann. My second specimen was taken June 9, in Marion Co., Ind., by sweeping herbage along a pathway in dense woodlands.

## Family TINGIDIDÆ

— (6441 $\frac{1}{4}$ ). *CORYTHUCHA MORRILLI* Osborn & Drake, 1917, 298.—This southwestern species has been recently taken at Dune-din and Royal Palm Park, in February and March by sifting grass roots and sweeping low herbage along the margins of swales. It is about 3 mm. in length and belongs under *b* of the key in Group C, page 460, of the "Heteroptera." From *marmorata*, which it closely resembles in markings, it is distinguished by having the marginal ciliae of paranota and elytra much shorter and more crowded, lateral carinae of pronotum longer and higher, curved outward, each with six or seven areolæ; elytra longer, narrower, with sides visibly concave and hyaline cells between the two dark apical cross-bars, larger. This

is the first record from east of the Mississippi. It is said to be common in Colorado and Arizona.

433 (—). *CORYTHAICA FLORIDANA* Blatch.—The second known example of this little tingid has been received from Messrs. Watson and Tissot of Gainesville. It was taken from moss collected from logs and stumps, November 2, 1926, at Citra, Fla., and afterwards put through a Berlese funnel. The unique type was from Dunedin, Fla.

465 (—). *HESPEROTINGIS ANTENNATA* Parshley.—Several examples of the brachypterous form of this tingid were beaten on each of three occasions in January, 1927, from bunches of Spanish moss hanging from the lower limbs of red oak, *Quercus rubra* L., growing in open pine woods near Dunedin, Fla. These oaks were several miles apart and, though the dense clumps of moss attached to nearby pines and other trees were thoroughly beaten, it was only on those attached to the oaks that the bug was found. It has not before been recorded south of Washington, D. C.

468 (677). *ATHEAS EXIGUUS* Heidemann.—The types of this minute tingid were from Sevenoaks, Fla., only five miles from my winter home at Dunedin. I have tried unsuccessfully for ten years to find it. After returning to Indianapolis in May, 1927, I found a single example of the tingid in a capsule containing specimens of the little lygæid, *Cymus bellus* Van D., which I had swept in April from low herbage about the margins of a pond near Dunedin. It has heretofore been definitely recorded only from the type locality.

476 (—). *LEPTOYPHA ILCIS* Drake.—One example of this species was taken at Gainesville, Fla., February 23, by beating *Vaccinium*. It is much darker, with hind portion of hind lobe of pronotum and discoidal areas distinctly more coarsely punctate, than in the one from Lake Wales, mentioned in the "Heteroptera."

#### Family PLOIARIIDÆ

491 (698). *EMPICORIS TUBERCULATUS* (Banks.)—My first Indiana example of this well-marked species was beaten, August 27, 1927, from the foliage of bur oak, *Quercus macrocarpa*

Miehx., in Marion Co., Ind. The species of *Empicoris* are apparently scarce in this state, but three having so far been taken.

504 (—). *PLOIARIA SETULIFERA* McAtee & Malloch.—In the key of McAtee and Malloch, as well as in my work, the relative lengths of the antennal segments of this species are wrongly stated. In their key (1925, 50) they state—"apical antennal segment shorter than subapical, equal to it only in *setulifera*." In fact, the relative lengths of the last three segments are: segment 2 one-fourth longer than 3, segment 4 two-fifths the length of 3.

#### Family REDUVIIDÆ

522 (725). *GNATHOBLEDA TUMIDULA* Stal.—One adult and two nymphs were taken April 5 at Royal Palm Park, Fla., from beneath masses of water purslane growing on the rocks along the sides of ditches. It has been recorded elsewhere in Florida only from Dunedin.

545 (—). *ZELUS ANGUSTATUS* Hussey.—I was much pleased at taking, on January 6, my first specimen of this recently described species. It was beaten from a bunch of Spanish moss near Dunedin and was known heretofore only from Gainesville, Fla.

558 (800). *SINEA DIADEMA* (Fabricius).—This common northern species is very scarce in Florida. One was swept from roadside herbage at Royal Palm Park on April 17. It was previously known from that state only from Dunedin and Biscayne Bay.

#### Family NABIDÆ

580 (833). *NABIS KALMII* Reuter.—The specimens recorded under this name from Marion Co., Ind., are probably only pale examples of the common *N. ferus* Linn. and it is very doubtful whether *kalmii* is more than a color variety of that species. The distinctions given by Reuter relate mainly to color and are quoted in the "Heteroptera."

#### Family NÆOGEIDÆ

588 (—). *MERRAGATA SLOSSONI* Van Duzee.—In the spring of 1927 this little velvet water-bug was taken by scores at Royal

Palm Park, by pulling masses of living *Chara* from the water on to the sides of a roadside limestone ditch, and then waiting for the bugs to crawl about over the bare rock. It was known heretofore only from Moore Haven and Biscayne Bay, that state.

#### Family ANTHOCORIDÆ

598 (842). *LYTCOCORIS ELONGATUS* (Reuter).—Dr. C. J. Drake has informed me that the specimen recorded on page 625 of the "Heteroptera" from Spring Hill, Alabama, should be referred to *L. stalii* Reut.

— (—). *LASIOCHILUS DIVISUS* Champion.—Drake and Harris record<sup>1</sup> this subtropical species from Canal Point, on Lake Okeechobee, Fla. They also record *L. fusculus* Reut. from Charleston, Miss., and Dechard, Tenn.

601 (—). *LASIOCHILUS GERHARDI* Blatchley.—Dr. Drake informs me that this minute brachypterous species is in the Parshley collection from Tyngsboro, Mass. It has been hitherto known only from Dunedin, Fla., the type locality.

606 (852). *ASTHENIDEA TEMNOSTETHOIDES* Reuter.—The known range of this species has been greatly extended by the records of Drake and Harris (loc. cit. p. 37). They record it from Miami, Marathon and Paradise Key, Fla., and Kerryville, Texas.

618 (—). *PHYSOPLEURELLA FLORIDANA* Blatchley.—Examples of this species are in the U. S. National Museum collection from Jamaica. It has been heretofore known only from Dunedin, Fla., the type locality.

619 (867). *CARDIASTETHUS ASSIMILIS* (Reuter).—Examples of this species are in the U. S. National Museum collection from as far north as Norfolk, Va., where it was bred from a corn ear. It is very common in Florida.

623 (871). *DUFOURIELLUS ATER* Dufour.—This European species is now known from Los Angeles, Cal. I have also seen a specimen from Henderson, Ky.

\* \* \* \* \*

Messrs. Carl J. Drake and Halbert M. Harris, of Ames, Iowa, are at present engaged in preparing a much needed revision of

<sup>1</sup> Proc. Biol. Soc. of Washington, Vol. 39, 1926, 35.

the North American species of this family. They issued, July 30, 1926, a preliminary paper which appeared in Proc. Biol. Soc. of Washington, Vol. 39, pp. 33-45, entitled "Notes on American Anthocoridae with Descriptions of New Forms." Of the nineteen forms described as new, eight were from the territory covered by the "Heteroptera," but their paper appeared too late for the inclusion of these in my work. They were as follows:

— (—). *LASIOCHILUS HIRTELLUS* D. and H. loc. cit., p. 33.—This form they described from Alabama, Gainesville, Fla. and numerous stations in the southwestern states. It is the same species as that included by me as *Lasiochilus pallidulus* Reuter, one of the most common Anthocorids in southern Florida, and the name of Drake and Harris is probably only a synonym of that of Reuter.

— (—). *LASIOCHILUS COMITALIS* D. & H., loc. cit., p. 34.—Described from specimens in the U. S. National Museum taken on *Hicoria* at Hendersonville and Tryon, North Carolina. A species 2.8 mm. in length, the head pronotum and base of scutellum shining rufo-piceous.

— (—). *XYLOCORIS BETULINUS* D. & H., loc. cit., p. 37.—Described from a single male, taken June 23, at Cranberry Lake, New York, from a worm burrow in a fallen yellow birch. "Closely related to *X. galactinus* Fieb., but distinguished by the much broader pronotum which has the posterior lobe distinctly depressed." (D. & H.)

— (—). *MACROTRACHELIELLA LAEVIS FLORIDANA* D. & H., loc. cit., p. 37.—Described from U. S. National Museum specimens taken by Schwarz and Knab at Key West, Fla., from galls of thrips on *Ficus indica*. "Differs from typical *laevis* Champ. in having the entire third antennal segment flavous and the clavus, except margins, whitish." (D. & H.)

Drake and Harris (loc. cit., p. 38), founded the genus *Xenotracheliella* allied to *Macrotrachelia* Reut. and *Macrotracheliella* Champ., but having the anteoctular portion, of head longer than post-ocular one; pronotum with a deep transverse furrow at middle, truncate in front, emarginate behind, narrowly margined; antennae stout, joint 1 reaching apex of head, 2 subequal in length to head; 3 and 4 united slightly longer than 2; osteolar



canal sloping obliquely forward, slightly curved. They included three species, two from the eastern states.

— (—). *XENOTRACHELIELLA INIMICA* D. & H., loc. cit., p. 38.—Dark brown to fuscous, the middle of clavus and a transverse fascia at apex of corium white; joint 2 of beak reaching middle of mesosternum; length 2.85 mm. Described from a single female taken, July 2, at Ithaca, N. Y.

— (—). *XENOTRACHELIELLA VICARIA* D. & H., loc. cit., p. 39.—Differs from *inimica* in having the body less flattened, ocelli less widely separated, side margins of pronotum wider; joint 2 of beak reaching base of mesosternum; clavus pale testaceous, its inner margin piceous; length 2.87 mm. Described from a male taken, August 28, at Marquette, Mich.

— (—). *TETRAPHLEPS EDACIS* D. & H., loc. cit., p. 43.—Length 3.66 mm. “Resembles *T. osborni* Drake, but hemelytra darker; beak shorter, scarcely reaching intermediate coxæ; osteolar canal nearly straight.” (D. & H.). Described from a single female, taken by Drake, August 3, at Wanakena, N. Y., from *Larix laricina* (DuRoi).

— (—). *SCOLOPOSCELIS MISSISSIPPIENSIS* D. & H., loc. cit., p. 43.—“Differs from *S. flavicornis* Reut. in having the pronotum broader anteriorly, elytra much shorter, anterior and posterior femora greatly and equally incrassate. Length 2.76–3 mm.” (D. & H.). Types taken at Ft. Gibson, Mississippi, July 22, from burrows of bark-beetles (*Ips. sp?*) in long-leaf pine.

#### Family CRYPTOSTEMMATIDÆ

626 (—). *SCHIZOPTERA BISPINA* McAtee & Malloch.—A fourth example of this little bug is at hand. It was taken at Ft. Myers, Fla., March 5, while sifting debris from the bottom of an extinct wet-weather pond. Taken before in this country only at Dunedin, Fla.

#### Family MIRIDÆ

674 (—). *EIONEUS GUTTICORNIS* Blatchley.—Knight,<sup>2</sup> following Poppius (1912), has pointed out that the genus *Eioneus*

<sup>2</sup> Bull. Brooklyn Ent. Soc., XXII, 1927, 98.

Distant (1893) is a synonym of *Dolichomiris* Reut. (1882), and that the species I named *E. gutticornis* is probably the same as the genotype *Dolichomiris linearis* Reut. The genotype was from Addah, West Africa. It is also recorded by Reuter (1912) from Palma, the Madeira and Canary Islands, the Alps-Maritimes of France, and Venezuela. From the latter country it was redescribed by Reuter as *D. tibialis* and from the Canary Islands by Noualhier as *Notostira longula*; these names, as probably that of mine, being synonyms of *D. linearis* Reut.

On December 22 and 27, 1926, I found this mirid in numbers on flowers of the Natal grass, *Tricholæna rosea* Nees, growing in open sandy woodland about one-fourth mile back of the bay front near Dunedin, Fla. Prof. Paul Weatherwax informs me that the original home of this introduced grass was in South Africa, but that it is now widely distributed in tropical and semi-tropical regions. It has been known in Florida since 1884. There is, therefore, little doubt but that this grass is the true and original host plant of the mirid and that together they have journeyed far and wide across the seas.

652 (—). TRIGONOTYLUS LONGICORNIS Blatchley.—Additional examples of this species were taken in December, 1926, from the tall grasses of tide-water marshes near the bay front at Dunedin. Both this and the preceding probably occur only in the immediate vicinity of salt-water.

673 (920). NEUROCOLPUS NUBILUS (Say).—My first and only Florida example of this common northern mirid was taken at Royal Palm Park, March 25, 1927, while beating the foliage of white bay. It is a female, 11.8 mm. in length, a uniform pale dull yellow throughout, the only deviation from this color being in the antennæ, joint 1 being sprinkled with reddish dots, 2 with apical third dull red, 3 and 4 pale yellow. The tibiæ lack the fuscous rings of typical *nubilus*, and the upper surface is much more densely, coarsely, and conspicuously pubescent, the tufts of hairs on basal half of pronotum being especially notable. The larger size and other characters mentioned are believed sufficient to justify the varietal name *flavescens*, which I therefore give it.

682 (971). GARGANTUS FUSIFORMIS (Say).—A single example was taken at Dunedin, Fla., on April 27. Recorded elsewhere in that State only from Jacksonville and Crescent City.

716 (934). *PHYTOCORIS EXIMIUS* Reuter.—On Sept. 5, 1927, this widely distributed phytocorid was beaten by scores from the foliage of a hedge-row of *Spirea van-houttei* Zabel, on the banks of White River, eight miles north of Indianapolis.

— (—). *Phytocoris radicola* new species.

Elongate, slender, sides subparallel. Pale brownish-yellow, thinly clothed with suberect yellowish hairs; basal half of pronotum faintly tinged with fuscous; scutellum lemon-yellow; corium with an oblique brown dash in front of middle and a shorter one near inner apical angle; cuneus with extreme tip and two small dots on inner margin, piceous; membrane pale fuscous, the veins yellowish; hind femora dull yellow with a very faint darker ring at apical fourth. Beak reaching first ventral, its tip piceous. Joint 1 of antennæ dull yellow, one-sixth longer than width of head across eyes; 2 yellow, its apex fuscous, two and a third times as long as 1; 3 and 4 fuscous, 3 one-half the length of 2, 4 two-fifths as long as 3. Sides of elytra straight and parallel to apical fifth, thence broadly curved into the rounded tips. Length 4.2 mm.

Crawford Co., Ind., August 30; swept from roadside herbage. Belongs in Group IV, p. 724 of the "Heteroptera," but differs from other members by its nearly uniform pale color and arrangement of piceous markings of upper surface.

743 (961). *CREONTIADES FILICORNIS* (Walker).—As shown in the footnote to page 884 of the "Heteroptera," this is a *Eustictus* and is the same as *Eustictus grossus* (Uhler), Walker's name having priority. This information was not received from W. E. China until after the page treating of the species of *Creontiades* had been printed. Not having Walker's unique type for examination, I followed Distant and Van Duzee in treating it as a *Creontiades*.

835 (919). *PARAXENETUS GUTTULATUS* (Uhler).—Twenty or more examples of this usually scarce species were taken, August 27—September 1, by beating foliage of dogwood and wild grape growing in a fence row along the river lowland in Marion Co., Ind.

839 (1186). *SEMIUM HIRTUM* Reuter.—Posey County, Ind., Sept. 22, is a new station record for this species, hitherto recorded from that state only from Marion Co.

849 (—). *PILOPHORUS BRIMLEYI* Blatchley.—This species was described before I had opportunity to study the generic de-

scription of *Barberrella* Poppius, his paper not being available to me until July 19, 1926. Knight, in his description of *Barberrella apicalis* (Hemiptera of Connecticut, p. 657), gave no characterization whatever of the genus *Barberrella* except three lines of a brief key. In a letter received from C. S. Brimley dated Sept. 8, 1926, he wrote: "Dr. Knight has been here and examined the type specimen of your *Pilophorus brimleyi*. He said it belonged to the genus *Barberrella* and was apparently new." Later,<sup>3</sup> Dr. Knight reversed this opinion and made *brimleyi* a synonym of his *apicalis*. Until the types of the two specific names can be compared I prefer to call the specimen I described *Barberrella brimleyi* (Blatch.).

856 (1131). *PILOPHORUS AMÆNUS* Uhler.—According to Knight<sup>4</sup> my Fig. 179 represents *P. strobicola* Kngt and not *P. amænus*. Dr. Drake informs me that this error was due to Knight having erroneously determined for him the species taken at Cranberry Lake, N. Y., and mentioned in my text as *amænus*. No mention of this error was on record at the time my text was prepared. Knight, loc. cit., states that *P. amænus* breeds only on the Jersey or scrub pine, *Pinus virginiana* Mill.

— (—). *Ceratocapsus insperatus* new species.

Elongate, slender, sides parallel. Black, feebly shining, basal fifth of pronotum and basal half of clavus sometimes slightly paler; membrane dusky translucent, distinctly iridescent; femora piceous-brown, antennæ and legs a paler brown. Eyes of male very large and very coarsely granulated, distinctly wider than interocular area. Beak reaching hind coxæ. Joint 1 of antennæ as long as width of vertex; 2 visibly thickened from base to apex, three and a half times as long as 1; 3 and 4 subequal in length, united three-fourths the length of 2, 4 fusiform, slightly stouter than 3. Upper surface not visibly punctate or alutaceous, the elytra only very sparsely pubescent with fine scattered erect black hairs. Length 5 mm.

Described from two males taken at Dunedin, Fla., March 18–20, at porch light. Belongs under *e.* of the key to Group I, p. 821. Allied to *C. modestus* (Uhler) but longer, more parallel, with much larger eyes, narrower vertex and different relative

<sup>3</sup> Bull. Brooklyn Ent. Soc., XXII, 1927, 102.

<sup>4</sup> Bull. Brooklyn Ent. Soc., XXII, 1927, 103.

lengths of antennal segments. One of the males was recorded as *modestus* on p. 823 of the "Heteroptera." The Florida record of that species is therefore to be eliminated.

951 (1073). *HALTICOTOMA VALIDA* Reut.— Knight has recently recorded<sup>5</sup> this species from South Carolina, Tennessee, Mississippi and Gainesville, Fla. It occurs in the east on the flowers of Spanish bayonet and other cultivated species of *Yucca*.

*HEMISPHERODELLA* Reuter, 1908, 297.

Small semiglobose black species possessing in great part the characters of the subfamily Bryocorinæ, as given on page 866 of the "Heteroptera," and having the head strongly transverse, but slightly narrower than base of pronotum, its front almost vertical; antennæ slightly longer than body, joint 1 as long as width of vertex, 3 and 4 subequal, each one-third longer than 2; pronotum transverse, convex, without a collar, calli prominent, almost reaching the side margins, the disk impressed in front and behind them; scutellum very large, as long as pronotum, equilateral; elytra wholly coriaceous, as long as and closely embracing the sides of abdomen, clavus, cuneus and membrane not differentiated but merged with the corium, the latter with inner margin strongly angulate at middle, serrate in front of the angle, concave behind it, thus surrounding and leaving exposed a lanceolate middle piece (the "metadorsum" of Reuter). This, in reality, is composed of the heavily chitinized sutural margin of each of the inner wings which are thus elevated to form what Reuter mistook for a longitudinal median carina; legs very long and slender, tibiae without spines, finely pilose. But one species is known.

— (—). *HEMISPHERODELLA MIRABILIS* Reuter, Wiener Ent. Zeit., XXVII, 1908, 298.

Black, glabrous, shining; beak, cheeks, antennæ and legs a uniform whitish yellow; under surface pale brown. Head and pronotum in front of calli almost smooth; pronotum behind the calli, scutellum, metathorax and elytra rather coarsely and closely punctate; basal half of elytra (corium) each with three vague, smooth, obtuse diverging ridges. Length 1.5—2 mm.

<sup>5</sup> Can. Ent., LIX, 1927, 37.

This very aberrant little mirid, here for the first time recorded from this country, was described by Reuter from specimens taken at Cayanos, Cuba, by E. A. Schwarz, and at St. Domingo by Aug. Busek. On April 3, 1925, I took a number of specimens by beating the foliage of moonvine, *Ipomœa bona-nox* L., at Royal Palm Park, Fla. Some of them, as No. 35, were sent H. H. Knight for naming. He returned them as "nymphs of *Halticus*." While they were apparently far different in form of body and long pale legs from any *Halticus* known to me, I accepted his determination and did not include them in my "Heteroptera." In December, 1926, after that work was published, I again swept the little bug in numbers from the foliage of sweet potato, *Ipomœa batatis* Lam., growing in low moist mucky soil near Dunedin, Fla. All stages were taken and the adults were quickly recognized as such. Not having the necessary literature for their identification, I, this time, sent specimens to E. P. Van Duzee who, after some time, found the description of Reuter as cited above. The insect probably occurs on various species of *Ipomœa* to which genus of plants it is apparently confined. In its form of body, peculiar elytra and presence of the so-called "metadorsum" it differs widely from any of our eastern Miridæ, and the genus should probably be given subfamily rank.

971 (1092). *FULVIUS IMBECILIS* Knight.—The known eastern range of this species has been extended by records of Knight (1927, 37) to include Virginia, Illinois, Tennessee, Alabama and Gainesville, Fla.

1015 (1116). *MACROLOPHUS SEPARATUS* (Uhler).—A single example of this species was taken in Marion Co., Ind., Sept. 11, 1926, while sweeping herbage in dense woodland. Recorded in that State only from Lake County.

Knight has recently published a Key to the North American Species of *Macrolophus*<sup>6</sup> and described two new species, one of which, *longicornis*, is a synonym of my *C. tenuicornis*, page 913 of the "Heteroptera." He gives its distribution as Branford, Conn., Cranberry Lake and Wanakena, N. Y., and Muskoka Lake District, Ontario.

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<sup>6</sup> Ent. News, XXXVII, Dec., 1926, 313-316.

— (—). *MACROLOPHUS BREVICORNIS* Knight, loc. cit., p. 315.—Length 3.6 mm. “Differs from *separatus* Uhler in having a fuscous stripe behind dorsal margin of eye; antennal segment II with apical one-fourth blackish; basal two-thirds of corium without fuscous points at base of hairs except one row bordering claval suture.” (*Knight*).

Ranges from New Jersey and Maryland, west to Iowa and Kansas.

*AMBLYTYLUS* Fieber, 1858, 325.<sup>7</sup>

This genus of the subfamily Phylinae and tribe Oneotylini compromises small elongate mirids having the head pentagonal or subconical, almost horizontal; tylus very prominent, projecting beyond the blunt tips of cheeks; loræ long, pointed, narrow; antennæ inserted between the eyes and base of cheeks; eyes small, subglobose, widely separated, contiguous with front margin of pronotum; beak reaching or surpassing hind coxæ; xyphus triangular, arched, its edges carinate; pronotum transverse, subtrapezoidal; scutellum triangular, equilateral; mesoscutum narrowly exposed. Elytra reaching apex of abdomen, female, slightly surpassing it, male; joint 2 of hind tarsi slightly longer than either 1 or 3, tarsal claws divaricate, pseudarolia attached to the claws along their full length but not projecting beyond their tips.

The genus belongs under *aa* of the key, page 918 of the “Heteroptera,” and differs from *Lopus* in the longer subporrect head, prominent tylus, short blunt cheeks, less broadly exposed mesoscutum and shorter pseudarolia. A half dozen or so species are known from southern Europe, and the first one taken in this country is herewith described.

— (—). *Amblytylus vanduzeei* new species.

Elongate or elongate-oval. Dull greenish-yellow, fading to straw-yellow with a greenish tinge, thinly clothed with short suberect bristle-like hairs; membrane pale dusky translucent. Joints 1 and 2 of antennæ yellow, 1 slightly passing tip of tylus, one-fifth shorter than width of vertex; 2 slender, cylindrical, three times the length of 1; 3 and 4 more slender, fuscous; 3 but slightly shorter than 2, 4 one-third as long as 3. Beak

<sup>7</sup> Critirien zur Generischen Theilung der Phytocoriden (Capsini Aut.) Wiener Ent. Monats, II, No. 10, 1858, 289–327; No. 11, 328–347.

reaching second ventral. Thorax one-half wider at base than apex, sides straight, gradually converging from base to apex, their margins narrowly explanate, feebly reflexed, hind angles rounded; disk shallowly, almost invisibly, punctate, transversely impressed in front of middle; calli small, well separated, placed obliquely in the depression. Elytra elongate-oval, not wider at base than thorax, sides very feebly but visibly curved from base to apex; disk punctate as the thorax, each minute puncture, as there, bearing a short blackish hair. Length 5 mm.

Described from one male taken in Marion Co., Ind., June 9, 1927, by sweeping herbage along a pathway in upland woods, and two females taken June 15 in Brown Co., Ind., in a similar habitat. Named in honor of the eminent North American hemipterist, E. P. Van Duzee, of San Francisco, Cal., who cited me to the literature descriptive of the genus.

1090 (1244). *PSALLUS VARIABILIS* (Fallen).—My inclusion of this European species in the "Heteroptera" was based on the records of Van Duzee (1889, 4; 1894, 179). Knight (1927, 104) states that the Van Duzee specimens were wrongly determined and that *variabilis* probably does not occur in this country.

— (—). *Psallus conspurcatus* new species.

Elongate-oval. Head, thorax and scutellum pale lemon yellow without reddish or darker markings; elytra pale yellow, everywhere thickly flecked with very small brownish spots, from which arise suberect blackish hairs; inner margin of cuneus with two oblong fuscous dashes; membrane pale yellow, thickly mottled with small fuscous vermiculate marks, the outer half with a pale spot opposite apex of cuneus, this followed by two wedge-shaped fuscous spots; femora pale yellow, flecked with very minute brownish dots; tibiae yellow with conspicuous black dots at base of each spine. Antennæ very slender, wholly pale yellow, joint 1, one-half as long as width of vertex; 2 five times as long as 1; 3 one-half the length of 2, 4 two-fifths as long as 3. Length 3 mm.

Type a male taken at Royal Palm Park, Fla., April 18, 1927, by sweeping grasses in a swale of the Caribbean pine woodland. Allied to *P. seriatus* (Reut.) but head and pronotum without dark spots, membrane with different markings and second antennal much longer and more slender.

— (—). *PSALLUS BALLI* Knight, Can. Ent., LVIII, 1926, 253.—"Distinguished from the known eastern species by the



pale yellow to orange color and conspurcate character of the membrane; more strongly red on pronotum, scutellum and cuneus; apical half of clavus infuscated; length 3.5 mm." (*Knight*).

Described from Sanford, Fla., and Charleston, Miss.

1098 (1268). *CYLLOCEPS PELLICIA* Uhler.—*Knight* states<sup>s</sup> that the type of this species in the U. S. National Museum shows it to belong to the genus *Cyrtorhinus*. Its name should therefore be *Cyrtorhinus pellicius* (Uhl.).

1100 (—). *EXCENTRICUS MEXICANUS* Van Duzee.—Another example of this little western species was taken at Dunedin, January 4, 1927, by beating juniper.

— (1272). *RHINACLOA FORTICORNIS* Reuter, 1876, 89.—Differs from *R. subpallicornis* *Knight* in the smaller size (1.8 mm.), darker color, the elytra being fuscous, paler at base of corium and on clavus; membrane blackish with veins testaceous; second antennal wholly dark.

This species was described from Texas and recorded by Barber (1914, 500) from Lake Worth and Biscayne Bay, Fla. I did not include it in the "Heteroptera" as I supposed that Barber's records referred to *subpallicornis*. *Knight* (1927, 36) has recorded *forticornis* from Urbana, Ill., and many points west of the Mississippi.

\* \* \* \* \*

Since those pages of the Heteroptera embracing the family Miridae were in type, Dr. H. H. *Knight* has issued 11 papers which include descriptions of a number of new species and records of others from the territory covered by my work. It is not feasible in this paper to include descriptions of his new species, but the title of each of his papers in the order in which they appeared, and the names and distribution of those eastern species not previously mentioned in this paper, is given. The student interested can thereby keep trace of the eastern species and, if he so desires, refer to the descriptions in the papers cited.

I. "Descriptions of Eleven New Species of *Phytocoris* from Eastern North America." (Bull. Brooklyn Ent. Soc., XXI, Oct. 6, 1926, pp. 158-168.)

<sup>s</sup> Bull. Brooklyn Ent. Soc., XXII, 1927, 105.

Describes *Phytocoris borealis* from Gull Lake, Ontario and Jamestown, N. Y.; *P. albifacies* from Agricultural College, Miss.; *P. oppositus* from Aberdeen, Miss.; *P. schotti* from Bound Brook, N. J.; *P. albitylus* (No. 712 of the Heteroptera) from Dunedin, Fla.; *P. exemplus* from Colyell, Louisiana; *P. angustifrons* (No. 731 of the Heteroptera) from Dunedin, Fla., Colyell, La., and Aberdeen, Miss.; *P. signatipes* from Silver Springs, Fla.; *P. taxodii* from Colyell and Sheriden, La., Okefenokee Swamp, Ga. and Durant, Natchez and Vicksburg, Miss.; *P. rubellus* (No. 738 of the "Heteroptera") from Laporte Co., Ind., and various stations west of the Mississippi, and *P. balli* from St. Augustine, Fla.

II. "*Capsus externus* Herrich-Schäffer is a *Paracalocoris*." (Ent. News, XXXVII, Oct. 15, 1926, pp. 258-262.)

Describes from Florida and Georgia vars. *solutus*, *scissus*, *totus* and *notatus*, all "spotted-dog" color varieties of *Paracalocoris externus* (H. S.), the species I treat as No. 675, *P. incisus* (Walk.), p. 695 of the Heteroptera.

III. "Descriptions of Six New Miridæ from Eastern North America." (Can. Ent. LVIII, Oct. 30, 1926, pp. 252-256.)

Describes *Plagiognathus tiliae* from District of Columbia, Washtenaw Co., Mich., and St. Paul, Minn.; *Psallus balli* from Sanford, Fla., and Charleston, Miss.; *Teleorhinus floridanus*<sup>9</sup> (No. 1017 of the Heteroptera) from Dunedin, Fla.; *Strongylocoris pallipes* from Beaufort, North Carolina and North Beach, Maryland; *Platytytellus zonatus* from Cheboygan Co., Mich., Wisconsin and other points west of the Mississippi, and *Platytytellus confraternus collaris*<sup>9</sup> (No. 660, var. of the "Heteroptera") from Ormond and Gainesville, Fla.

IV. "On the Miridæ in Blatchley's 'Heteroptera of Eastern North America,'" (Bull. Brooklyn Ent. Soc., XXII, April 28, 1927, pp. 98-105.)

No new species were described in this paper, but the names and range of some were changed or extended as noted on the foregoing pages.

V. "Notes on the Distribution and Host Plants of some North American Miridæ." (Can. Ent., LIX, 1927, 34-44.)

<sup>9</sup>Since this paper did not appear until after the "Heteroptera" was issued, these two forms will probably have to be accredited to me.

This paper gives records extending the former known range of a number of species of Miridæ treated in the Heteroptera. Some of these extensions are noted on the preceding pages. Four species are recorded from east of the Mississippi, which were not included in my work. These are:

*Platytylhellus atripennis* Reuter, formerly known only from Texas and Colorado, recorded from Florida and Coal Creek, Tenn.; *Phytocoris brevisculus* Reut., a Texan species, recorded from Eufaula, Alabama and District of Columbia; *Cyrtopeltocoris (Sericophanes) albofasciatus* Reut., also a Texan species, now known from Eufaula, Alabama, and *Lopidea minor* Knight, a northwestern species, recorded from Ithaca, N. Y.

VI. "Descriptions of Nine New Species of *Melanotrichis* Reuter from North America." (Can. Ent., LIX, 1927, 142-147.)

The Genus *Melanotrichus* comprises the *flavosparsus* group of *Orthotylus* and is distinguished by having two types of pubescence, viz., simple hairs intermixed with recumbent scale-like pubescence, and by the left genital clasper of male being a simple curved hook, not bifurcate into two equal parts as in typical *Orthotylus*. According to Knight it includes the following species treated in the "Rhynchophora"; *O. althææ* Hussey, *catulus* Van D., *concolor* Kirsch. and *flavosparsus* Sahlb. The types of *M. leviculus*, one of the nine species described by Knight in the paper cited, were from Sea Cliff, N. Y., the other species being from the western states and British Columbia.

VII. "Megalopsallus, a New Genus of Miridæ with Five New Species from North America." (Annals Entom. Soc. of Amer., XX, 1927, pp. 224-228.)

The Genus *Megalopsallus* differs from *Psallus* in having the head larger, shaped much as in *Lygus* Hahn; pseudarolia absent and characteristic male genitalia. Of the five species described in the paper, one variety, *M. latifrons diversipes*, is recorded from Biloxi, Miss., and one species, *M. brittoni*, from Westville, Conn., the other four species being from the western states.

VIII. "New Species and a New Genus of *Deræocorinæ* from North America." (Bull. Brooklyn Entom. Soc., XXII, 1927, pp. 136-143.)

In this paper Knight describes *Deræocoris triannulipes flavisignatus* from Marquette, Mich., and *Eurychiloptera brunneata* from Clay City, Ill.

IX. "Descriptions of Seven New Species of the Genus *Orthotylus* Fieber." (Can. Ent., LIX, pp. 176-181.)

Describes *O. ramus* from Mercer Co., Ohio, Berrien Co., Mich., and Ithaca, N. Y.; *O. ulmi* from Batavia, Ithaca and Wanakena, N. Y., and Ottawa, Ontario, and *O. nyctalis* from Cranberry Lake, N. Y. He also records *O. lateralis* Van D., formerly known only from Kansas and Colorado, from Willow Springs, Ill., where it was taken on poplar by Gerhard.

X. "Descriptions of Fifteen New Species of *Ceratocapsus*." (Ohio Journal of Science, XXVII, 1927, pp. 143-154.)

Describes *Ceratocapsus taxodii* from various points in Illinois, Tennessee, Mississippi and Florida; *C. bifurcus* from Miami and Cocoa, Fla.; *C. rubricornis* from Agricultural College, Miss.; *C. divaricatus* from Sanford, Fla.; *C. balli* from Sanford and Gainesville, Fla.; *C. uniformis* from various points between Virginia and Missouri; *C. quadrispiculus* from Maryland and Louisiana; *C. complicatus* from Maryland, Florida, Missouri and Mississippi; *C. fuscusignatus* from Florida and southwestern states; *C. barbatus* from Virginia and Maryland and *C. mcateei* from Maryland.<sup>10</sup>

XI. "Descriptions of Twelve New Species of *Miridæ* from the District of Columbia and Vicinity." (Proc. Biol. Society of Washington, XL, 1927, pp. 9-18.)

Describes *Sthenarus mcateei*, *Microphyllellus minuendus*, *Plagiognathus carneolus*, *P. albifacies*, *P. crocinus*, *Psallus clavicornis*, *Diaphnidia heidemanni*, *Xenoborus chionanthi*, *Dichrooscytus tinctipennis*, *Phytocoris junipericola*, *P. purvus* and *P. difficilis*, all from the District of Columbia or states adjoining. The *Sthenarus* is recorded also from Mississippi, the *Plagiognathus albifacies* from Illinois and the *Dichrooscytus* from Georgia and Minnesota.

<sup>10</sup> In many of the descriptions in this paper the characters are compared with other species previously described by Reuter and Knight, and unless correctly determined examples of these older species are at hand, such parts of the descriptions are worthless. See my paper on "Passing the Buck in Insect Descriptions," Ent. News, XXXIX.

## Family HYDROMETRIDÆ

— (—). *HYDROMETRA MYRÆ* Torre-Bueno.—This species has been recently described from Billy's Island, Okefenokee Swamp, Ga. Bueno states<sup>11</sup> that it differs from *H. martini* Kirk. in its more slender body, different relative length of antennal segments (2 being  $2\frac{1}{2}$  times the length of 1 and subequal to 4, whereas in *martini* it is only twice as long as 1 and about four-fifths as long as 4), and in having the terminal abdominal segment of male suddenly widened and with a long black spine.

## Family VELIIDÆ

1125 (1303). *MICROVELIA BOREALIS* Bueno.—Numerous examples of the wingless form of this species have recently been taken from small ponds and ditches near Dunedin, Fla., in March and April. It has not before been recorded south of New Jersey and Kansas. The Fig. 198, page 990 of the "Heteroptera," reproduced from Hungerford as representing *borealis*, is in reality that of *hinei*, the species having been wrongly identified by that author.

1126 (1306 $\frac{1}{4}$ ). *MICROVELIA ATRATA* Bueno.—A single wingless example of this little dark species was taken at Dunedin on January 19, while sifting weed debris some distance from water. Hitherto known only from Billy's Island, Ga., and Royal Palm Park, Fla.

1129 (1304). *MICROVELIA ALBONOTATA* Champion.—Taken by scores from the water of a boxed-in hillside spring near Dunedin, Fla., February 8, 1927. But one macropterous example was among the lot. This is the first definite station record for Florida, though both Van Duzee and Bueno mention the State as within its range.

## Family SALDIDÆ

— (1326). *SALDULA EXPLANATA* Uhler, (Proc. Ent. Soc. Wash., II, 1893, 383.)

Broadly oval or subelliptical, finely and sparsely pubescent. Head, thorax and scutellum black, rather strongly shining, with-

<sup>11</sup> Entomologica Americana, VII (N. S.), Dec., 1926, 110.

out pale markings, elytra black, subopaque, a small whitish spot near apex of clavus, four on discoidal area and two behind middle of costal area; membrane dull yellow with an oblong median black spot in each cell. Pronotum with sides feebly curved, their margins flattened, but little reflexed. Costal area of elytra with basal half wide, the margins strongly reflexed. Length 4-5 mm.

A single specimen is at hand, taken on the top of Whiteface Mountain, New York. It is a northwestern species described from Utah and recorded from California, Idaho and British Columbia, but not before from the eastern states. Resembles *S. orbiculata* (Uhl.) in size and shape but costal area wider, more reflexed and wholly black except two postmedian pale spots.

— (—). *Micranthia pumpila* new species.

Oblong-oval. Head pronotum and scutellum black, shining; clavus and inner half of corium black, opaque, without white marks except a minute dot each side of middle of commissure; embolium and costal area of corium dull white, with a small black triangular projection from corium just behind middle and usually another in front of middle; membrane dull white, the veins and one or two vague spots in each cell fuscous, legs pale dull yellow, the knees, tips of tibiae and apex of tarsi usually darker; under surface black, thickly clothed with fine short prostrate hairs, the last ventral paler; upper surface more thinly clothed with similar metallic yellow hairs. Antennae fuscous-brown, joint 1 scarcely longer than width of vertex, 2 twice as long as 1, 3 and 4 subequal, each stouter and slightly longer than 2. Beak reaching base of mesosternum. Eyes very large, wider than interocular area. Length 2.2-2.5 mm.

Type a male taken at Royal Palm Park, Fla., April 6, 1927. Paratypes from Dunedin and Ft. Myers, Fla., February 19—April 26. Frequent at both the latter stations on the mucky borders of dry wet-weather ponds in open pine woods. Distinguished from the northern *M. humilis* (Say) by its much smaller and narrower form, lack of white spots on corium, larger eyes and different relative length of antennal segments.

#### Family NERTHRIDÆ

1168 (—). *GELASTOCORIS SUBSIMILIS* Blatch.—Examples of this species taken near Plant City, Florida, have been received from C. H. Martin, Lawrence, Kans.

## Family CORIXIDÆ

1208 (1437). *ARCTOCORIXA INTERRUPTA* (Say).—Numerous examples of this widely distributed species, taken near Gainesville, Fla., are in the collection of the Agricultural Experiment Station at Gainesville. This is the first record from Florida, and probably the most southern one for the eastern United States.

\* \* \* \* \*

ERRATA IN THE TEXT OF THE HETEROPTERA OF EASTERN NORTH  
AMERICA

## Page

35. Second line of *b* of key, "dorsal" should be "ventral."  
498 and 500. Nos. 472 and 476, change "Leptophya" to  
"Leptoypa."  
736. No. 747. Replace dash in parenthesis with "992."  
911. Fifth line. "Wods" should be "woods."  
1087. In the last two columns of the table, after Family XXVI.  
Isometopidae, "4" should be "5."





A NEW GENUS AND SPECIES OF COREIDÆ FROM  
THE WESTERN STATES (HEMIPTERA-  
HETEROPTERA)

H. G. BARBER

ROSELLE, N. J.

*Nisoscolopocerus* new genus

Pterygo-dimorphic. Roughly granulated or apiculate and hispid. Head nearly quadrate, shorter than pronotum; antenniferous tubercles slightly prominent, porrect; tylus anteriorly strongly deflexed; anteoocular lateral margin a little over twice as long as the posterior ocular margin, the latter somewhat tumid and beset with two or three small hispid tubercles. Eyes not very prominent. Ocelli tumid, placed on a line drawn across posterior margins of eyes; spaced a little further apart than their distance from the eyes. Antennæ with the basal segment much incrassate, porrect, longer than the head, densely apiculate and hispid; second and third segments much more slender, fourth segment strongly incrassate. Bucculæ extended midway through the head, reaching as far back as anterior line of the eyes. Apex of the rostrum attaining intermediate coxæ; basal segment extended to posterior line of the eyes, second segment subequal to length of basal segment. Prosternum posteriorly, mesosternum and metasternum anteriorly, sulcate. Pronotum in macropterous forms wider than long; anterior and humeral angles unarmed, the latter obtuse; provided anteriorly with an indistinctly depressed collar; impressed lateral edge of the pronotum not reaching to anterior margin; posterior margin slightly concavely arcuate before base of scutellum. Legs terete, unarmed; tibiae obsoletely sulcate; tarsi with basal segment subequal to the second and third segments taken together. Posterior coxæ rather widely separated, the space between them about one-half the distance the coxæ are placed from the lateral margin of the pleuræ. Odoriferous orifices with the rim calloused and interrupted at apex. Posterior margin of the metapleura rounded, the outer angle obtusely rounded. Scutellum a little longer than wide, nearly equal to the length of commissure. In macropterous forms with costal margin of corium gently rounded, veins on surface strongly tumid; the posterior margin straight. Membrane not reaching to apex of the abdomen (macropterous), provided with numerous anastomosing sinuous nervures rising directly from apical margin of corium. Lateral margins of the abdomen strongly flaring; posterior margins of the third and fourth tergal segments strongly convexedly arcuated in the middle; genital segment of male truncate or very slightly sinuate in the middle; posterior angles of the sixth segment obtusely rounded, not extended beyond the

genital segment. In the female the last genital segment is strongly obtusely sinuate in the middle, the obtuse angles of the first genital not extended beyond the last genital. Venter with the first, second and third incisures straight in the middle, curved towards the sides. Spiracles set mid-way on the segments, closer to the side margins than to either segmental incisure.

Type of the genus: *N. apiculatus* n. sp. (= *Dasycoris humilis* Uhler 1875 not Uhler 1872.)

The only member of this genus so far known bears a rather close general resemblance to members of the *Arenocorinæ* (*Pseudophloeninæ*), but as pointed out by Dr. R. F. Hussey in 1922 this must be placed in the subfamily *Coreinæ* next to the genus *Scolopocerus* with which it agrees in many particulars of structure. The character of the odoriferous orifices and the position of the spiracles are as in that genus, but the veins of the membrane arise directly from the apical margin of the corium and the basal segment of the antenna is much longer than the head and the surface of dorsal parts is thickly studded with minute hispid tubercles. P. R. Uhler in the Fifth Annual Report U. S. Geological Survey published in 1872, p. 403, described *Dasycoris humilis* from several western states. In 1875 in Wheeler's Survey of the 100th, Meridian p. 834, Uhler mentions "the curious short winged form of *Dasycoris humilis* and figures it on Plate XLII fig. 8. The figure though poor can be recognized as having nothing to do with his former *D. humilis* and it has remained undescribed up to the present time.

***Nisoscolopocerus apiculatus* new species.**

Color fusco-cinereous, paler below. Roughly granulate and in great part finely apiculate and hispid. The subquadrate head furnished with a median longitudinal paler stripe, distinct only in fresh specimens; anteoocular margins infuscated, the outer apical angle acute, porrect, extended forward nearly as far as apex of tylus; the latter strongly deflexed in front. Antennæ with the first three segments and apical part of terminal one cinereous; the elongate incrassate basal segment attenuated at base, one-third longer than the head, densely apiculate and hispid; second and third segments subequal, very much more slender and finely hispid; the terminal segment subpyriform, acuminate at apex, more than basal half black, finely hispid, the apical part finely pilose. Legs terete and mutic, hispid, cinereous maculate with scattered fuscous spots. Each of the pleurites provided with a black sunken pit midway between acetabuli and lateral margins;

outer apical angle of metapleura obtuse. Pronotum is a trifle wider than long (macropterous), about twice as wide across humeral regions as the diameter of the anterior margin, this presenting a flattened area suggesting a collar but not separated off by a distinct incised line; nearly the anterior third depressed and provided with four short broad, shallow longitudinal excavations which do not reach to the anterior margin; posterior disk more elevated, with a broad longitudinal central sulcation and a narrower and more shallow sulcation just within the outer margins leaving this margin some what elevated and beset with small rounded tubercles some of which are hispid at apex; this lateral margin nearly straight; anterior angles not projected; humeral angles rounded, obtuse; posterior margin very slightly concave before the base of the scutellum. Scutellum a little longer than wide with margins and apex callously elevated leaving a broad shallow impression on the central disk; apex obscurely pale. Clavus wide, declivous, provided with three or four irregular rows of small tubercles each beset with a small bristle; commissure a little longer than the scutellum. Corium sparsely covered with small hispid tubercles, its outer margin gently rounded from base to apex, the latter reaches nearly to apical margin of the fourth abdominal incisure veins strongly tumid. Membrane sordid white, not quite reaching apex of abdomen provided with numerous, irregular, wavy anastomosing veins arising directly from the apex of the corium. Abdomen oval in outline; connexival margins of abdomen flaring, much exposed beyond margins of the corium; apical angles of segments not projected; the incisures and middle fascia on each segment obscurely pale; apical margins of the third and fourth segments in the middle posteriorly strongly arcuated. Venter pale cinereous, with a small black depression on segments 2 to 6 set midway between central line and the lateral edge; incisures between the second and third segments sinuate in the middle. Hypopygium of the male seen from below almost circular in outline but slightly truncate posteriorly; the lateral lobes of the sixth segment obtuse and extended back on a line with the posterior margin of genital segment.

*Brachypterous form.* Pronotum scarcely wider than long, densely beset with setigerous tubercles; compressed posteriorly so as to be nearly parallel sided; pleura somewhat visible from above; disk longitudinally depressed through the middle and provided with a slight carina which disappears before the posterior margin. Scutellum flatter than in the macropterous form but somewhat elevated posteriorly; provided with an evident longitudinal median carina and recumbent setigerous tubercles. Clavus much narrower than in the long winged form. Hemelytra much abbreviated with roughened elevated veins reaching to apex of second abdominal segment; costal margin strongly rounded from base to apex, apical margins of the two coria are nearly opposed to each other, only slightly divaricate behind the claval commissure, this space occupied by the very much abbreviated membrane which is not quite as wide as the diameter of the clavus. Abdomen broadly oval, flaring, the lateral margins strongly recurved; the whole

surface densely covered with setigerous tubercles; the apical margins of the third and fourth segments posteriorly strongly arcuated in the middle. Female with the sixth abdominal segment twice as wide as long, posterior angles prominent, obtuse. Seventh (1st. genital) four times as wide as long, with the posterior angles produced into subacute lobes extending somewhat beyond the angles of the sixth. Eighth (2nd genital) somewhat deeply incised in the middle, its short, obtuse lateral lobes extending but little beyond the angles of the seventh. Ventrally—the sixth segment is deeply, acutely incised in the middle; the central disk of which is furnished with a strongly depressed V shaped area the carinate arms of which do not reach the posterior margin of the segment.

Length 9–9.5 mm.; diameter of pronotum 2.6 (macrop.); 1.85 mm. (brach.)

Type (macropterous): Male—Ft. Collins, Colorado, Aug. 22, 1900 (E. D. Ball).

Type (brachypterous): Male—Ft. Collins, Col., Aug. 22, 1900 (E. D. Ball).

Paratypes: (All brachypterous); Males—2 Denver, Col. (U. S. N. M., Uhler Coll.); 1 No data (E. D. Ball). Females—1 Kimball, Nebr., Aug. 5, 1899 (E. D. Ball); 1 Northern Col. (E. D. Ball); 2 Colorado (U. S. N. M., Uhler Coll.); 2 Colorado (U. S. N. M., Baker Col.); 1 Colorado Springs, Col., June 15–30, 1896, EL. 6000 to 7000 Ft. (H. F. Wickham); 1 Medicine Hat, Alberta, Apr. (From H. M. Parshley.)

## THE CICADAS OF PORTO RICO WITH A DESCRIPTION OF A NEW GENUS AND SPECIES

BY W. M. T. DAVIS

STATEN ISLAND, N. Y.

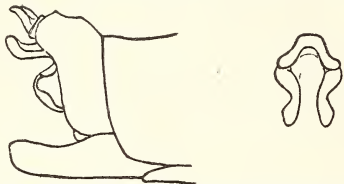
Anything written about the cicadas of Porto Rico at this time must be in the nature of a preliminary article. But two species can surely be credited to the Island, whereas there are no doubt several others to be found. The writer has examined a much broken female *Tibicen*, closely allied to *lyricen* of continental North America, received from the University of Porto Rico. Prof. Stuart T. Danforth writes concerning it: "The big cicada I did not collect personally, so I would not want to state surely that it was collected at Mayaguez; it was in with a lot of other insects collected here so the assumption was that it was too." In the writer's collection there is a male cicada supposed to have come from Porto Rico, that closely resembles *Odopoea dilata* described from Jamaica by Fabricius. As it is likewise a lone specimen without authentic data, it, like the preceding, can not be recorded. It may be stated, however, that *Distant* records *dilata* from the "Antilles" in "Genera Insectorum," 1914, but Mr. China has found no specimens of the species from Porto Rico in the collection of the British Museum.

The neighboring large island of Haiti has six species of cicadas known to the writer, and there are no doubt others. So it may be that the species of cicadas here recorded from Porto Rico will ultimately be doubled in number. The two species mentioned are the same as those recorded in "Insectae Portoricensis," a preliminary annotated check list of the insects of Porto Rico, by George N. Wolcott, *Journal of the Department of Agriculture of Porto Rico*, Vol. VII, January, 1923.

From the records it appears likely that a cicada may be taken in Porto Rico on any day of the year. *Proarna hilaris* seems to be most common from October to May, while *Boreneona aguadilla* has been collected from May to August.

The writer is indebted to Prof. G. N. Wolcott and to Prof. Stuart T. Danforth for the loan of specimens, also to Mr. Charles W. Leng who visited Porto Rico in February, 1927. Mr. W. E. China has kindly compared specimens in the British Museum.

*Proarna hilaris* Germar. (Plate I. Figs. 2 and 3.)



PROARNA HILARIS GERMAR

From the great similarity of several of the species of *Proarna* inhabiting the Antilles Mr. W. E. China labeled the female from Bayamon, P. R., which I sent to him, *hilaris*? Until more extensive collections are available, and comparisons can be made with Germar's type, this name, the one usually placed on the insect, can stand. The following specimens have been examined: Bayamon, 4 females; Mayaguez, October 4, 1912, female (C. W. Hooker); "12-18-21," male; Quebradillas, October 5, 1922, male (G. N. Wolcott); Ensenada, April, 1924, female, Coll. Cornell University; Mayaguez, May 17, 1927, female (S. T. Danforth); San Juan, February 23, 1927, male (C. W. Leng). This last is here figured.

In "Insectae Portoricensis" this species is recorded from Birds of Porto Rico by Alex. Wetmore, 1916, as being eaten by Mangrove Cuckoo, Ground Cuckoo, Woodpecker, Owl, Petchary, Flycatcher, Kingbird, Vireos, Yellow Warbler, Yellow-Shouldered Black-bird, Oriole and Mozambique. Also collected at light and found at the following localities: Condado, Martin Peña, Vega Alta, Guánica, Quebradillas and Pt. Salinas.

The second species found in some numbers is recorded in "Insectae Portoricensis" as a *Zammara*, and by Wetmore as a *Proarna*, no specific name being given in either instance. While this insect has the sides of the pronotum expanded as in *Zammara tympanum*, the type of the genus, it differs considerably

in genitalia and venation. The first cross vein in *Zammara* slants from the top outwardly, as in most cicadas, and the eighth marginal area has the upper vein ( $Cu_1$ ) arched, which is not so in the Porto Rico species. There does not appear to be any genus into which this species completely fits, but in most respects it is nearer to *Odopœa* than to either *Zammara* or *Proarna*.

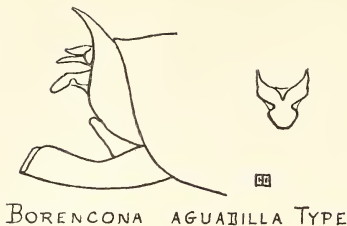
In the *Annals and Magazine of Natural History*, Vol. 6, Ninth Series, November, 1920, Mr. Distant described *Juanaria mimica* from Cuba, both genus and species being described as new and placed near *Odopœa*. Mr. China has procured for me an excellent photograph of the type, which is copied on the accompanying plate, and which we consider to be the *Cicada poeyi* Guer described and figured in *Sagra Hist. de Cuba*, Ins. p. 425 t. xiii, f. 16 (1857). It is also briefly described by Uhler in the *Trans. Maryland Academy of Sciences*, 1892, p. 169, under the name of *Odopœa poeyi*. We think that Distant was justified in placing this peculiar cicada, which Uhler characterized as "the most remarkable of all the species yet discovered in West Indies, if not in all America," in a separate genus. In having the wings nearly opaque the small species here described from Porto Rico resembles *Juanaria poeyi*, but is really more removed from it than it is from some of the other species of *Odopœa*. In our opinion it should occupy a genus to be placed between *Proarna* and *Juanaria*, whereas *Juanaria* with its very much curved  $Cu_1$  and broad abdomen in the male, should be placed nearer *Zammara*.

#### **Borencona** new genus

Body short and robust, and in the male considerably broader below the tympana than any where else. Head small, much narrower than the broad pronotum which has the lateral margins medially angulated. Tympanal coverings imperfect covering only the extreme outer part of the orifices; opercula short, broad and rounded; rostrum reaching the posterior coxæ. Fore wings nearly opaque, with the first transverse vein slanting inwardly toward the body, and not outwardly as in *Odopœa*, *Juanaria* and *Zammara*. Last marginal area with the upper or  $Cu_1$  vein curved as in *Odopœa* and not greatly arched as in *Juanaria* and *Zammara*.

**Borencona aguadilla** new species. (Plate I. Figs. 4 and 5.)

Type male and allotype female from Yauco, August 24, 1922 (Sein and Wolcott). Collection American Museum of Natural History.



Head narrow across eyes, about one half as broad as the pronotum, with the front produced into three lobes between the eyes. These lobes are also present in the *Proarna* from Porto Rico. Pronotum expanded medially angulated into sharp points; posterior angles rounded. Fore wings rounded at the extremities with the front and hind margins considerably curved; transverse fold crossing the wing at the node plainly developed, basal cell long with the front and hind margins nearly parallel and the first cross vein, starting from the basal fourth of the first marginal cell and slanting inwardly toward the body of the insect, instead of outwardly, as is more usual among cicadas. In *Proarna* this vein may slant toward the body or it may be verticle, but it generally starts from the central part of the first marginal cell, instead of from the inner fourth, as in *aguadilla*. Tympana much exposed, especially on the outer part, but not a great deal more so than in *Odopæa walkeri* Guer. from Cuba. Abdomen broadest below the tympanal orifices, the uncus as shown in the accompanying figures. Viewed from above there is a conspicuous notch each side between the second and third abdominal segments due to the expansion of the second segment in the same manner as in the large *Juanaria poeyi*. Opercula short and rounded, not reaching the third segment; last ventral segment rounded at the extremity. Beak reaching the hind femora and fuscous at the tip. Last ventral segment of the female with the hind margin extended into points one each side of the notch, as in many *Odopæa*.

General color brown greenish about the tympana and the margins of the pronotum, with a narrow and irregular darker dorsal stripe extending from the front of the head to the hind margin of the pronotum or collar. This stripe broadens on the mesonotum to the width of the cruciform elevation and is more or less bifid. The abdomen in both sexes has two pruinose curved lines, one on each side in the form of parenthesis; these lines are more curved in the female than in the male. Each abdominal segment is edged narrowly with greenish, and in the female the last two segments are dorsally pruinose. Beneath the abdomen is pale. Both fore and hind wings have all of the veins flecked with fuscous; on the costal margin of the fore wings, the spots are arranged in pairs. The central portions of all of the areas, especially those of the fore wings, are likewise flecked with brown.



## MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body .....	22	21
Width of head across eyes .....	5	5
Expanse of fore wings .....	56	61
Greatest width of fore wings .....	8.5	9

In addition to the above the following specimens have been examined: Mayaguez, July 1, 1912, female (C. W. Hooker); Mayaguez, male and female from Prof. S. T. Danforth; Aibonito, July 16, 1913, female (S. S. Crossman); Lares, August 25, 1922, female (Sein and Wolcott); Mayaguez, May 13, 1927, male (S. T. Danforth).

In "Insectae Portoricenses" this species is recorded from "Birds of Porto Rico" by Alex. Wetmore, 1916, as being eaten by King-bird and Flycatcher. Also taken at light at Aibonito; on coffee tree at Lares and at Corozal in mountains north of Yauco.

This species may be known by its brownish color and pepper and salt appearance; sharp lateral angles to the expanded pronotum, and the inward slant of the first cross-vein.

## PLATE I

- Fig. 1. *Juanaria poeyi* Guer. (*J. mimica* Distant.) (From Cuba.)  
Fig. 2. *Proarna hilaris* Germar. Male  
Fig. 3. *Proarna hilaris* Germar. Female.  
Fig. 4. *Borencona aguadilla*. Type  
Fig. 5. *Borencona aguadilla*. Allotype



CICADIDÆ



BRACHYPTEROLUS PULICARIUS (L.) IN  
AMERICA (NITIDULIDÆ)<sup>1</sup>

BY MELVILLE H. HATCH

*Brachypterolus pulicarius* (L.). Schaeffer, Bull. Brook. Ent. Soc. XXII, 1927, p. 170.—Hervey, Jr. Econ. Ent. XX, 1927, p. 809–814, fig. 381 (life history, larva).

*Heterostomus mordelloides* Notman, Jr. N. Y. Ent. Soc. XXVIII, 1920, p. 29 (1 male, 1 female, Essex Co., N. Y., June 28, 1918).—Leng, Suppl. Cat. Col. Am. n. of Mex., 1927, p. 31.

*Heterostomus pulicarius* (L.). Britten, Jr. Econ. Ent. XV, 1922, p. 311; 24th Rep. St. Ent. Conn. for 1924, 1925, p. 339.—Hatch, Tec. Pub. 17 N. Y. St. Coll. For. XXIV, 1924, p. 297.

*Mordelloides* Notman is said to be distinguished by the failure of the punctuation of the head and propygidium to be finer. I have compared American specimens with examples of *pulicarius* L. and ab. *linariae* Steph. from Moravia and find that the difference, if any, is evanescent. I cite, furthermore, the following evidence that the American examples are cospecific with the European and represent a recent introduction of that species: (1) no records of the species in America previous to 1918; its abundance locally in Mass., Conn., and N. Y. since that date; and its entire absence from other portions of the American continent; (2) the pubescence of American examples is brown, as in European specimens, not gray or white, as in the Siberian *im-mundas* Reitt. or the Turkestanian *dilutipes* Reitt. If the American specimens represented a native species, one would expect them to resemble their Siberian more closely than their European relatives. This is not the case.

<sup>1</sup> Contribution from the Zoölogical Laboratory of the University of Washington.

In America the species is injurious to *Fragaria* (strawberry) but appears to breed only in *Linaria*. In addition, it has been reported from the flowers of dandelion, wild mustard, clover, apple, and panicled dogwood. Specimens have been reported from Boston, Mass., Milford, Conn., Long Island, N. Y., and Albany, Dutchess, Columbia, Essex, Genesee, Greene, Niagara, Onondaga, Rensselaer, St. Lawrence, and Tompkins Counties, N. Y.

## NEW MEMBRACIDÆ, IV

BY FREDERIC W. GODING

Subfamily CENTROTINÆ

*Orthobelus wolcottii* new species.

Shining black, densely and coarsely punctured, with scattering pale hairs, slender in form somewhat resembling *urus* but smaller.

♀. Head triangular, rough, base broadly arcuate, ocelli near and above center of eyes, clypeus long, slender. Pronotum with base prominent, vertical then arcuate backward, median carina pereurrent; suprahumeral nearly straight, gradually acuminate, extended outward, slightly upward and curved very slightly backward, slender, flat, carinate above and below the latter serrate; posterior process base broad, gradually narrowed on basal half then subulate, long as abdomen tip reaching midway between interior angle and apices of tegmina; dorsum sinuate, apical third de-curved. Tegmina pale yellow hyaline, bases narrowly opaque black, coriaceous, punctured, a large clear white spot at bases of radial and 1st ulnar veins, veins fuscous, destitute of cross veins between ulnar veins, all margins very narrowly piceous. Body shining black, a narrow stripe each side of abdomen below and margins of abdominal segments below yellow; there is dense white tomentum below head extended each side to posterior coxæ, also a large patch each side at base of abdomen below. Legs piceous, apical half of middle and hind tibiæ sordid yellow, a row of stiff white hairs each side of all legs, tarsi pale.

Long. cum teg. 7; Lat. 1.2 mm. Habitat: Mt. Puilsboreau, Haiti. (*Wolcott.*)

Dedicated to Mr. G. N. Wolcott of the Service Technique, Haiti.

It differs from *havanensis* and *poeyi* in being much more slender, horns longer and extended differently, and from all other members of the genus in the absence of cross veins between ulnar veins; suprahumeral pointing outward, instead of backward and apically not broadened and abruptly bent as in *urus*.

## Subfamily MEMBRACINÆ

Genus *Leioscyta**Leioscyta rufidorsa* new species.

Fuscous with short pale hairs, a reddish stripe occupying dorsum from anterior angle to and including posterior apex. Head longer than broad.

base straight, clypeus diamond shaped, ocelli slightly nearer and even with center of eyes. Pronotum high and strongly projecting above head, with a percurrent median and 1 lateral carina each side meeting at summit, straight, extended almost to middle of lateral margins behind humerals, several short carinæ extended from median carina on metopidium; dorsum slightly undulate; front lightly, behind densely punctured. Tegmina with basal two-thirds fuscous, apical third opaque yellow. Body and legs concolorous.

Long. cum teg. 7-10; Lat. 3.75-4 mm. Habitat: Baños, Azogues, Tena, Chanoguero, Ecuad. (*Williams and Campos*). 53 examples.

***Leioscyta bituberculata* new species.**

Piceous, depressed, sparsely pubescent, a tubercle above each ocellus; legs hardly dilated. Head twice longer than broad, base arched, a small tubercle above each ocellus a depression between, ocelli near and above center of eyes; clypeus large, obtuse. Pronotum depressed, base strongly bisinuate and slightly overhanging head; median carina percurrent, 1 lateral carina each side, straight from front almost to middle of lateral margins; front convex, sloping backward; posterior process long as abdomen, dorsum slightly sinuate. Tegmina opaque piceous, a broken transverse band and apical cells transparent yellow. Body piceous, legs piceous very slightly dilated, not foliaceous, tarsi pale. Long. cum teg. 5; Lat. 1.5 mm. Habitat: Tena, Napo R. Ecuad. (*Williams*). 4 males.

***Leioscyta nigra* new species.**

Dull black, finely punctulate, destitute of lateral carinæ; legs hardly dilated. Head longer than broad, black, smooth, base bisinuate; ocelli near and above center of eyes; clypeus broadly rounded. Pronotum convex, sloping backward from base, dorsum slightly sinuate, median carina weak in front, foliaceous behind, deeply impressed each side in front of posterior apex, destitute of lateral carinæ. Tegmina with basal half opaque piceous, large central part brown, apical limb very broad and abruptly colorless. Body and legs black, tarsi yellow, front legs hardly dilated, middle pair slightly broader, none foliaceous. Long. cum teg. 4; Lat. 2 mm. Habitat: Tena, Ecuad. (*Williams*). Two males and one female.

***Leioscyta minima* new species.**

Very small, piceous with scattering yellow pubescence, a small median dorsal spot. Head twice longer than broad, base straight, ocelli near and above center of eyes with a minute tubercle above each. Pronotum with front convex sloping backward, an impressed transverse line near base from middle to above eyes; median carina strong, foliaceous posteriorly, 1 lateral carina each side almost meeting in front, nearly straight, abbreviated before reaching lateral margins, a small median white spot on dorsum. Tegmina yellowish brown to bases of apical cells, radial and first ulnar cells and



bases of clavus opaque, punctate, an irregular band across middle and apical cells hyaline, middle third translucent brown. Body black, legs sordid pale yellow and hardly dilated, not foliaceous. (Abdomen missing). Long. cum teg. 3; Lat. 1 mm. Habitat: Tena, Ecuad. (*Williams*). 1 example.

***Leioscyta pallipes*** new species.

Fuscous, golden pubescent, with a yellow dorsal spot. Head twice longer than broad, base straight, ocelli near and above center of eyes, apex of clypeus obtuse. Pronotum erect in front, summit rounded, a scar above each eye, tricarinate, lateral carinæ very near to median carina and curved over humerals, abbreviated before reaching lateral margins, all carinæ strong, median carina foliaceous posteriorly; finely and densely punctate, with a large median dorsal yellow spot. Tegmina fuscous, opaque, middle third paler, apical third yellow hyaline. Body fuscous, legs entirely sordid yellow, front legs hardly dilated, middle pair broader, none foliaceous. Long. cum teg. 3; Lat. 1.5 mm. Habitat: Tena, Napo R., Cuenca, Ecuador. (*Williams* and *Campos*). 16 male and female examples.

***Leioscyta fasciapennis*** new species.

Similar to *pallipes*, tricarinate, brown with a line along base of pronotum, humerals yellow, a broad white band across dorsum, extreme posterior apex black. Tegmina hyaline, base opaque fuscous, punctate, yellow pubescent, middle third white hyaline with a posterior brown margin, apical third pale yellow hyaline. Body dark brown, front and middle legs brown, broad, flat, tarsi pale yellow. Long. cum teg. 4; Lat. 1.5 mm. Habitat: Tena, Napo R., Ecuad. (*Williams*). 11 males and females. (All of the above have 2 discoidal cells in the corium).

Genus *Erechtia*

***Erechtia gilvitaris*** new species.

In general stature it resembles the figure of *Bolbonotodes ganglbaueri*, Fowl. in B. C. A. Hom. ii, pl. 2, f. 8, but the sculpture is totally different; while the wings have but 4 apical cells and the tegmina but 3 discoidals, there is a slight indication of a cross venule in the corium of two of the examples before me which, if present would form the 4th discoidal. As Fowler's species was described from a single example, it is possible that a series would present but 3 discoidals which would place it in the genus *Erechtia*. Head twice longer than broad, base broadly arcuate, sides gradually narrowed to acute apex, ocelli slightly nearer and above center of eyes; gray pubescent. Pronotum gray pubescent, strongly rounded, highest at middle of dorsum, strongly depressed and sides abruptly narrowed in front of posterior apex; coarsely punctured; 2 lateral carinæ each side, superior pair extended from front to behind middle of sides of posterior

process, behind them each side a short oblique carina from lateral margins. Tegmina black, tips broadly and abruptly clear hyaline, 3 yellow dots near bases, slightly longer than abdomen. Body and legs black, front and middle tibiae well dilated, tarsi deep yellow. Long. cum teg. 5; Lat. 2; alt. 3 mm. Habitat: Tena, Napo R., Ecuad. 7 examples male and female, one mutilated; sexes similar.

***Erechtia minutissima* new species.**

One of the smallest species; testaceous to piceous, densely golden pubescent, median carina reddish from summit to just before posterior apex which is concolorous. Head more than twice longer than broad, base straight, ocelli very near and above center of eyes, apex acute with dense yellow hairs. Pronotum arcuate from base, finely punctate, median carina strong in front, behind middle foliaceous, 2 lateral carinae each side, superior pair united with median carina well toward base, extended to middle of sides posteriorly; no short carinae on metopidium; dorsum straight, no subapical carinae; humerals brown. Tegmina short, broad, opaque brown with two curved rows of pale yellow dots across middle, apical fourth abruptly clear hyaline, basal half of corium and all of clavus coriaceous, punctate. Body brown to black, legs brown, tibiae broad, foliaceous, hind tibiae spined, tarsi pale. Long. cum teg. 2-2.5; Lat. 1 mm. Habitat: Tena, Napo R., Ecuad. (*Williams*). 5 examples, males.

***Erechtia brevis* new species.**

Head twice longer than broad, base straight, ocelli near and above center of eyes, sides gradually acuminate from eyes to acute apex; gray pubescent. Pronotum gray pubescent, front erect, summit broadly convex, dorsum lightly curved, median carina weak, impressed each side posteriorly, 2 lateral carinae each side, lower pair short, weak, upper pair not quite united with median carina in front, extended almost to lateral margins behind humerals; finely and densely punctate. Tegmina dark brown to piceous, a few scattering pale yellow dots at middle, opaque, punctate, apical third abruptly hyaline. Body piceous, front and middle tibiae dilated, hind tibiae minutely spined, tarsi pale yellow. Long. cum teg. 3; Lat. 1.5 mm. Two examples, abdomen missing. Habitat: Napo R., Ecuad. (*Williams*).

***Erechtia pulcholla* new species.**

Rich pale chestnut brown. Head one-half longer than broad, base straight, sides sinuous to acute apex, densely yellow pubescent; ocelli near and above center of eyes. Pronotum punctured, densely yellow pubescent; front erect, summit broadly rounded, dorsum straight, median carina not long as abdomen, foliaceous, 2 lateral carinae each side, superior pair distant from median carina extended to middle of sides posteriorly, a short subapical carina each side. Tegmina slightly longer than abdomen, base pale brown, opaque, coriaceous, punctate, abruptly translucent yellow at middle

third, apical third sordid hyaline, four brown dots on interior margin and clavus. Body piceous, legs brown, front and middle tibiæ dilated, hind pair spined. Long. cum teg. 4; Lat. 1.5 mm. Habitat: Napo R., Ecuad. (*Williams*). Two males and two females, similar.

In all of the above the corium has 3 discoidal cells; types are in my collection.

As the name *Pterygia* was employed for a genus in the *Molusca* by Bolton in 1798, by Link in 1807, and by Latreille in 1825, the genus in the Membracidæ bearing the same name must hereafter be called *Notocera*, Amyot and Serville (1843), it having priority over *Kallipterygia*, Kirkaldy, (1901).

An examination of Walker's type of *Uroxiphus patulus*, (described in the List of Homopterous Insects, Supplement, page 341) by Mr China, proves it to be the type of a new genus of the Bythoscopidæ.



## NEW MEMBRACIDÆ, V

BY FREDERIC W. GODING

Subfamily MEMBRACINÆ

Genus *Guayaquila***Guayaquila vexator** new species.

Light brown, densely yellow pubescent, summit of front horn black.

Head slightly longer than broad, densely pubescent, base broadly arcuate; ocelli nearer to and even with center of eyes; sides sinuous, apex broadly rounded, obtuse. Pronotum brown, densely pubescent, a transverse smooth scar above each eye; front horn broadly compressed at margins, summit rounded, piceous, longer in ♀; median carina distant from base, obsolete on dorsum, posterior process gradually acuminate, much longer than abdomen. Tegmina translucent yellow, apical half of costa piceous; base of interior discoidal cell more distant from base of corium than exterior cell. Legs yellow, front and middle tibiæ dilated, hind tibiæ darker tips piceous with strong black spines, and much longer than the other legs.

Long. cum ant. corn et teg. 10-12, ad proc. post. 8-9, lat. 3-3.5 mm.

Described from 5 ♂ and 7 ♀. Napo R., Ecuad. (*Williams*).**Guayaquila maxima** new species.

Piceous to black, finely distinctly punctured, moderately golden pubescent. Head pubescent, base broadly arched; ocelli slightly distant and above center of eyes; lateral margins sinuate, apex obtuse, broadly rounded, disk of clypeus weakly roundly elevated. Pronotum piceous to black, pubescent, a transverse impressed smooth scar above each eye; front horn short, porrect, rather narrow towards rounded summit which is briefly compressed; median carina distant from base, obsolete along dorsum; apex extended to tip of abdomen. Tegmina with basal half translucent ferruginous yellow, apical half subtransparent, the 3d, 4th and 5th apical cells colorless; bases of discoidal cells equal. Abdomen evenly punctate, hind margins of segments smooth shining yellow; body below piceous; front and middle legs testaceous yellow, tibiæ dilated, hind legs darker tibiæ with concolorous spines.

Long. pronot. cum ant. corn. 10, cum teg. 12, lat. 4 mm.

Described from 4 ♀. Colimes and Ana Maria, Ecuad. (*Campos*).

**Guayaquila sulfureus** new species.

Dull sulphur yellow, sparingly yellow pubescent. Head fuscous, broader than long, base straight, lateral margins sinuate yellow to the clypeus; ocelli slightly distant, above center of eyes; apex broadly rounded. Pronotum yellow, densely finely punctured, transverse smooth scar above each eye; front horn short, porrect, fuscous, margins broadly compressed, summit rounded; dorsum almost straight; median carina distant from base, fuscous below front horn, forming a smooth line from base of front horn to just before apex the apex not long as abdomen, tip depressed. Tegmina hyaline slightly tinged with yellow, radial cells coriaceous, opaque, punctured; bases discoidal cells equal. Abdomen shining pale fuscous, hind margins segments narrowly yellow; below fuscous yellow; legs yellow, front and middle tibiae dilated, hind tibiae with small fuscous spines.

Long. pron. cum ant. corn. 6, cum teg. 7, lat. 2.5 mm.

Described from a single female from Huigra, Ecuador. (*Williams*).

**Guayaquila roreriana** Goding, Bol. Med. Cir. xviii, p. 37, pl. 1, f. 5.

Since originally described nine males and twenty-one females have been taken, which adds to our knowledge of the species. The head is more or less fuscous to piceous long as broad, base broadly rounded as also is the apex; ocelli double the distance from each other as from eyes and above center of eyes; the pronotum is from cinnamon brown to piceous, front horn and posterior process longer in the female, median carina begins near base. It has been taken at Machala and Narangapata, Ecuador, and at Almirans River, Panama. (*C. B. Williams*).

Genus *Notocera***Notocera alataruna** new species.

Female. Dull black, roughly punctured, strongly spinose, apical half posterior pronotal process coarsely reticulate, 2d dorsal node alate each side.

Head twice longer than broad, lateral margins narrowed from eyes to rounded apex, disk of clypeus broadly and lightly depressed; eyes ovate, upper margins some elevated above base of pronotum; ocelli even with center of and slightly nearer to eyes. Pronotum highly convexo-elevated on anterior half, covered with coarse spines which are much longer behind suprahumeral to 1st dorsal node; suprahumeral very long and slender, diverging, summits well dilated; posterior process slightly longer than teg-

mina, much longer than abdomen, lateral margins subarcuate between dorsal nodes, apex acuminate; dorsal nodes equal in height to anterior convexity, 1st node at middle, erect, summit lightly recurved, some compressed antero-posteriorly, bearing a small laterally compressed spinous tubercle, 2d node seen from side inclined backward its front convex, vertical behind, distant from and obliquely sloping from base to extreme tip of apex, seen from front or behind or above a thin lateral dilatation begins just above base of 1st dorsal node, continues backward around middle of sides of 2d node forming a broad semi-circular disk or plate each side, each larger than the node it surrounds, meeting some behind 2d node midway between its base and posterior apex; together the plates form a large circular disk, its center occupied by 2d dorsal node; upper surface of disk is rectangularly coarsely reticulated, its margins strongly serrated. Tegmina with basal half narrow, piceous brown, punctured, opaque, then much broadened, translucent pale brown, limbus broad; corium with 2 discoidals; wings with 4 apical cells. Body and legs black, tarsi ferruginous, all tibiæ dilated. Long. 6; lat. 1.5 mm. Napo River, Ecuador.

Similar to *cruciata* Fabr., but greatly differs in the form of the posterior pronotal process. With the tegmina expanded it has a remarkable resemblance to an airplane.





RECORDS AND DESCRIPTIONS OF NEOTROPICAL  
CRANE-FLIES (TIPULIDÆ, DIPTERA), IVBY CHARLES P. ALEXANDER  
AMHERST, MASS.

The crane-flies considered in the present paper were included in material taken in Cuba by Messrs. S. C. Bruner and J. Acuña; in the Valley of Marga-marga, Chile, by Padres Felix Jaffuel and Anastasio Pirion; and at Bariloche, Argentina, by Mr. A. Merkle, the latter specimens having been sent to me through the kind interest of Dr. Carlos Bruch. Through the kindness of the above-named entomologists the types of the novelties are retained in my collection. The conditions under which the Chilean species were collected have been discussed in an earlier paper by Messrs. Jaffuel and Pirion (*Plantas fanerogamas del Valle de Marga-Marga, Revista Chilena de Historia Natural*, 25: 350-354, map; 1921).

Genus *Megistomastix* Alexander***Megistomastix cubensis*** new species.

General coloration light gray; antennæ of moderate length, clothed with a short pubescence; wings grayish yellow, the stigma small, subtriangular, dark brown; distal spur of  $R_{1+2}$  conspicuous.

Male.—Length about 6.8 mm.; wing, 7 mm.

Rostrum and palpi dark brown. Antennæ with the scape and basal two-thirds of the first flagellar segment yellow, the remainder of the organ uniformly dark brown; terminal segments broken; pubescence of flagellar segments short and inconspicuous, shorter than the verticils. Anterior vertex yellow, the posterior vertex light gray; occiput pale yellow.

Pronotum pale yellow. Mesonotal præscutum brownish gray without evident markings; scutal lobes somewhat darker; scutellum obscure yellowish, darker laterally; postnotum light gray. Pleura pale gray, variegated with dark brown, including the propleura and a spot on the anepisternum, together with most of the sternopleurite and meron. Halteres pale brown, the base of the stem brighter. Legs with the coxæ brown, paler apically; trochanters obscure yellow; femora brown, the tips narrowly dark brown; remainder of the legs passing into brownish black. Wings with a grayish

yellow suffusion, the prearcular and costal regions more yellowish; stigma relatively small, subtriangular, dark brown; veins brown, those in the costal region more yellowish. Macrotrichia very numerous, including all the cells beyond the cord, together with extensive areas in the outer ends of cells *R*, *Cu* and *1st A*. Venation: As in *portoricensis* but the distal spur of  $R_{1+2}$  long and conspicuous, reaching about mid-distance to costa; free tip of  $Sc_2$  far before  $R_2$ ; *Rs* short, in alignment with the other elements of the anterior cord.

Abdominal tergites brown, variegated before the incisures with obscure orange-yellow, the subterminal segments more uniformly darkened.

Habitat.—Cuba.

Holotype, ♂, Sierra Rangel, Pinar del Rio, altitude 500 feet, August 30, 1927 (J. Acuña and S. C. Bruner).

*Megistomastix cubensis* agrees with the genotype, *M. portoricensis* Alexander (Psyche, 19: 63–66, pl. 5; 1912) in the abundant macrotrichia in the cells of the wing beyond the cord. It differs especially in the shorter antennae with the pubescence short and inconspicuous, and the venation of the radial field, especially the long apical spur of  $R_{1+2}$ .

### Genus *Tricyphona* Zetterstedt

*Tricyphona crassipyga* new species.

Antennae 17-segmented; mesonotum reddish brown, pruinose, the præscutum with three darker brown stripes; pleura dark gray; tips of the femora and tibia infuscated; wings brownish yellow with a darker cloud at *r-m*; cell  $M_2$  open; male hypopygium with the ninth tergite profoundly bifid, each half being bilobed at apex.

Male.—Length, 10–11 mm.; wing, 12.5–13.5 mm.

Female.—Length about 13 mm.; wing, 14 mm.

Rostrum and palpi brownish black. Antennae 17-segmented, dark brown; flagellar segments short-cylindrical, the outermost more oval, the terminal segment larger than the penultimate. Head dark, gray pruinose, the tubercle on the anterior vertex conspicuous.

Pronotum dark. Mesonotal præscutum reddish brown, sparsely pruinose, with three broad, darker brown stripes; median stripe narrowly divided; scutal lobes and median area dark; scutellum brownish yellow, more or less pruinose; postnotum reddish brown, more yellowish laterally, the surface more or less pruinose. Pleura dark gray, pruinose. Halteres yellow, the knobs infuscated. Legs with the coxae obscure yellow, a little pruinose at base; trochanters yellow; femora yellow, the tips narrowly but conspicuously infuscated; tibia yellow, the tips narrowly infuscated; basal three

tarsal segments obscure yellow, the tips darkened; terminal tarsal segments uniformly dark brown. Wings with a brownish yellow suffusion, the base clearer yellow; stigma pale brown, ill-defined; a conspicuous brown cloud on *r-m* and adjoining veins; veins pale brown, more yellowish near the wing-base and in costal region. Venation:  $Sc_1$  ending beyond two-fifths the length of  $R_{2+3}$ ;  $R_2$  close to the tip of  $R_1$ ,  $R_{1+2}$  being very short;  $R_s$  moderately elongate, arcuated to feebly angulated on basal half; *r-m* at from one-half to two-thirds the length of  $R_{4+5}$ , the petiole of cell  $R_4$  short; cell  $M_2$  open by the atrophy of  $M_3$ ; cell  $M_1$  more than twice its petiole; *m-cu* on  $M_4$  shortly beyond origin.

Basal abdominal tergites obscure brownish yellow, the median area darker; sternites obscure yellow, the subterminal segments dark brown; hypopygium fulvous. Male hypopygium very large. Ninth tergite profoundly divided by a rectangular notch, each half appearing as an elevated bilobed fleshy plate, the mesal lobule longer and more slender; at base of this bilobed plate on mesal edge an additional conspicuous oval lobule. Ninth sternite very large, subglobular, bearing the large basistyle at apex. Dististyle very small, fleshy, smaller than the large ventro-apical lobe of the basistyle. Ventral interbases appearing as very conspicuous arcuated cylindrical rods that arise from the ventro-mesal portion of the basistyle, directed strongly dorsad, the tips obtuse.

Habitat.—Chile.

Holotype, ♂, Perales de Marga-marga, January, 1927 (A. Pirion).

Allotopotype, ♀.

Paratopotypes, 6 ♂♂, January–February 25, 1927 (A. Pirion); numerous specimens, September 10–14, 1927 (Jaffuel and Pirion).

### Genus *Limnophila* Macquart

#### *Limnophila araucania* new species.

General coloration gray; mesonotal præscutum with a broad median brownish black stripe; wings yellow with a heavy solid brown pattern, consisting of large spots and clouds that are confined to the vicinity of the veins; a large spot near outer end of cell  $M$ ; cell  $M_1$  only a little longer than its petiole.

Female.—Length about 10.5 mm.; wing, 10 mm.

Rostrum dark, sparsely pruinose; palpi black. Antennæ broken. Head dark with a heavy yellow pollen.

Pronotum dark brown, the scutellum dusted with a yellowish pollen. Mesonotal præscutum heavily yellow pollinose with a broad median brownish black stripe, the lateral stripes scarcely indicated; pseudosutural foveæ small, comma-like; remainder of mesonotum more grayish yellow. Pleura

grayish, the dorso-pleural region more buffy. Halteres broken. Legs with the coxæ pale, the fore and middle coxæ slightly darker basally; trochanters obscure yellow; remainder of the legs broken. Wings yellowish, with a sparse but heavy solid brown pattern, distributed as follows: At base of cells *R* and *M*; origin of *Rs*; along the cord; a large stigmal area extending caudad to vein *R*<sub>4</sub>; a large marginal area on *R*<sub>3</sub>, together with a smaller area on vein *R*<sub>4</sub>; conspicuous marginal spots on veins *M*<sub>3</sub>, *M*<sub>4</sub>, *Cu*<sub>1</sub>, *1st A* and *2nd A*, these areas becoming larger basally; axilla and central portion of cell *2nd A* darkened; a large circular spot at fork of *M*<sub>1+2</sub>; outer end of cell *1st M*<sub>2</sub> seamed; a large rectangular area near outer end of cell *M*, this connecting with a similar but smaller area in cell *R*; a dark clouding in cell *C* near midlength; veins yellow, darker in the infuscated areas. Venation: *Rs* arcuated at origin; *R*<sub>2+3+4</sub> subequal to *m-cu*; *R*<sub>1+2</sub> longer than *R*<sub>2</sub>; veins *R*<sub>3</sub> and *R*<sub>4</sub> gently divergent near outer ends; cell *M*<sub>1</sub> only a trifle longer than its petiole; *m-cu* about its own length beyond the fork of *M*; vein *2nd A* gently sinuous.

Abdominal tergites chiefly dark brown; sternites obscure yellow, the segments margined laterally and subapically with dark brown. Ovipositor with the sternal valves black, the tergal valves slender and almost straight.

Habitat.—Chile.

Holotype, ♀, Marga-marga, February 23, 1923 (A. Pirion).

Paratopotypes, several ♂ ♀, September 12–19, 1927 (Jaffuel and Pirion).

*Limnophila araucania* is distinguished from all similar regional species by the extensive brown cloud near the outer end of cell *M*.

### Genus *Austrolimnophila* Alexander

#### ***Austrolimnophila merklei* new species.**

General coloration pale brownish gray, the præscutum and pleura with brown stripes; femora yellow with a narrow brown subterminal ring; wings whitish subhyaline, abundantly dotted with brown; male hypopygium with a single dististyle.

Male.—Length about 14 mm.; wing, 14 mm.

Rostrum brown; palpi brown. Antennæ with the scapal segments dark brown, the flagellum a little paler; antennæ short, if bent backward extending about to the wing-root. Head brown, with a yellowish gray pruinosity, the anterior vertex somewhat brighter.

Pronotum buffy brown, the lateral margins more yellowish. Lateral pretergites yellow with a blackish spot opposite the pseudosutural foveæ. Ground-color of the mesonotal præscutum yellowish gray, with three brown stripes, the median stripe vaguely divided by a slightly paler median line; lateral margins of the sclerite behind the pseudosutural foveæ darkened;

pseudosutural foveæ oval, yellowish; scutum with the median area broadly brownish gray, each lobe with two large brown spots, the lateral ones being caudal extensions of the lateral præscutal stripes; scutellum and postnotum brownish gray. Pleura yellowish gray with two brown longitudinal stripes, the more dorsal extending from the propleura across the anepisternum and pteropleurite to the pleurotergite; the ventral dark stripe includes the ventral sternopleurite and the meron; dorso-pleural region extensively buffy. Halteres elongate, pale brown, the base of the knobs a little more infuscated, base of the stem restrictedly brightened. Legs with the coxæ brown, especially the fore coxæ; trochanters brownish yellow; femora yellow with a narrow subterminal ring, the extreme tips pale; tibiæ yellow, the tips narrowly infuscated; tarsi brownish yellow, the terminal segments a little darkened. Wings whitish subhyaline, with a very abundant dotted and spotted brown pattern, the major brown areas including the origin of *Rs*, the anterior cord, fork of *Sc* and outer end of cell *1st M*<sub>2</sub>; all cells of wing with abundant pale brown dots that tend to become confluent; veins pale brown, the costal veins more yellowish. Costal fringe short. Venation: *Sc*<sub>1</sub> ending shortly beyond the origin of *R*<sub>2+3</sub>, *Sc*<sub>2</sub> longer, close to its tip; *Rs* arcuated at origin; *R*<sub>2+3+4</sub> shorter than *m-cu*; *R*<sub>1+2</sub> a little longer than *R*<sub>2</sub>; *m-cu* a little less than its own length beyond the fork of *M*.

Abdominal segments obscure brownish yellow, the lateral margins narrowly dark brown; subterminal segments and hypopygium brown. Male hypopygium with the ninth tergite terminating in a small tubercle on either side of a rectangular median notch; a single dististyle, this trifold at apex, including a small black lateral spine and a long, slender extension on the inner edge.

Habitat.—Argentina (Patagonia).

Holotype, ♂, Bariloche, L. Nahuel Huapi, Territory of Rio Negro, April, 1922 (A. Merkle).

This conspicuous crane-fly is named in honor of the collector.

### Genus *Limnophilella* Alexander

#### *Limnophilella patagonica* new species.

General coloration testaceous yellow; vertex infuscated; wings brownish yellow, unmarked; *m-cu* from one-third to one-fourth its length before the fork of *M*.

Female.—Length about 13 mm.; wing, 13.5 mm.

Rostrum testaceous yellow; palpi brownish black. Antennæ with the basal segment yellow, infuscated apically; second segment and the flagellum uniformly dark brown. Head yellowish ochreous, the posterior vertex dark brown, sparsely pruinose, more conspicuously so on the orbits.

Pronotum yellow, a little darker anteriorly. Mesonotum almost uniformly shiny testaceous yellow, without clearly defined markings, the scutellum and

postnotum paler. Pleura uniformly pale testaceous yellow, the dorso-pleural region a little infused. Halteres long and slender, pale brown, the extreme base of the stem yellow. Legs with the coxæ and trochanters testaceous yellow; remainder of the legs brownish testaceous, the outer tarsal segments a little more darkened. Wings with a brownish yellow suffusion; veins dark brown. Venation:  $Sc_1$  ending beyond the origin of  $R_{2+3}$ ,  $Sc_2$  at its tip;  $R_s$  square and weakly spurred at origin;  $R_{2+3+4}$  shorter than  $m-cu$ ;  $R_{1+2}$  shorter than  $R_2$ ; cell  $M_1$  deep, its petiole subequal to  $m-cu$ ;  $m-cu$  about one-third to one-fourth its length before the fork of  $M$ ; third Anal vein indicated.

Abdominal tergites brownish yellow, darker laterally, the outer segments more uniformly darkened; basal sternites yellow, the outer segments slightly darkened.

Habitat.—Argentina (Patagonia).

Holotype, ♀, Bariloche, L. Nahuel Huapi, Territory of Rio Negro, April, 1922 (A. Merkle).

### Genus *Shannonomyia* Alexander

*Shannonomyia mesophragma* new species.

General coloration obscure brownish yellow; head dark brown; wings yellow with a handsome brown spotted pattern, together with a brown seam along the cord; a supernumerary crossvein crossing cell  $R$  from the angulation of  $R_s$  to  $M$ .

Sex?—Length to midlength of abdomen about 3 mm., the total length probably about 4.5 mm.; wing, 5 mm.

Rostrum and palpi dark brown. Antennæ short, if bent backward not extending far beyond the pronotum; scapal segments obscure yellow, the flagellum dark brown. Head dark brown.

Pronotum brown, sparsely pruinose. Mesonotal præscutum obscure brownish yellow with a vague darker brown median stripe, best indicated in front, becoming obsolete before the suture; lateral stripes barely indicated; remainder of mesonotum pale brownish yellow, the surface sparsely pruinose. Pleura pale brown, the surface very sparsely pruinose. Halteres obscure yellow. Legs with the coxæ testaceous yellow; trochanters yellow; femora and tibiæ brownish yellow, the tips scarcely darkened; tarsi similar, the outer segments a little darker brown. Wings yellowish, with a handsome brown spotted pattern that is confined to the vicinity of the veins, distributed as follows: Beyond arculus; origin of  $R_s$  and supernumerary crossvein in cell  $R$ ;  $Sc_2$ ; a narrow seam along the cord, widest on the anterior cord; stigma short-oval; outer end of cell 1st  $M_2$ ; large marginal seams at ends of veins  $R_3$  and  $R_4$ ; smaller clouds at ends of the remaining longitudinal veins, becoming larger on the posterior veins, largest on vein 2nd  $A$ ; veins yellow, darker in the infuscated areas. Venation:  $Sc_1$  ending

about opposite three-fourths the length of *Rs*, *Sc*<sub>2</sub> close to its tip; *Rs* angulated, with an arcuated crossvein in cell *R*, extending from the point of angulation to vein *M*, dividing cell *R* into two slightly unequal parts; *R*<sub>2</sub> subequal to *R*<sub>1+2</sub>; *R*<sub>3+4</sub> a little shorter than *R*<sub>2</sub>; *R*<sub>3</sub> relatively short, a trifle more than one-half *R*<sub>4</sub>; *r-m* very strongly arcuated; cell 1st *M*<sub>2</sub> elongate, gently widened distally, the second and third sections of *M*<sub>1+2</sub> subequal; *m-cu* shortly beyond the fork of *M*, about two-thirds the distal section of *Cu*<sub>1</sub>.

Abdominal tergites dark brown, the basal sternites obscure brownish yellow; abdomen broken beyond the fourth segment.

Habitat.—Cuba.

Holotype, Sex?, Jarahueca, Oriente, in the mountains, July 15, 1927 (S. C. Bruner).

The supernumerary crossvein in cell *R* is identical in both wings of the unique type. The wing-pattern is somewhat similar to the otherwise very different *S. lathraea* (Alexander) of Colombia.

### Genus *Gynoplistia* Westwood

***Gynoplistia* (Paralimnophila) *pirioni* new species.**

Antennæ simple in both sexes; femora yellow with three black rings; tibiæ china-white with the base and apex black and with a subbasal black ring; wings whitish, spotted and clouded with brown, including a series of brown spots in cell *R*; cell *R*<sub>3</sub> sessile.

Male.—Length about 7 mm.; wing, 7 mm.

Female.—Length about 8 mm.; wing, 9 mm.

Rostrum and palpi brownish black. Antennæ short, 16-segmented; scape and basal flagellar segments pale brown, the terminal flagellar segments darker; flagellar segments long-oval, the basal flagellar segments larger; all flagellar segments with verticils that exceed the segments in length but with no indication of toothing or other modifications of the segments. Head dull gray, a little more infuscated on the genæ, the anterior vertex paler; a broad conspicuous dark median vitta extending from the rostrum to the occiput.

Pronotum dark brown, variegated laterally and posteriorly with gray. Mesonotal præscutum yellowish gray, with three conspicuous dark brown stripes; lateral stripes with their outer ends bent strongly laterad; pseudo-sutural foveæ large, broadly lunate, black; scutum black medially, each lobe yellowish with the centers brownish black, restricting the ground-color of the lobes to narrow circles; scutellum small, obscure fulvous yellow, black medially; postnotum brownish yellow, blackish medially. Pleura dark brown, with a broad pale longitudinal stripe extending from the fore coxæ to the postnotum, the surface and that of the ventral pleurites more pruinose; dorso-pleural region dark brown. Halteres relatively long, white,

the knobs abruptly dark brown. Legs with the coxæ obscure brownish yellow, a little darkened distally; trochanters small, obscure yellow; legs very long and slender; femora yellow with three black annuli, the last and broadest terminal in position, the narrowest being the first, placed at about midlength of the segment; tibiæ china-white, the narrow base and apex black, a conspicuous subbasal black ring, preceded by a slightly wider white ring; basitarsi and tarsal segments two and three white, the tips narrowly infuscated; terminal tarsal segments uniformly dark brown. Wings tinged with whitish, the base and costal region more yellowish; a heavy brown spotted pattern; preareolar cells largely darkened; major brown costal blotches include the following: At mid-distance between areulus and origin of *Rs*; origin of *Rs*; a smaller area at *Sc*<sub>2</sub>, extending caudad to *Rs*; the extensive stigmal area, connected with a seam at the fork of *Rs*; large spots at tips of *R*<sub>3</sub> and *R*<sub>4</sub>; a series of smaller brown spots, so numerous as to be more or less confluent, occupy the entire length of cell *R*; similar brown clouds and broad seams in most cells of the radial field; posterior cord narrowly seamed with brown; a somewhat broader seam on the outer end of cell 1st *M*<sub>2</sub>; a circular cloud at the fork of *M*<sub>1+2</sub>; conspicuous dusky washes occupy most of cell *Cu* and *M*<sub>4</sub>; medial veins beyond the cord seamed with brown; small dusky clouds at outer ends of the Anal cells; veins brown, the costal veins light yellow. Venation: *Sc* relatively short, *Sc*<sub>1</sub> ending before the fork of *Rs*, *Sc*<sub>2</sub> far from the tip of *Sc*<sub>1</sub>, the latter alone being only a little shorter than the first section of *R*<sub>1</sub>; *Rs* long, strongly arcuated at origin; *Rs* in alignment with *R*<sub>4</sub>, cell *R*<sub>3</sub> being sessile; *R*<sub>2</sub> transverse; *R*<sub>1+2</sub> about equal to *R*<sub>2+3</sub>; cell *M*<sub>1</sub> a little longer than its petiole; *m-cu* close to the fork of *M*; cell 2nd *A* narrow.

Abdominal tergites dark brown, the sternites obscure yellow, the apices of the segments narrowly blackened; hypopygium small, black. Male hypopygium with the outer dististyle arcuated, a little dilated outwardly, the outer apical angle a gently curved hook.

Habitat.—Chile.

Holotype, ♂, Perales de Marga-marga, February 17, 1927 (A. Pirion).

Allotopotype, ♀.

Paratopotypes, 2 ♂ ♂, 1 broken ♀, January–February, 1927; 1 ♀, April, 1925 (A. Pirion); numerous ♂ ♀, September 14–17, 1927 (Jaffuel and Pirion).

This interesting species of *Paralimnophila* is named in honor of my friend, P. Anastasio Pirion, who has added greatly to our knowledge of the crane-flies of Marga-marga.



Genus *Eriocera* Macquart*Eriocera bruneri* new species.

General coloration obscure orange; antennal flagellum yellow; head black; præscutum with a single median brown stripe; legs yellow, the tips of the femora narrowly blackened; wings orange, with a heavy brown pattern; abdomen reddish yellow, the subterminal segments and hypopygium a little darker, more reddish brown.

Male.—Length, 15–17 mm.; wing, 12–12.5 mm.

Rostrum and palpi black. Antennæ relatively short, if bent backward not attaining the wing-root; scapal segments brownish yellow, the flagellum yellow; flagellar segments elongate-cylindrical, the first stouter. Head dull black.

Pronotum and mesonotum obscure orange or rusty yellow, the præscutum with a single narrow median brown stripe, the lateral stripes scarcely differentiated from the ground-color; scutum obscure yellow, the lobes vaguely variegated with darker; scutellum yellowish brown pollinose; postnotum dark brownish yellow, sparsely pollinose. Pleura yellowish brown. Halteres obscure yellow, the knobs dark brown. Legs with the coxæ and trochanters obscure yellow; femora yellow, the tips narrowly blackened; tibiæ obscure yellow, the distal half or less more or less darkened; tarsi yellowish brown, the terminal segments darker. Wings with a strong orange suffusion, the costal cell darker, the subcostal and radial fields more saturated; posterior fields of the wing paler, more ochreous; a heavy brown pattern, distributed as follows: Preareolar region; a semilunate area near proximal ends of cells *R* and *M*; origin of *Rs*; a broken band crossing the wing from costa opposite *Sc*<sub>2</sub>, along the cord to the caudal margin; stigma oval; a seam on outer end of cell *1st M*<sub>2</sub>; broken brown seams, consisting of numerous dots along veins *M*, *Cu* and *R*<sub>3</sub>; a narrow but conspicuous brown seam around the wing-margin from cell *R*<sub>2</sub> backward, wider in cell *2nd A*; a dusky wash in cells *Cu* and *1st A* on both sides of the Anal vein; veins yellow, a trifle darker in the infuscated areas. Venation: *Sc*<sub>1</sub> ending beyond midlength of *R*<sub>2+3+4</sub>, *Sc*<sub>2</sub> just beyond the fork of *Rs*; *R*<sub>2+3</sub> subequal to *R*<sub>1+2</sub>, both nearly twice *R*<sub>2</sub> alone; *Rs* strongly arcuated to angulated at origin; inner ends of cells *R*<sub>2</sub> and *R*<sub>4</sub> not so acutely pointed as in many species of the genus; cell *M*<sub>1</sub> lacking; cell *1st M*<sub>2</sub> rectangular; *m-cu* from one-third to one-half the length of the cell, much longer than the distal section of *Cu*<sub>4</sub>.

Abdomen elongate, obscure reddish yellow, the tergites in cases with a narrow brown line on either side, this probably caused by an internal discoloration; basal sternites clearer yellow, the subterminal segments, including the hypopygium, a trifle darker, obscure reddish brown.

Habitat.—Cuba.

Holotype, ♂, Jarahueca, Oriente, in the mountains, July 15, 1927 (S. C. Bruner).

Paratopotype, ♂.

This striking species of *Eriocera* is named in honor of Mr. S. C. Bruner, who has added so materially to our knowledge of the insects of Cuba. By means of the author's key to the Antillean species of *Eriocera* (Ent. News, 27: 347; 1916), the present species runs to couplet 3. It is very distinct from both included species, *E. ocellifera* Alexander (Porto Rico) and *E. domingensis* Alexander (Santo Domingo).

***Eriocera acuñaí* new species.**

General coloration dark; antennal flagellum weakly bicolorous; mesonotal præscutum gray with four nearly concolorous stripes that are margined with black; legs chiefly yellow; wings grayish, with a conspicuous brown pattern; a supernumerary crossvein in cell  $R_4$ .

Male.—Length about 12.5 mm.; wing, 11 mm.

Rostrum and palpi black. Antennæ with the scapal segments blackish; proximal flagellar segments weakly bicolorous, the basal three segments black with the tips conspicuously obscure yellow; terminal segments more uniformly darkened. Head dark, sparsely pruinose.

Mesonotal præscutum dark gray, with four subconcolorous stripes that are indicated chiefly by a narrow, velvety black margin; scutum similarly dark gray, each lobe with a circular black ring; scutellum and postnotum lighter gray, with a dark longitudinal line on either side of the meson, on the sides passing into yellowish gray. Pleura black. Halteres dark brown. Legs with the fore coxæ black, the extreme tips paler; remaining coxæ black, the tips broadly pale yellow; trochanters yellow; femora yellow with a vague darkening before the tips; tibiæ and tarsi obscure brownish yellow, the distal segments darker brown. Wings grayish, conspicuously variegated with darker; prehumeral region darkened; cell  $C$  on basal half more buffy, variegated with brown, the distal half dark brown; subeostal cell chiefly buffy; the dark markings appear ocelliform in the bases of cells  $R$  and  $M$ , at the origin of  $R_s$  and on  $m-cu$ ; elsewhere the ocelliform appearance is more or less obliterated, the brown coloring appearing as broad seams to most of the veins beyond the cord; outer edges of the seams broken into punctiform dots; stigma oval, darker brown; cell  $R_2$  entirely darkened; in the Anal cells, the brown coloration is confined to the margin; supernumerary crossvein in cell  $R_4$  surrounded by a darkened area; veins dark brown, more yellowish in the stigmal region. Venation: Veins beyond the cord elongated; a supernumerary crossvein in cell  $R_4$  at near two-thirds the length of the cell; cell  $1st\ M_2$  rectangular, about two-fifths the length of vein  $M_{1+2}$  beyond it;  $m-cu$  far out toward the outer end of the cell, being about one-half longer than the distal section of  $Cu_1$ .

Abdomen brown, vaguely marked with brownish black, especially the lateral region and a subterminal ring.

Habitat.—Cuba.

Holotype, ♂, Los Animas, Sierra Rangel, Pinar del Rio, altitude 1,500 feet, August 29, 1927 (J. Acuña and S. C. Bruner).

*Eriocera acuña* is very distinct from all described species of the genus. It is named in honor of Senor J. Acuña, who collected the type material in co-operation with Professor Bruner.

### Genus *Atarba* Osten Sacken

***Atarba (Atarba) angustipennis* new species.**

Antennæ bicolorous, the basal half of the individual flagellar segments pale; mesonotum yellowish chestnut, the pleura conspicuously pruinose; wings relatively narrow, grayish yellow, the costal region clearer yellow; *Sc* short, *Sc*<sub>1</sub> more than three-fourths the length of the short *Rs*; abdominal tergites bicolorous, the basal portion pale, the broader apex dark brown.

Female.—Length about 5.5 mm.; wing, 5.2 mm.

Rostrum chestnut-brown; basal two segments of the palpi pale, the terminal segments black. Antennæ bicolorous, the distal half of the individual flagellar segments black, the basal half yellow. Head chiefly light colored.

Mesonotal præscutum, scutum and scutellum yellowish chestnut, the postnotum darker. Pleura brown, the surface conspicuously blue-gray pruinose. Halteres yellow, the knobs dark brown. Legs with the fore coxæ a little darkened; remaining coxæ yellow; trochanters yellow; remainder of legs yellow, the terminal tarsal segments dark brown. Wings relatively narrow, with a strong grayish yellow tinge, the costal region and cell *Cu*<sub>1</sub> clearer yellow; stigma elongate-oval, pale brown; veins slightly darker brown. Venation: *Sc*<sub>1</sub> ending opposite the origin of *Rs*, *Sc*<sub>2</sub> some distance from its tip, *Sc*<sub>1</sub> alone more than three-fourths *Rs*; cell 1st *M*<sub>2</sub> relatively elongate; *m-cu* at or close to the fork of *M*.

Abdominal tergites bicolorous, the basal third to two-fifths of the segments yellowish testaceous, the remainder dark brown; sternites uniformly yellowish testaceous; genital segment rather bright yellow; tergal valves of ovipositor relatively straight and slender, reddish horn-color.

Habitat.—Cuba.

Holotype, ♀, Sierra Rangel, Pinar del Rio, in pine grove, altitude 1,500 feet, August 29, 1927 (J. Acuña and S. C. Bruner).

### Genus *Gonomyia* Meigen

***Gonomyia (Ptilostena) angustissima* new species.**

General coloration dark brown, narrowly lined with pale; flagellar segments bicolorous; wings very long and narrow, with a restricted dark pattern; *Sc* short, ending opposite the origin of *Rs*.

Female.—Length, 9 mm.; wing, 6 mm., its greatest width, 1.15 mm.

Described from an alcoholic specimen.

Rostrum and palpi brown. Antennæ brown, the apices of the individual flagellar segments conspicuously pale; terminal segments broken. Head with the anterior vertex pale; posterior vertex and occiput dark, sending a median dark line onto the anterior vertex.

Pronotum dark brown. Mesonotum with the præscutum having four narrow brown stripes on the disk, the lateral margins behind the pseudosutural foveæ similarly darkened; humeral region pale yellow, the interspaces more infuscated; scutum brownish yellow, the lobes extensively darkened; scutellum and postnotum yellowish brown. Pleura dark brown, with narrow pale longitudinal stripes, the most ventral stripe longer, beginning on the posterior face of the fore coxa, traversing the suture between the sternopleurite and anepisternum, the dorsal portion of the meron and the ventral metapleura to the abdomen, passing immediately above the posterior coxæ; a second short pale line occupies the ventral pteropleurite, beneath the halteres; a third, slightly longer line, occupies the dorsal pteropleurite and pleurotergite, above the halteres; dorso-pleural region largely pale. Halteres relatively elongate, pale, the base of the knobs a little darker. Legs with the bases of the coxæ abruptly infuscated, the remainder pale; trochanters pale yellow; femora and tibiæ obscure yellow, the tips a little darkened; tarsi passing into darker brown. Wings very long and narrow, as shown by the measurements, the veins and cells correspondingly elongate; ground-color pale brownish yellow, with a restricted brown pattern, as follows: Stigma; vague seams at origin of *Rs*, the anterior cord and *m-cu*; less evident clouds on *R*<sub>3</sub> and *R*<sub>4</sub>; veins pale brown, a little darker in the infuscated areas. Venation: *Sc* short, *Sc*<sub>1</sub> ending opposite the origin of *Rs*, the latter long, strongly angulated at origin; petiole of cell *R*<sub>2</sub> elongate, approximately two-thirds *Rs*; *R*<sub>3</sub> short, straight, oblique; *R*<sub>4</sub> strongly arcuated; cell *R*<sub>5</sub> small; *m-cu* about one and one-half times its length before the fork of *M*; prearcular region extensive.

Abdomen elongate, brown, the lateral margins of the segments and the pleural membrane pale. Ovipositor with the tergal valves slender, gently upcurved.

Habitat.—Cuba.

Holotype, ♀, Jarahueca, Oriente, in the mountains, July 15, 1927 (S. C. Bruner).

### Genus *Molophilus* Curtis

*Molophilus titan* new species.

Belongs to the *gracilis* group, *ruficollis* subgroup; size very large (wing, ♂, over 8 mm.); mesonotal præscutum brownish yellow with three brown stripes; pleura dark brown; halteres yellow; wings with a brownish yellow

suffusion; *m-cu* angulated and weakly spurred; male hypopygium with the inner dististyle a more or less sinuous, slender rod.

Male.—Length, excluding head, about 6.5 mm.; wing, 8.4 mm.

Head broken.

Pronotum brown; lateral pretergites yellow. Mesonotal præscutum with the ground-color obscure brownish yellow, with three brown stripes; median stripe broad, reddish brown, margined laterally with darker brown; lateral stripes darker brown, the humeral region obscure yellow; scutal lobes dark brown, the median region in front and the posterior callus yellow; scutellum brown, darker brown basally; postnotum reddish brown, the cephalic portion a little darker. Pleura dark brown, scarcely variegated with paler; dorso-pleural region dusky. Halteres yellow. Legs with the coxæ and trochanters obscure yellow; remainder of legs broken. Wings with a brownish yellow suffusion, the stigmal region somewhat darker; veins darker brown. Venation:  $R_{2+3}$  elongate, about two-thirds  $R_{1+2}$ ;  $R_{4+5}$  more than one-half  $R_{2+3}$ , in alignment with  $Rs$ , the latter angulated and spurred at origin; *m-cu* angulated and weakly spurred; vein *2nd A* ending about opposite the base of cell  $M_3$ .

Abdomen dark brown, the sternites more variegated with obscure yellow. Male hypopygium with the ninth tergite broad and rather deeply notched, the lateral lobes very slender, each terminating in two stout curved setæ. Basistyle stout, the ventral lobe produced into a stout fleshy lobe, unarmed as in the subgroup. Dististyles two, the outer a little shorter, terminating in a powerful flattened beak, with a slender, appressed lateral spine on outer margin; inner dististyle longer, appearing as a more or less sinuous slender cord, the tip acute. Aedeagus elongate, straight, subequal in length to the inner dististyle.

Habitat.—Chile.

Holotype, ♂, Marga-marga, February 25, 1927 (A. Pirion).



A REVISION OF THE GENUS EUREMA (LEP.  
PIERIDÆ). PART I. NEW WORLD SPECIES,  
MORPHOLOGY AND PHYLOGENY

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The genus *Eurema* has long been considered as more or less of a stumbling block in the path of taxonomists. Quite a number of the species appear to be extremely liable to form variants under the influence of relatively slight differences in locality or season. There has never been any work at all adequately covering the whole genus or its entire range of distribution. Moreover, what work has been done has been based almost entirely upon color and pattern characters, ignoring the genitalia. Because of this unfamiliarity of authors with these very variable species in all their forms, many have been described and long considered as distinct species which, upon examination of the genitalia and comparison of large series of specimens from numbers of localities, prove merely to be either different forms of the same species or else minor and seemingly erratic variants.

Because of the delays and difficulties attendant upon the scarcity of material, the inaccessibility of most of the types, and the inadequacy of many of the original descriptions, it seems inadvisable to wait to cover the genus fully in one article. In the present work are presented descriptions of those structures which appear most significant in determining the relationship of the species to one another, and the conclusions based upon a study of these. The synonymy will be covered in a later paper.

The first part of the present article consists of keys and explanatory notes for the differentiation of those species and groups of species which can be separated by structures other than those of color and pattern. In the second part are traced out the relationships of the species, based mainly on structural characters, and their significance in determining the probable development from the primitive form.

The plates are for the most part tracings from micro-photographs.

## PART I

### *Structures and Terms Used.*

#### Male Genitalia (Fig. 1).

*Uncus.* The uncus shows little change of form other than of two main types. In one, characterizing Groups 5 and 6, the free part is relatively short, Fig. 13a. In the other it is long, slender and curved, Figs. 1 & 10. In *reticulata*, in which the free part is long, the tip is slightly bifurcate dorso-ventrally. This is the only New World species in which the free part is not plain. A number of the Old World species have the uncus bifurcate, but the furcation is lateral.

*A lobe-like cephalad extension of the saccus.* See Fig. 1.

*A series of lobes located on the ental surface of the valve, and a process on the distal end of the valve.* The greatest number of lobes is found in *nise* Cramer in which there are, in some individuals, 2 lobes on the dorsal side of the valve and 3 on the ventral, while the distal process bears a greater or less number of teeth which represent other lobes in process of formation. I have accordingly designated these lobes *a, b, c, d* and *e*, Fig. 13.

*Fornsi* Poey and *lucina* Poey show the simplest valve, with only one dorsal and one ventral lobe, and with a simple distal process. These two lobes would then represent lobes *a* and *e*, Fig. 4.

In the primitive form the valve probably lacked the distal process and all of the lobes. These lobes, except for lobe *a*, appear to originate distally and migrate toward the base of the valve, others forming in their place and moving proximally in turn. The distal process is then taken to represent one or more lobes in process of formation. Probably lobe *a* represents a modified form of the clasper, lobes *b* and *e* are homologous with the digitus and the pollex respectively, and the distal process with the margin. See Pierce, "The Genitalia of the British Noctuidae."

#### Venation.

The only constant characters for specific differentiation are in the arrangement of the veins around the discal cell of the secondaries.



- a) In Groups 2 and 4,  $R_s$  and  $M_1$  are stalked, Fig. 16.  
 b)  $M_1$  and  $M_2$  may be almost or quite connate, Fig. 18, or the middle discocellular may be long, Fig. 17.  
 c) There is considerable variation in the length of the upper discocellular.

Six major groups are recognizable. There are in addition a number of odd species which represent either transitionals between the groups or else offshoots on other lines of development.

## KEY TO GROUPS AND ISOLATED SPECIES

- |  |                   |
|--|-------------------|
| 1. Distal process of valve bearing prominent teeth. Free part of uncus short .....   | 12                |
| 1. Distal process of valve not bearing prominent teeth. Free part of uncus long and slender.....   | 2                 |
| 2. A pointed lobe or flap attached to distal process ventrally .....   | 8                 |
| 2. No pointed lobe or flap attached to distal process ventrally .....  | 3                 |
| 3. Lobe <i>b</i> absent or very minute .....   | 4                 |
| 3. Lobe <i>b</i> present and well developed .....  | 7                 |
| 4. Lobe <i>a</i> long, strongly recurved, well basad.....  | 5                 |
| 4. Lobe <i>a</i> shorter, simply curved.....   | 6                 |
| 5. $R_s$ and $M_1$ connate from the cell, with the lower discocellular not strongly bent and not much longer than the middle discocellular ..... | <i>thymetus</i>   |
| 5. $R_s$ and $M_1$ not connate from the cell, or with the lower discocellular strongly bent and much longer than the second .....                | Group 1           |
| 6. Uncus bifurcate dorso-ventrally at extreme tip. No process on dorsal margin of valve near lobe <i>a</i> .....                                 | <i>reticulata</i> |
| 6. Uncus simple. A process bearing very fine teeth on dorsal margin of valve near lobe <i>a</i> .....  | <i>deva</i>       |
| 7. Extension of saccus more than $\frac{3}{4}$ the length of the base of the valve .....   | Group 2           |
| 7. Extension of saccus less than $\frac{3}{4}$ the length of the base of the valve .....   | Group 3           |
| 8. Distal process short .....  | 9                 |
| 9. Lobes <i>a</i> , <i>b</i> , <i>d</i> and <i>e</i> present. $R_2$ stalked on $R_3 + R_4 + R_5$ .....   | <i>amelia</i>     |
| 8. Distal process long .....   | 10                |
| 9. Lobes <i>a</i> , <i>b</i> and <i>e</i> present. Lobe <i>a</i> very small. R running off cell .....  | <i>albula</i>     |
| 10. Lobe <i>a</i> very small .....   | <i>nicippe</i>    |
| 10. Lobe <i>a</i> well developed .....   | 11                |

11. Lobes *a*, *b*, *d* and *e* present.  $R_s$  and  $M_1$  stalked. Lobe *a* simply curved ..... Group 4
11. Only lobes *a* and *e* present.  $R_s$  and  $M_1$  not stalked.  
Lobe *a* recurved ..... *fornsi* and *lucina*
12. Outer angle of secondaries rounded. Middle discocellular at least a third as long as lower..... Group 6
12. Outer angle of secondaries angular or tailed. Second discocellular very small or absent ..... Group 5

Discussions of the groups follow. The odd species will be taken up in the second part under the discussion of the relationships of the species.

*Group 1.* See Figs. 5 & 6.

Excepting *fornsi* Poey this group contains all of the species in which the males regularly have a black or fuscous bar on the primaries just above and parallel to the inner margin, and in addition *agave* Cramer and *phiale* Cramer. The characteristic genitalic structure is the long, sharply pointed, strongly recurved lobe *a*, which is placed well basad on the valve. With the exception of *agave* and *phiale* I find it impossible to separate the species from each other by structural characters alone. In these two species, Fig. 6, lobe *d* is well developed and separated from the distal process, and lobe *a* is rather thick and bluntly pointed. *Agave* and *phiale* also differ slightly from the other species in that the upper discocellular is reduced. The characteristic lobe *a* is also possessed by *thymetus* Fabricius which, however, differs in venational characters, as noted in the key, and is also in color and pattern very much like the species of Group 6.

As the species appear to be very subject to local variation the taxonomy is in very bad shape. The following will probably prove of specific rank:

*jucunda* Boisduval & Leconte

*demoditas* Hubner

*ebriola* Poey

*palmyra* Poey

*elatheia* Cramer

*tegea* Felder

*agave* Cramer

*phiale* Cramer

*Group 2.* See Fig. 9.

Structurally this is a very compact group, and the species are hardly distinguishable from each other except by color and pattern. In *boisduvaliana* Felder and *ecuadora* Hewitson lobe *b* is very small, usually narrower than lobe *e*. In the other species it is as wide as lobe *e* and with the base considerably broader than the tip, Fig. 9. *Xanthochlora* Kollar also shows some slight tendency toward a reduction in size of lobe *a*. In all of the species the secondaries are angulate. Species included are:

- ecuadora* Hewitson
- boisduvaliana* Felder
- gratiosa* Doubleday and Hewitson
- xanthochlora* Kollar
- graduata* Butler

*Group 3.* See Fig. 11.

The forms included are not separable save by color and pattern. In these they show very close relationship, so that they may conceivably represent merely different forms of the same species. Forms are:

- pyro* Godart
- f. *hyona* Menetries
- portoricensis* Dewitz
- messalina* Fabricius

*Group 4.*

1. Uncus bearing two socii, Fig. 10.....*salome* Felder
1. Uncus not bearing socii, Fig. 11.....*mexicana* Boisduval

*Salome Felder* is one of the extremely variable species, in consequence of which a great number of its forms have been described more or less at random, with resulting confusion. Except for the socii on the uncus of *salome Felder* these two species are genitally practically indistinguishable. On the secondaries  $R_s$  and  $M_1$  are stalked, as in Group 2, *salome* Felder showing a slightly longer stalking than *mexicana*. See Fig. 16.

*Group 5.* See Figs. 14 & 18.

- gundlachia* Poey
- proterpia* Fabricius

Except for the slightly longer tails of the secondaries of *gundlachia* I cannot separate these two species by any structural characters, nor can I find any constant genitalic differences between them and the species of Group 6, q.v. On the whole the distal process of the valve of *proterpia* and *gundlachia* appears to be a little longer and with slightly smaller teeth than of any of the Group 6 forms, but this difference is one which is only apparent to one acquainted with a considerable series of specimens. In spite of the very different wing shape and pattern *gundlachia* and *proterpia* show evident relationship to the species of Group 6, both in the toothing of the distal process and in the lack of stalking of  $R_s$  and  $M_1$ , which differentiates them from the species of Group 4 which also possess tailed secondaries. See Figs. 17 & 18. The chief structural differences between Groups 5 and 6 lie in the wing shape, as noted in the key, and in the absence or extreme shortness of the middle discocellular in Group 5. See under discussion of the relationships of the species ff.

*Group 6.* See Figs. 12, 13 & 17.

*lisa* Boisduval & Leconte

*dina* Poey

*nise* Cramer

The members of this group all show great individual variation in structures. Because of this it appears to be impossible to separate them from each other except by color and pattern, and not in all cases there. *Nise* in particular varies exceedingly, even between specimens taken flying together. In some individuals there are clearly 5 lobes on the valve, besides a number of well developed teeth on the distal process, Fig. 13, while in others there are only 4 lobes on the valve and an only slightly toothed distal process. Again, in some specimens the upper discocellular is lacking, with  $R_s$  and  $M_1$  connate, while in others the upper discocellular is at least half as long as the middle, Fig. 17. *Nise* is a very puzzling species anyway. It is very subject to local variation, in consequence of which a large number of forms have been described which I am not inclined to accept as valid. In a case like this of a wide range of variation and a wide geo-

graphical range, with intergrades between all forms, an almost unlimited number of names could be applied. Forms representing the culmination of a line of variation would be held worthy of a name, but named forms that merely represent transitionals on these lines should be placed as synonymous whenever possible.

## PART II

For graphical representation of phylogeny of species see Fig. 19.

In discussing the lines of development each line has been designated by a letter ( $A_1$ ,  $A_2$ , etc.) which, for convenience in reference, is also given on the chart, Fig. 19.

I assume that in the primitive form the valve was quite generalized, as in some of the more primitive of the existing *Pieridæ*. It was smooth and rounded, lacking the distal process and all of the internal lobing. The clasper in its primitive form may have been present. Most of the lobes appear to originate distally, but there is no reason to suspect that lobe *a* does so. In many of the genera of the *Pieridæ*, such as *Anthocharis*, in which the genitalia appear to be comparatively unmodified, the clasper is typically present, flat and rounded in form, but never the ampulla. I therefore consider lobe *a* to represent a modified form of the clasper, in spite of its present form which is more suggestive of the ampulla.

Figs. 4, 5 & 6 illustrate well the method of development of the other lobes from the distal process. In Fig. 4 the process is simple and there is no trace of lobe *d*. In Fig. 5 lobe *d* is apparent, developing on the process as a ventrad flap, and in Fig. 6 lobe *d* has developed fully and migrated down onto the valve, leaving the process simple as before.

From the primitive stock there appear two lines of development,  $A_1$  and  $A_2$ :

$A_1$

In none of the forms referred to this line is there any trace of lobe *b*. It would therefore appear that either lobe *b* fails to develop or that it fails to appear until lobes *a*, *d* and *e*, and possibly *c*, are fully formed. Here again there are two lines of development,  $B_1$  and  $B_2$ :

B<sub>1</sub>

Lobe *a* is long, sharply pointed, well basad and strongly recurved. *Lucina* and *fornsi* show this, but in these two species the distal process is always simple, showing no trace of developing lobes. It would appear that they represent a primitive stage on the line of development to the "barred" species. I am aware of the existence of two other forms identical with *lucina* and *fornsi* structurally but differing sufficiently in color and pattern to be considered species. These, however, cannot at present be described because of lack of really sufficient material. In view of this I should place *lucina* and *fornsi* as a distinct group were it not for the fact that they are so evidently on the direct line of development to Group 1.

In the members of Group 1, lobe *a* is strongly recurved as already developed in *lucina* and *fornsi*, and the distal process bears a lobe or flap ventrad representing the developing lobe *d*, Fig. 5. In *agave* and *phiale*, Fig. 6, this lobe *d* is well formed and has moved down onto the valve itself, a bit more in *phiale* than in *agave*. Some specimens of "barred" males, which I call *tegea* Felder though I am not sure of the applicability of the name, show this lobe *d* partly separated from the process. These *tegea* specimens would then represent a slightly higher state of development than the other barred species, with *agave* and *phiale* successively still more highly developed. In *agave* the upper discocellular is much shorter than it is in any of the barred species, and in *phiale* it is absent with R<sub>s</sub> and M<sub>1</sub> connate.

*Thymetus* Fabricius is another name which I must apply with reservations. In the absence of the type it is impossible to be absolutely sure just exactly what *thymetus* Fabricius is, so meagre is the original description. However I am arbitrarily applying it to a species which appears to fit the somewhat vague specifications as well as if not better than anything else. This form, which is rather rare, is genitally identical with the barred species. It is, however, of greater size, and in color and pattern resembles the Group 6 species, except that there are rather strong reddish brown markings on the secondaries and the apices of the primaries underneath. It differs distinctly from the barred species in venation, as noted in the key, but equally much from the Group 6 species. I therefore consider that

it bears no relationship to the Group 6 species other than a purely superficial one of color and pattern, and have accordingly placed it near the barred species—Group 1.

### B<sub>2</sub>

Lobe *a* remains simply curved. In *deva* Doubleday, Fig. 7, lobe *d* shows signs of separating from the distal process which it does not in *reticulata* Butler. *Deva* also has a specialized process on the dorsal margin of the valve near lobe *a* which is absent in *reticulata* or only slightly indicated. It seems curious that *deva* alone should have developed this process, of which there is no positive trace in any other member of the genus.

### A<sub>2</sub>

This line is characterized by the fact that lobe *b* evidently develops before lobe *a*. In *albula*, Fig. 3, lobe *b* is well formed while lobe *a* is very small, as is also the case further down the line with *nicippe*. *Albula* is a relatively simple species, with lobe *a* very small and lobes *b* and *e* barely on the valve from the distal process. The process is very short and is rounded, showing no trace of developing lobes.

From this line there are again two opposing lines of development, C<sub>1</sub> and C<sub>2</sub>:

### C<sub>2</sub>

M<sub>1</sub> tends to stalk with R<sub>s</sub> and the middle discocellular is very oblique. In *nicippe*, Fig. 15, R<sub>s</sub> and M<sub>1</sub> are not yet stalked, but the obliqueness of the middle discocellular shows an evident relationship to the stalked forms. *Nicippe* has lobe *a* still very undeveloped, lobes *b* and *d* well developed, and a long but simple distal process. In the more highly developed species of Group 2, R<sub>s</sub> and M<sub>1</sub> are stalked, though shortly, and lobes *a*, *b* and *e* are well developed on the valve, with lobe *d* well developed, though still on the distal process. In the still further developed species of Group 4, lobes *a*, *b*, *d* and *e* are all well developed and on the valve. The process, having lost lobe *d*, is again simple. See Figs. 1 and 10. R<sub>s</sub> and M<sub>1</sub> are well stalked in *mexicana* and more so in *salome*, Fig. 16.

Extending through both Groups 2 and 4 there appear to be two parallel lines of development in pattern. One is characterized by a narrow, fairly even black margin on the wings above,

the chain of development leading from *xanthochlora* through *graduata* to *salome*. In this connection it is interesting to note that I possess specimens of *graduata* with both the primaries and secondaries yellow, instead of the primaries being yellow and the secondaries white as is the normal. These specimens are in color and pattern almost identical with some of the *salome* forms, but in venation and genitalia are identified with typical *graduata*. They might be considered as showing a linkage between *graduata* and *salome*. In the other line of pattern development the black marginal border of the wings is wide and deeply sinuate internally, as represented by *ecuadora*, *boisduvaliana*, *gratiosa* and *mexicana*.

This line appears to be the point of origin of the genus *Teriocolias* Röber. Although perfectly distinct from *Eurema* this small genus shows marked affinities to it in both venation and genitalia. It will be discussed in a separate paper.

#### C<sub>1</sub>

Although the upper discocellular is sometimes very short or fused with R<sub>s</sub> entirely, M<sub>1</sub> and R<sub>s</sub> are never stalked. In the forms of Group 3 the cephalad extension of the saccus is very short, Figs. 11 and 11a. Lobe *d* is more or less formed, but is still attached to the distal process. From here as a further development lobe *d* forms fully and migrates down onto the body of the valve. Two lines diverge:

#### D<sub>1</sub>

R<sub>s</sub> comes off the cell well basad from the end. The middle discocellular is very short or absent, so that the end of the cell is closed almost entirely by the lengthened lower discocellular, Fig. 18.

In *amelia*, Fig 2, the distal process is short and simple, showing little development. In *gundlachia* and *proterpia* the process appears to begin developing a number of teeth at once, representing incipient lobes. Here tailed or angular secondaries are also developed. *Amelia* is a most puzzling species, the exact relationships of which are hard or impossible to determine. The singular hind wing venation is identical with that of *proterpia*. Here, however, its resemblance to any other *Eurema* stops. The genitalia, while highly developed, lack any distinct specializa-



tion. In the fore wings  $R_2$  is stalked on the stem of  $R_3 + R_{4+5}$ , a character possessed by no other member of the genus. It is worthy of note that this stalking of  $R_2$  occurs also in *Leucidia*, a genus certainly related to *Eurema*.

## D<sub>2</sub>

In the *nise* forms and related species, Group 6, the anal angle of the secondaries is rounded, the middle discocellular is always at least a third as long as the lower, and  $R_s$  comes off the cell either near  $M_1$  or concurrently with it, Fig. 17. As was stated before, *nise* and its related species *dina* and *lisa* show great individual variation. Some specimens of *nise* show 5 lobes on the valve, besides a varying number of potential lobes in the form of teeth on the distal process, which represent the highest genitalic development found among the species studied. See Figs. 12 & 13.

Evaluating these various characters, I consider the following to be approximately the proper taxonomical arrangement of the species studied. No attempt has been here made at revising the synonymy, and in the main only forms are listed which are considered fully worthy of specific rank.

<i>albula</i> Cramer	<i>ecuadora</i> Hewitson
<i>lucina</i> Poey	<i>gratiosa</i> Doubleday & Hewitson
<i>fornsi</i> Poey	<i>boisduvaliana</i> Felder
<i>reticulata</i> Butler	<i>graduata</i> Butler
<i>deva</i> Doubleday	<i>xanthochlora</i> Kollar
<i>thymetus</i> Fabricius	<i>amelia</i> Poey
<i>jucunda</i> Boisduval & Leconte	<i>mexicana</i> Boisduval
<i>daira</i> Godart	<i>salome</i> Felder
<i>ebriola</i> Poey	<i>proterpia</i> Fabricius
<i>palmyra</i> Poey	<i>gundlachia</i> Poey
<i>elathea</i> Cramer	<i>lisa</i> Boisduval & Leconte
<i>tegea</i> Felder	<i>dina</i> Poey
<i>agave</i> Cramer	f. <i>westwoodi</i> Boisduval
<i>phiale</i> Cramer	<i>nise</i> Cramer
<i>nicippe</i> Cramer	f. <i>limbia</i> Felder ?
<i>pyro</i> Godart	<i>et al.</i>
<i>messalina</i> Fabricius	

Structural characters are plainly insufficient for the differentiation of more than a few of the New World species of *Eurema*. They do, however, point to the existence of a number of small perfectly distinct groups of species. The species in these groups are nearly or entirely identical structurally. It seems evident from this that the species have only recently split off from each other, and in the most mutable characters, and are at present probably in rather a plastic stage, with numbers of potential species and subspecies still in the process of splitting off. As yet many of these do not appear to have developed definite or constant enough characters to be worthy of specific or even subspecific rank, and names must be applied cautiously. In the course of time this differentiation may proceed far enough to validate the application of names to the variants. That, however, is of the problematical future. It therefore appears that when the nomenclature of *Eurema* is dealt with a goodly number of names will have to be placed as synonyms.

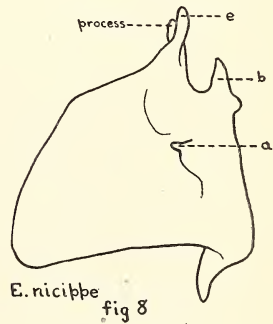
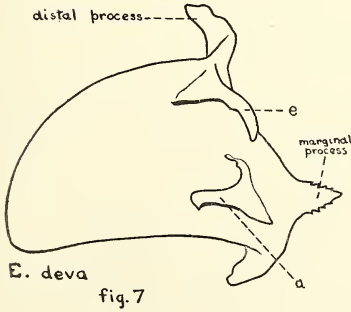
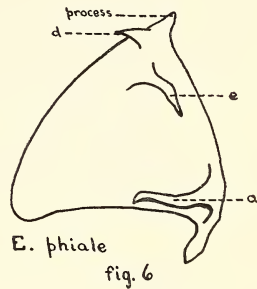
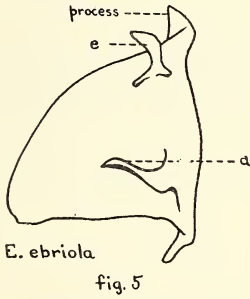
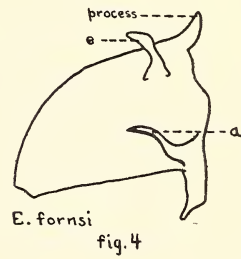
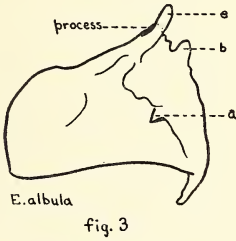
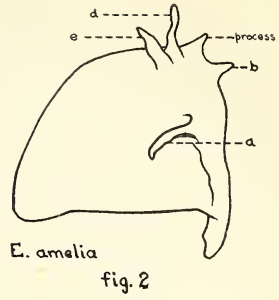
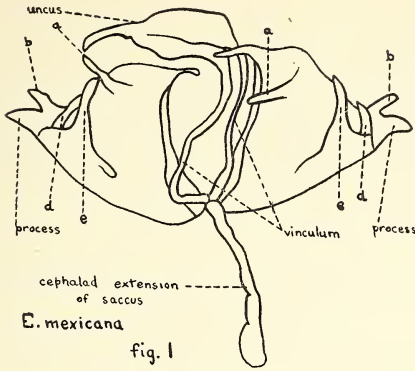
The genitalia and other structures of all of the prominent Old World forms of *Eurema* have been examined. They appear to possess no close kinship to any of the New World forms, and thus will be treated separately. Related genera of the *Pieridae* have also been examined in an effort to obtain data on the relationship and development of the genus. This subject also I hope to cover in a later paper.

I am now working on the synonymy of the New World forms, and expect to have this ready for publication in the near future.



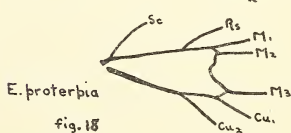
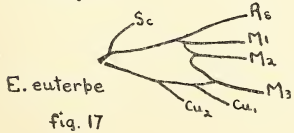
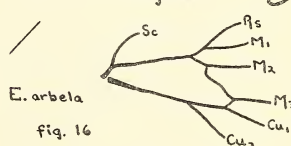
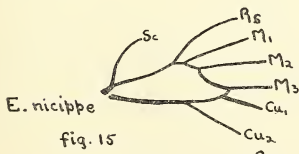
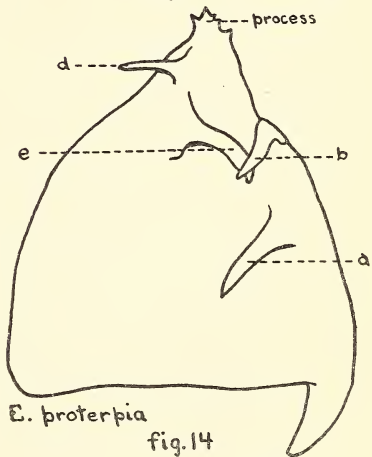
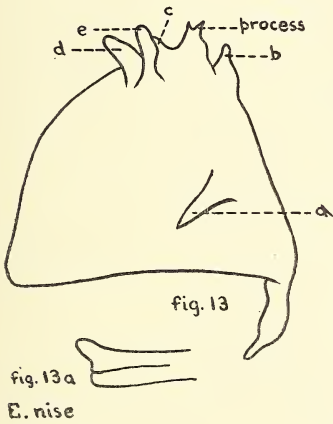
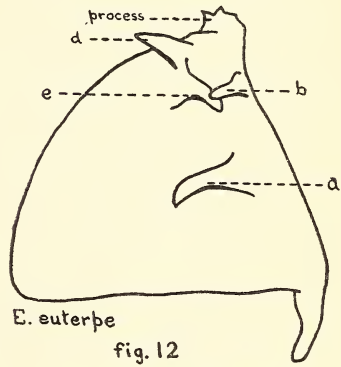
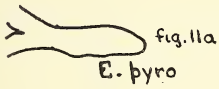
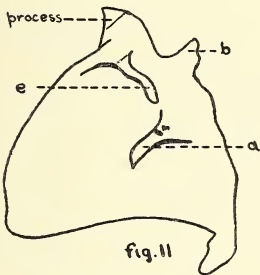
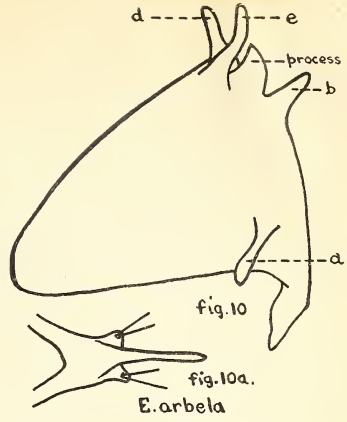
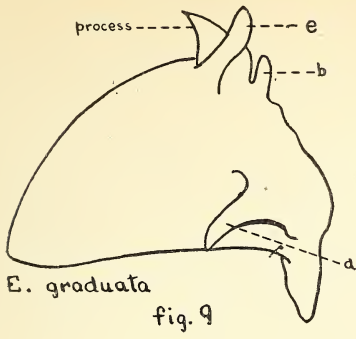
## PLATE II

- Fig. 1. Male genitalia, *Eurema mexicana* Boisduval  
Fig. 2. Ental aspect, left valve, *Eurema amelia* Poey  
Fig. 3. Ental aspect, left valve, *Eurema albula* Cramer  
Fig. 4. Ental aspect, left valve, *Eurema fornsi* Poey  
Fig. 5. Ental aspect, left valve, *Eurema ebriola* Poey  
Fig. 6. Ental aspect, left valve, *Eurema phiale* Cramer  
Fig. 7. Ental aspect, left valve, *Eurema deva* Doubleday  
Fig. 8. Ental aspect, left valve, *Eurema nicippe* Cramer



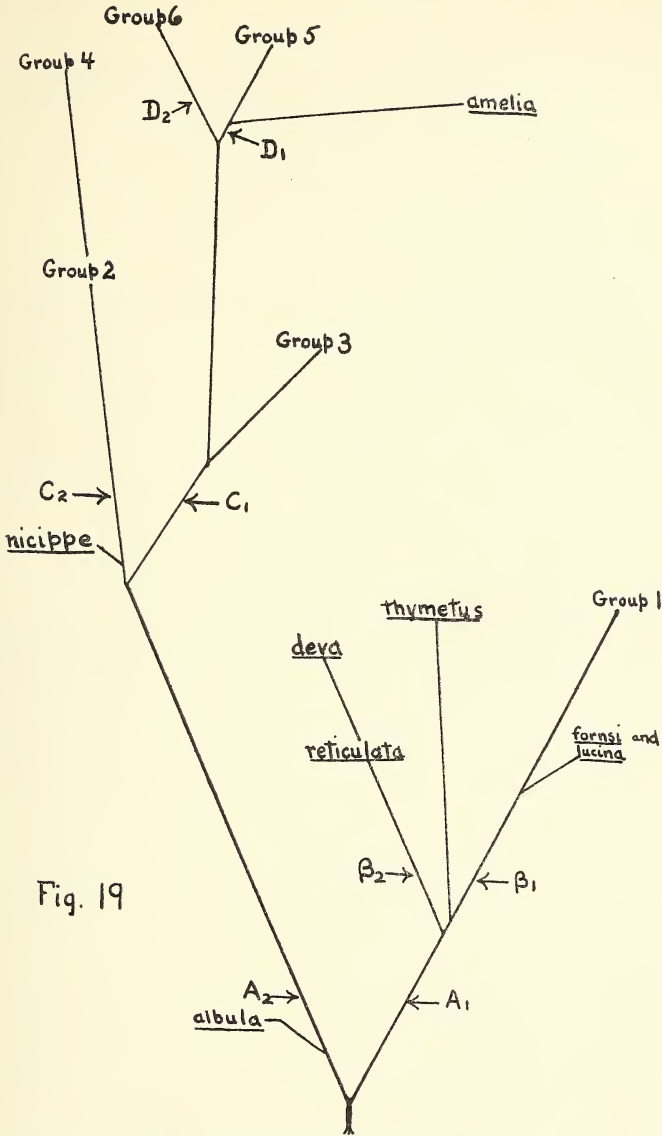
## PLATE III

- Fig. 9. Ental aspect, left valve, *Eurema graduata* Butler  
Fig. 10. Ental aspect, left valve, *Eurema arbela* Hubner  
Fig. 10a. Ventral aspect, distal part of uncus, *Eurema arbela* Hubner  
Fig. 11. Ental aspect, left valve, *Eurema pyro* Godart  
Fig. 11a. Cephalad extension of saccus, *Eurema pyro* Godart  
Fig. 12. Ental aspect, left valve, *Eurema euterpe* Menetries  
Fig. 13. Ental aspect, left valve, *Eurema nise* Cramer  
Fig. 13a. Lateral aspect, distal part of uncus, *Eurema nise* Cramer  
Fig. 14. Ental aspect, left valve, *Eurema proterpia* Fabricius  
Fig. 15. Venation around discal cell of secondary, *Eurema nicippe* Cramer  
Fig. 16. Venation around discal cell of secondary, *Eurema arbela* Hubner  
Fig. 17. Venation around discal cell of secondary, *Eurema euterpe* Menetries  
Fig. 18. Venation around discal cell of secondary, *Eurema proterpia* Fabricius









GRAPHICAL REPRESENTATION OF PHYLOGENY OF SPECIES



## A NEW TERIOCOLIAS (LEPIDOPTERA PIERIDÆ) FROM THE ANDES

By WM. T. M. FOBRES

CORNELL UNIVERSITY, ITHACA, NEW YORK

The following curious species is described at this time because of its significance in a morphological and genealogical study of the Pieridæ, and especially the genus *Eurema*, on which Mr. Alex. B. Klots is working. It appears to be a connecting link between early *Euremas* leading up to the *mexicana* group, and *Teriocolias atinas*, which flies in the same general region of South America.

### ***Teriocolias andina* new species**

Expanse 45-50 mm. Antenna clothed with hair-scales at base, but not as rough as in *T. atinas*. Fore wing of normal shape, with well-marked apex; hind wing nearly straight from  $M_2$  to  $Cu_2$ , and then sharply bent in anal region, about as in *Teriocolias atinas*. Fore wing with  $R_2$  barely stalked,  $M_2$  closely approximate to stem of R, but separated by a short vertical middle discocellular vein. Hind wing with cell much shortened on costal side, the discocellulars strong oblique; Sc strongly arched and widely separated from cell;  $M_1$  connate or barely stalked;  $M_2$  about 3 or 4 times as far from  $M_3$  as from  $M_1$ . The characteristic male genitalia will be described by Mr. Klots.

Upper side of the usual *Eurema* yellow, a little darker in the old specimens from the H. Edwards collection, but perhaps as a result of age. Base shaded shortly with black, the shading extending out on inner margin. Outer margin with black border, extending in almost to end of cell at costa, concave and only a little wider than an average interspace at the middle, narrowing below and ending abruptly just below  $Cu_2$ , slightly extended in at veins  $Cu_1$  and  $Cu_2$ . Discal dot a slender black lunule, in the male reaching top of cell but not down to  $M_3$ , in the female shorter; weaker in middle, or almost cut in two by yellow scales. Hind wing without border, but in male with blackish streaks on tips of upper veins, and dots on  $M_3$  to  $Cu_2$ , a blackish shade with scattered black scales through lower side of cell from base and obliquely across the outer part of the wing to join the marginal spot on  $M_1$ ; a bar across subcoastal cell near middle, an oblique postmedial streak across from  $M_3$  to  $Cu_2$ .

Base shaded with black, below the cell extending about  $1/3$  way to margin. *Under side* of fore wing slightly more ochreous yellow, darkening to the costa as usual, with the border light ochre dusted with indian red, and diffuse. Deep reddish terminal points, the one at  $R_2$  emphasized. Hind wing with the markings of the upper side repeated in indian red dusting on a light ochre base, and strongly contrasting; the streak in the lower part of the cell and below it often obscure, but with a strong oblique median shade across cell Cu, continuing the direction of the streak from the lower angle of the cell to  $M_1$ . Discal dot small and blackish, at upper angle of cell.

In the female the markings on the upper side of the hind wing are strongly emphasized, while in the male they may be inconspicuous; both sexes are variable. *Under side* strongly variable in the relative amount of reddish dusting and shading.

Peru. Holotype and allotype from Hy. Edwards collection, in the American Museum of Natural History; catalogue no. 3511. Paratype ♂ in Coll. of Cornell University, from Matucana at about 8000 ft. in the Andes, May 11, 1920, C. U. Lot 607, Sub 41; type no. 834. Two ♀ paratypes from the same lot as the holotype, one of them retained for the Cornell collection.

This very distinct species is easily recognized by the pattern on the upper side of the hind wing, which is, I believe, unique in the Rhodocerini. The pattern of the under side is substantially that of *Teriocolias atinas*, and *Eurema nicippe*. Genitalic characters show it to be more primitive than *T. atinas*, with a real relation to the *mexicana* group, which the venation also approaches. It is barely possible that this is *T. pacis* Röber, which is very insufficiently described, and only the under side figured; but I think I have recognized that form in a dark female of *T. atinas*.

ON THE RARE OCCURRENCE OF CERTAIN  
AMERICAN MUSCOID FORMS OF  
STRIKING CHARACTER

BY CHARLES H. T. TOWNSEND

It is worthy of note how few individuals of certain very striking species of American muscoid flies have been turned up. The following are some of the more outstanding cases:

**Cephenemyia phobifer** Clk.

One male was taken by J. Abbott about the beginning of the past century in the southern Appalachians of central Georgia and described in 1815. The next specimens taken were five males, discovered by F. E. Watson and W. T. Davis in 1913 and 1914 in the Adirondacks of New York. The species remained undiscovered for a hundred years. No American females of this genus are known in collections. *mf*

**Talarocera nigripennis** Wd.

This very remarkable Brazilian species was described in 1830 from a single female. H. H. Smith took both sexes in 1886 at Santa Anna da Chapada in Matto Grosso. Doctor Zuercher took a male in Paraguay in 1915. No other specimens are known. Until recently I had never examined a specimen. I had the Zuercher specimen in my keeping for a year before I discovered its identity, never having suspected its presence in all that time, though I had often looked at it as one amongst a lot of pinned specimens. The genus is an aberrant member of the tribe Larvaevorini.

**Bibiomima handlirschi** BB.

This most interesting and bizarre member of the Phasiidæ was described in 1889 from a specimen in the Winthem collection, taken in Bahia, Brazil, many years before. H. H. Smith took a

single specimen at Santa Anna da Chapada in 1886 and I published a note on it in 1916. Only these two specimens are known.

#### *Polistiopsis mima* TT.

This wonderful wasp-counterfeit is so far known in a single specimen taken by Sumichrast in Tehuantepec in the sixties of the past century. It evidently belongs in the tribe *Cylindromyiini*. The specimen stood undescribed in the U. S. N. M. collection all through Coquillett's time. I believe he regarded it either as a monstrosity or as a humbug—a wasplike hybrid or a syrphoid body with muscoid head etcetera—and was afraid to describe it! One can hardly blame such distrust, for its likeness to a brown *Polistes* and to certain wasplike syrphids is so faithful as to be positively startling. I almost doubted my own judgment when I described it.

#### *Tricharaea brevicornis* Wd.

This *Scatophaga*-counterfeit was described in 1830 from Montevideo. In 1858, Walker described a specimen from the Amazons as *Dexia albicans*. In 1868, Thomson described a third specimen from Rio de Janeiro as *Tricharaea scatophagina*, new genus and species. In 1925, Doctor Aldrich erected *Mallonotum*, new genus, on the Wiedemannian specimen. These three specimens are the only ones known.

#### *Cryptocladocera prodigiosa* Bzz.

This fissicorn form was described in 1923 from a single male that Bezzi had found in his collection amongst a lot of material purchased from Staudinger many years before. Evidently he was ignorant of its presence for many years until he happened to turn a lens on its head. It is from Dutch Guiana. No other specimen is known. It apparently belongs in the *Frontinini*. Bezzi erred in his supposition that *Talarocera* and *Cryptocladocera*, "having lost the plumosity of the arista, are replacing it by feathering the third antennal joint" (page 649, *Fissicorn Tachinidae*); for, were such the case, the females would also possess the feathering. Aristal plumosity is always the same in

the two sexes. In my opinion, the splitting of the third antennal joint is initiated for the purpose of affording greater olfactory or other sensory surface, analogous to the involutions of the brain surface, and may later be carried to extremes in the male by sexual selection.

#### *Ucayalimyia antlerata* TT.

This most astonishing of all fissicorn flies was described in 1926 from a single male that I took on September 13, 1925, at Canchahuayo on the lower Rio Ucayali in eastern Peru. While collecting, it is my nearly invariable custom to glance with a lens at the head of each fly as soon as I bottle it. Only when it seems quite unmistakably to be one of the common forms that I have taken repeatedly do I neglect this examination. I did not turn the lens on this fly till after I had pinned it, which is sufficient commentary on its appearance to the naked eye. The same thing happened on August 2, 1927, when I was fortunate enough to take a second male in a patch of rain-forest at Oxapampa in the Peruvian montana, at 5600 feet altitude. No other specimens are known. This is without doubt the most marvellous muscoid fly yet discovered. It bears a remarkable analogy to what would be termed in big-game parlance a many-point buck, hence the specific name. The Ucayali specimen is in the 90-point class. The Oxapampa male shows many less points. The genus appears to belong in the Phoriniini. In view of my experience, I recommend all muscoid students and collectors to examine separately with a lens the head of every fly in their collections. Doubtless there are to be discovered in collections fissicorn specimens of whose presence the possessor is ignorant.

#### *Dichocera lyrata* Wll.

Various specimens of this species were taken by Doctor Aldrich in Idaho in 1895. It has not been met with elsewhere. This and its close allies, *Dichocerosia* and *Neodichocera*, seem to belong in the Germariini. *Dichocerosia orientalis* Cq., from Massachusetts, known only in the female, may or may not have a fissicorn male.

***Neodichocera tridens* Wlt.**

Two males of this species were taken by V. L. Wildermuth or associates in northern New Mexico in 1913. I took a female in 1917 on the East Verde river in central Arizona. No other specimens are known. The female was taken September 30 on a drift log stranded on a big rock in midstream. It looks almost exactly like a common sarcophagid. The forenoon was showery and I was fishing. Not suspecting its identity, I caught it in my hand with the intention of using it for fishbait, but recognized its rare nature in time to save it from the hook. The incubating uterus is gutlike, quite thick, in four or five coils, not straplike; eggs in four to eleven rows, fairly regularly disposed but not with precision; no maggots were yet developed; capacity a thousand or over. Preuterus present, as long as the elongated macrotype egg.

***Acronarista mirabilis* TT.**

This was described in 1908 from a male taken by H. G. Dyar in southern Florida. It has not been recovered. Like most of the small fissicorn forms, this goes in the Actiini. *Acronaristopsis bahamensis* TT, known only in the female, is a member of the same tribe and may or may not have a fissicorn male; its three bristled veins signify nothing in this connection, as this character occurs in widely diverse forms.

***Imitomyia sugens* Lw.**

This interesting form was described by H. Loew from Illinois in 1863. It was never found again until about 1915, when numerous specimens were collected in Saskatchewan.

***Euthera tentatrix* Lw.**

This was described by H. Loew in 1866 from New York. Isolated specimens have been found since in a half dozen separate localities, ranging from Massachusetts to Georgia and Texas. A male was taken on wet muddy soil May 14, 1915, at Chevy Chase, Maryland, by G. E. Quinter. The species is thus not a late-summer form, as was imagined by Bezzi.



A single male specimen of *Euthera*, described by Bezzi in 1925 as *E. barbiellini*, was taken by Count A. A. Barbiellini some years since in Sao Paulo, Brazil. It is the only specimen of the genus as yet known from the entire continent of South America.

As the late Paul Stein has aptly remarked, the affinities of *Euthera* have caused much brainwreck over a period of many years. Brauer and Bezzi have favored *Schineria* as the nearest ally; Stein, Trixa; Osten Sacken, *Scopolia*; Williston, *Acemya*; Mik, Villeneuve and Townsend, *Phasia*. The diversity of views obtaining indicates the complexity of the affinities in question. With Villeneuve and Stein, I have always considered *Schineria* to belong in the vicinity of the Larvaevorine Series of tribes (supertribe Larvaevoroini), with which *Euthera* has little special affinity, yet both Brauer and Bezzi considered it to possess *Cylindromyiine* and thus *Phasiid* affinities. Trixa and *Scopolia* appear to fall in the *Calirroidae*. *Acemya* is classed by Stein in the *Phasiidae*, by others in the *Calirrhoidae*. *Euthera* presents certain affinity with the *Calirrhoidae* but appears better placed in the *Phasiidae*, along with *Imitomyia* and *Hesperophasia*. The female internal reproductive-system characters are still unknown, but the male characters appear to approach most nearly those of *Cenosoma*. The vasa efferentia are mere necks in *Euthera* and practically absent in *Cenosoma*, while the other characters are very similar in the two genera. But *Cenosoma* itself is rather on the borderline between the *Calirrhoidae* and the *Phasiidae*.

#### ***Hermya afra* RD.**

Described from Brazil in 1830 and not rediscovered. Seems near *Penthosia*.

#### ***Icelia flavescens* RD.**

Also described from Brazil in 1830 and not yet rediscovered. Evidently came from Minas Geraes. Seems close to *Hemyda*.

#### ***Macromyia depressa* RD.**

This, also described from Brazil in 1830, must be a very striking form. Despite the discrepancies in Desvoidy's description,

one might easily jump at the almost irresistible conclusion that *Paradejeania rutilioides* is *Macromyia depressa*, but he would certainly be wrong. In favor of this conclusion there are the following facts: Desvoidy states that *Macromyia* differs from *Rutilia* only in the somewhat longer third antennal joint and absence of facial carina; that it is wide, depressed, yellowish, etc.; Jaennicke named his species *rutilioides*; the measurements of *depressa* and *rutilioides* are the same, 16 to 18 mm, and no other similar flies are known of this size. Against the conclusion is the fact that coloration, length of second antennal joint and abdominal chaetotaxy all conflict. *Macromyia depressa* remains still to be rediscovered. Since the description of *M. analis* RD almost tallies with *Tropidopsis pyrhraspis* Wd., it is most probable that *Macromyia* belongs in the Hystriciini.

#### **Leschenaultia cilipes** RD.

Described in 1830 from Dutch Guiana and not yet rediscovered. It seems to be a *Harrisia* with spinelike machrochaetae and tomentose arista.

#### **Olinda brasiliensis** RD.

Described in 1830 from Brazil. *Olinda* is the name of a seaside suburb of Pernambuco, which would indicate that this species was collected near there. The genus appears allied to *Xiphomyia*, which is a *Lydella*-like form with a piercer as long as its abdomen. It remains to be rediscovered.

#### **Spathipalpus philippii** Rdi.

Described in 1863 from Valdivia, Chile, and not yet rediscovered. It is probably either a *Leskiine* or an *Aphriine*.

#### **Dumerillia rubida** RD.

Described in 1830 from Brazil and not yet rediscovered. It seems to come near *Jurinia*.

#### **Chætogyne vexans** Wd.

Described from Sao Paulo, Brazil, in 1830 and not yet rediscovered.

***Pachymyia macquartii* TT.**

This was identified by Macquart in 1843 from Sao Paulo as *vevans* Wd. Brauer & Bergenstamm state that it is quite distinct. It has not been rediscovered.

***Myiophasia australis* TT.**

This was described by Wiedemann in 1830 as *Tachina aenea*, from Montevideo, and has never been rediscovered. The combination, in male, of deeply yellowish wings, rust-yellowish wingveins and deep yellowish squamae, with strongly oblique crossveins, as per Wiedemann's description, is known in no North American specimen. I believe that the locality label of Montevideo is correct, that the Wiedemannian specimen came from Uruguay and that the species will eventually be rediscovered. If it came from Uruguay, it can scarcely be the same species as *metallica* TT from a range far removed with no specimens in between. Aside from the wing differences, the first two antennal joints are reddish-yellow and the third black, while in *metallica*, the first two joints are not so contrasted in color with the third, which is usually an important character. There are a number of minor differences in both color and structure.

***Sophia filipes* RD.**

Described in 1830 from Brazil and not yet rediscovered. For a long time I could not place this form, but I finally concluded that it must be congeneric with *Euantha liturata* Ol. I still incline to that view, but may be wrong.

***Cordyligaster analis* Meq.**

Described in 1851 from the Amazons, on a single male. In recent years Parish took a female in British Guiana which Aldrich has provisionally referred to this species. No other specimens are known.

***Cordyligaster tipuliformis* Wlk.**

A single female described in 1857 from South America and the species not yet rediscovered.

**Xystotrixa anthracina** Wd.

Described in 1830 from Brazil and not yet rediscovered. It appears to be related with Therobia and Trixa.

**Sumichrasti aurea** GT

Described in 1893 by Giglio Tos from a specimen collected by Sumichrast in Mexico in the sixties of the past century. Some twelve or fifteen years ago, H. T. van Ostrand rediscovered it in a single female at Real del Monte in the State of Hidalgo, 9000 feet.

**Lasiopalpus flavitarsis** Meq.

Described by Macquart in 1847 and three specimens taken by Lindig in Venezuela in 1864. It has not been rediscovered since.

**Argyromima mirabilis** BB.

Described in 1889 on a single specimen from South America and not rediscovered. It is a dolichopodid-counterfeit.

**Exopalpus.**

Described by Macquart from Colombia and not rediscovered.

**Gonistylum.**

Described by Macquart from Brazil and not rediscovered.

**Gnadochaeta.**

Also described from Brazil by Macquart and not rediscovered.

**Pterotopeza tarsalis** Sch.

Taken by Lindig in Venezuela in 1864 and described in 1868. Not yet rediscovered.

**Jaenimyia albicincta** TT.

Taken in Jaen province, eastern Peru, in 1911. No other specimens known before or since.

**Euscopoliapteryx nebulosa** TT.

Described in 1917 from a single specimen taken by H. H. Smith on the Rio Cuyabá in 1886. No other specimen known.

**Chiricahuia cavicola** TT.

Taken in the Chiricahui Mountains of Arizona in 1917, in a single female. No other specimen known.

**Bezzimyia busckii** TT.

Taken by Busck in Panama about 1912. Only one specimen known.

**Anametopochaeta olindoides** TT.

A single specimen taken in 1910 in eastern Peru. No other known.

The foregoing species are rare in both sexes; the following may be rare in only one sex, usually the female:

**Trixodes obesa** Cq.

The males of this species are common on living pine trunks in the mountains of southeastern Arizona, southwestern New Mexico and northwestern Mexico. I have taken forty-four males but only two females. These two females are the only ones known and were taken in 1894 on the West Fork of the Rio Gila in New Mexico, and in 1899 on the Head of the Rio Piedras Verdes in the Sierra Madre of western Chihuahua. In 1917 I took forty-two males in Arizona.

**Charapemyia calida** TT.

Only males are known. I have taken numerous males in three separate localities of the Peruvian montanya (Rio Charape, Uruhuasi, Oxapampa) and at Itaquaquecetuba in southern Brazil, but never a female. On Aldrich's identification, I have also taken males of the genus in the White Mountains of New Mexico. This genus is entirely distinct from *Neotrafoia* TT, of which I have taken various specimens of both sexes in three localities of the Peruvian montanya (Cuzco, Uruhusia, Oxapampa). There are no less than thirteen important generic distinctions between *C. calida* and *N. incarum*, the two most striking being in the ocellar bristles and the proboscis. Throughout the Muscoides, the direction in which the ocellars are inclined is

always practically the same in the two sexes. The proboscis of *Charapemyia* is much stouter and shorter than that of *Neotrafoia* and of quite distinct type. The wings of *N. incarum* are conspicuously blackish on costa from stigma to tip of R3, while in *C. calida* they are perfectly clear. This last character easily separates the two species.

#### **Xylocopodes semiatra** Wd.

At Petropolis, Brazil, Foetterle has taken about 100 males of this remarkable fly during a period of years within the past decade or two, always in summer and mostly in February, and only on a certain particular tree trunk, until the collecting of further specimens was summarily stopped by the owner of the tree ordering it cut down. Two or three females were taken elsewhere near Petropolis. No other females are known. The species was described in 1830 from a male taken near Rio de Janeiro. Another male has been taken in the State of Espirito Santo.

#### **Pseudogametes hermanni** Bsch.

Only three specimens known. The holotype, a male, is from Minas Geraes. Two other males have been taken in northwestern Sao Paulo, on a tree trunk. No females are known.

#### **Atrypoderma** spp.

I have taken about 100 males of this genus sitting on rocks and twigs in wet and dry canyons and washes of southwestern North America, with never a female in their company. Occasional females are found flying, on the scout for hosts. The males take their stations while awaiting the females, as in the case of *Xylocopodes*, *Trixodes* and *Pseudogametes*, but, unlike these three genera, they never frequent tree trunks.

The above facts illustrate the danger of falling into serious error in attempting to force conclusions of identity of forms that closely approach each other on most characters but show certain differences. One form may occur commonly and the

other be of very rare occurrence, the two being quite distinct. Or one sex may be common and the other rare. Long series of a given form may not be the same as a single specimen described a century ago or yesterday, despite their close agreement in all but certain minor characters. No matter how large and full a collection, we can not hope to find all forms represented in it. We must remember further, that only about one-fifth of the existing forms are so far named and described. It may seem strange that a given form was collected a century ago in a certain locality and that intensive collecting today in the same general region or district fails to reveal anything like it. Yet such is the fact in numerous cases, as above pointed out at length. Nor is any vital change in the environment to be held responsible for their disappearance, since suitable refuge has always been open to all of the above-mentioned forms. Quite certainly none of these forms is extinct. The fact is that many of the rarer species may not be met with once in a century. Furthermore, consider the vast number of forms still unknown, that nearly two centuries of collecting has so far failed to turn up!





## THE ENTOMOLOGY OF HOOKE AND LEEUWENHOEK

BY HARRY B. WEISS AND G. M. ZIEGLER

ROBERT HOOKE

(1635-1703)

When Robert Hooke was making his contributions to human knowledge, London was a walled city, with gates locked at night and with bellmen calling the hour and weather all through the night. Although it was a frivolous and drinking age, Hooke's versatility did not embrace the lighter activities of his time. An Oxford graduate, professor of geometry, one-time city surveyor, fellow of the Royal Society and secretary from 1677 to 1682, inventor, and author, his energies were distributed in such fields as physics, architecture, chemistry, mathematics, philosophy, astronomy and microscopy. Grotesque and small in physique, unkempt in appearance, irascible, offensively argumentative, arrogant, melancholy, incredulous, stingy, invidious and with jaundiced eye, he was not loved by his contemporaries. Nevertheless his mind was able and prolific, and to it we owe the balance wheel of watches, many inventions, improvements in astronomical and physical instruments, and observations anticipating the work of others in optics and gravitation. Hooke started much more than he finished and, with all his other interests, he dipped also into the field of zoology, including entomology.

Hooke was more of a microscopist than an entomologist, and his observations on insects were incidental to his interest in the microscope, the invention and improvement of which had opened up a big field for students of detail. He stuck all sorts of things under his lenses—watered silks, sand, seaweed, the edge of a razor, poppy seeds, the feet, head and wings of flies, ants, bookworms, lice, mites, fleas, spiders, glass, sponge, cork, charcoal, etc.—and his observations were published in London by the

Royal Society in 1665 under the title, "Micrographia or some Physiological Descriptions of Minute Bodies made by Magnifying Glasses, with Observations and Inquiries thereupon."

In the preface to his work, Hooke says, "It is the great prerogative of Mankind above other Creatures, that we are not only able to *behold* the works of Nature, or barely to *sustain* our lives by them, but we have also the power of *considering, comparing, altering, assisting,* and *improving* them to various uses. And as this is the peculiar privilege of humane Nature in general, so is it capable of being so far advanced by the helps of Art, and Experience, as to make some Men excel others in their Observations, and Deductions, almost as much as they do Beasts. By the addition of such *artificial Instruments* and *methods*, there may be, in some manner, a reparation made for the mischiefs, and imperfection, mankind has drawn upon it self, by negligence, and intemperance, and a wilful and superstitious deserting the Prescripts and Rules of Nature, whereby every man, both from a deriv'd corruption, innate and born with him, and from his breeding and converse with men, is very subject to slip into all sorts of errors."

Altogether sixty observations are listed by Hooke, and many of them are accompanied by large black and white drawings said to have been made by the author. Nineteen observations refer to parts of insects, entire insects or related creatures, and the titles of these (omitting observations 47 and 48, on spiders) are as follows: "Obser. 37. Of the Feet of Flyes and other Insects"; 38, "Of the Wings of Flyes"; 39, "Of the Head of a Fly"; 41, "Of the Eggs of Silkworms"; 42, "Of a blue Fly"; 43, "Of a water Insect"; 44, "Of the tufted Gnat"; 45, "Of the great belly'd Gnat"; 46, "Of a white moth"; 49, "Of an Ant"; 50, "Of the wandring Mite"; 51, "Of a Crab-like Insect"; 52, "Of a Book-worm"; 53, "Of a Flea"; 54, "Of a Louse"; 55, "Of Mites"; 56, "Of small Vine-Mites."

"Of the Water-Insect or Gnat," Hooke writes in part as follows: "This little creature, described in the first Figure of the 27. Scheme, was a small scaled or crusted Animal, which I have often observ'd to be generated in Rain-water; I have also observ'd it both in Pond and River-water. It is suppos'd by

some, to deduce its first original from the putrifaction of Rain-water, in which, if it have stood any time open to the air, you shall seldom miss, all the Summer long, of store of them frisking too and fro." He then describes the larva, its shape, bristles and tufts, its motion and characteristic position of hanging head downward. The pupa also is described, its "horns," its movement in the water and the emergence of the adult. He says nothing about the use of the siphon of the larva and he did not see the eggs of the gnat, but supposed that they were dropped into the water by the adult. Another idea was that the eggs were brought down by falling rain, and still another that "whether multitudes of those other little creatures that are found to inhabit the Water for some time, do not, at certain times, take wing and fly into the Air, others dive and hide themselves in the Earth, and so contribute to the increase both of the one and the other Element." He concludes by discussing nut insects, and galls and their contents.

Concerning the flea, some of his observations are as follows: "The strength and beauty of this small creature, had it no other relation at all to man, would deserve a description. For its strength, the Microscope is able to make no greater discoveries of it then the naked eye, but onely the curious contrivance of its leggs and joints, for the exerting that strength, is very plainly manifested, such as no other creature, I have yet observ'd, has any thing like it; for the joints of it are so adapted, that he can, as 'twere, fold them short one within another, and suddenly stretch, or spring them out to their whole length." He then describes its leaping motions—its polished body and armor and its proboscis.

In observation 54, before outlining the shape, feeding methods, etc., of the louse, Hooke writes entertainingly,—"This is a Creature so officious, that 'twill be known to every one at one time or other, so busie, and so impudent, that it will be intruding it self in every ones company, and so proud and aspiring withall, that it fears not to trample on the best, and affects nothing so much as a Crown; feeds and lives very high, and that makes it so saucy, as to pull any one by the ears that comes in its way, and will never be quiet till it has drawn blood."

As to the feet of flies and their ability to walk on substances including glass, he says, in observation 37, after describing the pulvilli and their small "bristles" which he likens to the wire teeth "of a Card used for working Wool,"—"hence the two Tallons drawing the feet forwards, as I before hinted, and these [the pulvilli] being applied to the surface of the body with all the points looking the contrary way, that is, forwards and outwards, if there be any irregularity or yielding in the surface of the body, the Fly suspends it self very firmly and easily, without the access or need of any such Sponges fill'd with an imaginary gluten, as many have, for want of good Glasses, perhaps, or a troublesome and diligent examination, suppos'd. Now, that the Fly is able to walk on Glass, proceeds partly from some ruggedness of the surface; and chiefly from a kind of tarnish, or dirty smoaky substance, which adheres to the surface of that very hard body; and though the pointed parts cannot penetrate the substance of Glass, yet may find pores enough in the tarnish, or at least make them." Hooke's "imaginary gluten" was later found to be the secretion of glandular hairs.

Hooke's difficulties with some of his specimens are indicated in observation 49, on the ant, wherein he writes, "This was a creature, more troublesom to be drawn, then any of the rest, for I could not, for a good while, think of a way to make it suffer its body to ly quiet in a natural posture; but whil'st it was alive, if its feet were fetter'd in Wax or Glew, it would so twist and wind its body, that I could not any wayes get a good view of it; and if I killed it, its body was so little, that I did often spoile the shape of it, before I could throughly view it: for this is the nature of these minute Bodies, that as soon, almost, as ever their life is destroy'd, their parts immediately shrivel, and lose their beauty." He finally placed it in "a drop of very well rectified spirit of Wine," and then laid it on paper until the spirit of wine had evaporated, after which he easily adjusted it with a pin.

In observation 45 on "the great Belly'd Gnat or female Gnat," he wrote in part, "One of these Gnats I have suffer'd to pierce the skin of my hand, with its proboscis, and thence to draw out as much blood as to fill its belly as full as it could hold, making

it appear very red and transparent; and this without any further pain, then whilst it was sinking in its proboscis, as it is also in the stinging of Fleas: a good argument, that these creatures do not wound the skin, and suck the blood out of enmity and revenge, but for meer necessity, and to satisfy their hunger. By what means this creature is able to suck, we shall shew in another place.”

Hooke's descriptions are confined, for the most part, to what he could see through his microscope and frequent references are made to the drawings. They are not comparable of course to present-day descriptions. The complexity and interrelationship of parts had not yet been studied and the terminology was meager. Woodruff states “Although the work is replete with singular anticipations of the discoveries and inventions of other workers in various branches of science, the biologist's interest is chiefly in Hooke's application of his improved compound microscope to the study of plants and animals which paved the way for the more special, profound, and methodical studies of the contemporary students of nature. In the *Micrographia* are clearly described and figured for the first time the ‘little boxes or cells’ of organic structure, and his use of the word ‘cell’ is responsible for its application to the protoplasmic units of modern biology. It is fair to say that the influence of the *Micrographia* permeated the sciences in various directions and the illustrations of microscopic objects were copied for nearly two centuries.”<sup>1</sup>

ANTHONY VAN LEEUWENHOEK  
(1632–1723)

During Leeuwenhoek's life-time, the Netherlands declined from the height of commercial and maritime supremacy to a second-class power, but it is doubtful if Leeuwenhoek knew what was happening. Changing political and economic conditions held no interest for him, but grinding lenses and looking through microscopes did. Starting as a dry-goods apprentice in Amsterdam and later operating his own store at Delft, he found himself, at the age of forty, without money or reputation, but through

<sup>1</sup> *Scientific Monthly*, 1921, p. 260.

the influence of relatives he managed to get the job of janitor to the sheriff's office in Delft. Although one usually associates janitors with furnaces, brooms and mops, Leeuwenhoek was not that kind of janitor. He had a political janitorship and, as a result, plenty of leisure time which he devoted to the grinding of lenses and to the microscopic examination of innumerable small objects.

He examined the structure of fruits, seeds, deciduous trees, conifers, etc. He was the first to make a microscopic study of yeast cells, to correctly describe red blood corpuscles, to discover bacteria, Hydra, protozoa, micrococci, to see crystals in plant tissue, to satisfactorily demonstrate the capillary flow of blood, to give a satisfactory account of plant lice and their development, to see the eggs of ants, and to make many other observations which eventually led to more refined work by later investigators. Insects came in for a fair share of his attention. He described insect eyes, trachea, wing scales, the sting of the bee, gall insects, cheese maggots, cochineal insects, etc., and often made observations on their life-histories.

Leeuwenhoek had few scientific acquaintances, but he was fortunate in having the friendship of Regner de Graaf, who made him known to the Royal Society of London, which printed most of his papers in their Transactions (numbers 94-380), and made him a fellow in 1680. He also sent letters to the French Academy. Many of his papers were accompanied by drawings made, not by him, but undoubtedly under his supervision.

In the Philosophical Transactions for 1673 (T. 8, No. 94, pp. 6037-6038) under the title, "A Specimen of some Observations made by a Microscope, contrived by M. Leewenhoeck in Holland, lately communicated by Dr. Regnerus de Graaf," Leeuwenhoek writes as follows.

"2. The *Sting* of a *Bee* I find to be of another make than it hath been described by others. For I have observed in it two other stings, that are lodged within the thickness of the first sting, each having its peculiar sheath.

"3. Further I observe, on the Head of a *Bee* before, two *artus* or limbs with *teeth*, which I call *Scrapers*, conceiving them to be the organs wherewith the *Bee* scrapes the Waxy substance from

the Plants. Besides, I find two other limbs, each having two Joints, which I call *Arms*, wherewith I believe this Insect performs its work and maketh the Combs. Moreover, there is also a little Body, which I call the *Wiper*, being rough and exceeding the other Limbs in thickness and length, by which I am apt to believe the Bee wipes the Honey-substance from the Plant. All which *five* Limbs the Bee, when she doth not work, knows curiously to lay close under her head, in very good order."

"4. As to the *Eye* of the Bee, which I have taken out of the Head, exposing its innermost part to the Microscope; I find, that the Bee receives her light Just with the same shadow as we see the Honey-combs: Whence I am prone to collect, that the Bee works not by art or knowledge, but only after the pattern of the light received in the *Eye*."

Leeuwenhoek's odd supposition that the hexagonal honeycomb cells were due to a sensation received from the hexagonal eye facets of the bee was confuted by Swammerdam in his "Biblia Naturae." In a later number of the Transactions (No. 97, pp. 6116-6118, 1673) Leeuwenhoek's figures, which should have accompanied paper number 94, are printed together with explanations.

In 1694, the Transactions (T. 18. No. 213, pp. 194-199) carried, "An Extract of a Letter from Monsieur Anthony Van Leuwenhoek to the Royal Society, containing the History of the Generation of an Insect, by him called, The Wolf. With Observations on Insects bred in Rain-Water, in Apples, Cheese, &c." In this, Leeuwenhoek states that,—"The Wolf is a small white Worm armed with two red Sheers or Teeth at the fore part of its Head, wherewith it bores and feeds on the Grains of Corn, and makes its way through Wood it self." He then describes its feeding habits in wheat, the emergence of the adult moths in his glass tubes, eggs, scales, etc., in fact most of the article is devoted to the "wolf," which is apparently one of the grain moths. He claims that fair control was got by fumigation with sulphur.

Another paper (Philos. Trans. 1698. T. 20. No. 240, pp. 169-175) is entitled, "Part of a Letter from Mr. Anthony van Leeuwenhoek, F.R.S. concerning the Eyes of Beetles, &c." Among

other things he states: "Amongst the rest, I have, last Summer, shewn to several English Gentlemen, the Multiplicity of Eyes that are to be seen in the *Tunica Cornea* of a Beetle, that is called the Eye." "This Sight was very strange to the said English Gentlemen; because, that if one will reproach a Man with Blindness, or Dimness of Sight, they use to say in English, *You are as Blind as a Beetle*, because they reckon a Beetle to be Blind." He then describes what he saw under microscopes and the results of his dissections of the eyes of flies. He also writes,—“The Paws of these Flies, Chiefly that Side they run withal, are plentifully provided with Hair-like Parts, wherewith they know to run upon Polished Glass, more than any other sort of Flies. I have cut off Paws, and fixed them before the Magnifying Glass, for to shew the Tools wherewith they are able to fix themselves to the Polished Glass, and so to run up.”

In "A Letter from Mr. Anthony van Leeuwenhoek, F.R.S. concerning some Insects observed by him him (sic) on Fruit Trees," (Philos. Trans. 1700. T. 22, No. 266, pp. 659-672), he deals with plant lice on quince, plum, currant and cherry, and refers to his letter of 1695, wherein the parthenogenesis of aphids is mentioned. He was responsible for much new information about these insects, their cast skins, the excretion of honey dew, parasites, etc.

Miscellaneous observations on gall insects and cheese maggots are contained in "Part of a Letter of Mr. Anthony Van Leeuwenhoek, F.R.S., concerning Excrescencies growing on Willow Leaves &c." (Philos. Trans. 1701 (1700 err. typ.) T. 22. No. 269, pp. 786-792).

Leeuwenhoek studied the life-history of fleas, from the eggs to the adults, and found that Father Kircher was wrong in attributing their origin to dust and debris. Concerning the mouth parts of fleas, he says in "Microscopical Observations on the Structure of the Spleen, and the Proboscis of Fleas. By Mr. Anthony Van Leeuwenhoek, F. R. S." (Philos. Trans. 1706. T. 25. No. 307, pp. 2305-2312),—"This Scabbard of the Flea is divided into 2 parts, and each of them has a Cavity like a Canal, in order to contain the Sting when those Parts are close shut together; but that which was most remakable (sic) to me was, that each of



those hollow Parts, that compose the Sheath or Scabbard, was compos'd of Parts like the Teeth of a Saw. These Teeth, I conclude, are so made as to indent one within another when the Sting is in the Sheath, in order to hinder the opening of the same at any other time than when the Flea would make use of it: Yea, that which is more, we discover'd at the end of each of the Scabbards 3 Teeth standing out, which I judge was for no other end than to shut within one another."

What appears to be a wandering account of several species of Dermestidæ, with notes on his feeding experiments, descriptions of larvæ, and habits of the beetles, etc., is found under the title, "Additional Observations upon the Production of Mites, &c. In a Letter from Mr. Anthony van Leeuwenhoek, F.R.S." (Philos. Trans. 1712. T. 29. No. 333, pp. 398-415).

Ants, spiders, cochineal insects, body lice, etc., were also the objects of his investigations, and many additional facts were uncovered. Although he sometimes drew wrong conclusions and never exhausted the possibilities of any of his subjects, and although he did not have the patience of Swammerdam, he was responsible for many worth-while discoveries. Doctor Becking<sup>2</sup> believes that erratic, illiterate, uncultured and unimaginative Leeuwenhoek obtained his place in the same group with Swammerdam and Malpighi by "reflection." Becking states, "It is only the genius that can synthesize a vast group of disconnected facts under a general law, where the truthful observer only can describe and catalogue. In that respect Leeuwenhoek did not reach the mental level of a taxonomist; his descriptions were not catalogued." However, Leeuwenhoek was a pioneer in a hitherto unexplored field. There was no incentive for him to dig deeply in any one place. A hundred things called to him at once and he went from one to another. If he had not wasted part of his time in making 527 gold, silver and brass microscopes, and if he had worked in order in a much smaller field, and if he had been a college graduate, he might or might not have contributed more to science. He was simply himself. He did what he did because it pleased him and because it was interesting.

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<sup>2</sup> Sci. Mon. Vol. 18, pp. 547-554.

His place among the immortals is due to his microscopes and to his curiosity.

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## PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF APRIL 5, 1927

A regular meeting of the New York Entomological Society was held at 8 P. M., on April 5, 1927, in the American Museum of Natural History; President Henry Bird in the chair, with twenty-one members and twelve visitors present.

The treasurer reported receipt of a letter from Farmers' Loan and Trust Co., stating the investment of the Woodruff bequest as follows:

\$5,000 participating interest in a \$14,000 Bond and Mortgage on Recreation Rooms and Settlement 186-188 Chrystie St.

\$5,000 participating interest in a \$145,000 Bond and Mortgage on Progress Club 1-9 West 88th St., N. W. Corner Central Park West.

The rate of interest on the first is 5 per cent. payable May and November 25, on the second 5½ per cent. payable April and October 21.

The program committee reported Dr. Lutz and Mr. Lemmer as the speakers at next meeting.

Dr. Howard's letter accepting his election as an honorary member was read.

Mr. Davis exhibited Dr. Chittenden's paper on Nut Weevils and Mr. Weiss' paper on Insects captured at Lookout Stations in N. J.

Dr. Garman read a paper on "Organization and Work of the Connecticut Station in Entomology" illustrated by about 100 lantern slides. He pointed out the age of the station, established in 1895 and gave interesting details of its personnel and accomplishments. A summary of the varying periods of recurrence of maximum infestations by various pests excited great interest and discussion by Dr. Lutz, Mr. Bird and Mr. Davis, bringing a statement that twelve years often elapsed between the maxima.

Mr. Leng spoke of "Collecting Beetles in Porto Rico," illustrated by a map, postal cards, and the Carabidæ as arranged by Mr. Mutchler and himself from the previous collections made at the American Museum of Natural History and the experiment stations in Porto Rico.

Mr. Wm. T. Davis exhibited a male of the cicada *Okanagama opacipennis* Davis, and stated that but two specimens had thus far been recorded. The female type was collected at Buckman Springs, San Diego Co., California in 1925 by Prof. W. S. Wright, who also collected the second specimen at the same locality, June 26, 1926. Now that the male is known, it is found to be a distinct species from *Okanagama arctostaphylæ* Van D., which got its name from the fact, that like *opacipennis*, it is found on the manzanita bush, the reddish bark of which they both closely resemble in color. He also exhibited the second known specimen of *Clidophleps vagans* Davis. It had

been sent from the British Museum for determination, and came from Yosemite, California, July 17, 1922, C. B. Pearson, collector.

Mr. Davis further stated that a small brood of 17-year Cicadas is expected this year in the Half-Way Hollow Hills north of Wyandanch, Long Island, where the insect occurred as a swarm in 1910.

Mr. Ragot exhibited and spoke of recent interesting finds including an infant shrew infested by fifty fleas; a *Mallodon dasystemus* found in L. I. City August 30 last at light, a deformed *Cecropia* moth, a series of *Anasa tristis* found March 19 under bark of fallen willow of which 70 per cent. were dead and many eaten hollow.

He spoke of the abundance of *Carabus nemoralis* and of one attacking an eight inch garter snake also of *Silpha inaequalis* active March 3 despite the cold being sufficient to freeze the dead rat in which he found them to the ground.

#### MEETING OF APRIL 19, 1927

A regular meeting of the New York Entomological Society was held at 8:00 P. M., on April 19, 1927, in the American Museum of Natural History; President Henry Bird in the chair with twenty-three members and eight visitors present.

In the event of Dr. K. Jordan being unable to attend the meeting of May 3 the Secretary was authorized to postpone the meeting by postal card notices, the by-laws being suspended for the purpose.

Dr. Lutz spoke of the American Objections to Dr. Poche's propositions in Zoological Nomenclature; those present individually signed a vote against them.

The program committee announced Messrs. Davis and Sherman as speakers at the next meeting.

Mr. Lionel Lacey, 107 Sixth Ave., Pelham, N. Y.

Mr. Richard Lacey, 107 Sixth Ave., Pelham, N. Y.  
were elected members of the Society.

Dr. Lutz spoke on "Some Problems in Insect Physiology." He commended the report of the Committee on Policy of the American Association of Economic Entomologists as to the need of an increased amount of fundamental research concerning the physiology of insects. He also called attention to the advantages offered by insects as material for the study of problems in pure physiology, and cited as examples of such work a number of papers on very diverse subjects. An account of a number of experiments conducted by himself closed his interesting discourse which was discussed by Dr. Campbell and Messrs. Hartzell, Bridwell, and Ragot.

Mr. Lemmer exhibited a splendidly prepared box of moths collected at Lakehurst, N. J., which excited the admiration of all the members. He described the room in which many of his captures at light were made, so constructed that he could reach the ceiling and moths could come in all night. Before sunrise he caught those outside the windows before birds

got them. Among the species specially discussed was *Catocala herodias* var. *gerhardi* especially in reference to its food plant, scrub oak.

Mr. Davis recalled the article in our JOURNAL by Charles Sleight, vol. XVII, 1906, p. 166, giving *Quercus nana* as the particular scrub oak on which the larva was found.

Mr. Ragot exhibited the puparium of a Cuterebra fly found April 9 near Valley Forge, Staten Island, and spoke of its larva living under the skin of rabbits. He also exhibited two small beetles with organisms attached to the anal extremity by slender filaments.

Mr. Angell spoke of the study of chemistry at Princeton.

#### MEETING OF MAY 3, 1927

A regular meeting of the New York Entomological Society was held at 8 P. M., on May 3, 1927, in the American Museum of Natural History; President Henry Bird in the chair with eighteen members and eight visitors present.

The Program Committee reported Mr. Nicolay as speaker on May 17.

Mr. George B. Gross, 30 Old Slip, was elected a member.

Communications from absent members, Howard Notman and R. J. Hunter were read by Mr. Davis, to whom Mr. Notman had sent a postal card from each place thus far visited on his 11,000 mile automobile journey.

Mr. Mutchler spoke of Japanese Beetle Quarantine Station recently established at 2000 Bronx St., West Farms.

Mr. Davis read a paper on "Pink Katydids" to be published in full. In answer to questions he said that the female usually laid 30 to 40 eggs and described the various methods of oviposition and the ease with which the true katydids may be caught at night by touching them, when discovered by their song and a flash light, with a long bamboo pole so that they drop to the ground.

Mr. Sherman spoke on "Entomological Books" exhibiting a number of rare works, commenting especially on the value of the first book on each subject. Some astonishing advances in value were instanced and many more instances of a lack of gain in value. A comparison with the result of keeping the original money at interest was given to show that even the highest prices involved a loss rather than a gain.

Messrs. Watson, Davis and Ragot gave some dates of first appearance observed viz: Monarch butterfly April 27, Asterias butterfly May 1, Turnus butterfly April 20, *Calasoma calidum* May 2, to which may be added *Amara sp.* and *Carabus nemoralis* April 11 and 12, *Amara* again April 20, those being especially warm days in April.

#### MEETING OF MAY 17, 1927

A regular meeting of the New York Entomological Society was held at 8 P. M., on May 17, 1927, in the American Museum of Natural History with fourteen members and seven visitors present; President Henry Bird in the chair.

Mr. James Irving Kendall, Sterlington, N. Y., was elected a member of the Society.

On motion by Mr. Sherman the secretary was instructed to send the Society's congratulations to the Jugatae of Cornell University.

Mr. Davis read postal cards from Mr. Notman who on May 14 had reached Pensacola.

The president exhibited the recently issued "Biochemistry of American Pitcher Plants," published in Trans. Wagner Free Inst. of Science of Philadelphia XI, April, 1927, by Hepburn, Jones, and St. John, praising the work therein of Frank Morton Jones.

Mr. Nicolay spoke of "Beetling at Greenville, S. C.," illustrating his remarks by photographs and specimens. He had visited Ware Shoals near Greenville early in April and found among other species *Ferestria acuta*, *Eumolops collossus*, and *Platymus limbatus*. He also spoke of collecting at Greenwood Lake on May 8 and at Orangeburg May 15; the first yielding Buprestidæ on pines, the second *Elaphrus*.

The president asked for spring collecting notes. Mr. Angell described *Cremastocheilus* under bark and flying in South Carolina; Mr. Bird told of the gill-bearing larva of *Nymphula*, a pyralid moth found in the overwintering seeds of Bladderwort (*Utricularia purpurea*) on Long Island and of *Paria canella vittata*, a beetle identified by Mr. Notman found hibernating in Spanish Moss. Mr. Davis exhibited a new dragon fly *Neurocordulia virginiana*, description of which will shortly be published.

Mr. Chapin told of finding an albino *Colias* and other interesting captures.

Mr. Huntingdon spoke of the butterflies found on the second ridge east of Glen Station, Greenwood Lake region, reached from Hewitt, N. J., and at Coram, Long Island, where *Thanaos brizo* was abundant on May 8.

Mr. Mutchler spoke of *Lyctus planicollis* bred from Red Oak and of Clerids which occurred with it.

Mr. Ragot had a number of living *Passalus cornutus* found May 14 on Staten Island.

Mr. Sherman exhibited the exceedingly rare "New Species of Curculionites," published in 1831 at New Harmony, Ind., by Thomas Say.

Mr. Leng described some spring swarming of beetles seen in former years, especially *Cetonia inda*, *Melanactes piceus* and *Cremastocheilus harrisi*.

Mr. Gross told of his receipts of *Morpho butterflies* from French Guiana.

Mr. Schiffer, present as a visitor, spoke of *Dermestes elongatus* on Long Island and Mr. Mutchler told how one had flown into his window at the Museum just when needed for the collection. Mr. Schiffer also reported finding a dead specimen of *Anthophilax malachiticus* near a stump, on Mt. Washington in the Berkshire Mts., Mass.

#### MEETING OF OCTOBER 4, 1927

A regular meeting of the New York Entomological Society was held at 8 P. M., on October 4, 1927, in the American Museum of Natural History;

President Henry Bird in the chair with eighteen members and seven visitors present.

A letter from Dr. Johannsen relating to the International Congress of Entomology to be held in Ithaca in August, 1928, was referred to the Executive Committee.

Mr. Davis exhibited two recent publications, viz: "Guide to Insects of Connecticut, part V, Odonata" by Philip Garman; and "Histological Technique, a guide for use in a Laboratory course in Histology," by B. F. Kingsbury and O. A. Johannsen

Dr. W. E. Britton, present as a visitor, spoke of the Japanese Beetle in Connecticut, the occurrence of eighteen specimens in 1926 at Stamford, and of eight distinct infestations in 1927 in Bridgeport, one of which on Washington Avenue involved eighty-four specimens. He also spoke of a solitary hellgramite in a railroad station which, through exaggerated reports, appeared in local and other newspapers as having a thirty-six inches wing spread and as being followed by a whole battery the next day.

Dr. Stanley B. Fracker also present as a visitor, spoke of the Mexican fruit fly's serious depredations in the Lower Rio Grande Valley where the cultivation of Grape Fruit on a large scale is an important industry. He said that as the fly has four broods in a year it may be possible, by ceasing the cultivation of other hosts, to deprive the fly of food between March and September.

Prof. A. E. Stone, of Kingston, R. I., described the difficulty of dealing with the corn borer in Rhode Island from the large number of small areas under cultivation.

Mr. Ned J. Burns exhibited a *Mantis religiosa* which he had found at Sands Point, Long Island, together with other specimens loaned by Mr. Davis of this and two other species of Mantis. The species *religiosa* has been found, introduced, at Rochester and Ithaca and the specimen found by Mr. Burns is a great extension of its range.

Mr. Davis exhibited, through the courtesy of Col. Wirt Robinson, *Dynastes tityus* from Wingina, Virginia. The exhibit included the coffee-bean like droppings, by which Col. Robinson detects the presence of the beetle; the larvae, pupae, pupal case, and adults of both sexes. A female, named "Wingina Mary" by Mr. Davis, had been kept alive in the Staten Island Museum until September 23, having been collected August 22. During most of the time she ate banana, often devouring a considerable quantity. The interesting fact was that during a part of the time she was the color of the so called greasy specimens in collections (the ones that are soaked in benzine, tetrachloride of carbon or some other agency to bring back the spots). A few days before the beetle died she resumed the green color and spotted condition.

Mr. Davis exhibited also post cards received during the past summer from Messrs. Notman, Engelhardt, Bell, Hunter, and Dr. Bequaert, members who had traveled far from home. In answer to a question of Dr. Felt's he spoke also of the injury to lilac at Yaphank.

Mr. Sherman described the forests and sphagnum bogs on Monhegan Island, twelve miles from Boothbay Harbor, Maine, as offering splendid opportunities for collecting.

Mr. Barber also exhibited enthusiasm for northern collecting having obtained 1400 specimens in four weeks. Sifting an area three feet wide and twelve feet long at Indian Lake in the Adirondacks produced interesting results.

Mr. Angell reported taking *Sphaeroderus lecontei* on Sept. 20 at Cook's Falls, N. Y., and other collecting at Oradell, Greenwood Lake, and on Staten Island.

Mr. Hall had again visited the mountains of Wyoming and showed pictures of their August snowdrifts. Amid them by spending several days above the tree line he had collected butterflies which will be exhibited later.

Mr. Chapin reported on a vacation spent near Litchfield, Conn., which brought death to many wasps and grasshoppers he had added to his collection.

Mr. Huntington's most memorable trip had been to the famous "Butterfly Station" at Karner, New York, where in an hour and a half thirty-six *Lycaena scudderi* met his net.

Mr. Watson considered the season poor for butterfly collecting but remarkable for the abundance of *Colias eurytheme* and *Junonia coenia*.

Mr. Shoemaker had sought *Basilarchia astyanax albofasciata* in the Pocono Mts. in July with success; moonlight nights had reduced the results of sugaring. At Washington in September he also had found *Colias eurytheme* unusually common there and four or five in Bronx Park. By the use of 60 bait bottles at Washington he added to his stock of *Cychnrus stenostomus* and *ridingsii* but had not had the luck to capture the species named for him, *shoemakeri*. He described the drainage operations which will partly obliterate the collecting grounds on the Eastern Shore where he has heretofore found *Ardistomis obliquus* and *Casnonia ludoviciana*.

#### MEETING OF OCTOBER 18, 1927

A regular meeting of the New York Entomological Society was held at 8 P. M., on October 18, 1927, in the American Museum of Natural History; Mr. Wm. T. Davis in the chair with seventeen members and ten visitors present.

Mr. Davis called attention to an article by Mr. Weiss in "The American Collector" on the "First Book on Insects printed in America and its Author."

Dr. Lutz delivered an address on "Wind and the Direction of Insect Flight" which will be printed in full. It was freely discussed by Messrs. Davis, Lemmer, Hartzell, Angell, Barber and Weiss.

Mr. Barber read a paper on "A Lygaeid Bug that Mimics an Ant" which will also be printed in full. The terms "myrmecoidy" for ant



resemblance, and "ethology" for individual behavior were used, following authors quoted by Mr. Barber.

Mr. Bell spoke briefly of his two weeks collecting in Colorado and of his trip to Washington, D. C.

Messrs. Mutehler, Schwartz, and Lemmer reported some incidents of the past summer.

Mr. Davis exhibited, for Oscar Fulda, a *Colias eurytheme* caught near Richmond, Staten Island, on September 4, 1927.

Mr. Angell quoted John Woodgate as reporting increasing rarity of *Cicindela santaclarae*.

Mr. Albert Hartzell reported that he had spent his vacation in Pennsylvania with the Bureau of Plant Industry and incidentally had collected a few leafhoppers, for the most part species of *Empoasca*.

Mr. Weiss described his efforts, with the aid of seven watchmen on fire towers in New Jersey, to gain information on insect flight.

Mr. Angell introduced a discussion on *Vespa crabro* in the course of which Mr. Davis described some of his experiences with it and allied species, leading him to the belief that such wasps work on moonlight nights.



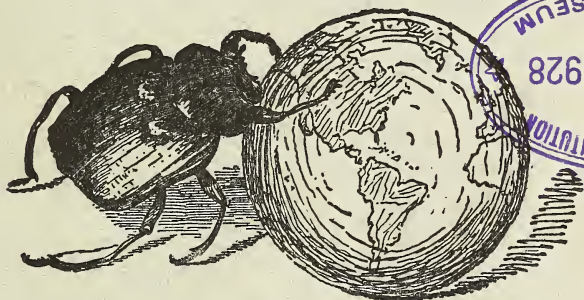
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*Devoted to Entomology in General*



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# JOURNAL

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### A PHYLOGENETIC STUDY OF THE GENUS TERIOCOLIAS ROEBER (LEPIDOPTERA, PIERIDÆ)

BY ALEXANDER B. KLOTS

ITHACA, N. Y.

In the course of the author's study of the genus *Eurema* it was necessary to examine the structures of related genera of the *Pieridæ*. *Teriocolias* then consisted of but one species, *atinas* Hewitson, which, previous to the erection of the genus *Teriocolias* by Roeber, had been considered as belonging to *Eurema*. Naturally all possible data on this were examined. At the present time, in view of the description of a new *Teriocolias*, *andina*, by Dr. Forbes, it seems advisable to publish these data on the structures of the two species, and the conclusions drawn from a study of these regarding the probable origin of the genus.

Genitally *atinas* and *andina* are very similar to each other, and are more closely related to *Eurema* than are any other New World forms, with the possible exception of *Leucidia*. It should be stated that in the present article "*Eurema*" refers solely to the New World species of the genus, as the Old World forms are quite different. The male genitalia of *atinas* and *andina*, Figures 1 and 2, fail, however, to show any decided enough characters to enable one to determine, by this means alone, to just what species of *Eurema* the relationship is most close.

In order to make clear this relationship it seems advisable to give an outline of the author's theory of the development of the

*Eurema* genitalia. For a more comprehensive description reference should be made to the author's article on the subject. See Figures 1, 2 and 5. Lobe *a* is considered as representing a modified form of the clasper, and as having arisen, in all probability, as an evagination from the valve in its present position. The other lobes are believed to arise from the distal process and when formed to migrate down onto the body of the valve. The greatest number of lobes found in any species of *Eurema* or any related genus is five, on the valve of *E. nise*. These lobes were accordingly designated by the letters *a*, *b*, *c*, *d* and *e*. The last four originate on the distal process in the probable order *e*, *b*, *d*, *c*, or *e*, *d*, *b*, *c*.

In the hind wing of *andina* (Fig. 4),  $R_s$  and  $M_1$  are well stalked. This characteristic occurs on but one line of development in *Eurema*, on which line *nicippe* Cramer represents a primitive form; *graduata* Butler and a number of related species are intermediate, and *salome* Felder and *mexicana* Boisduval show the highest development. In *nicippe* this stalking is very incompletely shown, while in the genitalia lobes *b* and *e* are well developed, lobe *a* is very small, and lobe *c* is absent with the distal process showing no trace of its development. *Graduata* and its kindred species show a higher development approximating that of *andina* both in venation and genitalia; in the latter lobe *d* being formed but still on the distal process, while *arbela* and *mexicana* are the most highly developed in the line, with lobe *d* fully formed and moved down onto the valve, leaving the distal process simple as before.

In the matter of the stalking of  $R_s$  and  $M_1$ , *andina* has progressed farther than *atinas*. On the primary, however, the stalking of  $R_2$  on  $R_{3+4+5} + M_1$  has progressed farther in *atinas* than in *andina*. Genitally *atinas* is the better developed, as it not only has lobe *d* slightly better developed on the distal process but also a specialized process on the dorsal margin of the valve (Fig. 1, "dorsal process"), which is absent or only slightly indicated in *andina*.

This "dorsal process" also occurs in *Eurema deva* Doubleday but, inasmuch as *deva* is on a line which is characterized by the failure of lobe *b* to develop, the similarity must be regarded as

merely analogous. Another species of *Eurema*, *amelia* Poey, shows the stalking of  $R_2$  on  $R_{3+4+5} + M_1$  which is a *Teriocolias* characteristic; *amelia*, moreover, shares with *Eurema proterpia* Fabricius the extreme shortness or absence of the middle discocellular of the secondary which is also possessed by *Teriocolias*. I do not think that *amelia* can, however, be regarded as a *Teriocolias*, although I am not satisfied with its position in *Eurema*. It does not seem to warrant the erection of a new genus, but is still a distinctly different species, possessing marked affinities to both *Eurema* and *Teriocolias*, but not positively a member of either.

The conclusions reached are:

(1) *Andina* and *atinas* show an almost equal development in venation, but *atinas* is slightly the more highly developed genitally.

(2) The line of development of *Teriocolias*, characterized by the scaling of the antennæ, the characteristic wing shape and pattern, the absence of the upper and the absence or extreme shortness of the middle discocellulars in the secondary, and the stalking of  $R_2$  on  $R_{3+4+5} + M_1$ , arose from a line of development of *Eurema* that is characterized by the stalking of  $R_s$  and  $M_1$ . Both species of *Teriocolias* have progressed, in characters common to the two genera, to a point about equal to *E. graduata*. Inasmuch, however, as they have developed in addition the generic characters, they must be regarded as being somewhat more highly advanced than *graduata*—just how much it is of course impossible to evaluate.

In Figure 6 I have endeavored to show this. The *Eurema* line is included, represented by a double line, while that of *Teriocolias* is single.

Following is a key for the differentiation of the two species of *Teriocolias* by structural characters:

1. Male genitalia with a conical process arising from the dorsal margin of the valve. On the primary  $R_2$  stalked on  $R_{3+4+5} + M_1$  for a distance greater by at least twice than the length of the middle discocellular. On the secondary  $R_s$  and  $M_1$  not stalked or very slightly so.....*atinas*
1. Male genitalia with no conical process arising from the dorsal margin of the valve. On the primary  $R_2$  stalked on  $R_{3+4+5} + M_1$  for a distance subequal to the length of the middle discocellular. On the secondary  $R_s$  and  $M_1$  well stalked.....*andina*

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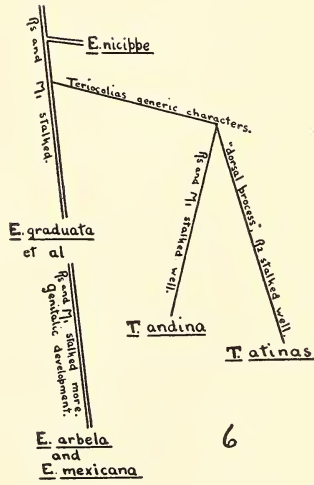
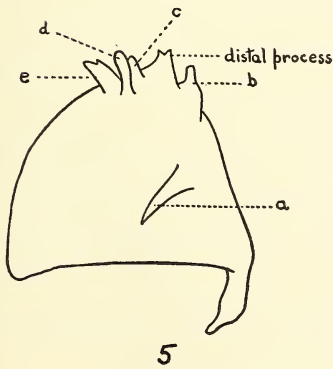
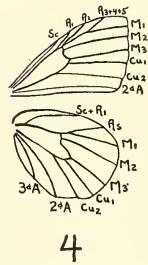
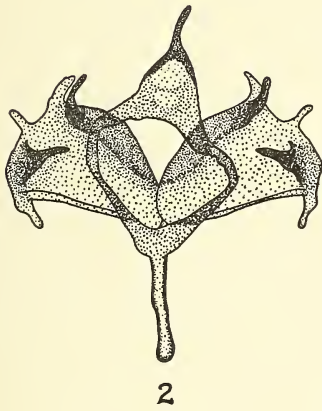
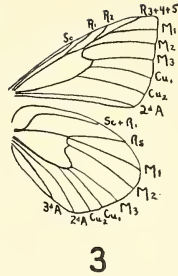
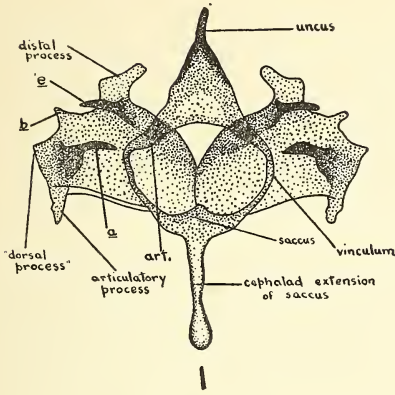
1. *Tericolias*. Röber in Seitz, *Macrolepidoptera of the World*, Vol. V, p. 89, 1924.
2. *atinas* (Hewitson), *Terias atinas*, *Bol. Butt.*, p. 4 (1874).
3. *andina* Forbes, *Jour. N. Y. Ent.*, Vol. XXXVI, Mar. 1928.
4. *Eurema genitalia* Klots, *Jour. N. Y. Ent.*, Vol. XXXVI, Mar. 1928.

## PLATE V

- Figure 1. Male genitalia, *Teriocolias atinas* Hewitson; Tarma, Peru. In coll. Cornell University.
- Figure 2. Male genitalia, *Teriocolias andina* Forbes; Holotype, Peru. Henry Edwards' coll., no. 3511, in A. M. N. H.
- Figure 3. Venation, *T. atinas*, as above.
- Figure 4. Venation, *T. andina*, Holotype as above.
- Figure 5. Outline, ental aspect, left valve, *Eurema nise* Cramer.
- Figure 6. Phylogeny of *Teriocolias*.

NOTE.—The articulation of the valves has been severed, in order that they might be spread out flat. Normally the structure labelled "articulatory process," in Figure 1, is articulated to the uncus at point marked "art."





TERIOCOLIAS



## THE ENTOMOLOGY OF THE HIEROGLYPHICS OF HORAPOLLO

BY HARRY B. WEISS  
NEW BRUNSWICK, N. J.

If Horapollo is remembered at all by entomologists, it is probably in connection with his misconceptions concerning the scarab. Living perhaps during the fourth or fifth century, he is supposed to have taught at Alexandria and Constantinople and to have been the author of two volumes, written in the Egyptian language, presumably explaining the symbols inscribed upon the Egyptian monuments. His work exists only in a Greek translation made by one Philip who is thought to have lived a century or two later than the author. As it will be noted, Horapollo has more to say about the scarab than about other insects, nevertheless he does mention other species such as flies, wasps, ants, gnats and grasshoppers.

The following extracts from Horapollo's works have been taken from A. T. Cory's translation<sup>1</sup> of the Greek text, and most of them contain a reference to some insect. Horapollo had much to say about other animals, too, such as the hyena, the beaver, the pigeon, the basilisk, etc., and repeated many of the apocryphal conceptions of Aristotle, Pliny, Aelian and other ancient precursors. His animals serve as symbols for one thing or another, and the quotations, although referring mainly to insects, are fair samples of his method of treatment.

"How an only begotten.

"To denote an only begotten, or generation, or a father, or the world, or a man, they delineate a Scarabaeus. And they symbolise by this an only begotten, because the scarabaeus is a creature self-produced, being unconceived by a female; for the propagation of it is unique after this manner:—when the male is desirous of procreating, he takes dung of an ox, and shapes

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<sup>1</sup> The Hieroglyphics of Horapollo Nilous, 1840, London.

it into a spherical form like the world; he then rolls it from the hinder parts from east to west, looking himself towards the east, that he may impart to it the figure of the world, (for that is borne from east to west, while the course of the stars is from west to east): then, having dug a hole, the scarabaeus deposits this ball in the earth for the space of 28 days, (for in so many days the moon passes through the twelve signs of the zodiac). By thus remaining under the moon, the race of scarabaei is endued with life; and upon the nine and twentieth day after having opened the ball, it casts it into the water, for it is aware that upon that day the conjunction of the moon and sun takes place, as well as the generation of the world. From the ball thus opened in the water, the animals, that is the scarabaei issue forth. The scarabaeus also symbolizes generation, for the reason before mentioned—and a father, because the scarabaeus is engendered by a father only—and the world, because in its generation it is fashioned in the form of the world—and a man because there is no female race among them. Moreover there are three species of scarabaei, the first like a cat, and irradiated, which species they have consecrated to the sun from this similarity: for they say that the male cat changes the shape of the pupils of his eyes according to the course of the sun: for in the morning at the rising of the god, they are dilated, and in the middle of the day become round, and about sunset appear less brilliant: whence, also, the statue of the god in the city of the sun is of the form of a cat. Every scarabaeus also has thirty toes, corresponding with the thirty days duration of the month, during which the rising sun [moon?] performs his course. The second species is the two horned and bull formed, which is consecrated to the moon; when the children of the Egyptians say, that the bull in the heavens is the exaltation of this goddess. The third species is the one horned and Ibis formed, which they regard as consecrated to Hermes [Thoth], in like manner as the bird Ibis.” (Book I, X.)

“How they denote Hephaestus [Phthah].

“To denote Hephaestus [Phthah], they delineate a scarabaeus and a vulture, and to denote Athena [Neith],<sup>2</sup> a vulture and a

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<sup>2</sup>“To denote Phthah they delineate a scarabaeus; and a vulture, to denote Neith?”

scarabaeus; for to them the world appears to consist both of male and female, (for Athena [Neith] however they also depict a vulture) and according to them, these are the only Gods who are both male and female." (Book I, XII.)

"How a man that has not travelled abroad.

"To symbolize a man that has not travelled out of his own country, they delineate an onoccephalus [creature with an ass's head], because he is neither acquainted with history, nor conversant with foreign affairs." (Book I, XXIII.)

"How they denote an imperfect man.

"To denote an imperfect man, they delineate a frog, because it is generated from the slime of the river, whence it occasionally happens that it is seen with one part of a frog, and the remainder formed of slime, so that should the river fall, the animal would be left imperfect." (Book I, XXV.)

"How Impudence.

"To denote impudence, they represent a fly, for this, though perpetually driven away, nevertheless returns." (Book I, LI.)

"How a murderer, or the blood of a crocodile.

"A wasp flying in the air signifies either the noxious blood of a crocodile, or a murderer." (Book II, XXIV.)

"What they denote by engraving *origanum* (wild marjoram) for a hieroglyphic.

"When they would symbolise the departure of ants, they engrave *origanum*. For if this plant be laid down over the spot from whence the ants issue forth, it causes them to desert it." (Book II, XXIV.)

"How they denote wasps.

"When they would denote wasps, they depict a dead horse; for many wasps are generated from him when dead." (Book II, XLIV.)

"How a swarm of gnats.

"When they would represent many gnats swarming together, they depict maggots; for from them gnats are engendered." (Book II, XLVII.)

"How a mystic man.

"When they would symbolise a mystic man, and one initiated, they delineate a grasshopper; for he does not utter sounds

through his mouth, but chirping by means of his spine, sings a sweet melody." (Book II, LV.)

"How a man that never stirs out.

"When they would symbolise a man that never stirs out, they depict an ant and the wings of a bat; because, when these wings are placed over an ant's nest, none of them come forth." (Book II, LXIV.)

From the foregoing it is apparent that Horapollo was not much of an entomologist, and according to Thorndike<sup>3</sup> neither does he rank high as a philologist, an archaeologist or as an astronomer.

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<sup>3</sup> A History of Magic and Experimental Science (New York, 1923).

## A NEW AFRICAN GALL MIDGE

BY E. P. FELT

STATE MUSEUM, ALBANY, N. Y.

**Megauchomyia** new genus

This remarkable form belongs in the Dasynuriariae, and falls in our key next to *Stomatosema* Kieff., from which it is easily separated by the fourteen antennal segments, and especially by the greatly produced neck, and the prolonged mouth parts. Type, *M. africana* new species.

**Megauchomyia africana** new species.

The small midges were taken by Dr. Jos. Bequaert of the Department of Tropical Medicine, Harvard University Medical School, as they were hovering over coccids at the end of a branch at Bakratown, Liberia. He suggests that they may be a parasitic species. The peculiar structure of the mouth parts indicates a possibility that they were attracted by honey-dew secreted by the scale insects.

MALE: Length 2 mm., antennæ probably extending to the base of the abdomen, presumably with fourteen sub-cylindrical, sub-sessile segments; the first with a length one-half greater than its diameter, tapering basally; the second globose. Palpi very slender, quadriarticulate, the first segment with a length fully five times its diameter, the second one-half the length of the first, the third nearly twice as long as the second, and the fourth as long as the third, somewhat dilated; all sparsely setose. Eyes large, black, holoptic, comprising most of the head, three ocelli. The yellowish mouth parts are greatly produced and with a length distinctly greater than the diameter of the head. The caudo-ventral aspect of the head with a thick tuft of long curving setæ; the more ventral ones turning anteriorly. Neck slender, with a length almost equal to that of the entire thorax. Mesonotum yellowish, scutellum whitish, post-scutellum yellowish and sparsely haired. Abdomen pale yellow, wings hyaline, sub-costa uniting with the margin at the basal third; the third vein well beyond the apex; the fifth near the basal third; its branch at the distal fourth. Halteres fuscous yellowish, whitish basally. Legs a nearly uniform pale straw, the distal tarsal segments darker; claws moderately long, strongly curved, probably all unidentate; pulvilli rudimentary. Genitalia, basal clasp segment moderately long, stout, with a distinct internal lobe near the middle; terminal segment long; slender and slightly curved sub-basally and sub-apically; dorsal plate broad, partly divided, the lateral lobes irregularly and roundly excavated and the lateral angles prolonged as broad, tapering, setose appendages; ventral plate short, broad, triangularly emarginate.

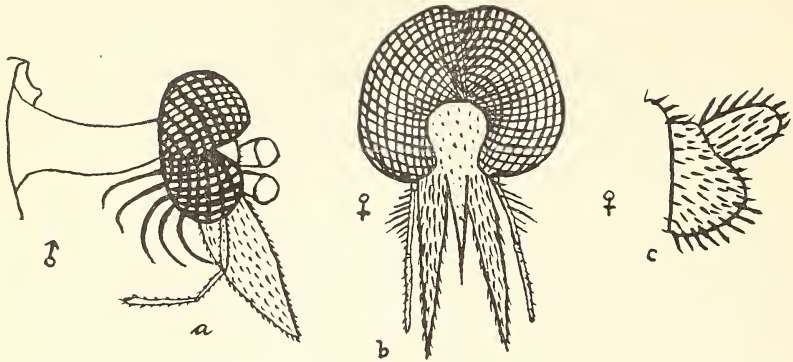


FIGURE 1. *Megauchomyia africana*: *a*, dorso-lateral view of head of male, showing neck, eyes, basal antennal segments and mouth parts; *b*, front view of head of female; *c*, side view of tip of female abdomen, showing lobes of the ovipositor (original).

FEMALE: Length 2.5 mm., antennæ with fourteen sub-cylindrical, subsessile segments; the first with a length nearly twice its diameter; the second sub-globose; the fifth sub-cylindrical with a length two and one-half times its diameter; terminal segment with a length three times its diameter and a long, stout, finger-like apical process. Palpi nearly as in the male except that they are a little stouter. Mouth parts consisting of two long, densely setose, outer processes, which are readily apposed and a median narrow triangular structure, presumably the labium. Ovipositor short, the terminal lobes biarticulate, the basal segment sub-quadrate, the distal segment narrowly oval; the former densely setose ventrally, the latter rather sparsely clothed with stout, coarse setæ. Otherwise practically as in the male.

Type: C. A-3524, New York State Museum.



EXTERNAL MORPHOLOGY OF THE COLORADO  
POTATO BEETLE (*LEPTINOTARSA*  
*DECEMLINEATA* SAY)<sup>1</sup>

By E. RIVNAY

INTRODUCTION

From an economic standpoint, the Chrysomelidæ, or leaf-beetles, constitute one of the most important groups of beetles, while from the size and great diversity of types included, the family has become of the very greatest interest and importance to the taxonomic student. A considerable amount of work has been accomplished toward the identification and classification of these forms but much remains to be done. Perhaps because of the general small size of the included members, the morphology of the Chrysomelidæ has been sadly neglected. The present writer strongly feels that there should be more coöperation between the taxonomist and morphologist, thus minimizing the misinterpretations of body-parts and the consequent confusion of terms in use. The purpose of the present discussion is to present a detailed morphological description, not only of the external features, but of the internal genitalia as well.

General works on the morphology of various groups of Coleoptera in American literature include the following: The external morphology of *Phyllophaga*, one of the Scarabæidæ, by Hayes (1922), with a somewhat similar treatment of the Elateridæ by Van Zwaluwenberg (1922). More recently certain important works treating of the Coleoptera in general have been published: The head-capsule by Stiekney (1923); the wing-venation and methods of folding by Forbes (1926), Graham (1922) and others; and the female genitalia by Tanner (1927). As a result of these various works, certain new interpretations in parts have been proposed, and a correlated discussion such as the present work attempts seems to be greatly needed.

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<sup>1</sup> Contribution from the Ent. Lab. of the Mass. Agric. Coll., Amherst, Mass.

For the purposes of the present study, the Colorado potato beetle was chosen because of its size, being one of the largest chrysomelids in this country, and because of its wide distribution and economic importance. Of all the Chrysomelidæ this is one of the most common pests, being found over the entire United States, in Canada, Mexico, Central America, and, in recent years, it has been carried to Europe, where it is now apparently permanently established.

The insects collected were preserved in 70 per cent. alcohol, and when needed for dissection were washed in water and boiled in a 10 per cent. solution of potassium hydroxide to remove soft tissues. Additional specimens with the soft tissues retained were also examined. A Zeiss binocular microscope was used in all dissections, and a strong light was furnished by a Spencer high power Mazda microscope lamp (400 wt., 100 volt).

This work has been done at the suggestion, and under the direction, of Dr. G. C. Crampton. To him, for his helpful advice and to Dr. H. T. Fernald and Dr. C. P. Alexander, who read the manuscript, and made some helpful comments, the author wishes to express his sincere appreciation and thanks.

#### GENERAL DESCRIPTION

The Colorado potato beetle, *Leptinotarsa decemlineata* Say, belongs to the subfamily Chrysomelinæ, differentiated from other chrysomelids in having the head inserted in the thorax to the eyes, antennæ widely separated at base, and the front coxæ transverse. The genus *Leptinotarsa* to which it belongs is characterized by having the tarsal claws simple, third joint slightly emarginate, pronotum margined at base, and mesosternum not raised above the level of the prosternum. The adult beetle is oval, robust and convexly round. The total length ranges from 6–11 mm. The ground color of the beetle is dull yellow. The following areas are black or blackish: a "heart" shaped spot on vertex, entire occiput, posterior parts of genæ and gula, the margins of the pronotum, two short divergent lines on pronotal disk with six small spots on either side. The size and number of these spots vary in different individuals. The margins of the three sterna, coxæ, genicula of legs, and tarsi are also black.

Oblong spots are found on each pseudo-pleuron, and four on each ventral segment. Each elytron has the sutural margin with five lines black, the second and third unite at apex. Tip of antenna is piceous-black.

#### THE HEAD

**HEAD CAPSULE** (Figs. 1 and 3). The head capsule of *L. decemlineata* Say is composed of several sclerites, many of which have fused entirely, so that in this species certain sutures present in other insects, or even in other Coleoptera, have disappeared. When we examine the head of a potato beetle from its dorsal surface (Fig. 1) we note the epicranial suture (*es*) (see Stickney, 1923), branching at its anterior end into a left and right arm (*esa*). The epicranial stem of this suture (*es*) is faint, especially at its posterior end; the epicranial arms, however (*esa*), are more distinct, directed laterad and later curve laterocephalad. The punctured area (KF) between the epicranial arms is a fusion of the frons (F) and clypeus (κ) and has been termed *clypeo-frons*. For demarcation between frons and clypeus we may draw an imaginary line between the two frontal pits (FP) near the ends of the epicranial arms. These pits are the external manifestation of internal invaginations that form the anterior processes of the tentorium to be discussed later, and in most cases serve as such demarcations. On each side of the clypeus is a minute sclerite, the clypealia (*k*, Figs. 4 and 5) (paraclypeus of certain authors). Each of these sclerites is quadrangular and fits into a socket of the mandible, furnishing thus a point of articulation for the latter. The membranous ante-clypeus (AK) is the anterior part to the clypeus and is connected to the labrum (LR).

On both sides of the epicranial stem are found the punctured sclerites of the vertex (V). The punctured occiput (O) is posterior to the vertex, and the genæ are situated laterally. The ventral surfaces of the genæ (GE) bear small punctures in which are minute setæ. In the cephalo-ventral end of each gena there is a cavity known as the acetabulum of the gena (AC, Fig. 4); this acetabulum receives the condyle of the mandible and fur-

nishes thus a second point of articulation for the latter. There is a ridge near the acetabulum which, together with the ridge traversing the submentum, form a demarcation between mouth-parts and head capsule (Fig. 3). The smooth area marked *g*, Fig. 3, is the gula. Its anterior demarcation is the gular-mental suture (*gms*) and from the genæ it is demarked by the gular sutures (*gs*) on both sides; the curvature of these latter give the gula a bell-shaped appearance. The cavity (FM) caudad to the gula is the foramen magnum, or occipital foramen. Through this opening the alimentary canal, blood vessels and nerve cord, etc., pass from the head to the body.

ENDOSKELETON (Figs. 3 and 6). The posterior parts of the gular sutures are known as the gular pits (*gp*). These are the external manifestation of the internal processes that are visible as two lobes through the foramen magnum. These lobes are the posterior arms of the tentorium (*pT*), and they are continuous with the apodems along the gular sutures. Projections of this membrane connect each of these lobes with the respective anterior arm of the tentorium (*aT*); a thin membrane (*bT*) also connects the two lobes to each other, and that may represent the body of the tentorium. This entire structure serves for strengthening the head capsule and for muscle attachment.

EYES. The eyes (E) are very prominent organs in the head. They are oblong and about three times longer than wide.

ANTENNÆ (Fig. 2). Near the end of each epicranial arm is the antennal socket (*as*), Fig. 4. This cavity receives the bulb, the basal part of the first antennal segment, and is supported by the antennifer (AF). The first segment of the antenna is called scape, and, as in all insects, it is the longest of the segments. The second segment is called the pedicel and is the shortest of all. The five first segments are glabrous and bear single setæ, the six other segments, especially those at the apex, are broader and more pubescent. The seventh segment has a tooth-shaped projection at the side of its apex.

LABRUM (Fig. 9). The labrum is hinged to the membranous anteclypeus. It is quadrangular with the anterior margin rounded and posterior angles the tormæ—projecting caudad. The external surface of the labrum bears setiferous punctures;

the internal surface is membranous and is a continuation of the external cuticula. It extends caudad, and forms a roof to the pharynx; hence it is termed epipharynx. The anterior margin is covered with sensory setæ, and a group of gustatory spinules is found a little caudad of the anterior margin. The epipharynx is connected at its lateral margins to two rods of chitin (*d*) which are united at their anterior end to the tormæ of the labrum; at their distal third they bend dorso-mesad so that their distal ends approach each other. A strong muscle attaches these ends to the dorsal region of the head. The entire pharynx and part of the œsophagus are suspended upon this structure. The phylogenetic origin of these rods is not clear. They are found in the cerambycid beetles, as *Tetraopes tetraophthalmus*, and in other chrysomelids, *Chrysochus auratus* and *Chelymormpha cassidea*. They are soft and partly membranous in certain scarabæids, and are obsolete in Cantharoidea. It is probable that the rods in question arose by chitinization of the lateral margins of the epipharynx.

MANDIBLES (Figs. 4, 5, 7 and 8). The mandibles are found on both sides of the labrum and are partly covered by it. In the chrysomelid beetles in general they serve for cutting leaves rather than for grinding, hence are sharp and their margins, the incisors, overlap each other like a pair of scissors. They articulate with the head capsule at two points; a dorso-lateral point where the clypealia fit into the socket of each mandible (Fig. 4), and the ventro-lateral point where the globular swelling of each mandible, the condyle (*Q*) fits into the acetabulum of each gena. The mandibles are opened when the adductor muscles contract. These are attached at meso-ventral side of each mandible. The adductor muscles are the larger, and are attached to tendons. The edge of each mandible is provided with three denticles, the one continuous with the ventral margin, the so-called distal denticle; a second one dorsad to the distal denticle; and a smaller one at the middle of the dorsal margin. At the proximal end of the dorsal margin is situated the submola (*SMo*). This is a submembranous lobe and lies under the labrum. The spinules upon it are probably sensory organs, as are probably the setiferous punctures upon the external surface of the mandibles. The

molar region (*Mo*) is smooth and not well developed as in other beetles.

**MAXILLÆ** (Fig. 10). The maxillæ are situated ventrad of the mandibles and consist of the following parts: the cardo, stipes, palpifer, palpus, subgalea, lacinia, and galea. The cardo (*Ca*) is the sclerite which articulates with the gena, the point of articulation being the groove marked *CaG*. The cardo process (*CaP*) projects laterad into the head capsule, and to it is attached the muscle that opens the maxilla. The sclerite attached to the cardo is usually regarded as the stipes, though it is probably only a basal sclerite of the stipes. The margins of this sclerite are folded dorsad and are united with each other by membrane. The palpifer (*PF*), a cylinder of chitin, is attached to stipes and bears the four-segmented palpus (*MXP*). The so-called subgalea (*SGa*) is also connected with the stipes and bears the two-segmented galea (*Ga*) and the broad semi-membranous lacinia (*La*). The palpus, galea and lacinia are all covered with sensory spinules, probably organs of touch, smell and taste.

**LABIUM** (Fig. 11). The labium or the under lip is attached to the head capsule at its ventral wall between the two maxillæ. The gula (*g*) unites with the submentum (*bm*), a sclerite which is heavily chitinized and is traversed by a ridge. At the lateral ends of the submentum are two chitinized rods which project dorso-laterad into the head capsule, and unite firmly with the genæ, thus bracing the entire labium. The lateral margins of the mentum (*m*), which is attached to the submentum, are bent dorsad and are connected with the membranous hypo-pharynx (*HX*). The prementum (*pm*) is the membrane connecting the mentum with the so-called ligula (*LG*), which is composed of the two paraglossæ (*pgl*) and the median glossa, a rudimentary single piece, embedded between the paraglossæ. The palpiger (*PG*) on both sides of the paraglossæ bear the three-segmented labial palpi (*LIP*). The anterior margins of paraglossæ merge into the membranous tongue-shaped hypopharynx (*HX*) which forms the floor of the mouth. A curved rod is embedded in the ventral part of the hypopharynx, this rod in turn is connected with the glossa, and thus strengthens the hypopharynx. Very minute spinules which are probably gustatory organs are scat-

tered all over the hypopharynx. The three segmented palpi born by each palpiger bear setæ, which also are probably sensory.

#### THE THORAX

**PROTHORAX.** The pronotum (Figs. 12 and 14) is convex, about one and one-half times as broad as long. The sides at the anterior end curve mesad, so that the base of this sclerite is broader than its apex. The pronotum does not end with the lateral carina, but extends further to the ventral surface where its margins overlap the pleura and fuse with them (See Crampton, 1926). The area SN along the ventral side of the lateral carina is the *subnotum*. The triangular area *q* is the ventral part of the pronotum and has been termed pseudo-pleurum; this part apparently has fused with the pleurum on each side. The prosternum (Fig. 14) is comparatively small. The median part (*bs*) is the basisternum, and the lobe (*L*) between the coxæ is the prosternal lobe. The two arms (*px*) extending from the basisternum laterad and uniting with the pseudopleura are the *pre-coxales*. Upon removing the coxa from the coxal cavities, the concave areas of the furcasternum (*fc*) are exposed. The posterior margins of these areas are more chitinized than in the center. In some Chrysomelids this chitinization is complete, so that the margin reaches the same level of the pseudopleuron and prosternal lobe; then the coxal cavities are called closed; otherwise they are called open. The *furcal pits* (*fc**p*) are the external manifestation of the invagination forming the *furcæ* (*fc*).

**PROTHORACIC LEG** (Fig. 13). At the anterior lateral angle of the coxal cavity *cc* lies the *trochantin* (*tr*), a small curved sclerite attached to the internal muscles of the prothorax. The acetabulum of this sclerite receives the condyle of the coxa. The coxa, *C*, one and one-half times as long as wide, rotates in the coxal cavity antero-posteriorly. At the apex of the coxa there is a cavity which receives the condyle of the trochanter (*TR*). This is a small sclerite and its articulation with the coxa is side-wise across the body and being firmly attached to the femur (*F*) it swings the entire leg in those directions. The *femur* is more than twice as long as wide. The proximal end is more slender

than the apex, where a cavity receives the condyle of the tibia (T). A notch at the ventral margin of the apex of the femur gives the tibia considerable freedom in its articulation so that the latter can describe a circle of about  $120^\circ$ . The tibia is a little longer than the femur, but more slender, especially at its proximal end. The apical end is hairy and its margin is armed with a row of minute spinules. The socket at this end receives the condyle of the first tarsal segment. The margin of this socket is notched dorsally, to give the tarsus freedom in movement. In the tarsus (TA) the fourth segment is much reduced and firmly united with the fifth, so that the tarsus appears as four-segmented. (This type of tarsus is characteristic of all Cerambycoid beetles and also of Rhynehophora, where the fourth and fifth segments fuse.) Of the basal three tarsal segments, the second is the smallest. The three are pubescent beneath, broad and emarginate at the apical edge. The last segment is glabrous, slender, longer than the others, and bears two large simple claws.

MESOTHORAX (Figs. 15 and 16). Of the three thoracic segments, the mesothorax is the smallest. In the mesonotum (Fig. 15) we distinguish three distinct areas: the prescutum, *psc*<sub>2</sub>, scutum *sc*<sub>2</sub> and scutellum *sl*<sub>2</sub>. The prescutum (*psc*<sub>2</sub>) is a heavily chitinized area with two antero-lateral pointed projections, the anterior notal wing processes (AWP), and two blunt lateral tubercles, the posterior notal wing processes (PWP). Both processes on either side are connected by means of membrane to the process of the elytron as shown on the right-hand side in Fig. 15. The scutum (*sc*<sub>2</sub>) is the depressed area posterior to the prescutum on both sides of scutellum (*sl*<sub>2</sub>). The two grooves on both sides receive the anterior projecting margins of the elytra which are held thus in place during rest. The scutellum, the triangular elevated area *sl*<sub>2</sub>, is the only exposed part of the mesonotum and its margins overlap the anterior mesal angles of the elytra during rest.

The mesopleurum (Figs. 16, 19 and 20) is represented by two sclerites, the episternum (*et*<sub>2</sub>) and epimerum (*er*<sub>2</sub>). The pleural suture (Ps) which is the external manifestation of the internal pleural ridge (PR) serves as demarcation between the two sclerites. The anterior dorsal process of the episternum is known



as the ventral wing process (*VWP*). It supports the process of the elytron and is attached to it by membrane and tendons. The ventral margin of the episternum is connected with the mesosternum and touches the trochantin. A hairy diagonal ridge divides the episternum into two areas, the dorsal-anterior one being small and smooth, and the ventral one larger with roughened surface. The epimeron (*er*<sub>2</sub>) is connected only at its anterior margin with the episternum, the other sides being free, for under this sclerite is hidden the second thoracic spiracle and a free passage of air is necessary. The pleural ridge (*PR*) is broad and tapers ventrally and reaches the furca. These processes both furnish points of attachment for the thoracic muscles. The pentagonal area *bs*, Fig. 16, is the basisternum, while the areas in front of the coxal cavities are the precoxales of the mesosternum. The front part of the precoxales rest on the coxæ of the prothorax and therefore are concave and smooth. Upon removing the coxæ the furcasternum (*fc*) is exposed with the furcal pits (*fc**p*) at the lateral margins. The areas of the furcasternum are closely connected with the inflexed region of the metasternum. The sutures between the furcasternum and inflexions of the metasternum are the external manifestation of an internal projection which forms a connecting bar (*ba*, Fig. 20) between the two coxal cavities (Fig. 20). The mesothoracic legs are much like those of the prothorax, except that they are very slightly larger.

**ELYTRA.** Each elytron is triangular and convex, when viewed from above. The anterior margin tapers downward abruptly into the apophysis (*AP*, Fig. 15). The two other sides of each elytron taper gradually into a point. The two elytra taken together cover most of the mesothorax, metathorax and abdomen, and give the insect a hemispherical appearance. There are eleven punctured striae in each elytron. The sutural margin of each elytron, and also the five alternating intervals, are black, while the epipleurum is pale. The apophysis of the elytron is well connected to the first axillary plate, and to the anterior wing process of mesonotum. The second axillary plate which is embedded in the alary membrane links the apophysis with the wing process of the mesoepisternum. The third axillary plate connects the apophysis to the posterior notal wing process. The axillaries are

well interlocked with the apophysis, flexible, vary in shape and their position only is shown in Figure 19.

During rest the elytra are kept in position by means of the following devices:

1. By fitting the swollen median margin of the elytra into the median groove (G, Fig. 15), on the metanotum.

2. By slipping the anterior median angles of the elytra under the mesoscutellum ( $sl_2$ ).

3. By slipping anterior margin into the lateral grooves of the metascutum.

4. By coadaptation of lateral margin of the elytra to the ridges of the metaepisternum.

**METATHORAX** (Fig. 15). The metathorax is the largest of the three thoracic segments in accord with the larger metathoracic wing muscles. In the metanotum there are four distinct areas: prescutum,  $psc_3$ , scutum,  $sc_3$ , scutellum,  $sl_3$ , and postscutellum,  $psl_3$ . The prescutum ( $psc_3$ ) is a narrow arched sclerite just beneath the mesoscutellum. At the anterior margin it is connected by means of membrane to the mesothorax; the posterior margin merges into soft chitin connecting it with the scutum. The prescutum at the middle is narrow, becoming wider laterally. The lateral margins (MK) are termed the muscle disks; they are more chitinized, blunt, and fuse with the scutum ( $sc_3$ ). A depression on either side demarks the muscle disks from the mesal portion of the prescutum.

The scutum,  $sc_3$ , largest of the metanotal areas, is divided longitudinally by the median groove (G); this latter receives the thickened mesal margins of the elytra during rest, holding them in position. Each of these portions is further divided by a long curved furrow, this being the external manifestation of internal invagination for muscle attachments. At the lateral ends of the scutum are the anterior notal wing processes (*AWP*) and the posterior notal wing processes (*PWP*). The scutellum is the third area marked  $sl_3$ . The median groove (G) likewise divides this into right and left divisions. The scutellum becomes very narrow as it spreads laterad, and is closely connected with the posterior wing process of the scutum. The postscutellum is the narrow sclerite ( $psl_3$ ). In the middle it is very narrow, and the

lateral ends of it are closely connected with the metaepimerum, Figs. 18, 22.

The metapleuron (Fig. 18) consists of the metepisternum and the metepimeron. The diagonal pleural suture (Ps) demarks the two sclerites. The metepisternum is prolonged dorsally into the ventral wing process (VWP); the smooth region (MK), below the process is a muscle disk. The metepimeron is partly membranous, and heavier chitinization occurs along the pleural suture. The membrane in the middle merges with the alar membrane.

The metasternum is the large sclerite (ST, Fig. 16). A longitudinal suture divides it into left and right sections. The anterior inflexion forms part of the coxal cavities of the metathorax and merges with the furcasterna. The posterior inflexion (*pi*) projects laterally and merges into two strips of soft chitin and membrane which surround the metacoxæ.

The metathoracic leg differs from the other legs in the following respects: there is no trochantin; the rotation of the coxa is more restricted; the entire dorsal surface of the latter is membranous; the femur is a little thicker than the other femura and the entire leg is a little larger than the other legs.

WING ARTICULATION. The wing is connected to the body by means of the alar membrane. This membrane is strengthened by small curved sclerites called axillaries. The costa of the wing articulates with the ventral wing process of the episternum. The base of the subcosta forks into dorsal and ventral projections. The dorsal projection articulates with the first axillary (1X) which is supported by the anterior wing process, and the ventral projection is supported by the ventral wing process of the metepimeron. The radius is articulated with the second axillary (2X) which is below closely connected to the first axillary. The cubitus and perhaps the base of median are supported by the third axillary (3X) while the anal region is connected to the fourth axillary (4X). When the wing is to be folded during rest, the fourth axillary rotates mesad, its middle angle resting on the plate (*x*), until the anterior end of this axillary is in the fold between the notal wing process and the first axillary. The connection with the wing is such that the entire anal region of

the wing is drawn over the abdomen and the rest of the wing folded over it along the line CD, Fig. 17.

**WING FOLDING.** In figure 17, the dotted lines represent convex folds, while the full lines show concave folds. By the use of this figure, it is not difficult to explain this folding. The anal area folds under the wing along the convex fold (CD), and the apical part of the wing also folds along the line (AB). At the same time, however, the concave fold (QP) causes the two areas OPX and QPY to approach and lie upon one another. The secondary radial folding along OR, OS and OT causes the fold OX to lie upon OY; in their new position the folds OX and OY are under the wing along the line o-xy. At the same time a secondary folding along o-xy brings the tip of the wing under WVQ. It should be noted that the folding has had much to do with the reduction and modification of the venation. If the two figures 17 and 21 are compared, it will be noted that the main foldings are along veins, thus the fold AB is partly along radial branches and partly along M, where as QOT is along M, and branches of R, and the fold CD along 3A and 2A.

**VENATION.** In recent years different authors have made a study of the wing venation of Coleoptera, but there is lack of agreement as to the interpretation of the various veins. Since Forbes has made a more detailed comparison with other insects, his interpretation has been followed in the present paper.

The main feature characteristic of the wings of Coleoptera is that the main veins C, Sc, R, and M are crowded to the costal margin, Cu and the anal veins occupy the remainder of the wing. As shown by figure 21, C and Sc with R fuse together to form the pterostigmatic area at the middle of costal margin. R runs to about the middle of the wing and ends blindly; its branches occupy the area RRR and none of them reach the apex of the wing.

Tillyard interprets the vein labeled CuM as Cu; and d'Orchymont believes that the vein labeled  $M_1$  is really  $M_{1+2}$ , and that the vein labeled  $CuM_4$  is really  $M_{3+4}$ . Graham interprets the vein labeled  $M_1$  as  $R_5 + M_1$ . The slender vein M is interpreted by Forbes, Tillyard and others as being the Median, its basal part is obsolete and therefore it is called the recurrent vein. Between

the recurrent vein and Cu there is an open cell called the apterum, and this is characteristic of all phytophagous beetles. The Adepnaga have a closed oblong cell called the oblongum. The veins posterior to Cu are the anals.

#### THE ABDOMEN

Not all the abdominal segments present in other Coleoptera are found in the Colorado potato beetle. Modifications in structure have taken place, especially in the last abdominal segments. The first two tergites (1T and 2T) have no corresponding pleurites or sternites. The segments beyond the seventh are obscure and their shape and number differ in the male and female, to be discussed later.

**TERGITES.** The first six tergites, being covered and protected by the elytra, are soft and thinly chitinized; the seventh tergite, being exposed, especially in gravid females, is more chitinized and is termed the *pygidium*. Membranes connect the tergites with each other. These membranous areas are continuous with the membrane of the pleural region and that merges with the membrane of the metepimeron and with the pleurites. The first tergite is the narrowest of the seven, the second and third are the broadest, and the others are subequal. The membrane of the pleural region bears the abdominal spiracles.

**SPIRACLES.** There are two pairs of spiracles in the thorax, and seven pairs are visible in the abdomen. The first thoracic spiracles are situated in the membrane connecting the prothorax and mesothorax (Fig. 14, *Sp*). The second thoracic spiracles are in the membrane under the mesoepimeron. The first abdominal spiracles are behind the metapostscutellum (Fig. 22, 1 *Sp*). The other abdominal spiracles are situated in the lateral membrane connecting the tergites and pleurites, one pair corresponding to each of the first seven tergites. According to Tanner there should be one more pair near the eighth tergite.

**PLEURITES.** The five pairs of pleurites (3P to 7P) correspond to the five last visible tergites. The first of these pleurites (3P) is large and is continuous with the membrane of the metepimeron; parts of it are more chitinized than the others. The other pleurites are smaller, and their dorsal margin is thin and merges into pleural membrane.

**STERNITES.** There are only five visible sternites; the first two have either fused with the third or else disappeared. The sternites are much more chitinized than the pleurites and tergites, and are pigmented after a definite pattern. The inflexed margins of the sternite (3s) form the posterior portion of the coxal cavity of the metasternum.

**TERMINAL ABDOMINAL SEGMENTS.** ♀ (Figs. 25 and 28). The posterior margin of the seventh tergite bends and folds internally and is connected by membrane with a plate of chitin (8r) which is very thin, especially along the median area. This plate is the eighth tergite (See Tanner, 1927). Its posterior margin is bent and folded also, and merges with the dorsal wall of the rectum (RM). Between the anus (AN) and vagina (VA) there are two plates (xt) interpreted as the coxite and styli (Sl) of the ninth segment. The sclerites (*v*) near the coxites are the valvifers. The plate (8s) at the ventral margin of the vagina opening is the eighth sternite, which is connected by membrane with the inwardly folded posterior margin of the seventh sternite. Near the opening of the oviduct into the vagina there is the opening of the recepticulum seminis (SR); the tips of the seventh sternite and tergite as well as the styli bear sensory setæ.

**TERMINAL ABDOMINAL SEGMENT.** ♂ (Figs. 23-24). The posterior margin of the seventh tergite (7r) folds internally and is connected by membrane with the eighth tergite (8r). The connecting membrane is quite broad and enables the eighth tergite to be protruded during copulation. The posterior margin of the eighth tergite bends inwardly and is connected with the rectal membrane, forming the dorsal margin of the anus. The ventral part of the anus is muscular and two chitinous plates (Figs. 23, 26) support this fleshy lobe laterally. The ventral part of this lobe is continuous with a transparent membranous tube surrounding the copulatory organ; the opening of the transparent tube is connected ventrally with the inwardly bent seventh sternite. The posterior margin of the tube is connected with the rounded v-shaped tegmen (Figs. 23, 26, *Tg*) (See Charp and Muir, 1912). The tegmen surrounds the median lobe (ML), which is chitinized, curved and pointed. Some authors call this organ the flagellum or penis. The median lobe is composed of two lateral halves, and

the place of fusion of the two is still thinly chitinized. Two rods of chitin (*d* Figs. 23, 26) are connected to the posterior margin of the transparent tube. These are fused at the other end, and lie below the median lobe.

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ABBREVIATIONS ON PLATES

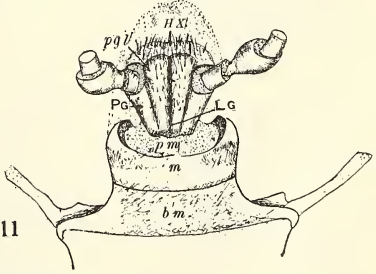
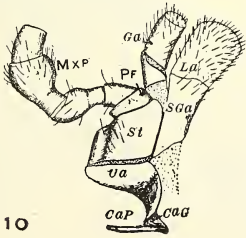
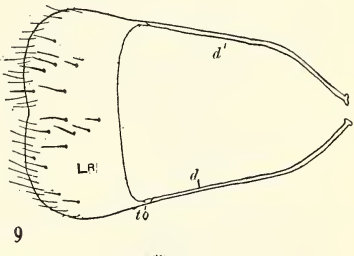
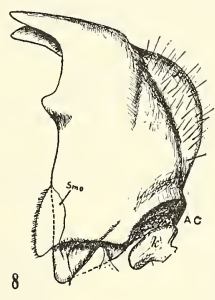
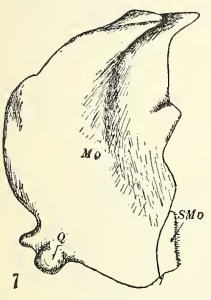
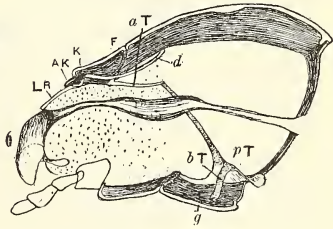
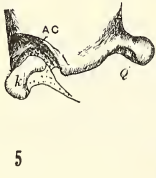
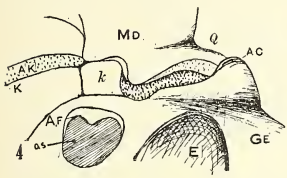
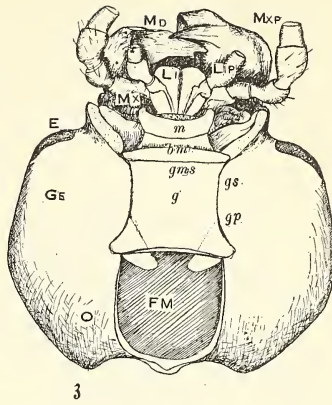
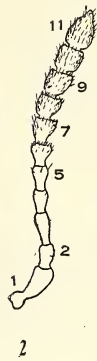
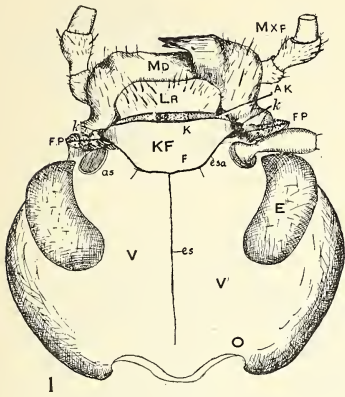
A, Anal vein.	GE, Gena.
AC, Acetabulum.	gms, Gula mentum-suture.
AF, Antennifer.	gp, Gular pits.
AK, Anteclypeus.	gs, Gular suture.
AN, Anus.	HX, Hypopharynx.
AP, Apophysis.	κ, Clypeus.
as, Antennal socket.	k, Clypeala.
aT, Anterior process of tentorium.	KF, Clypeofrons.
AWP, Anterior wing process.	L, Prosternal lobe.
ba, Internal process of mesofurcasternum.	LG, Ligula.
bm, Submentum.	LI, Labium.
bs, Basisternum.	LIP, Labial palpus.
bT, Base of tentorium.	LR, Labrum.
C, (In Fig. 21) Costa.	M, Median vein.
C, Coxa.	m, Mentum.
Ca, Cardo.	MD, Mandible.
CaG, Cardinal groove.	MK, Muscle disk.
CaP, Cardinal process.	ML, Median lobe.
Cu, Cubitus.	Mo, Molla.
d, Rod of chitin.	MX, Maxilla.
E, Eye.	MXP, Maxillary palpus.
EL, Elytron.	O, Occiput.
er, Epimeron.	Od, Oviduct.
et, Episternum.	p, Pleurite.
F, Femur.	pi, Posterior inflection of metasternum.
F, Frons.	PR, Pleural ridge.
fc, Furca.	PS, Pleural suture.
fcp, Furcal pits.	psc, Prescutum.
fs, Furcasterna.	psl, Post scutellum.
Fl, Flagellum.	pT, Posterior process of tentorium.
FP, Frontal pits.	PWP, Posterior wing process.
G, Metanotal groove.	px, Precoxales.
g, Gula.	Q, Condyle.
Ga, Galea.	q, Pseudonotum.



R, Radius.	T, Tibia.
RM, Rectum.	T, Tergite.
s, Sternite.	TA, Tarsus.
SC, Subcosta.	Tg, Tegmen.
sc, Scutum.	TR, Trochanter.
sl, Scutellum, Fig. 25 and 28 style.	tr, Trochantine.
SMo, Submola.	v, Vertex.
SN, Subnotum.	V, Valvifer.
Sp, Spiracle.	VA, Vagina.
SR, Seminal recepticulum.	VWP, Ventral wing process.
ST, Sternum.	X, Axillary plates.
St, Stipes.	x, Small axillary plate.
	xT, Coxite.

## PLATE VI

- Figure 1. Head—(dorsal view).
- Figure 2. Antenna.
- Figure 3. Head—(ventral view).
- Figure 4. Base of mandible, showing attachment to head capsule.
- Figure 5. Base of mandible detached, showing condyle and acetabulum.
- Figure 6. Cross-section of head, showing interior structures.
- Figure 7. Mandible (right one), ventral surface.
- Figure 8. Mandible (right one), dorsal surface.
- Figure 9. Labrum (dorsal surface), showing the chitin rods.
- Figure 10. Maxilla (right one) ventral (exterior) surface.
- Figure 11. Labium.



LEPTINOTARSA

## PLATE VII

- Figure 12. Prothorax (front view).  
Figure 13. Fore leg.  
Figure 14. Prosternum.  
Figure 15. Meso- and Metanotum, showing attachment of fore and hind wings.  
Figure 16. Meso- and Metasternum and respective pleural plates.  
Figure 17. Outline of wing, showing method of folding.  
Figure 18. Metapleuron.  
Figure 19. Mesopleuron.  
Figure 20. Mesopleuron, interior aspect, showing pleural ridge, furcum and sternal process.  
Figure 21. Wing and its venation.  
Figure 22. Side view of abdomen, showing spiracles, etc.  
Figure 23. Tip of abdomen of ♂, interior parts, showing genitalia and alimentary canal.  
Figure 24. Tip of abdomen of ♂, exterior aspect.  
Figure 25. Tip of abdomen of ♀, showing genitalia and alimentary canal.  
Figure 26. Genitalia of ♂, taken out of abdomen.  
Figure 27. Genitalia of ♀, dorsal view, the rectum being pulled away.  
Figure 28. Tip of abdomen of ♀, side, dorsal and ventral view.





SOME DATA RELATIVE TO THE RELATIONSHIP  
OF TEMPERATURE TO CODLING  
MOTH ACTIVITY<sup>1</sup>

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ABSTRACT

Thermal constants for beginning emergence and maximum emergence of the overwintered generation and the first summer generation of codling moth, determined by summation of day degrees of effective temperature, exhibit a sufficiently small amount of variation from year to year to render them satisfactory indicators of time when insecticidal applications should be made for the control of the larvæ of that insect entering apples, but that the dates, as determined by the thermal constants, should be checked against the codling moth bait pan records in order to make sure that the season in question does not exhibit some unusual type of variation. While the dates of beginning emergence and maximum emergence of the overwintered generation and the first summer generation seem to vary according to the latitude and altitude phase of the bio-climatic law, the writer feels that further data should be secured before dependence is placed upon this principle for determining the dates of insecticidal applications. When the average weekly minimum temperature approaches 60° F. codling moth transformation from larva to pupa ceases. It is probable, however, that the determination of this tendency of larvæ to pupate occurs under a somewhat higher average minimum than 60° F. and it seems, in the writer's experience, that this determination of tendency takes place before the larva starts to spin its cocoon.

INTRODUCTION

The writer's general interest in the relation existing between temperature and insect activity, together with the pronounced advantage in the use of a thermal constant in practical codling moth control, first led him to undertake this study. The work of Mr. P. A. Glenn (1) on this subject further excited his interest because it indicated that the thermal constant might be used for the timing of insecticidal applications against the codling moth.

<sup>1</sup> Paper No. — of the Journal Series of the New Jersey Agricultural Experiment Stations, Department of Entomology.

The first question to be answered in the course of this study was—"Can the thermal constant be used as a practical and satisfactory indicator for the timing of insecticidal treatments against the codling moth?" The second question to be answered was—"Can the determination of the time of insecticidal treatments made at one point be extended to other regions of New Jersey through the operation of that phase of the bio-climatic law which relates to latitude and altitude?" The third question that this work was designed to answer was—"Is there anything in the temperature records which may be taken as an indicator that the transformation of codling moth larvæ will cease to occur for the balance of the season?"

#### METHODS USED

The period covered by this study includes the following years and series of experiments: one series in 1919, one series in 1920, one series in 1921, one series in 1922, five series in 1926 and one series in 1927, making, all told, ten series in six years.

In every case codling moth larvæ were gathered from the tree trunks during the fall and winter. Each larva was placed in a small glass vial, stoppered with cotton or covered with a layer of cheesecloth. These vials were then placed upright in a screen-bottom box, painted white and hung on the branches of an apple tree in an orchard under observation. In the early experiments one hundred larvæ per box were used. In later experiments four hundred to five hundred larvæ per box were used. These larvæ were examined early enough in the spring to catch the first emergence and thereafter, until emergence ceased, they were examined at weekly intervals. Larvæ of the first generation were collected from the tree trunks as they descended, placed in glass vials and handled in precisely the same manner. Temperature records were secured in some cases from instruments kept in the orchard and in other cases from regular stations nearby. In the season of 1926 the records came directly from maximum and minimum thermometers, a set of which was placed in each orchard where a box of larvæ had been stationed.

The effective day degrees of temperature were computed on the basis of the formulæ found on page 283 of a publication (1).



TABLE 1  
STUDY OF THE RELATION OF EFFECTIVE DAY DEGREES OF TEMPERATURE TO EMERGENCE OF HIBERNATING AND FIRST SUMMER GENERATIONS OF CODLING MOTH

Year	Place Name	Location		Begin Emergence	Accum. Temperature	Maximum Emergence	Accum. Temperature	End of Emergence	Accum. Temperature
		Latitude	Elevation Above Sea						
1919	Moorestown	40° 1'N.	75'	May 5	298.68	May 29	561.03	June 9	814.28
1920	Moorestown	40° 1'N.	75'	May 22	298.91	June 7	524.16	June 21	767.16
1921	Glassboro	39° 39'N.	130'	April 27	448.34	May 7	499.37	May 26	721.15
1922	Glassboro	39° 39'N.	130'	May 5	348.30	May 17	502.05	May 31	759.48
1926	Glassboro	39° 39'N.	130'	May 24	305.20	June 4	444.47	July 2	860.72
1927	Glassboro	39° 39'N.	130'	May 24	397.10	June 9	632.54	July 8	1252.39
1926	Pattensburg	40° 38'N.	700'	June 5	400.53	June 16	552.79	July 13	1162.17
1926	New Brunswick	40° 29'N.	110'	May 28	374.83	June 19	664.48	July 10	1088.45
1926	Riverton	40° 1'N.	15'	May 25	343.89	June 11	648.26	July 3	1055.32
1926	Bridgeton	39° 26'N.	90'	May 24	385.41	June 5	532.40	July 9	1205.28
Total for all years .....					3601.19		5561.55		9686.40
Average Thermal Constant .....					360.11		556.15		968.64

TABLE 1—(Continued)

STUDY OF THE RELATION OF EFFECTIVE DAY DEGREES OF TEMPERATURE TO EMERGENCE OF HIBERNATING AND FIRST SUMMER GENERATIONS OF CODLING MOTH

Year	Place Name	Location		Begin Emergence	Accum. Temperature	Maximum Emergence	Accum. Temperature	End of Emergence	Accum. Temperature
		Latitude	Elevation Above Sea						
1919	Moorestown	40° 1'N.	75'	July 7	1425.70	Aug. 2	2025.45	Aug. 30	2607.95
1920	Moorestown	40° 1'N.	75'	July 9	1138.66	July 27	1428.91	Aug. 26	2094.66
1921	Glassboro	39° 39'N.	130'	July 1	1450.53	July 18	1923.28	Aug. 14	2578.28
1922	Glassboro	39° 39'N.	130'	July 6	1562.48	July 26	2068.93	Aug. 26	2829.13
1926	Glassboro	39° 39'N.	130'	July 13	1122.22	July 30	1490.97	Aug. 27	.....
1927	Glassboro	39° 39'N.	130'	July 15	1448.14	Aug. 5	1955.34	Sept. 19	2626.84
1926	Pattensburg	40° 38'N.	700'						
1926	New Brunswick	40° 29'N.	110'						
1926	Riverton	40° 1'N.	15'						
1926	Bridgeton	30° 26'N.	90'						
Total for all years .....					7967.73		10,892.88		12,736.86
Average Thermal Constant .....					1327.82		1,815.48		2,547.37

These computations were made by the junior clerk in the department office in order that no personal bias might enter into the results.

#### THE THERMAL CONSTANT STUDY

The summarized results of the thermal constant study are set forth in the following table:

For the purpose of comparing average results in thermal constants with similar studies in the state of Illinois, the writer is submitting Table No. 2.

TABLE 2  
COMPARISON OF AVERAGE THERMAL CONSTANTS DERIVED FROM ILLINOIS AND NEW JERSEY

State	No. of Years Averaged	Accumulated Temperatures to Appearance of First Adults of Overwintered Generation	Accumulated Temperatures to Appearance of Adults of First Summer Generation
Illinois .....	3	340°	1342°
New Jersey .....	6	360.11°	1327.82°

Examination of these tables serves to show a remarkably close thermal constant for the appearance of the first adults of the overwintered and the first adults of the first summer generation as determined in two such widely separated areas as the state of Illinois and the state of New Jersey. It seems that this close correspondence may be taken to indicate that not only does such a thermal constant exist, but that variables, other than temperature, influence the emergence of codling moth to only a minor degree when the rainfall varies from 30 to 45 inches.

For the purpose of examining the extreme variation in thermal constants, resulting from the work in New Jersey, Table No. 3 is submitted.

Examination of this table serves to show that the percentage variation will average close to 30 per cent. or less for beginning and maximum emergence which are above all the critical indications. It therefore seems that in any one year the average

thermal constant would not miss the extreme variation by more than about 15 per cent. If this variation be translated into days on the overwintered generation, the period of the phenomenon would not vary much more than a week while on the first summer generation it would vary only a few days.

Thus far the thermal constant seems to have a real and reliable existence and to show an amount of variation sufficiently small to render it rather practical for determination of the time of insecticidal applications against the codling moth.

TABLE 3

EXTREME VARIATION IN THERMAL CONSTANTS AS SHOWN IN NEW JERSEY WORK

Thermal Constants for Overwintered Generation								
Begin Emergence			Maximum Emergence			End Emergence		
Max.	Min.	Dif.	Max.	Min.	Dif.	Max.	Min.	Dif.
448.34	298.68	149.66	664.48	444.47	220.01	1252.39	721.15	531.24
Per cent. Variation.....					33	43		

Thermal Constants for First Summer Generation								
Begin Emergence			Maximum Emergence			End Emergence		
Max.	Min.	Dif.	Max.	Min.	Dif.	Max.	Min.	Dif.
1562.48	1122.22	440.26	2068.93	1428.91	640.02	2829.13	2094.66	734.47
Per cent. Variation.....					22	30		

Of course, the only satisfactory method of testing the application of the thermal constant as a determinator of time for insecticidal applications for the codling moth lies in its actual field employment. This phase of the investigation was undertaken in 1927 and the thermal constant was checked against emergence from the codling moth boxes and against adult moths caught in bait pans. The results are set forth in Table No. 4.

Examination of Table No. 4 shows that the emergence in numbers of the overwintered generation of codling moth in the boxes

TABLE 4

TEST OF THE APPLICATION OF A THERMAL CONSTANT AS A MEANS OF DETERMINING THE TIME WHEN INSECTICIDAL TREATMENTS SHOULD BE GIVEN FOR CODLING MOTH CONTROL

Date	Moth emergence		Moths caught in 10 bait pans		Larvæ en- trance of fruit	Day degrees of accumu- lated tem- perature
	Moths emerged	Moths accumulated	Moths caught	Moths accumulated		
April 4/27						0.0
" 5						0.0
" 6						5.06
" 7						8.88
" 8						0.0
" 9						0.0
" 10						0.0
" 11						11.37
" 12						16.93
" 13						0.0
" 14						19.93
" 15						24.75
" 16						39.27
" 17						
" 18						51.06
" 19						62.10
" 20						85.85
" 21						103.10
" 22						105.10
" 23						105.87
" 24						0.0
" 25						107.71
" 26						111.78
" 27						114.44
" 28						118.38
" 29						124.0
" 30						0.0
May 1						129.82
" 2						137.05
" 3						151.12
" 4						164.37
" 5						176.37
" 6						188.12
" 7						199.87
" 8						206.87
" 9						220.87
" 10						242.87
" 11						260.12
" 12						269.87
" 13						276.25
" 14						285.10

TABLE 4—(Continued)

Date	Moth emergence		Moths caught in 10 bait pans		Larvæ en- trance of fruit	Day degrees of accumu- lated tem- perature
	Moths emerged	Moths accumulated	Moths caught	Moths accumulated		
May 15						291.60
“ 16						296.35
“ 17						306.60
“ 18						314.85
“ 19						320.85
“ 20	0	0				333.10
“ 21			Bait pan placed			346.60
“ 22						368.10
“ 23						387.60
“ 24			48	48		397.10
“ 25						407.85
“ 26						422.35
“ 27	100	100	11	59		433.62
“ 28						441.00
“ 29						454.62
“ 30						471.12
“ 31			170	229		485.12
June 1						495.46
“ 2			46	275		508.54
“ 3	191	291	71	346		522.29
“ 4						541.54
“ 5			51	397		559.79
“ 6						575.04
“ 7			159	556		589.79
“ 8						607.79
“ 9			49			632.54
“ 10	285	576		605		662.29
“ 11			91	696		689.04
“ 12						713.29
“ 13			127	823		722.04
“ 14						726.54
“ 15			24	847		737.79
“ 16						749.79
“ 17	298	874	101	948	Entry noticeable	762.54
“ 18						777.54
“ 19						791.54
“ 20						821.54
“ 21			130	1078		847.29
“ 22						874.54
“ 23						900.04
“ 24	120	994	76	1154		934.29
“ 25						966.54
“ 26						996.04
“ 27			66	1220		1017.54
“ 28						1035.54
“ 29			240	1460		1061.04
“ 30						1084.04

TABLE 4—(Continued)

Date	Moth emergence		Moths caught in 10 bait pans		Larvæ en- trance of fruit	Day degrees of accumu- lated tem- perature
	Moths emerged	Moths accumulated	Moths caught	Moths accumulated		
July 1	43	1037	97	1557		1105.79
" 2						1125.79
" 3						1148.79
" 4						1169.54
" 5			70	1627		1186.36
" 6						1201.64
" 7			44	1671	Entry ceased	1226.14
" 8	4	1041				1252.39
" 9			6	1677		1277.14
" 10						1299.39
" 11			3	1680		1324.14
" 12						1350.39
" 13			0			1382.14
" 14						1415.14
" 15	7		5	5		1448.14
" 16						1480.64
" 17						1509.89
" 18			0			1537.64
" 19						1558.39
" 20			1	6		1581.39
" 21						1604.14
" 22	158	165	0		No new entry	1623.14
" 23						1645.14
" 24			1	7		1667.39
" 25						1688.64
" 26			1	8		1713.64
" 27						1739.64
" 28			5	13		1766.39
" 29	197	362				1795.89
" 30						1826.14
" 31						1852.34
Aug. 1			1	14		1877.34
" 2						1900.59
" 3						1918.09
" 4			7	21	Abundance of new entry	1932.59
" 5	163	525				1955.34
" 6						1975.34
" 7						1998.84
" 8			13	34		2025.09
" 9						2053.34
" 10			24	58		2073.59
" 11						2090.84
" 12	182	707	36	94	New entry pres- ent but scarce	2110.84
" 13						2133.59
" 14						2155.34
" 15			12	106		2176.34
" 16						2198.59

TABLE 4—(Continued)

Date	Moth emergence		Moths caught in 10 bait pans		Larvæ en- trance of fruit	Day degrees of accumu- lated tem- perature
	Moths emerged	Moths accumulated	Moths caught	Moths accumulated		
Aug. 17			18	124		2211.09
" 18						2225.34
" 19	67	774	10	134		2239.84
" 20						2254.09
" 21						2271.09
" 22						2289.59
" 23			40	174	New entry con- tinuing slowly	2307.04
" 24						2326.34
" 25			22	196		2341.59
" 26	71	845				2356.09
" 27						2371.84
" 28						2382.09
" 29			16	212		2397.34
" 30						2415.34
" 31						2434.34
Sept. 1						2454.34
" 2	31	876				2476.09
" 3						2497.34
" 4						2524.59
" 5						2547.34
" 6						2567.34
" 7			25	237	New entry continues	2586.34
" 8						2605.84
" 9	19	895				2626.84
" 10			3	240		2641.84
" 11						2662.34
" 12						2679.84
" 13			1	241	New entry continues	2693.09
" 14						2708.84
" 15			3	244	New entry ceased	2735.34
" 16	0					2760.34
" 17			0			2779.09
" 18						2799.34
" 19						2818.84
" 20			0			2835.59
" 21						2848.34
" 22						2858.99
" 23	0		0			2870.25
" 24						2880.04
" 25			0			2886.80
" 26						2898.52
" 27			0			2911.23
" 28						2920.70
" 29						2938.20
" 30						2961.20



began on some date lying between May 20 and May 27. Judging from the numbers found on May 27 it is probable that emergence began closer to May 20 than to May 27. On May 21 the accumulated day degrees of effective temperature were 346.60, while one day later the accumulated temperatures were 368.10. It seems, therefore, that the average thermal constant, as shown from the New Jersey work ( $360.11^{\circ}$ ) and from the Illinois work ( $340.0^{\circ}$ ), pretty nearly coincides with the actual accumulation shown in New Jersey by the records of 1927.

Examination of Table No. 4 shows that maximum emergence of the overwintered generation occurred shortly preceding June 10, on which date there was an accumulation of 662.29 day degrees of effective temperature. It is probable that the maximum emergence was reached on June 9, when the day degrees of effective temperature accumulation were 632.54. When we consider that the average thermal constant for this phenomenon, as set forth in Table No. 1, was  $556.15^{\circ}$ , the variation ( $76.39^{\circ}$ ) is very small, being accumulated within a period of four days or less.

Examination of Table No. 4 shows that the end of emergence of the overwintered generation of codling moth came about July 8, when there was an average accumulation of 1,252.39 day degrees of effective temperature. The average thermal constant for this phenomenon, as set forth in Table No. 1, was  $968.64^{\circ}$ , a difference of  $283.75^{\circ}$ , which would have been accumulated in a period of about twelve days. Obviously the correspondence between the average thermal constant and the actual accumulated day degrees of effective temperature shows, in this case, much greater variation than in either of the other two cases.

Examination of Table No. 4 shows that emergence of the first summer generation of codling moth began in the boxes shortly previous to July 15, when an accumulation of 1,448.14 day degrees of effective temperature had occurred. The average thermal constant for this phenomenon, as set forth in Table No. 1, is  $1,327.82^{\circ}$ , or a difference of  $120.32^{\circ}$ , which was accumulated in 1927 in a period of about four days.

Examination of Table No. 4 shows that maximum emergence of the first summer generation of codling moth occurred in the

boxes about August 2, when there had been an accumulation of 1,900.59 day degrees of effective temperature. The thermal constant for this phenomenon, as set forth in Table No. 1, is 1,815.48°, or a difference of 85.11°, which was accumulated in 1927 within about three and a half days.

Examination of Table No. 4 shows that the end of the emergence of the moths of the first summer generation came on September 9 when there had been an accumulation of 2,626.84 day degrees of effective temperature. The thermal constant for this phenomenon, as set forth in Table No. 1, is 2,547.37°, or a difference of 79.47°, which was accumulated in 1927 within four days.

In summarizing the correspondence between the average thermal constant determined by six years and ten series of experiments and the actual accumulated day degrees of effective temperature in 1927 it may be said: (1) that the variation of the actual date of beginning emergence of the overwintered generation of codling moth in 1927 from the date indicated by the average thermal constant does not exceed two days; (2) that the variation of the actual date of the occurrence of maximum emergence of the overwintered generation of codling moths in 1927 from the date indicated by the average thermal constant does not exceed four days; (3) that the variation between the actual date of the ceasing of emergence of the overwintered generation of codling moth in 1927 from the date indicated by the average thermal constant does not exceed twelve days; (4) that the variation of the date of beginning emergence of the first summer generation of codling moth in 1927 from the date for that phenomenon, as indicated by the average thermal constant, does not exceed four days; (5) that the variation of the actual date on which occurred the maximum emergence of the first summer generation of codling moth in 1927 from the date as indicated by the average thermal constant does not exceed three and a half days; (6) that the variation of the actual date on which occurred the end of emergence of the first summer generation of codling moth in 1927 from the date of that phenomenon, as indicated by the average thermal constant, does not exceed four days.

Naturally, there would exist in the reader's mind a question as to whether the codling moth box records correctly represent

that which has occurred in the orchard where the box has been placed. In order to check up this phase of the question, there is set forth in Table No. 4 the catches of codling moth on the wing which occurred in the bait pans. All told, of the overwintered generation, 1,680 specimens of adult codling moth were caught in bait pans. The catch began during the week existing between May 20 and May 27, thus definitely placing the beginning of moths on the wing within that week and indicating that possibly it may have begun a little earlier. The maximum emergence of the overwintered generation of the codling moth occurred shortly preceding June 10, while the maximum catch in the bait pans occurred on June 15 or five or six days later. The end of the emergence of the overwintered generation came on July 8 and the end of the bait pan catch came on July 11 or three days later. The beginning of the emergence of the first summer generation of codling moth in the boxes occurred shortly previous to July 15, while the first catch of this brood in the bait pans occurred either July 15 or July 20. This uncertainty concerning the identity of the bait pan catch is due to the fact that the five specimens caught July 15 might possibly be a hang-over. The maximum emergence of the first summer generation of codling moths occurred in the boxes about August 2 while the maximum catch of this brood in the bait pans arrived about August 17 or about two weeks later. The end of emergence of the first summer generation of codling moth occurred in the boxes on September 9 while the end of bait pan collections occurred on September 15 or a little less than one week later.

This correspondence between the bait pan record and the codling moth emergence in the boxes seems adequately to bear out the notion that the phenomena of beginning, reaching maximum, and ceasing emergence of both broods rather satisfactorily reports that which is occurring in the orchard. The only important difference seems to lie in the fact that the bait pan record indicates a beginning emergence in the orchard somewhat earlier than that which occurred in the boxes.

A further indication of the relation of emergence in codling moth boxes to that which actually occurs in the orchard is indicated in Table No. 4 in the column devoted to entry of the fruit by codling moth larvæ.

Disregarding the blossom fall spray the time of which is absolutely determined by the development of the apple tree, it may be said that sprays for codling moth must be upon fruit and foliage when the larvæ are hatching, crawling upon the foliage, and trying to enter the fruit. Where infestation in unsprayed trees will not exceed 50 per cent. of the apples, it has been found in practice that one cover spray for the first brood and one cover spray for the second brood serves to effect a satisfactory degree of control and that accurate timing of these sprays is a matter of high importance. It has been the common practice in New Jersey for many years, under these conditions, to recommend the application of the first cover spray immediately after the maximum emergence of the overwintered generation has occurred in the codling moth boxes. Examination of Table No. 4 will serve to show that the application of the first cover spray would have begun June 9 or 10 and would have been completed within six or seven days. The first entry noticeable was discovered on the seventeenth day of June and was not, at that time, even the oldest examples, more than two days old. Thus it appears that the time of this cover spray would have been correct. In past years, in making a timing recommendation for the cover spray for the second brood of larvæ, it was customary to advise the same to begin just before the maximum emergence of the first summer generation had taken place. This would have meant in 1927 that the cover spray would have started July 29 and would have been completed within a week. Examination of Table No. 4 shows that new entry was abundant on August 4, indicating that the timing of this spray, on the basis of the codling moth box, would have been satisfactory.

In regions where the codling moth will infest more than 50 per cent. of the apples borne on unsprayed trees, experience has shown that the cover spray applications for the first brood of larvæ must begin shortly before entry of the fruit starts and be repeated often enough to maintain a thorough coating of fruit and foliage until entry by the first brood of larvæ ceases. On this basis in 1927 cover sprays should have begun June 9, should have been repeated about June 19 and again on June 29, thus preserving an anti-codling moth coating throughout the period

of entry by larvæ of the first brood, under conditions of rainfall such as existed in that year. In timing treatments for the second brood of codling moth larvæ, if any are deemed necessary, cover sprays in 1927 should have begun about July 29 and should have been repeated about August 12. As a matter of fact, experience shows that if three cover sprays are properly given for the first brood there is little need of further spraying during the balance of the season.

Thus we see that the average thermal constant may be used as an indicator of the time when anti-codling moth sprays should be applied for both the first and the second broods of larvæ and that the bait pan records afford a very desirable check up on the data offered by the thermal constant. In timing spray operations against codling moth in New Jersey in 1928, twenty-five to thirty sets of maximum and minimum thermometers will be placed in strategic orchards in different parts of the state. Likewise, in each of these orchards a group of ten bait pans will be maintained. The records will be forwarded to the central office and, on the basis of this data, an attempt will be made to determine the proper treatment dates for the entering codling moth larvæ of the first and second broods. It is not anticipated, however, that it will be necessary to continue spray applications for the second brood, providing cover sprays for the first brood are adequately maintained.

EXTENSION OF THE USE OF THERMAL CONSTANTS FROM  
AREAS IN WHICH THERMOMETERS AND BAIT PANS  
ARE LOCATED TO OTHER AREAS

If the data obtained on the thermal constant at one or more points can be extended to other points where the thermometer and bait pan records are not taken, with our present knowledge it will have to be done through the utilization of that phase of the bioclimatic law which deals with latitude and altitude. In 1926 stations were maintained at six different points in the state. The latitude and altitude of these points were secured from the records and the theoretic difference in days worked out for a comparison with the actual difference in days. Table No. 5 will serve to set forth the results.

TABLE 5

APPLICATION OF THE BIOCLIMATIC LAW TO CODLING MOTH EMERGENCE  
IN NEW JERSEY IN 1926

Place	North Latitude	Altitude in feet	Theoretic Difference in Days	Actual Difference in Days Begin Emergence
Glassboro .....	39° 39"	130		
Pattensburg .....	40° 38"	700	9.63	12
New Brunswick .....	40° 29"	110	3.13	4
Riverton .....	40° 1"	15	0.31	1
Bridgeton .....	39° 26"	90	1.26	0

Examination of this table indicates that the bioclimatic law does approximately apply to the occurrence of the beginning of emergence of the overwintering generation of codling moth in the areas where the study was made. Although the correspondence is reasonably close, it is felt, however, that further confirmative data should be available before the operation of this law is depended upon for the timing of spray applications.

RELATION OF THE LATE SUMMER AND EARLY FALL TEMPERATURE  
RECORD TO THE TIME WHEN CODLING MOTH LARVÆ  
CEASE TO TRANSFORM TO PUPÆ

In 1927, beginning on July 8, regular weekly collections of larvæ were made. In each collection the percentages of larvæ and of pupæ were determined. The moth emergence from each collection was also checked up. The minimum temperatures of the week, ending on date of collection, have been averaged and introduced in the table for purposes of comparison. The results are set forth in Table No. 6.

Examination of Table No. 6 shows that all pupation ceased in the week ending August 12, when the average minimum temperature was 61.4° F., indicating that pupation ceases as the weekly minimum average approaches 60° F. The writer believes that the initiating weekly average temperature is somewhat higher

TABLE 6  
PUPATION AND EMERGENCE FROM CODLING MOTH LARVÆ  
COLLECTED AT GLASSBORO IN 1927

Date of Collection	Per cent. Larvæ	Per cent. Pupæ	Per cent. Moth Emergence	Average Minimum Temperature
July 8, '27.....	90	10	100.0	
“ 15 .....	70	30	100.0	70.2
“ 22 .....	40	60	96.1	67.4
“ 29 .....	30	70	95.5	66.2
Aug. 5 .....	50	50	67.2	64.0
“ 12 .....	75	25	20.5	61.4
“ 19 .....	90	10	10.0	58.8
“ 26 .....	90	10	7.7	58.5
Sept. 2 .....	98	2	0.0	58.7

because his experience indicates that the tendency to pupate or to overwinter has been determined before the cocoon is spun.

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## SERUM DIAGNOSIS AND RHOPALOCERA

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Serum reactions are one of the methods in the hands of the biochemists for detecting the subtle differences in the make-up of the protoplasm and proteins of animals. Numerous experimentors have investigated the reactions of vertebrate proteins and more recently proteins and protein allies derived from invertebrates have been used. Unfortunately, the method requires special training, a sizable laboratory, experimental animals, such as guinea pigs or rabbits, and time. Thus it is cumbersome for general routine in investigating the relationship of animal forms.

The method is based on the fact that a foreign substance injected into an animal causes a definite and specific reaction. This may be any one of several types. In this work we are interested in but one type, the production of *precipitins* or *agglutinins*, which, as their names indicate, cause a precipitation or agglutination of the irritating medium upon a future injection. They are derived by injecting into a guinea pig (or any suitable animal) a suspension of the protoplasm or protein; in our case we used that of *Eurymus philodice*. This irritating material is termed the "antigen."

As the antigen is absorbed into the system of the experimental animal, the blood builds up the combative elements, in our case precipitins or agglutinins. These are called the "antibodies." When the blood serum has built up considerable of these it is said to be "sensitized" to the antigen used (i.e. protoplasm of *Eurymus philodice* in this experiment). An injection of the antigen at this time will cause the blood serum to precipitate it and bring about an anaphylactic shock or even death. So instead of causing the reaction to take place in the guinea pig and thereby needing a great number of sensitized animals, we

draw from its heart 8–10 milliliters of blood, allow this to coagulate, and recover the serum. This serum contains the antibodies and the precipitating reactions between them and the antigen can be carried on in a test tube in a constant temperature bath at blood heat, 37.5° C.

The intensity of serologic reactions are recorded as follows:—

- 4 plus—extremely strong, entirely precipitated or agglutinated.
- 3 plus—strong, almost but definitely not a complete reaction.
- 2 plus—a fair reaction, probably 50% perfect.
- 1 plus—a good, recognizable reaction, not very intense.
- plus-minus—a slight or doubtful reaction.
- negative—no reaction.

The more intense is the reaction the closer relation it indicates between the sensitizing and reacting antigens. The less intense reactions will be differentiated more strongly in the higher dilutions than the lower dilutions of the antigen.

The authors are interested in insects and wished to determine if closely related forms give specific reactions when the usual methods applied to serum work are used; and, if these did not, just how closely forms might be related and still react specifically. In each of the three recorded experiments the sensitized serum was obtained from guinea pigs inoculated with “philodice antigens” described in Experiment One.

#### EXPERIMENT I

Ten male specimens of *Eurymus philodice* were macerated entire with 20 mls of physiologic saline solution. The mash was then held at 50° C. for one hour, filtered hot through coarse filter paper and sterilized at 58°–60° C. for one hour. The resultant antigen was yellow and clear. It contained 0.004 grams of extracted material per milliliter.

A 700 gram male guinea pig was selected and the fluid injected subcutaneously daily in doses beginning with 0.5 ml and progressing geometrically until a total of 7.5 mls had been injected amounting to 0.029 g. of “philodice antigens.” On the tenth day five milliliters of blood were drawn from the heart and the serum separated. This was reacted undiluted with vary-

ing dilutions of the standardized antigens at 37.5° C. These standardized antigens were made from males of *Papilio Troilus*, *Pieris rapæ*, *Eurymus philodice*, *Eurymus eurytheme* and *Argynnis cybele*. Our standard was arbitrary, one milligram of suspended material in each milliliter of physiologic saline solution, and was prepared in a manner identical to the suspension used for the injections.

After 48 hours at 37.5° C. the following readings were noted:

	ANTIGEN DILUTION			
	1:1	1:10	1:100	1:1000
<i>Eurymus philodice</i> .....	4 plus	4 plus	t.c.	1 plus
<i>Pieris rapæ</i> .....	2 plus		4 plus	1 plus
<i>Papilio troilus</i> .....	neg.	3 plus	1 plus	neg.
<i>Argynnis cybele</i> .....	neg.	neg.	neg.	neg.

(t.c.—tube cracked during incubation)

The insects used in this experiment were papered specimens 17 to 18 months old. The results showed us that it would be profitable to repeat the experiment in the summer when fresh materials were available. Experiment I may be interpreted to show a very strong inter-family reaction (*Papilionidae* vs. *Nymphalidæ*) with a distinct differentiation between sub-families (*Papilioninæ* vs. *Pierininæ*) related to the insect used as sensitizer. (Note reaction of antigen dilutions 1:100 and 1:1000.)

## EXPERIMENT II

The first experiment was repeated as planned with freshly killed specimens and the results verify Experiment I. As will be seen by the following readings there is a distinct inter-generic differentiation (*Eurymus* vs. *Pieris*) in dilutions 1:10 and possibly an Order reaction in 1:1 dilution, indicated by the "plus-minus" of *Argynnis*, both of which were lost by the use of dried specimens.

	ANTIGEN DILUTION			
	1:1	1:10	1:100	1:1000
<i>Eurymus</i> .....	4 plus	4 plus	4 plus	2 plus
<i>Pieris</i> .....	4 plus	2 plus	3 plus	plus-minus
<i>Papilio</i> .....	3 plus	1 plus	2 plus	neg.
<i>Argynnis</i> .....	plus minus	neg.	neg.	neg.
<i>control</i> .....	neg.	neg.	neg.	neg.

## EXPERIMENT III

The third series of tests were carried on with dried insects to determine if two species as closely related as *E. philodice* and *E. eurytheme* would show any differentiation. No evidence that would tend to prove it was found in dilutions up to 1:100,000 and with incubation up to 72 hours.

## CONCLUSIONS

1. The serum of guinea pigs sensitized by the injection of suitably prepared insect antigens, as of male *Eurymus philodice*, showed a specific reaction when the family was used as a unit, and
2. There was a distinct inter-subfamily reaction when dried insects were used, and
3. There was a distinct inter-generic reaction when freshly killed insects were used, and
4. There was no inter-specific reaction when dried, very closely allied species of insects were used, as *E. philodice* and *E. eurytheme*.

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## A SYSTEM OF ABBREVIATIONS FOR USE IN MUSCOID DESCRIPTION

BY CHARLES H. T. TOWNSEND

Nearly all improvements on time-honored custom experience hard sledding at the start and the writer's system of muscoid abbreviations is no exception to the general rule. At least one person has cried out loudly against it, while two or three publications have declined to print it. On the other hand, six publications have accepted it to date. Like other useful innovations, the system has come to stay, for it has already demonstrated its advantages. As a matter of fact, it is nothing more than an extension, to descriptive texts and synoptic tables, of the current system of abbreviating anatomic parts on published plates, to which no one has ever objected.

It is highly desirable that all students adopt this system regardless of the language in which they write. It not only cuts down the required space to about half but also works for uniformity and clarity. Universally adopted, it would greatly facilitate the study of descriptions in all languages, for its construction is simple and all students understand the English terms from which it is built. The purpose of this article is to present an analysis of it, whereby any student familiar with the terminology may acquire facility in its use in half an hour.

With the exception of the capital letters used for wing veins, wing cells and abdominal sternites five and ten, all are lower case letters unless the abbreviation begins a sentence, in which case the first letter is capitalized. If an abbreviation consisting of a single letter begins the sentence, there is no conflict with capital letters referring to the wings, for these are always in combination with Arabic numerals. The sternite capitals are suffixes.

Alone, a means acrostichals; pra, preacrostichals and pa, post-acrostichals; otherwise final a means angle as ra, right angle; or antennæ as ba, base of antennæ; or ampulla as ga, greater ampulla; or alar as ia, intraalars; or anterior as la, lateral anterior

bristles. The prefix *a* means acute as *aa*, acute angle; or anal as *af*, anal forceps. *An* means antennæ; *ar*, arista; *ab*, abdomen; *aps*, apical scutellars; *ang*, angular; *arc*, arcuate. The arista and antennal joints are designated by placing the Arabic numerals before the abbreviation; *anx* is antennal axis; *anf*, antennal fossa or fossæ. Length of abdomen is *abl* and width of abdomen, *abw*; thus *w* as suffix to a noun means width, while *l* in similar circumstances means length except in *arl*, *oml*, *moml*, *vl*, *fel*, *frl*, *sql*, *ml*, meaning respectively, arista level, oral margin (of epistoma) level, medial oral margin level, vibrissal level, facialia, frontalia, squamulæ, median line, plumose.

The single letter *b* and *b* followed by *l* or *w* mean body. As a prefix *b* means base or basal as *ba*, base of antennæ; *bb*, base (of vein) bristled or bristled only at base; *bjs*, basal joints; *banjs*, basal antennal joints; *barjs*, basal arista joints; *bls*, basal or anterior lateral scutellar bristle; *bsg*, basal or actual first abdominal segment; *bse*, basal section of costa. *Br* is bristle, *brs* is plural and *brst* is bristled.

Alone, *c* means clypeus; *cl*, length of clypeus, *ew*, width of clypeus; *cpl*, plane of clypeus; *es* means costal spine; *ex*, *coxæ*; *ch*, cheeks and *chg*, cheek grooves; *cb*, cubitulus; *cls*, claws; *cil*, ciliate; *col*, coloration.

The letter *d* refers to discal bristles; *dr*, discal row of bristles; *ds*, discal scutellars; *md*, median discals. *Dec* means decussate or crossed and *div* means divaricate or spreading, both referring only to bristles.

*E* means eyes; *em*, eye middle; *el*, length of eye; *ew*, width of eye; *ep* means epistoma; *epl*, length of epistoma; *epw*, width of epistoma; *epp*, epistomal profile; *eppl*, epistomal plane; *epe* means epicephalon and *ept* is epaulet. *Eq* means equal to, equals or equalling; *eql* means equilateral.

*F* is femora; *ff*, front femora; *mf*, middle femora; *hf*, hind femora; *fc* is face; *fel*, facialia; *pfel*, parafacialia; *few*, width of face; *felw*, width of facialia below; *pfew*, width of one parafacial in middle; *fcp*, facial profile; *fec*, facial carina; *fed*, facial depression; *fco*, facioorbitals; *fp*, facial plate; *fr* means front; *frl*, frontalia; *pfrl*, parafrontalia; *pfrw*, width of one parafrontal in middle; *frlw*, width of frontalia; *frll*, length of frontalia; *frls*,

striae of frontalia; frw, width of front; frp, frontal profile; frfep, frontofacial profile; feorp, faciooral profile; fro, frontoorbitals; pfro, proclinate frontoorbitals; rfro, reclinate frontoorbitals; frs, frontals; frr, frontal rows of bristles; fm means fulcrum; fls means flowers. Otherwise initial f means following as fjs, following joints (tarsi except metatarsi); or front as fph, front posthumeral bristle; fst, front sternopleural; fwm, front margin of wing; fts, front or prothoracic spiracle; fex, front coxæ; fels, front claws.

Ga is greater ampulla of epipleura; gno is genoorbitals; gen is geniculate.

H is head; hh, head height; hl, length of head; hw, width of head; hp, head profile; hs means haustellum; hpl, hypopleurals; hm, humerals; hy means hypopygium; hyp, hypopygial profile; hysg, hypopygial segment, with lhysg, etc.; hytg, hypopygial tergite. The prefix h means hind as hst, hind sternopleural bristle; hph, hind posthumeral; hls, hind lateral scutellar; hwm, hind margin of wing; hmtt, hind metatarsi; hts, hind (functional) or mesothoracic spiracle and htvs, valve of same.

Ia means intraalars; pri, preintraalars; pi, postintraalars; ivrs means inner verticals; ih, intrahumerals; ipal, intrapostalars; ipral, intraprealars; iv is inner pair of thoracic vittæ; ic, inner hind corner of squamæ; isgs, intermediate abdominal segments or third and fourth actual segments (usually second and third apparent segments); ipr, inferior proximal process of remigium ("subcosta"); ifrel, infraclinate.

J means joint and js is plural.

L means legs; lf, front legs; lm, middle legs; lh, hind legs; lb is labella; ln, lunula; lx is longitudinal axis. Otherwise initial l means lateral as lp, lateral plates of postscutellum; ls, lateral scutellars; ld, lateral discal bristles of abdominal segments; la, lateral anternors of same; lm, lateral marginals of same; or lower as lbe, lower border of eye; lbh, lower border of head, being lowest portion of oral profile; loo, lower occipital orbits; loce, lower occiput; or last as lsc, last section (of a vein); ltj, last tarsal joint.

M means median as in ml, median line; also marginal as in mm, median marginal bristles of abdominal segments and mr, mar-

ginal row of bristles; md, median discals of same; ma, median anterior bristles of same; mv, median vitta; mom, median oral margin, in which the final m means margin; or meso as in mplr, mesopleura and ms, mesopleural bristles; mms, median mesopleurals and mss, mesopleural-spiracular bristle; mse, mesoscutum; or middle as in mls, mex, mtr, mf, mtb, mt, mmtt, and meta as in mtt, metatarsi; or mouth as in mw, mouth width of 5R or apical cell. Mach is macrochaetæ and mich is microchaetæ.

Np means notopleural bristles and nplr means notopleura.

As a prefix o means obtuse as in oa, obtuse angle; or oral as in om, oral margin of epistoma and omb, oral membrane of same, also oml, oral margin level, but orp is oral profile; or outer as in ov, outer pair of thoracic vittæ and ovrs, outer vertical bristles; or occipital as in oo, occipital orbits, final o thus meaning orbits. Oe means ocelli; oec, occiput; oes, ocellar bristles; oces, occipitocentral bristles; oct, ocellar triangle; ocb, occipital beard; oef, occipital fringe (of bristles); ocar, occipital area; ocp, occipital profile; oepl, occipital plane.

P means proboscis; pr, pair both singular and plural; plp, palpi; pt, ptilinum and pts, ptilinal suture; per, sharp piercer of female fly; psl, peristomalia and pslr, peristomal row of bristles; plr, pleura and ptplr, pteropleura; pb, pubescent; pc, pectinate; pl, plumose; pet, petiolate; pol, pollinose. The prefix pr means presutural or before the transverse suture of the mesoscutum except in the cases of pral, prealar bristles and praps, preapical scutellars; in any case it means pre or before, as in prse, prescutum. The prefix p means postsutural when applied to bristles or parts of the mesoscutum, as in pse, postscutum; post when applied to bristles of the vertex; pro when applied to pleural bristles and parts, as in pstn, prosternum and pst, prosternals; proclinate when applied to orbital bristles and para when applied to head parts. As suffixes to nouns, p usually means profile and pl always means plane. Fp means facial plate; ump, upper section of median plate of postscutellum. In accord with above prefixes, pal means postalar; pi, postintraalars and pri, preintraalars; ps, postsuturals and prs, presuturals; psa, postsupraalars and prsa, presupraalars, ph, posthumeral; pp, propleurals and pplr, propleura; prep, preepaulet; paw, postalar wall or outer



vertical wall of the postalar callus and praw, wall of the prealar callus; in accord with both prefix and suffix, pfepl is parafacial plane and pfrpl, parafrontal plane.

As prefix, *r* means right as in *ra*, right angle; *rm* is remigium; *rel*, reclinate and *rfro*, reclinate frontoorbitals.

*Sc* means scutellum; *sq*, squamæ and *sql*, squamulæ; *sqf*, squamal fringe and *sqj*, junction of squama and squamula; *sqplr*, squamopleura; *sg*, abdominal segment and *sgs* plural, with *1sg*, first apparent abdominal segment, etc.; *st*, sternopleurals and *stplr*, sternopleura; *stn*, abdominal sternite and *stns* plural, with *1stn*, first actual abdominal sternite, etc.; *stn V*, fifth actual sternite, being the sternite of the anal or fourth apparent abdominal segment, and *stn X*, tenth sternite; *stp*, stump (of vein); *sept*, subepaulet; *sa*, smaller ampulla; *sin*, sinuate and *sprel*, supraclinate.

*T* means tarsi, with *ft*, *mt* and *ht*, front, middle and hind tarsi; *tb*, tibiæ, with *ftb*, etc.; *tg*, tergite and *tg*s plural, with *1tg*, etc.; *th*, thorax; *thl*, length of thorax; *thw*, width of thorax; *thv*, thoracic vittæ; *ts*, transverse suture; *tr*, trochanters, with *ft*r, etc.; *tyr*, tympanic ridge and *typ*, tympanic pit; *thk*, thickened.

*Ump* means the upper section of the median postscutellar plate, which may better be known as the infrascutellum, to distinguish it from the postscutellum of which it forms a part; it exists as a mere rim in most of the lower muscoid forms but is well developed in the higher forms. *Ums* means the upper mesopleural bristles; *uoo*, upper occipital orbits and *uoce*, upper occiput.

*V* is *vibrissæ*; *va*, vibrissal angles; *vap*, vibrissal angle profile; *var*, vibrissal area; *vx*, vibrissal axis; *vl*, vibrissal level; *vr*, vertex; *vrw*, width of vertex; *vrs*, vertical bristles; *vn*, venter and *vnc*, ventral carina of female fly.

When used alone, *w* means wings; *wb*, wing base or bases; *wm*, wing margin; *wt*, wing tip; *wv*, wing veins; *ww*, width of wing and *wl*, length of wing; *wp*, wing pattern. *Wr* is wrinkle; *w* following a fraction means way.

The multiplication sign  $\times$  means times, always used after an Arabic numeral.

It saves much space to substitute & for and, and to use the Arabic numerals for numbers.

The capital letters combined with Arabic numerals referring to wing veins and cells are C1, first cubital or fifth longitudinal vein; M1, first medial or apical crossvein; M2, second medial or fourth longitudinal vein; M3, third medial or hind crossvein; 3M, third medial or discal cell; R1, first radial or first longitudinal vein; R3, third radial or second longitudinal vein; R5, fifth radial or third longitudinal vein; 5R, fifth radial or apical cell; R6, sixth radial or small crossvein; S1, first subcostal or humeral crossvein; S2, second subcostal or axillary vein.

This system, which is completely given above in analysis, has grown out of the necessity for recording over 150 characters on a single card to be filed either in alphabetic order or by tribes. The standard 5- by 8-inch cards were at first used when less than half as many characters were tabulated. With the increased characters found desirable to record, it has become necessary to use 7- by 11-inch cards.

The great saving of space in these tabulations suggested the considerable advantage of employing the system in publication, thereby saving 50 per cent. of the cost in paper, typesetting, proofreading, ink, presswork, folding and binding, as well as carriage of the completed publication. Further, it was shortly recognized that the system will prove a time- and eye-saver to the student, for it greatly facilitates reference. It is far easier and requires much less time to scan a description that is all on one or at most two pages, than to have to turn and laboriously wade through a text that covers at least two pages and may run on parts of four pages. It also saves a great amount of time in preparation of manuscripts. Altogether, the system most highly commends itself to the busy student.

REVISION OF THE GENUS PTOCHIOMERA SAY  
(HEMIPTERA, LYGAEIDAE)

BY H. G. BARBER

ROSELLE, N. J.

In Enumer. Hemipt., IV, 1874, p. 152, Stal gives a synopsis of the species of Ptochiomera known up to that time from the Nearctic and Neotropical realms. The characters for distinguishing the genus he states on p. 144 as follows: "Second and third ventral segments destitute of stridulatory vittæ. Anterior lobe of the pronotum not at all or not more than doubly longer than posterior lobe. Head scarcely or very slightly exserted, suddenly or somewhat suddenly contracted behind the eyes, post-ocular space shorter or subequally long as space between eyes and antennæ. Hemelytra strongly punctate. Clavus punctate in three regular series; body less long, oblong or hardly elongate; scutellum at least behind middle furnished with a median longitudinal obtuse carina."

Now, although these characters do set off this genus as understood by Stal from the closely related genera of the Myodochini, I find as a result of a recent study of this aggregate of species that it should be broken up into four well marked genera. These four genera are distinguished from each other by as equally well marked characters as those separating such genera as *Ligyrocoris*, *Orthaea*, *Zeredoneus* and *Heraeus*. Fortunately three of these already have a name in the literature.

SYNOPSIS OF GENERA

1. Antennæ relatively long and slender; second and third segments filiform, the former longer than the latter; fore tibia of the male nearly straight, either mutic or armed with a small preapical tooth. (Type *E. minima* Guerin.)..... **Exptochiomera** n. gen.
2. Antennæ relatively short, more or less incrassate, sometimes clavate..... 2
2. Antennæ scarcely clavate, provided with short erect hairs; nude, subshining; pronotum strongly constricted between the two lobes, the anterior one four times longer than the posterior one (brachypterous

- form); fore femora strongly incrassate; fore tibia of the male strongly curved and armed with a preapical tooth. Most commonly brachypterous. (Type *C. ferruginea* Stal.).....**Carpilis** Stal
- Antennæ more or less clavate, without erect hairs; fore femora not so strongly incrassate; fore tibia of the male straight either armed or unarmed ..... 3
3. Third segment of the antennæ more incrassate than the fourth; nude, subshining; pronotum strongly constricted between the two lobes; fore tibia of the male unarmed. (Type *P. nodosa* Say.).....**Ptochiomera** Say
- Third segment of the antennæ less incrassate than fourth; dull fusc ferrugineous, rather densely sericeous; pronotum rather feebly constricted between the lobes. Brachypterous. (Type *S. puberula* Stal.) ..... **Sisamnes** Distant

#### **Exptochiomera** new genus

1. Fore tibia of male unarmed; head and pronotum nude, subshining; pronotum not strongly constricted between the two lobes. Small, somewhat depressed species. Tex. (Stal); Ariz. ....**fuscicornis** Stal
- Fore tibia of male armed with a small preapical tooth; head and pronotum either tomentose or sericeous; pronotum strongly constricted between the two lobes..... 2
2. Costal margins strongly concavely arcuate before the middle; head and pronotum somewhat tomentose; anterior lobe of the pronotum strongly inflated dorsally. Robust for the genus. Mex., Guat., Panama (Distant); Arizona .....**formosa** Dist.
- Costal margins obsoletely sinuate before the middle; head and pronotum sericeous; anterior lobe of the pronotum not inflated dorsally..... 3
3. Head and pronotum rather sparsely sericeous, subshining; pronotum more strongly constricted between the two lobes. Larger species. Cuba (Guerin), Fla., Tex. (= ? *albomaculata* Dist.).....**minima** Guerin
- Head and pronotum more densely sericeous, dull; pronotum less strongly constricted between the lobes. Smaller species. Mex. (Stal), Grenada, W. Ind. (Uhler); Mex., Guat., Panama (Distant).....**oblonga** Stal

Note: To this genus also belong *caeca* Distant from Guatemala; *fæda* and *quadristillata* Stal from Brazil; *tumens* Stal from Colombia; *japonica* Distant from Japan, and *albomaculata* Distant from Guatemala. The latter seems to me to be a synonym of *minima* Guerin.

#### Genus **Carpilis** Stal

1. Antennal segments 1 to 4 strongly incrassate, with third segment one-half the length of basal one; humeral angles pale. Only brachypterous form known. Fla. (Blatchley).....**barberi** Blatchley
- Antennal segments 2 and 3 not so strongly incrassate as 1 and 4, third segment little shorter than basal; humeral angles concolorous. Pterido-

dimorphous. Tex. (Stal), Me., L. Is., Adirondaack Mts., N. Y. ....  
 ..... **ferruginea** Stal

Genus **Ptochiomera** Say

The only included species is *nodosa* Say, readily distinguished by the characters given in the key, chief of which are: the unarmed fore tibia of the male, nude shining body, the black anterior lobe of the pronotum as well as the last two segments of the antennæ sharply contrasting with the general stramineous color. The enlargement of the third segment of the antenna is more noticeable in the female. United States (Say); from Mass. south to Fla. and west to Mo., Kans., and Texas.

Genus **Sisamnes** Distant

1. Antennæ distinctly clavate, second segment evidently shorter than third; fore tibia of the male unarmed. Only brachypterous forms known. Col. (Uhler); Utah, Neb., Kans., Mo., Long Is., N. Y., N. J. ....  
 ..... **clavigera** Uhler
- Antennæ not so distinctly clavate, second segment of antenna longer than third; fore tibia of male armed with a preapical tooth. (= *antennata* Van Duz. and ?*Sisamnes contractus* Distant.) Tex. (Stal); Fla. (Van Duzee); Guatemala for *contractus* (Dist.); Ariz. (Barber); Col. (Uhler) ..... **puberula** Stal

Note: To this genus apparently belongs *P. annulicollis* Berg. Argentina.



## NOTES ON THE BEHAVIOR AND HABITS OF STIGMATOMMA PALLIPES HALDEMAN

BY CARYL PARKER HASKINS

It has so happened that in the course of the past several years the writer has chanced to be enabled to observe rather closely the Ponerine ant, *Stigmatomma pallipes* (Tribe Amblyoponi), both under natural conditions and in the artificial nest. During this time a few notes of behavior have accumulated which have been of personal interest, either because they indicated traits eminently primitive or degenerate, or, in some cases, startlingly plastic for so ancient a form. None of these notes can possibly be more than corroborations of the statements of others, but the hope that as such they might be of some interest to those concerned with the ant has induced me to bring a few of them together in condensed form.

### NESTING HABITS AND THE FORMATION OF NEW COLONIES

The communities, ranging in number from two to rarely more than sixty individuals, are ordinarily found in thick, damp woodlands, the typical localities in which most timid hypogeaic forms find refuge. Although the majority of these forms seem dependent for their continued existence upon these forests, with their concomitant opportunity of escape from more dominant types, it is certain that *pallipes* has not become entirely so, nor has it completely lost the ability to exist in proximity with glade or even field forms. In Petersham, Massachusetts, a colony taken under a broad stone in an open clump of young white pine, which was nesting beside two species of open-woods ants (*L. americanus* and *A. picea*), was unusually populous, and so prosperous as to aggressively resent intrusion. A more remarkable illustration of the same fact came to personal observation. A portion of an old, thick and damp forest of mixed coniferous and deciduous growth near Schenectady, N. Y., was cut over in 1915

for the purpose of forming building lots. At that time *pallipes* was the dominant ant of the region, experiencing competition only from a few small and depauperate colonies of ants of the genera *Leptothorax*, *Lasius*, *Myrmica* and *Prenolepis*. Ten years later, *pallipes* was still very abundant in the uncut portion of the land, which had remained unchanged. But the ants were equally abundant in the cut-over area, which had been built upon. Prosperous colonies were found in many flower beds, an unusually splendid one being taken five feet from a house foundation. An adjoining meadow had been transformed to a truck garden, a portion of which, owing to reflection from a concrete surface and a full southern exposure, was exposed to the most brilliant light and almost unbearable heat every cloudless day from ten o'clock onward. Yet here, too, the insects flourished, existing side by side with numerous colonies of *F. subsericea*, *A. claviger*, *L. niger* and *M. rubra*. In the space of ten years numerous colonies of *pallipes* had been suddenly brought from conditions of dense shade and coolness to the full heat and sunlight of open conditions, and the full competition of a field association which lost no time in occupying the ground, and in that time had contrived not only to continue to exist, but to so thoroughly adapt themselves to the new circumstances as to prosper.

The reluctance of the winged females of this Ponerine to emerge for the nuptial flight from an artificial nest caused some doubt for a time as to the existence of such a flight under natural conditions. The question, of course, has been definitely solved. Ample personal evidence of the existence of such a flight has been obtained, which, as it may chance to be of corroborative interest, has been included.

Males are almost always ready to take flight from the artificial nest. Numerous males took flight from personally observed Lubbock nests in 1924, 1925 and 1926. They were usually but three or four days old. A single callow queen emerged from an artificial nest in 1924, but did not take flight. In 1925 four queens, all in the red callow condition, emerged, of which one took flight. Eight others left their nests immediately after having cast the wings.

More conclusive evidence has been obtained from wild colonies. On the afternoon of September 12, 1925, a very hot and humid



day, fourteen males of *Stigmatomma pallipes* were taken from a pool of water in the tract of woodland already mentioned. They had evidently been caught while participating in the flight. A very large proportion was alive. Later a single queen was taken. The insect was, to judge from pigmentation, but two or three days old, and had perished, probably becoming caught on descending. On September 26, 1926, a young winged queen was found sauntering about the top of a stone, from underneath which a typical gallery opened. The ant appeared to be about to take flight, but did not do so, returning after about fifteen minutes in the open. The individual was in the callow condition. On September 4, 1927, three queens, all of which were still living, were taken in some small water dishes standing in the truck garden already mentioned. As they had emerged about noon on a very hot and bright day, the heat and light were such as to be endured for but a few moments at a time, so that the observations are scattered. The three ants were all very active, and when dried and confined to a dark place, exhibited such marked signs of positive phototropism that they were brought again into the sunlight and momentarily released. One individual took flight on three occasions, being in each case struck down. The females remained feverishly active and positively phototropic until late in the afternoon, when they became suddenly photobopic and returned underground.

Little personal evidence has been secured on the procedure followed by the young queens on descending. All isolated individuals, even when regularly fed, have shown no desire to form nests, and have shortly either escaped or perished. On the other hand, young queens remaining with the parent colony have taken part actively in its functions. The large number of queens ordinarily found in a single colony, together with the similarity in stature of the worker and queen, and the rambling type of nest-form observed in the majority of localities, seem to indicate that in most cases new colonies are formed simply by extensions from the parent. The first broods of queens taken from certain localities, however, possess the power to pupate prematurely, as in the cases of those higher ants whose queens form independent communities. A small and apparently isolated colony taken in 1925,

consisting of a young queen, two workers of the normal form, a few small eggs and larvæ, and four tiny cocoons, brought three larvæ to maturity, all of which were hatched from eggs laid in the artificial nest. Between the fifteenth and the twenty-fifth of the following January, these larvæ pupated, although but about one-half the normal size. Larvæ of the same size and age, likewise hatched in artificial nests but belonging to larger colonies, continued to feed and to grow, the first not spinning until June 22. The young ants of the incipient colony, on hatching, were perfect, but exceedingly small, and unusually heavily pigmented, exactly like the first-brood adults of higher ants. The cocoons from which these insects were eclosed were of exactly the size and form of those taken with the colony, they having perished.

#### LENGTH OF DEVELOPMENTAL PERIODS

The time consumed in the development of the young is unusually long with *pallipes*, and varies widely between individuals, and with conditions of temperature and moisture. The period consumed by the embryo in development has been found fairly uniform, ranging in length from forty to sixty days. When incubated from the time of laying in an atmosphere containing from fifty to seventy-five per cent. of oxygen, eggs have hatched in twenty-seven days. The length of life of the larva is enormously variable, since larvæ are accustomed to hibernate at any stage of growth, and possess the power of remaining inert over long periods, even during warm weather, when food is scarce. The extremes of development which have been observed are 137 and 233 days. The first figure represents the total length of larval life, but the second individual had passed the winter in a nearly mature condition before it was taken, so that the total figure must be nearly double this. The length of pupal life varies almost directly with weather conditions. The observed extremes have been 41 and 57 days, made under very similar conditions of temperature (a mean of about 20° C.). Under more widely variant conditions the figures would doubtless be farther apart. But one personal observation which can be credited as of any value has been made on the length of adult life. The insect in question was hatched in the artificial nest and died,

giving some evidence of actual decease from old age, when between twenty-four and twenty-five months old. This ant had been active during both the intervening winters, which may have tended to shorten its natural span of life, which, however, it is to be supposed must be shorter in any case than that of higher ants. The insect in question was a worker. The winged castes are produced irregularly from July to September in the New England States and northern New York, the observed extremes being July 27 (queen) and September 23 (queens and males).

#### RELATIONSHIPS BETWEEN ADULTS, AND ADULTS AND BROOD- NESTING HABITS

Regurgitation has never been personally observed, nor, I believe, recorded between adults of *pallipes*, thus removing one of the strongest bonds between the adults of the colony. Individuals are frequently licked, as among the higher ants. The primitive root from which the habit of deportation seems to have developed is to be observed. The deported individual is grasped by the first gastric segment, or by any portion of the head, and uncertainly dragged for a distance, being handled in the awkward fashion characteristic of the ant when moving cocoons. This "deportation" is rarely practiced when danger is threatened, but may be at any other time. Frequently individuals have been observed to drag others which were feeding upon an insect newly brought in away from the food. This procedure was followed for several minutes by a dozen individuals on one occasion, thirteen separate cases being observed inside of two minutes.

The adults are very solicitous of the eggs, licking them and carrying them about with great frequency. As in higher ants, trophallaxis forms the bond between adults and larvæ, but no larva has been observed to be fed with liquid food. *Pallipes* has been seen to pinch larvæ to assist in the exudation of fluids—no doubt the remnant of a primitive Vespine trick. Larvæ quickly devour dead members of the brood, but no larva has been observed to actually kill another, or to devour ova. Young larvæ have occasionally been accidentally impaled on the sharp mandibles of the adults, indicating a significant lack of care on the part of the nurses in their handling of the young.

Little has been observed concerning the nature of the provender brought into the brood chamber by foraging adults. In a single instance, portions of some Myriopod were found distributed among the larvæ of a wild colony, but the animal had been too long exposed to the ravages of the young ants to be identified. In captivity, any Articulate has been taken readily by the most enterprising colonies, although the more timid often confined themselves to the pupæ of higher ants. Although both adults and young when under natural conditions are wholly entomophagous, the former have taken fruit quite readily, but have never offered it to the larvæ. Honey is not recognized as edible by adult females, but is greedily devoured by males—perhaps another ancient habit derived from Vespine stock.

The integrity of colonies is well preserved with *pallipes*, alien ants being quickly detected and attacked. This is more strictly true with isolated colonies of compact type than among those in which the rambling galleries apparently extend for considerable distances. As among the higher ants, the recognition seems due to a definite odor constant for a colony, but a marked individual odor has also been found to have been present in a number of tested ants. The characteristic odor appears when the ant is but a few hours old, and is well developed within forty-eight hours.

Nests have been found excavated in rotten wood, and in coarse sand, clay loam, and almost pure colloidal yellow clay, marked preference being shown for the last-named medium. No evidence of accessory structures, of course, has been seen at any time.

THE ENTOMOLOGY OF DOCTOR BRICKELL'S  
"NATURAL HISTORY OF NORTH  
CAROLINA"

BY HARRY B. WEISS  
NEW BRUNSWICK, N. J.

Ever since Columbus discovered America, visitors to these shores have been going home and recording their impressions in print, and John Brickell, M.D., was no exception. He traveled in North Carolina previous to 1723 and found the planters living at ease in pleasant and picturesque surroundings. Poverty was almost unknown; food was plentiful, cider and persimmon beer were made at home and rum and brandy were imported. Cock fighting, horse racing, wrestling, dancing, cards, and dice furnished adequate amusement, and the girls were handsome. Being a doctor, however, he found it necessary to inject a discordant note, and so he mentions the prevalence of yaws, cholera morbus, convulsions, whooping cough, ring worms, rashes, prickley heat and the itch, together with a few more ailments not usually expressed by present-day visitors. The domestic animals, the trees, and vines, fruit production, bears, pole-cats and other wild animals, frogs, lizards, toads, birds, rattlesnakes, insects, whales, fishes, the laws, roads, negroes and Indians all come in for more or less extended comment, some of which is quite diverting. For instance, Brickell says: "The Indian Women are never known to scold, and it is a thing impossible to hear them make use of that unruly Member the Tongue, with such Rage and Malice as our European Dames are subject to, whom I could wish would set these Indians for a Pattern, by which means there would be more Quietness and better Harmony in most Families than at present is to be met with."

Some eight or nine pages are devoted to such insects as bees, silkworms, butterflies and moths, grasshoppers, cicadas, fire-flies, crickets, hog lice, lady bird beetles, ants, blister beetles, earwigs, black flies, gad-flies, clothes moths, bed bugs, roaches, tumble

“bugs,” stag beetles, sand flies, dragon-flies, wasps, hornets, fleas, lice and mosquitoes. For the most part the accounts are descriptive of the habits rather than of the insects themselves and are general enough to apply to groups rather than species.

Doctor Brickell stresses the supposed medicinal qualities of the insects; in fact, his medical opinions break forth throughout his book whenever the plants and animals are thought to possess healing virtues. Dried, powdered silkworms “laid to the Crown of the Head, are good in Megrims, Vertigoes and Convulsions, and the Ashes of the Silk cleaneth Wounds, &c.” Powdered cicadas, which Brickell calls grasshoppers, “given with Pepper, help the Cholick.” Hog lice are “good in all Obstructions, Jaundice, Cholick, King’s Evil, old sordid and rebellious Uleers, Convulsions, Stone and Gravel, Rickets in Children, dimness of Sight,” etc. The eggs (probably pupæ) of ants “help deafness, and many other excellent virtues are attributed to them.” And so on throughout, indicating that Brickell was familiar with Pliny and later authors, repeating as he does their mistakes and quaint conceptions.

The following extracts are examples of Brickell’s method and style:

“The *Lady Bird* is a beautiful small Insect (with red Wings and black spots thereon) which the Children in *Ireland* frequently play with; it is to be met with in *Carolina* in the *Summer* time, and is a wonderful Cordial, curing all Fevers how poysonous or malignant soever, by its sudorifick quality. The Powder of its Body is of a deep Purple colour, and emits its Tincture into Water and Spirits of Wine, being not inferior to Saffron.”

“The *Moth* is there likewise, and differs in nothing from those in *Europe*, being as mischievous and destructive to Woollen Cloths and Books as those with us. An Oil made of them is said to cure Deafness, Warts, and the Leprosy, and being mixed with Tar, to be good in all sorts of rebellious Uleers, Botches, Scabs, Whittles, &c.”

“The *Weevil*, is a little small Worm, not much bigger than a *Mite*, and is very distructive to Trees, but more especially to Corn, for I have seen Barrels full of *Indian* Wheat or *Maiz* in-

tirely ruined by these Insects, when there has not proper care been taken, to prevent their doing mischief. They never meddle with any grain (exposed in the weather) but when it is put up in close places, such as barrels and the like, yet this may be easily remedied by shaking a little Salt at the bottom and top of those vessels the Corn is in."

"The *Chinch Wall-louse*, or *Buggs*; these are flat, red, and in shape and bigness like the *Sheep-louse*, they have an offensive smell when they are killed, they haunt Beds, suck Men's Blood very greedily, especially about the Neck and Face, which in many appeareth for a Day or two, as if stung with Nettles, and are as numerous in this Province as in *France* or *Spain*. *Pliny* saith, they are good against all Poysons and biting of *Serpents*. *Marcellus* saith, that the Powder of them cures all Fevers, their Scent, the Fits of the Mother, and that they are successful to force away the Birth, and After-birth."

"The *Cock-roch*, is a kind of *Beetle*, something larger than a *Cricket*, and of a dark brown Colour; they frequent the Houses, and are very mischievous among Books and Linnen, by eating innumerable Holes in them, if there be not care taken to sweep and keep those places clean where those things are laid up. When they are killed, they stink like *Buggs*; their Uses in Physick are uncertain."

Doctor Brickell's book was published in Dublin, 1723, and the subscribers according to the 1737 edition (8vo, xv + 408 pp.) numbered 211. The title page of this edition is as follows: The Natural / History / of / *North-Carolina*. / with an / Account / of the / Trade, Manners, and Customs of the / Christian and Indian Inhabitants. Il- / lustrated with *Copper-Plates*, whereon are / curiously Engraved the *Map* of the Country, / several strange *Beasts, Birds, Fishes, Snakes, / Insects, Trees, and Plants, &c. / By John Brickell, M.D. / Nostra nos in urbe peregrinamur* Cic. / Dublin / Printed by James Carson, in *Coghill's-Court, Dame- / street*, opposite to the *Castle-Market*. For the Author, / 1737.

Brickell's "Natural History" appeared eight years before volume one of Catesby's "Natural History of Carolina, Florida and the Bahama Islands" was published, but so far as the in-

sects, and probably the other animals also, are concerned it added little or nothing of scientific value to the then existing knowledge. However, its readability as a traveler's narrative and the interest at that time in America were more than likely responsible for the later editions of 1737, 1739 and 1743. Doctor Brickell was also the author of a folio entitled "Catalogue of American Trees and Shrubs, which will endure the climate of England," London, 1739.



KEY TO THE SPECIES OF ONCEROMETOPUS  
WITH DESCRIPTIONS OF FIVE NEW  
SPECIES (HEMIPTERA, MIRIDÆ)\*

BY HARRY H. KNIGHT  
AMES, IOWA

The species of *Oncerometopus* Reuter have in general a red and black aspect, and such material as has been collected in the southwestern United States has usually passed as *Oncerometopus nigriclavus* Reuter, the type of the genus. After collecting a species in the mountains of Colorado which was obviously different from *nigriclavus* Reut., and later receiving a nearly black species from Mr. A. A. Nichol collected at Kaibab Point, Arizona, I was led to make a study of all available material. The results are presented in the form of a key with descriptions of five new species.

The writer is indebted to Mr. W. L. McAtee for comparison of Texas specimens of *O. nigriclavus* Reut. with the type in Stockholm, and which he pronounced to be good homeotypes. Mr. McAtee also took notes on *O. ruber* Reut. which have proved useful. This latter species is apparently rather scarce in collections, for I have seen only a single specimen from Kansas which could be called *ruber* Reut. I also have a female paratype of the recently described *Oncerometopus californicus* Van D., which Mr. Van Duzee has kindly sent in exchange.

Only one species, *O. nitens* n. sp., has been taken east of the Mississippi river, and chiefly from Tennessee and Mississippi, with odd specimens from Alabama and North Carolina, while a single specimen has been taken at Glen Echo, Maryland. At first glance this species might be taken for a *Lopidea*, but the diverging arolia and pronotal characters place it in *Oncerometopus*.

\* Contribution from the Department of Zoology and Entomology, Iowa State College, Ames, Iowa.

Contrary to previous expectations the color pattern of the different species varies only slightly, as I have found after study of five species with a good series of each. Therefore, I have dared to simplify the key by the introduction of certain color characters, which taken alone would not be sufficient to define the species, yet prove highly useful for locating your specimens.

**Oncerometopus nicholi** new species.

A small black form with orange stripe each side on the dorsum; distinguished by the sharply angulate pronotal margin just above coxal cleft; antennal segment II shorter than the combined length of segments III and IV.

♂. Length 4.3 mm., width 1.6 mm. Head: width 1.03 mm., vertex .52 mm.; frons moderately full, tylus as viewed from the side only slightly arcuate, not at all prominent. Rostrum, length 1.86 mm., reaching to base of fourth ventral segment. Antennæ: segment I, length .41 mm.; II, 1.29 mm., thickness .13 mm., being equal to segment I; III, .815 mm., thickness .104 mm.; IV, .65 mm.; black. Pronotum: length 1.01 mm., width at base 1.58 mm.; lateral margins nearly rectilinear, angulately prominent just above coxal cleft; collar sharply narrowed behind the eye.

Black, stripe on outer half of corium, crossing base of clavus, lateral margins of pronotal disk and more or less on propleura, orange to orange red. Venter except genital segment, juga, lora, and spot on genæ, reddish. Dorsum clothed with rather prominent blackish pubescence.

♀. Length 5 mm., width 2.1 mm. Head: width 1.09 mm., vertex .59 mm. Antennæ: segment I, length .41 mm., thickness .12 mm.; II, 1.18 mm., thickness .118 mm., tapering to more slender at base; III, .77 mm.; IV, .62 mm. Pronotum: length 1.14 mm., width at base 1.74 mm. Very similar to the male in essential structures and coloration.

*Holotype*: ♂ August 25, 1926, Kaibab Point, Arizona (A. A. Nichol); author's collection. *Allotype*: same data as the type. *Paratypes*: ♂ ♀, taken with the types. ♂ Aug. 15, 1925, Dolores, Colorado (H. H. Knight). 2 ♂, Utah (Vasco M. Tanner). Named in honor of the collector, Mr. Andrew A. Nichol.

**Oncerometopus impictus** new species.

Allied to *nicholi* but distinguished by the different angulation of the pronotal margin; a beautiful red and black species in which the red is deeper and more broadly displayed than in *nicholi*.

♂. Length 5.3 mm., width 2.3 mm. Head: width 1.11 mm., vertex .53 mm.; frons and tylus nearly as in *nicholi*. Rostrum, length 1.95 mm., reaching upon third ventral segment. Antennæ: segment I, length .44 mm.; II,

1.45 mm., cylindrical, equal in thickness (.12 mm.) to segment I; III, .90 mm., thickness .104 mm.; IV, .69 mm.; black, clothed with short, fine, pale to dusky pubescence. Pronotum: length 1.12 mm., width at base 1.9 mm.; lateral margins of disk very slightly sinuate, not sharply angulate above top of coxal cleft; collar only slightly narrowed behind eye.

Black, broadly on lateral margins of pronotal disk, median ray behind calli, propleura except around coxal cleft, basal half of clavus, outer half of corium, embolium largely, and venter except lower half of genital segment, deep red with perhaps an orange tint. Pubescence yellowish to blackish but not so stiff or prominent as in *nicholi*.

♀. Length 5.8 mm., width 2.4 mm. Head: width 1.18 mm., vertex .61 mm. Antennæ: segment I, length .47 mm.; II, 1.3 mm., thickness .118 mm., tapering to more slender at base; III, .83 mm., about equal to greatest thickness of segment II; IV, .68 mm. Pronotum: length 1.24 mm., width at base 2.03 mm. Very similar to the male but usually a little more broadly red.

*Holotype*: ♂ August 20, 1925, Pingree Park, Colorado (H. H. Knight); author's collection. *Allotype*: same data as the type. *Paratypes*: 5 ♂ 3 ♀, June 20 and June 22, 1925, Pingree Park, Colorado (H. H. Knight); Mr. F. C. Hottes collected and kindly presented three or four of these specimens. COLORADO—5 ♀ Aug. 13, 1925, Mancos (H. H. Knight). 3 ♀ Aug. 26, 1926, North Park (B. B. Fulton). ♀ July 17, 1916, Duck Lake, alt. 11,000 ft., near Grant (L. O. Jackson). ♂ July 19, 1903, Sunset, alt. 8000 ft. (E. P. Van Duzee). ♂ ♀ "Colo." (C. F. Baker); U. S. N. M. ARIZONA—♀, Prescott (H. G. Barber). 3 ♀, "Ariz. 2123" (C. F. Baker); U. S. N. M. collection. WYOMING—♀ July, 1913, Rock River (H. G. Hungerford). ♀ Aug. 4, Yellowstone National Park.

***Oncerometopus atriscutis* new species.**

Suggestive of *nigriclavus* Reut., but with black scutellum and longer second antennal segment which in both sexes exceeds the combined length of segments III and IV.

♂. Length 5.4 mm., width 2.1 mm. Head: width 1.12 mm., vertex .55 mm.; black, lora showing some red beneath fuscous. Rostrum, length 2.3 mm., reaching upon third ventral segment. Antennæ: segment I, length .44 mm.; II, 1.77 mm., just equal to basal width of pronotum, equal to thickness of segment I, although tapering to slightly more slender near base; III, .80 mm.; IV, .59 mm.; black. Pronotum: length 1.18 mm., width at base 1.77 mm.; with a pair of punctures between calli but not impressed between outer margins of calli and anterior angles of disk as in *nigriclavus*.

Red, slightly shining, head, collar above and below, calli and usually extending back over disk and along basal margin, scutellum, clavus, narrow inner margin of corium, cuneus except narrowly on base, membrane, rostrum, sternum, legs, and lower half of genital segment, black. It is worthy of notice that while the head, pronotal disk largely, and scutellum, are black, the clavus never has more than the narrow inner margin black. Red areas with fine yellowish pubescence, elsewhere black.

♀. Length 5.9 mm., width 2.5 mm. Head: width 1.18 mm., vertex .62 mm. Antennæ: segment I, length .53 mm.; II, 1.83 mm., cylindrical, more slender than segment I; III, .89 mm.; IV, .59 mm. Pronotum: length 1.35 mm., width at base 2.07 mm. More robust than the male but very similar in coloration.

*Holotype*: ♂ June 1, 1926, Chiricahua Mts., alt. 6000 ft., Arizona (A. A. Nichol); author's collection. *Allotype*: same data as the type. *Paratypes*: 4 ♂ 4 ♀, taken with the types on *Cowania* sp. which Mr. Nichol records as the host plant. ARIZONA—♀ June 18, Ashfork (H. S. Barber). ♀, "Ariz." NEW MEXICO—15 ♂ ♀ July 7 to July 12, 1915, 10 ♂ ♀ Aug. 1 to Aug. 15, 1916, Jemez Springs (J. Woodgate). ♂ 2 ♀, Magdalena (Strickler). ♂ June 5, Faywood (W. J. Gerhard).

The present material as well as the host plant record would seem to indicate that this species occurs only in the mountainous parts of the southwestern states.

***Oncerometopus nitens* new species.**

Bright red, clavus and corium inside the radial vein black, strongly shining; distinguished by the long second antennal segment.

♂. Length 4.8 mm., width 2 mm. (larger specimens 5.6 mm.). Head: width .98 mm., vertex .49 mm.; frons less prominent than in *nigriclavus*. Rostrum, length 2.04 mm., reaching upon third ventral segment. Antennæ: segment I, length .36 mm.; II, 2.07 mm., thickness .133 mm., slightly exceeding thickness of segment I; III, .65 mm.; .71 mm. Pronotum: length 1.03 mm., width at base 1.54 mm.; lateral margins slightly sinuate, basal margin strongly rounded.

Bright red, distinctly shining, antennæ, tylus, base of vertex and more or less on frons, clavus, corium except exterior to the radial vein, cuneus except narrowly at fracture, membrane, femora except basal half of hind pair, and spot on sternum, black. Pubescence yellowish on the red areas, elsewhere black.

♀. Length 5.4 mm., width 2.1 mm. Head: width 1.03 mm., vertex .56 mm. Antennæ: segment I, length .38 mm.; II, 1.70 mm., more slender than segment I, tapering to more slender at base; III, .80 mm.; IV, broken.

Pronotum: length 1.11 mm., width at base 1.72 mm. Very similar to the male in coloration.

*Holotype*: ♂ July 7, 1921, Poplarville, Mississippi (C. J. Drake); author's collection. *Allotype*: same data as the type. *Paratypes*: ♂, taken with the types. ALABAMA—3 ♀ Oct. 24, 1916, Kushla (W. S. Adkins). GEORGIA—♂ July 16-29, 1912, Spring Creek, Decatur Co. (J. C. Bradley). MARYLAND—♀, summer 1922, Glen Echo (J. C. Bridwell). MISSISSIPPI—♂ ♀ July 30, 1921, Biloxi, ♂ July 25, Woodville; ♀ Aug. 8, 1921, Pascagouia (C. J. Drake). NORTH CAROLINA—♀ Sept. 24, 1915, Elrod (R. W. Leiby). ♂, early Oct., 1908, Raleigh (S. C. Clapp). ♀, June, 1909, Southern Pines (A. H. Manee). TENNESSEE—♂ ♀ Aug. 15, 1916, alt. 2000 ft., La Follette (W. S. Adkins).

***Oncerometopus nasutus* new species.**

Suggestive of *nigriclavus* Reut., but distinguished by the strongly angulate tylus, longer second antennal segment, with first two segments largely yellowish to brown.

♂. Length 5.8 mm., width 2.1 mm. Head: width 1.06 mm., vertex .56 mm.; tylus angulately prominent on base. Rostrum, length 2.04 mm., scarcely attaining posterior margins of hind coxæ. Antennæ: segment I, length .52 mm., yellowish brown, darker at tip and near base; II, 2.28 mm., cylindrical, equal in thickness (.148 mm.) to segment I, yellowish brown, a blackish annulus at base; III, .83 mm.; IV, broken. Pronotum: length 1.21 mm., width at base 1.98 mm.; lateral margins distinctly sinuate, anterior angles above top of coxal cleft scarcely evident.

Color light orange red, lower half of head lighter, antennæ largely yellowish to brownish, apical half of rostrum, clavus, narrow inner margin of clavus, tip of cuneus, membrane, apical one-fourth of hind femora, tibiæ and tarsi, black. Pubescence yellowish, surface dull as in *nigriclavus*.

♀. Length 5.9 mm., width 2.5 mm. Head: width 1.09 mm., vertex .62 mm. Antennæ: segment I, length .47 mm.; II, 1.9 mm., more slender than segment I; III, .86 mm.; IV, .59 mm.; black, apical half of segment II brownish. Pronotum: length 1.24 mm., width at base 2.1 mm. Very similar to the male in coloration.

*Holotype*: ♂ Aug. 26, 1925, Sterling, Colorado (H. H. Knight); author's collection. *Allotype*: same data as the type. *Paratype*: ♂ Aug. 25, Hudson, Colorado (H. H. Knight); this specimen rather small (length 4.3 mm.) but otherwise very similar to the male type.

## KEY TO THE SPECIES OF ONCEROMETOPUS

- |  |                           |
|--|---------------------------|
| 1. Scutellum red .....   | 2                         |
| Scutellum black .....  | 6                         |
| 2. Clavus black .....  | 3                         |
| Clavus reddish, tibiæ largely pale .....   | <i>ruber</i> Reut.        |
| 3. Tylus angulately prominent on base, equally prominent as the frons;<br>antennal segments I and II largely yellowish.....  | <i>nasutus</i> n. sp.     |
| Tylus not angulately prominent at base, frons more prominent than<br>tylus .....   | 4                         |
| 4. Antennal segment II of male long, exceeding basal width of pronotum,<br>in the female slightly less; corium black, red exterior to radial vein<br>only; dorsum distinctly shining .....   | <i>nitens</i> n. sp.      |
| Antennal segment II shorter, in male about equal to basal width of pro-<br>notum; corium red, or black on inner half only .....  | 5                         |
| 5. Shining; inner half of corium black .....   | <i>californicus</i> V. D. |
| Dull, opaque; corium with narrow inner margin only black.....  | <i>nigriclavus</i> Reut.  |
| 6. Antennal segment II longer than the combined length of segments III<br>and IV .....   | <i>atriscutis</i> n. sp.  |
| Antennal segment II shorter than the combined length of segments III<br>and IV .....   | 7                         |
| 7. Pronotal margin sharply angulate just above top of coxal cleft; collar<br>sharply narrowed behind eye; black, corium with a rather narrow<br>orange colored stripe running lengthwise through outer half and ex-<br>tending along lateral margins of pronotum ..... | <i>nicholi</i> n. sp.     |
| Pronotal margin not sharply angulate above top of coxal cleft; collar<br>only slightly narrowed behind eye; corium bright red, inner angle only<br>black, pronotum broadly red, black behind calli but median line usually<br>showing red .....                        | <i>impictus</i> n. sp.    |

## PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF NOVEMBER 1, 1927

A regular meeting of the New York Entomological Society was held at 8 P. M., on November 1, 1927, in the American Museum of Natural History, with fourteen members and four visitors present.

Mr. Chapin described the entomological episodes of the week of August 7-4, spent in western Connecticut where low mountains, 1,000-1,640 feet elevation, with abandoned farms, spruce bogs, and hardwood forests made interesting collecting. It was in part the region in which Mr. Woodruff collected and includes the Halsted Mountain Forest Reserve. *Cicindela harrisi*, and the albino form of *Colias* were among the specimens shown, besides a number of unidentified insects from the spruce bogs and the pitcher plants which grow there.

Mr. Leng spoke of his "Sixteen Years' Secretarial Service," distributing copies of the history of the society printed in 1918 and continuing the records of attendance, etc., to date. He placed on record the services of Miss Helen M. Martin and Miss Agnes L. Pollard in typewriting these minutes during these sixteen years; and, after commenting on the lack of mention of such taxonomists as Casey, Fall, and Rehn & Hebard in Imms' "Text Book of Entomology," pointed out that the foundation of the science rests primarily on the collector of insects, and those who name the insects thus caught. The encouragement, by field meetings, social gatherings, perhaps even by prizes for beginners, should therefore not be entirely neglected.

Messrs. Lemmer, Engelhardt, Mutchler, Angell, Nicolay, and Dr. Lutz took part in discussion of the Society's Local Collection intended for such encouragement for beginners. A vote of appreciation of Mr. Leng's work as secretary was passed.

Mr. Engelhardt spoke of Dr. Schwarz's feeble condition as his 84th birthday approached, but said he still spends half a day at the museum and is mentally active though unfortunately his speech is impaired. He spoke also of Dr. Howard's retirement and of the excellent care of Col. Casey's collection under Mr. Buchanan's labors.

Mr. Angell spoke of the sale of the Wenzel collection to the Ohio State University.

Mr. Davis recorded *Colias eurytheme* at St. George, Staten Island, October 22, as an additional evidence of its abundance in 1927.

MEETING OF NOVEMBER 15, 1927

A regular meeting of the New York Entomological Society was held at the American Museum of Natural History, on November 15, 1927, at 8 P. M.,

with President Henry Bird in the chair and twenty-four members and six visitors present. Mr. E. L. Bell was elected Secretary *pro tempore*.

Mr. Barber reported that at a meeting of the executive committee the question of a donation from the Society for the purpose of entertaining guests during the meeting of the International Congress had been discussed, but that no decision had been reached.

Mr. Ezekiel Rivnay, 2050 Harrison Avenue, Bronx, N. Y., was elected to membership.

Mr. Davis reported the death of Archibald Weeks, on Sunday, November 13th.

Mr. Sheridan, on behalf of the New York Microscopical Society, extended an invitation to the members of the Society, to attend the exhibition at the American Museum of Natural History on November 19, in commemoration of their 50th Anniversary.

Dr. L. O. Howard spoke of efforts to raise a fund for the entertainment of our foreign visitors during the meeting of the International Congress; that \$10,000 was expected from the Carnegie Peace Society and that they hoped to get donations from other Societies; that some visitors would come from England, Dr. Horn would come from Germany, but very few others from the Continent as they did not have the money to spare for this purpose; a total of forty European visitors would be doing very well; tentative plans for their entertainment included a trip to Niagara Falls, and possibly to Washington.

Mr. Barber, under the title "Collecting Hemiptera at Indian Lake," gave a brief description of the lake and the surrounding terrain. He described his method of collecting on an exposed hill-side by searching amidst the dead leaves and sparse vegetation, frequently pulling up and shaking over his sifting cloth clumps of grass, moss and various weeds. In this method of collecting the ground-frequenting Lygaeidae were the most numerous. Many were still in the nymphal form and of considerable interest was the fact that the brachypterous forms predominated over macropterous forms. During August of 1921 and the same month this year he took altogether twenty species of Lygaeidae, seven of which were also palaeartic. In order to throw some light on the relative abundance of certain species he placed on the blackboard in parallel columns several lists representing the result of Lygaeidae collecting in the north—Drake and Van Duzee, the east—Smith's List of New Jersey—the west, Gillette's Colorado List and the south—his own Florida List. He further brought out the fact that several families of Heteroptera were either absent entirely in northern New York or were represented by very few species. On August 16 he collected the Hemiptera on a measured area 3 x 12 for three hours and reported the capture of 106 specimens representing twenty-two species. Other forms of life were not recorded. He exhibited the specimens collected, some 1,400 in number.

His remarks were briefly discussed by the members, Dr. Howard saying that particularly interesting results were shown by Mr. Barber's exhibition



of specimens collected in a small, restricted area, and stressed the importance of intensive collecting over small areas, as little was known of the enormous numbers of small insects which are continually at their work of destruction.

Under the title "Notes on Collecting in Virginia" Mr. W. T. Davis gave an account of his visit, in August, 1927, to the home of Col. Wirt Robinson, near the James River, in Nelson Co., Virginia, mentioning a number of the interesting animals and plants that he had seen, especially those associated with the insects exhibited to the Society. Some of the observations will appear as short notes in the JOURNAL. He showed a *Papilio turnus*, 110 millimeters in expanse of wings and an *Argynnis cybele* of 92 millimeters, stating that some of the butterflies grow to a much larger size in Virginia than they do in New York, and that the black females of *turnus* considerably outnumber the yellow ones. He showed an aberration of *Junonia cænia*, and stated that he and Col. Robinson had seen a house wren capture one of these butterflies on August 13. In early morning he had found the clear-wing moth *He maris diffinis* on a chip of wood beneath a bush, where it had no doubt spent the night, and the sphinx moth *Ampelophaga myron* among some dead leaves on a tree, where it had prepared to spend the day. Nine examples of *Catocala epione* were found on August 19 flat on the ground of a tree-shaded dirt road, some in the ruts and uneven places. Along this same road, as well as on other roads, many large horse-flies were seen sucking in the damp places. Those collected or examined with a glass, were *Tabanus sulcifrons* and *Tabanus atrata*, and the observation of Col. Robinson, that as in *Papilio* and *Colias* among butterflies, only males suck mud, seemed to be fully borne out. A considerable enemy of *Papilio* butterflies, is the dragonfly *Dromogomphus spinosus*, and one was shown with the *asterias* that it had captured. *Hagenius brevistylus* was also shown as one of the enemies of *Papilio*. Among the beetles exhibited there was a *Pasimachus depressus* that had been observed for a considerable time scratching about on the ground among dead leaves in the hot sun; a number of *Leptotrachelus dorsalis* that had been found hidden between the stem and leaves of the grass *Panicum stipitatum*; several *Ludius attenuatus*, a specimen of which was captured by Col. Robinson while it was flying in good form with one of its elytra missing; many *Buprestis rufipes* that had been taken on the trunks of dead beech trees, and a *Leptura emarginata* that was captured as it flew across an opening in the woods. *Vespa carolina* wasps were stated to have been chiefly responsible for cleaning the skeletons of two rattlesnakes and a corn snake, and a *Vespa maculata* was seen to catch several of these wasps and then let them go. The *maculata* had probably mistaken them for flies, although one *Vespa* will sometimes catch and devour another wasp.

Several additions have been made to the published list of the *Orthoptera* taken about Wingina, that now numbers eighty-nine species. *Cicadas* were very scarce and *Tibicen chloromera* was the only species taken, a great contrast to the year 1921 when six species were in great abundance. Mr. Davis stated that not only do particular species of our large black and green

*Cicadas* appear occasionally in great numbers, but even more interesting is the fact that several species are likely to thus appear in the same locality the same summer, thereby producing a *Cicada* year. There are evident advantages to any species with a life cycle of more than one year, to appear as adults at the same time, thus increasing the chance of meeting others of their kind.

Mr. Davis' paper was discussed by the members.

#### MEETING OF DECEMBER 6, 1927

A regular meeting of the New York Entomological Society was held at 8 P. M., on December 6, 1927, in the American Museum of Natural History, President Henry Bird in the chair, with twenty members and seven visitors present.

The Program Committee reported Dr. Bertha Chapman Cady as the speaker for December 20.

On motion by Mr. Mutchler, subscription to *Insecta* part of *Zoological Record* was ordered.

Mr. Stanley W. Bromley, *c/o* American Cyanamid Sales Co., 535 Fifth Ave., N. Y. City, was elected a member.

Miss Irene D. Dobroschky was reinstated as a member.

Messrs. Angell, Mutchler, and Davis spoke of the forthcoming List of N. Y. State Insects.

Mr. Mutchler spoke also of the Florida List which Dr. Leonard had undertaken, and the president referred also to publications by the Academy of Sciences on Porto Rico lists, several of our members being at work on the Entomological volumes.

Mr. Nicolay made an interesting address on "Beetling at Mt. Mitchell, North Carolina," describing the automobile road to the summit, the rainy weather he and Mr. Quirsfeld had encountered, and the meager accommodations found at the inn. This mountain is about 6,700 feet in height and was, until commercially cleared, covered with rhododendron, azalea, and coniferous trees, especially above 4,000 feet. It still affords good collecting. Some of the species obtained were the Cychrini, *Stenostomus canadensis*, *Maronetus hubbardi*, *Scaphinotus aeneicollis*, *S. irregularis*, the Carabids, *Platynus gracilentus*, *Trechus hydropticus*, the longhorn *Anthophilax hoffmani*, all originally found by Beutenmuller, and several interesting Rhynchophora, *Paraplinthus shermani*, *Hypomolyx picens*, and *Trichalophus foveirostris*.

Mr. Nicolay prefaced his remarks by a reference to the lamented death of Frank R. Mason, his companion on many previous expeditions, who died May 30, 1927, aged 45, as a result of a clot on the brain.

Miss Dobroschky spoke, under the title of "Entomological Notes from Europe," of three months spent in England, France, Germany, Austria, and Hungary, visiting museums and entomologists and including attendance at the Tenth International Zoological Congress at Budapest. Dr. Howard, by a happy accident, was her traveling companion both ways on the ocean; and

among the entomologists encountered were Imms, Davidson, Edith Patch, Story, Austin, Elsner, Maidel, Horvath, Thompson, Ellinger, Swaine, Horn, Marsh, Schulder, Mell, Komarik, Silandi, Harnisch, Martini, Schulz, Emerson, Prell, and others.

Dr. Felt spoke of the 400 odd species found last summer on the roof of the Education Building in Albany, especially of those which were not included in the New York State List.

#### MEETING OF DECEMBER 20, 1927

A regular meeting of the New York Entomological Society was held at 8 P. M., on December 20, in the American Museum of Natural History, President Henry Bird in the chair, with nineteen members and nine visitors present.

The Librarian reported accessions.

The Program Committee reported Dr. Leonard as the speaker at the next meeting.

Mr. Edgar Nelson, 56 West 70th St., New York City, and Mr. C. H. Ballou, Japanese Beetle Laboratory, Moorestown, N. J., were elected members.

Dr. Lutz reported attendance at the Ottawa meeting of the Entomological Society of Ontario, commenting on the fine *esprit du corps* which existed in Canada and giving some details of the establishment of the Entomological Department in the Provincial Museum at Victoria.

Mr. Davis, having completed twenty-four years' service as treasurer of the Society, expressed a desire to be excused from further service.

The president appointed as a Nominating Committee Messrs. Barber, Mutchler and Watson. In doing so he thanked the officers and committee for their efficient service during the past year, and commented with satisfaction upon the excellent showing the Society's members made in the fourth edition of "American Men of Science."

Dr. Cady read a paper on "A Study of the Supposed Toxic Properties of Insect-Infested Cereal Food Products." After stating the popular belief that such infested products were unfit for food, even for cattle, and the consequent annual destruction of about 3 per cent. of the stored product, amounting to an economic loss of \$200,000,000 yearly, she proceeded to show that every recorded test contradicted the popular belief. She then gave the results of her own carefully conducted experiments in which 153 animals, albino rats, guinea-pigs, and Himalayan rabbits were fed, some for 227 days, on different infested cereals. The animals were divided into test and control groups, the latter being fed on clean cereals, and no injury whatever to either young or mature could be discovered. The conclusion was that, while the unpleasant odor of insect-infested cereals makes them unpalatable to human beings, they acquire no toxic properties and are entirely suitable for cattle food.

The paper was discussed by several members. Mr. Davis testified to the bitter taste of heavily infested oatmeal, the unpleasant odor of *Calandra* larvæ, and suggested that different species would give different results. One might eat *Calandra* without damage, but a heavy dose of Dermestids might lay us out.

Mr. Sim and Mr. Ballou gave some account of the new Japanese Beetle Laboratory on a thirteen-acre farm near Moorestown, N. J., where buildings 70 ft. long, greenhouses, etc., are devoted to research work by the cooperation of the Bureau of Entomology with the Agricultural Departments of New Jersey and Pennsylvania. Mr. Sim told of his experiments with *Onthophagus cribricollis* indicating an unexpectedly short larval period.

Mr. Angell spoke of a letter received in regard to American subscriptions to the expenses of European entomologists visiting us next year; also of the distribution of *Dorcus nanus* not including New York State.

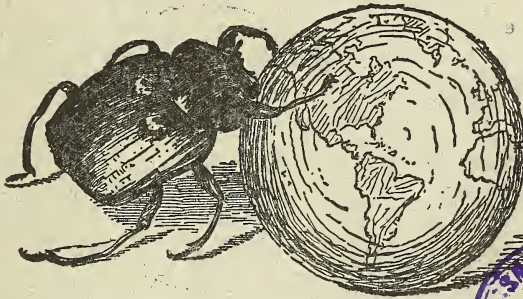
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SEPTEMBER, 1928

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**OF THE**  
**NEW YORK**  
**ENTOMOLOGICAL SOCIETY**

*Devoted to Entomology in General*



**SEPTEMBER, 1928**

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*Publication Committee*

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# JOURNAL

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## New York Entomological Society

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### MEMBRACIDÆ OF SOUTH AMERICA AND ANTILLES, III. SUBFAMILY MEMBRACINÆ

By FREDERIC W. GODING

*Tribe Membracini*

Genus **MEMBRACIS**

Fabricius, *Systema Entomologiæ*, p. 675; *Cryptonotum*, Buckton, Monograph Membracidæ, p. 43.

#### KEY TO SPECIES

- 1 (20). Apex pronotum distinctly extended beyond apical angle of tegmina; pronotum highly compresso-elevated, dorsum rounded behind middle to depressed apex, vertical front margin foliaceously produced beyond head.

#### Division A

- 2 (13). Front margin of pronotum strongly produced downward below basal margin in a rounded lobe.
- 3 (10). Posterior pronotal process with a white or yellow or red subapical band which may include apex.
- 4 (9). Pronotum black with white or yellow or red stripes or bands.
- 5 (6). Dorsum with a transverse white band extended to and along lateral margins to subapical band, anterior half of pronotum immaculate black .....*fairmairi*
- 6 (5). Dorsum destitute of a transverse white band.
- 7 (8). Median carina of pronotum regularly convex, a very broad arcuate lateral yellow stripe each side not extended to front margin, passing from lateral margins anteriorly to curve above humerals and occupying lateral margins to subapical band.....*arcuata*
- 8 (7). Median carina of pronotum sinuate-convex, a lateral white stripe extended from lateral margins anteriorly over humerals to

- middle of posterior process distant from lateral margins and reddish subapical band .....*buctoni*
- 9 ( 4). Pronotum yellow with a broad transverse band extended from humeral over dorsum to humeral, and a large triangular spot before apex, black .....*maculata*
- 10 ( 3). Posterior pronotal process destitute of a subapical band.
- 11 (12). Pronotum black with 3 vertical yellow bands each side not extended to dorsum, the front band touching lateral margins, the others distant from lateral margins sometimes united below by a short curved stripe .....*foliata*
- 12 (11). Pronotum black excepting a very broad white stripe occupying vertical front margin .....*albolimbata*
- 13 ( 2). Front margin of pronotum not or barely extended below basal margin; pronotum black with white or yellow markings.
- 14 (17). Posterior pronotal process with a transverse white or yellow subapical band which sometimes includes apex.
- 15 (16). Pronotum with a yellow stripe each side, narrow at front margin, broader along lateral margins to subapical band and connected by a short transverse dorsal band; humerals black.....*trimaculata*
- 16 (15). Sides of pronotum with an oblique nearly straight yellow stripe from summit of metopidium to middle of and along lateral margins to subapical band, including apex.....*zonata*
- 17 (14). Posterior pronotal process destitute of a subapical band.
- 18 (19). Pronotum immaculate fuscous .....*fusca*
- 19 (18). Sides of pronotum with a large vertical oblong spot at middle distant from dorsal and lateral margins, a smaller round spot on lateral margins posteriorly, white.....*carinata*
- 20 ( 1). Pronotum compresso-elevated, highest in front of middle, straight or lightly sinuate and gradually acuminate behind middle to apex which is not or slightly extended beyond apical angle of tegmina.

## Division B

- 21 (30). Foliaceous compressed part of pronotum prominent anteriorly, obtusely rounded and produced below basal margin; pronotum black, posterior process with a white or yellow or red subapical band which sometimes includes apex.
- 22 (27). Middle of dorsum destitute of a transverse white or yellow band.
- 23 (24). Front margin of pronotum concolorous, destitute of a white stripe .....*nigrifolia*
- 24 (23). Front margin of pronotum more or less white or yellow.
- 25 (26). Sides of pronotum destitute of spots or stripes, front margin roundly prominent and very broadly white.....*elevata*
- 26 (25). Sides of pronotum with a white spot at middle.....*lefebvrei*
- 27 (22). Dorsum with a white or yellow transverse band.



- 28 (29). Dorsal band orange yellow, very broad, occupying anterior half of pronotum excepting a cordate spot at summit of metopidium, humerals, and posterior half interrupted by subapical band, black; front and dorsal margins sinuate.....*cingulata*
- 29 (28). Dorsal band sordid white, extended nearly to lateral margins; front margin truncate with a moderately broad whitish stripe from base nearly to summit of metopodium; tarsi black .....*trifasciata*
- 30 (21). Foliaceous part of pronotum not extended below basal margin.
- 31 (44). Foliaceous part of pronotum slightly produced in front of head; posterior process with a white or yellow or red subapical band which sometimes includes apex.
- 32 (41). Pronotum black with white or yellow or red markings.
- 33 (36). Dorsum with a white or yellow or red spot or transverse band.
- 34 (35). Sides of pronotum with a very broad stripe each side extended from above head, curved above humerals, then united by a median transverse band, rose red .....*rosea*
- 35 (34). Sides of pronotum destitute of a stripe, with a small spot at base of median carina, a small dorsal spot, and subapical band, yellow; dorsum not highly elevated .....*peruviana*
- 36 (33). Dorsum destitute of a white or yellow or red spot or band.
- 37 (38). Front of pronotum concolorous black, destitute of spot or stripe .....*compressa*
- 38 (37). Front of pronotum more or less white.
- 39 (40). Sides of pronotum with a white stripe extended from front margin to middle of posterior process, continuous on front margin nearly to apex of metopidium .....*confusa*
- 40 (39). Sides of pronotum destitute of white stripes or spots; pronotum black excepting a stripe on front margin and subapical band white .....*tectigera*
- 41 (32). Pronotum white or yellow or reddish brown, not black.
- 42 (43). Pronotum yellow or reddish yellow with numerous brown or black spots which sometimes coalesce to form irregular stripes or bands .....*mexicana*
- 43 (42). Pronotum white with small spots or a stripe on front margin, lateral margins interrupted by humerals, and a dorsal spot, black .....*dorsata*
- 44 (31). Front margin of pronotum flat, not advanced or foliaceous at base above head; posterior process with subapical band or spot.
- 45 (48). Pronotum black or ferruginous, dorsum with a yellow or clear spot.
- 46 (47). Dorsal and apical spots small, clear; anterior half of pronotum brown, posterior half ferruginous, apex black; tegmina blackish brown with a large hyaline spot at interior angle.....*ambigua*

- 47 (46). Dorsal spot yellow, occupying posterior half of pronotum, apex black; anterior half black with a small horizontal white band above but not touching head .....*tricolor*
- 48 (45). Pronotum steel gray, shade variable, with darker punctures, a stripe broad at base gradually acuminate to summit of metopidium, and subapical band (sometimes interrupted), white; tegmina concolorous, base piceous; seen from side pronotum conical, summit well advanced above head, front margin straight forming an acute angle with dorsal carina, then straight, very slightly sinuate just before broad apex; body and head piceous, tarsi paler; front and middle tibiæ dilated, posterior margin of hind tibiæ distinctly serrated or dentate; long. cum teg. 6, lat. 2, alt. 3 mm. ....*serratipes* n. sp.

## LIST OF SPECIES

- fairmairi** Godg., nom nov; *flaveola* Fairm. Rev. Memb. p. 245, pl. 4, f. 21; *foliata* Fairm. l. c., p. 245. Cayenne, D. Guiana.
- arcuata** Deg. Mem. Ins. iii, p. 206; *peripharia* Fairm. l. c., p. 245, pl. 4, f. 15; *subtecta* Buckt. Mon. Memb., p. 42, pl. 3, f. 7. Cayenne, D. Guiana; Kartabo, B. Guiana; Para, Amazons, Braz.
- buctoni** Funkh. n. n., Ent. News, xxxii, p. 151; *militaris* Buckt. l. c., p. 43, pl. 3, f. 8; sanguineoplaga Schm. Stet. Ent. Zeit. lxxvii, p. 360; *completa* Schm. l. c., p. 361; *nigricauda* Schm. l. c., p. 361. Sao Paulo, Santarem, Amazona, Braz; Iquitos, Peru.
- maculata** Stoll, Cig., p. 17, pl. 1, f. 2; *foliata* Fabr. Mant. Ins. ii, p. 262; *flaveola* Germ. Rev. Ent. Silb. iii, p. 224; Buckt. l. c., pl. 1, f. 4, and pl. 2, f. 2; *foliata* Schel. Ov. Tidj. Ent. xii, pl. 9; *expansa* Walk. List, p. 475; *celsa* Walk. l. c., p. 475; *surgens* Walk. l. c., p. 475; *jessica* Godg. Bol. Med. Cir. Ecuad. xviii, p. 37, f. 1. Surinam, D. Guiana; Venez; Canelos, Lliquino, Yaruquies, Ecuad.
- foliata** Linn. Syst. Nat. (12), i, p. 705; *fasciata* Deg. l. c., p. 205, pl. 8, f. 9; *lunata* Fabr. Mant. Ins. ii, p. 262; Schel. l. c., pl. 9; Buckt. l. c., pl. 2, f. 3; *albomaculata* Stoll, l. c., p. 33, pl. 5, f. 24; *c-album* Fairm. l. c., p. 224; Fowl. Biol. C. A. Hom. ii, pl. 1, f. 1; Buckt. l. c., pl. 2, f. 1; *mimica* Walk. List Suppl., p. 123; *flexa* Walk. Ins. Saund. Hom., p. 58. Surinam, Cayenne, D. Guiana; Kartabo, B. Guiana; Colomb.; Braz.; Venez.; Canelos, Lliquino, Yarnquies, Ecuad.; Mex.; C. Am.
- albolimbata** Fowl. l. c., p. 5, pl. 1, f. 2. C. Am.; ?Narangapata, Ecuad.
- trimaculata** Fairm. l. c., p. 245, pl. 4, f. 14; *nebulosa* Buckt. l. c., p. 36, pl. 2, f. 8. Colomb.; Baños, Ecuad.; C. Am.; San Estaban, Venez.
- zonata** Fairm. l. c., p. 248, pl. 4, f. 16; *continua* Walk. List Suppl. p. 123; Buckt. l. c., pl. 2, f. 4; *fusifera* Walk. Ins. Saund. Hom., p. 58; *curvilinea* Walk. l. c., p. 58. Para, Teffe, Ega, Braz.; Normandie, Oriente, Ecuad.

- fusca* Deg. l. c., p. 208, pl. 32, f. 14; *Buckt.* l. c., pl. 1, f. 5; *atrata* Fabr. Syst. Rh., p. 8. Cayenne, D. Guiana; C. Am.
- carinata* Fabr. Syst. Rh. p. 8; *Fairm.* l. c., pl. 4, f. 20. Cayenne, D. Guiana; Kartabo, B. Guiana.
- nigrifolia* Stoll, l. c., p. 68, pl. 27, f. 92; *tectigera* *Buckt.* l. c., p. 39, pl. 3, f. 3. Surinam, D. Guiana; New Amsterdam, B. Guiana; LaPlata, Argent.; Braz.; Venez.; El Oriente, Ecuad.
- elevata* Fabr. Syst. Rh. p. 8; *fuscata* Fabr. l. c., p. 9; *alta* Walk. List. p. 476; *Buckt.* l. c., pl. 3, f. 4. Chimbo, Venez.; Baños, Ecuad; Braz.
- lefebvrei* *Fairm.* l. c., p. 246; *Fowl.* l. c., pl. 1, f. 3; *Buckt.* l. c., pl. 4, f. 2; *divisa* Walk. List Suppl., p. 123; *confinis* *Buckt.* l. c., p. 41, pl. 3, f. 5. Cayenne, D. Guiana; New Amsterdam, B. Guiana; Amazona, Braz.; Canelos, Napo R., Ecuad.; Mex.
- cingulata* Germ. l. c., p. 307; *cucullata* A. & S. Hem. p. 534, pl. 9, f. 2; *fasciata* *Buckt.* l. c., p. 38, pl. 3, f. 2. Minas, Braz.; Napo R., Ecuad.
- trifasciata* Stal. Bid. Memb. Kan. p. 269. Bogota, Colomb; Chosica, Peru; Kartabo, B. Guiana; Tena, Ecuad.; Mex.
- rosea* *Fairm.* l. c., p. 246, pl. 4, f. 24. Minas, Braz; Napo R., Tena, Baños, Ecuad.
- peruviana* *Fairm.* l. c., p. 249, pl. 4, f. 26; *intermedia* *Fairm.* l. c., p. 249; *trisignata* Stal, l. c., p. 269; *humilis* *Fowl.* l. c., p. 6, pl. 1, f. 6; *aurora* Funkh. J. N. Y. E. Soc. xxvii, p. 267. Chile; Chosica, Porto Chicama, near Pascamayo, Peru; Bogota, Colomb.; Kartabo, B. Guiana; Braz.; Tena, Baños, Ecuad.; Mex.; Corozal, Caracas, Venez.
- compressa* Fabr. Syst. Rh. p. 9. Baños, Ecuad.
- confusa* *Fairm.* l. c., p. 247, pl. 4, f. 23; *malleonotata* *Fairm.* l. c., p. 247; *juncta* Walk. Ins. Saund. Hom., p. 59; *exigua* *Buckt.* l. c., p. 42, pl. 4, f. 1. Para, Rio J., Braz.; Bogota, Colomb.
- tectigera* Stoll, l. c., p. 58, pl. 14, f. 71; *provittata* *Buckt.* l. c., p. 42, pl. 3, f. 6. Surinam, D. Guiana; Tena, Baños, Napo R., Ecuad.; San Esteban, Venez.
- mexicana* Guer. Ic. Reg. An. iii, p. 364, pl. 59, f. 1; *Fowl.* l. c., pl. 1, ff. 4-5; *Buckt.* l. c., pl. 2, f. 5 and 6; *stolida* *Fairm.* l. c., p. 248; *sexmaculata* Walk. Ins. Saund. Hom., p. 59; *suffusa* *Buckt.* l. c., p. 38, pl. 3, f. 1; *bipars* Schm. Ent. Mit. xiii, p. 290; *divergens* Schm. l. c., p. 291. U. S. A.; Mex.; C. Am.; Pan.; Colomb.; Narangapata, Machala, Yaguachi, Loja, Ecuad.
- dorsata* Fabr. Syst. Rh. p. 11; *ephippiata* Stal, Hem. Fabr. ii, p. 42; *arcuata* *Fairm.* l. c., p. 247, pl. 4, f. 25; *Buckt.* l. c., pl. 2, f. 7; *vergens* *Buckt.* T. L. S. Lond. ix, p. 330, pl. 21, f. 2. St. Catharina, Sao Paulo, Braz.; Napo R., Normandie, Baños, Ecuad.
- ambigua* *Fairm.* l. c., p. 249. Cayenne, D. Guiana.
- tricolor* *Fairm.* l. c., p. 249. Colomb.; Braz.
- serratipes* Godg. (in this revision). Huigra, Ecuad. (Williams).

Genus **ENCHOPHYLLUM**

Amyot and Serville, Hemipteres, p. 534.

Subgenus *Enchophyllum*Stal, Hemip. Fabr. ii, p. 38; *Tropidocera* Stal, l. c., p. 38.

## KEY TO SPECIES

- 1 (18). Front of pronotum white or yellow or red; pronotum with or without spots or stripes of similar colors.
- 2 ( 3). Pronotum white, front horn, subapical band, posterior apex and body, black .....*biplagum*
- 3 ( 2). Pronotum black or blackish, with white or yellow or red spots or stripes.
- 4 ( 7). Dorsum of pronotum with a transverse band which joins a stripe each side extended anteriorly to base and curved above humerals, and a large subapical band, yellow or red.
- 5 ( 6). Summit of metopidium produced in a long porrect horn; pronotal bands red, dorsal band erect in front of middle.....*cruentatum*
- 6 ( 5). Summit of metopidium produced in an obtuse angle; pronotal bands yellow, dorsal band oblique passing behind middle.....*nigroluteum*
- 7 ( 4). Dorsum or pronotum destitute of a transverse red or yellow band near middle and lateral fasciae.
- 8 (17). Dorsum with a white or yellow spot at middle.
- 9 (12). Humerals covered with a large yellow or red spot.
- 10 (11). Dorsum with a median and subapical yellow or white spot.....*quinquemaculatum*
- 11 (10). Dorsum reddish yellow or orange yellow from base of posterior process to apex .....*rileyi*
- 12 ( 9). Humerals concolorous, destitute of yellow or red spot.
- 13 (14). Front of pronotum almost totally white, yellow or red, with a median dorsal spot and subapical band concolorous with front; front horn long, nearly straight .....*fulicum*
- 14 (13). Front of pronotum with a narrow vertical stripe or small spot, dorsal spot and subapical band or spot white, yellow or red.
- 15 (16). Front horn short, conical .....*nigrocupreum*
- 16 (15). Front of pronotum produced superiorly in a rounded angle, destitute of a horn .....*imbelle*
- 17 ( 8). Dorsum of pronotum destitute of a median white or yellow spot; with a yellow subapical band, and three yellowish or red spots or a median stripe on front .....*ensatum*
- 18 ( 1). Front of pronotum concolorous black; dorsal spots sometimes coalesce, yellowish.
- 19 (20). Front horn short, conical .....*malaleucum*
- 20 (19). Front horn long, subarcuate .....*dubium*

## LIST OF SPECIES

- biplagum** Walk. Ins. Saund. Hom. p. 60; *albidum* Fowl. Biol. C. A. Hom. ii, p. 7, pl. 1, f. 8. Colomb.; C. Am.
- cruentatum** Germ. Rev. Ent. Silb. iii, p. 266; Am. & Serv. Hem. pl. 9, f. 3; Buckt. Mon. Memb., pl. 4, f. 5; *proboscidea* Burm. Zool. Handb. Atlas, p. 138, pl. 31, f. 26. Rio J., Braz.; La Plata, Argent.; Mex. Pl. 8, Fig. 1.
- nigroluteum** Funkh. J. N. Y. E. Soc. xxxv, p. 159, pl. 17, f. 1. Diamantina, Mimas, Geraes, Braz.
- quinquemaculatum** Fairm. Rev. Memb. p. 250, pl. 4, f. 27; *maculatum* Buckt. l. e., p. 45, pl. 4, f. 7. Rio J., Braz.
- rileyi** Godg. Can. Ent. xxv, p. 56; *auropecta* Buckt. l. e., p. 50, pl. 6, f. 3. St. Vincent, W. I.
- fulicum** Germ. Rev. Ent. Silb. iii, p. 225; Fairm. l. e., pl. 4, f. 28; *decoratum* Erich. Schomb. Reis. p. 615; *simulans* Stal, Hem. Rio J. ii, p. 23. Rio J., Braz.; Guiana.
- nigrocupreum** Walk. l. e., p. 60; *trimaculatum* Stal, Stet. Ent. Zeit. xxv, p. 68; *tripustulatum* Stal, Bid. Memb. Kan., p. 270. Rio J., St. Catharina, Braz.; Mex.
- imbelle** Stal, l. e., p. 271. St. Catharina, Braz.
- ensatum** Fabr. in Coq. Ill. Ins. ii, p. 76, pl. 18, f. 2; *scenicum* Walk. List p. 487. Rio J., Braz.; Colomb.
- malaleucum** Walk. Ins. Saund. Hom. p. 59; Fowl. l. e., pl. 1, f. 7; Buckt. l. e., pl. 4, f. 8. Mex.; C. Am.; Juiz de Fora, Braz.
- dubium** Fowl. l. e., p. 8, pl. 1, f. 9. C. Am; Pan.

Subgenus *Phyllotropis*

Stal, Hem. Fabr. ii, p. 38.

## KEY TO SPECIES

- 1 (4). Pronotum black, with a yellow or white stripe of spot.
- 2 (3). Front of pronotum with a yellow fascia, and white subapical band ..... *fasciatum*
- 3 (2). Front of pronotum destitute of a white fascia, dorsum with three white spots tandem ..... *schmidti*
- 4 (1). Pronotum yellow, spot on dorsum anteriorly, another larger at middle, and posterior apex, with tegmina, black ..... *peruana*

## LIST OF SPECIES

- fasciatum** Fabr. Mant. Ins. ii, p. 262. Cayenne, D. Guiana.
- schmidti** Funkh. nom. nov. Cat. Memb. p. 53; *trimaculata* Schm. Ent. Mitt. xii, p. 294. Colomb.
- peruana** Schm. l. e., p. 291. Peru.

Genus **ENCHENOPE**

Amyot and Serville, Hemipteres, p. 535.

Subgenus *Enchenopa*

## KEY TO SPECIES

- 1 (30). Dorsum of pronotum destitute of white or yellow or red stripes or spots; pronotum white or yellow or blackish.
- 2 (19). Pronotum black or fusco-ferruginous.
- 3 ( 6). Pronotum destitute of a front horn, summit of metopidium and dorsum forming a more or less acute angle.
- 4 ( 5). Tegmina brown, clearer toward tips, a clear diffuse band towards interior margin; legs brown .....*truncata*
- 5 ( 4). Tegmina blackish, apices clear hyaline; tarsi pale .....*apicalis*
- 6 ( 3). Pronotum produced anteriorly in a horn or process.
- 7 (16). Front horn long, straight, porrect.
- 8 (11). Superior lateral carinæ abbreviated posteriorly, not extended to lateral margins behind humerals.
- 9 (10). Pronotum black or fuscous, not pubescent; dorsum including front horn above pale ferruginous; tarsi white .....*gladius*
- 10 ( 9). Pronotum ferruginous, finely pubescent, with 5 or more carinæ each side; tarsi concolorous .....*multicarinata*
- 11 ( 8). Superior lateral carinæ extended to posterior apex, or to lateral margins behind humerals.
- 12 (13). Superior lateral carinæ parallel, converging toward and extended to posterior apex which is longer than abdomen.....*sericea*
- 13 (12). Superior lateral carinæ extended to lateral margins behind humerals; apex usually not longer than abdomen.
- 14 (15). Dorsum of pronotum convex posteriorly; pronotum fuscous anteriorly, paler posteriorly; front horn very broad at base, slender towards summit; tegmina blackish diaphanous, tips paler.....  
.....*altissima*
- 15 (14). Dorsum lightly concave posteriorly, lurid toward apex; pronotum ferruginous; front horn moderately broad at base, gradually narrowed to obtuse summit; tegmina brown .....*ferruginea*
- 16 ( 7). Front horn short, subconical; tarsi yellow.
- 17 (18). Lateral carinæ of pronotum straight or lightly curved, superior pair extended to lateral margins behind humerals; pronotum black or brown, punctate; tegmina brown, apical spot subhyaline .....*monoceros*
- 18 (17). Lateral carinæ of pronotum very irregular, abbreviated before reaching lateral margins; pronotum black, rugose; tegmina subhyaline brown, finely mottled .....*rugosa*
- 19 ( 2). Pronotum yellow or yellowish.
- 20 (21). Front of pronotum vertical above head, forming a conical crest with dorsum, with an irregular band at base, spot on crest, subapical band, and apex, black .....*humilior*
- 21 (20). Front of pronotum produced in a horn.

- 22 (23). Superior lateral carinæ extended to lateral margins behind humerals; front horn long, horizontal, lightly curved, gradually acuminate, much longer than space between eyes; posterior process slender, acute, dorsum concave, longer than abdomen; tegmina and tarsi yellow .....*squamigera*
- 23 (22). Superior lateral carinæ of pronotum not extended to lateral margins.
- 24 (27). Apex of posterior pronotal process black or fuscous; front horn straight; head and body yellow.
- 25 (26). Front horn thick at base, oblique, margin below is straight, superior lateral carinæ abbreviated just behind posthumeral sinus and distant from lateral margins; apex of head subacute; tegmina yellow with a brown fascia .....*concolor*
- 26 (25). Front horn rather slender at base, porrect, margin below it obtusely sinuate, superior lateral carinæ extended to middle third of posterior process nearly to lateral margins; apex of head obtusely rounded; tegmina ferruginous, tips paler.....*caruata*
- 27 (24). Apex of posterior pronotal process concolorous, not black or fuscous; front horn arcuate below; lateral carinæ extended nearly to lateral margins behind posthumeral sinuses; apex of head obtusely rounded.
- 28 (29). Tegmina yellowish with a pale oblique fascia at middle; front horn porrect, subarcuate, concave from summit to base below, not quite half length of body, dorsum nearly straight; size rather small .....*gracilis*
- 29 (28). Tegmina brownish yellow, destitute of a median fascia; front horn broad, margins parallel, summit obtuse, lightly inclined upwards, its dorsum concave at base, length from head to summit and from head to posterior apex equal; size very large.....*strigilata*
- 30 ( 1). Pronotum black or fusco-ferruginous; dorsum with a yellowish stripe or 2 spots.
- 31 (36). Dorsum of pronotum with a white or yellow stripe from base of horn abbreviated in front of posterior apex.
- 32 (35). Front horn longer from head to summit than from head to posterior apex.
- 33 (34). Front horn oblique, straight .....*albidorsa*
- 34 (33). Front horn porrect, strongly curved .....*ephippiata*
- 35 (32). Front horn one-half as long from head to summit as from head to posterior apex, nearly porrect, sometimes with yellow spots on base above head .....*ignidorsa*
- 36 (31). Dorsum of pronotum with 2 white or yellow spots tandem.
- 37 (40). Pronotum piceous or ferruginous, front horn long, curved; superior lateral carinæ extended to middle of lateral margins behind humerals.

- 38 (39). Summit of front horn dilated, destitute of a white stripe below on median carina .....*binotata*  
 39 (38). Summit of front horn compressed, not dilated, with a white stripe below on median carina .....*lanceolata*  
 40 (37). Pronotum brown to piceous, produced anteriorly in a very short rudimentary horn or conical angle with 1 or more white spots below .....*quadricolor*

## LIST OF SPECIES

- truncata* Fairm. Rev. Memb. p. 253; *maculosa* Fairm. l. e., p. 253. B. A., Arg; Braz.  
*apicalis* Stal. Stet. Ent. Zeit. xxv, p. 68. Mex; ? Machala, Ecuad.  
*gladius* Fabr. Syst. Rh. p. 13; Fowl. Biol. C. A. Hom. ii, pl. 1, f. 15; Buckt. Mon. Memb. pl. 5, f. 7. Amazona, Braz; Pan; Cayenne, D. Guiana; Tena, Napo R., Ecuad.  
*multicarinata* Fowl. l. e., p. 11. Mex; Pan.  
*sericea* Walk. List p. 493; Fowl. l. e., pl. 1, f. 13; Buckt. l. e., pl. 5, f. 8. pl. 6, f. 6. Venez; Chiriqui; Pan, Mex.  
*altissima* Fairm. l. e., p. 252, pl. 4, f. 31; *bicuspis* Walk. List p. 487; Canelas, Ecuad.  
*ferruginea* Walk. l. e., p. 489; Buckt. l. e., pl. 5, f. 10. Venez.  
*monoceros* Germ. Mag. Ent. iv, p. 28; Buckt. l. e., pl. 4, f. 9; *varians* Walk. Ins. Saund. Hom. p. 62; *andina* Schm. Ent. Mitt. xxii, p. 293. Rio J., Braz; Urug; Kartabo, and New Amsterdam, B. Guiana; Huigra, Baños, Ecuad; Bogota, Colomb; C. Am; Tovar, Venez.  
*rugosa* Fowl. l. e., p. 10, pl. 1, f. 14. Mex; Playas, Ecuad.  
*humilior* Walk. Ins. Saund. Hom. p. 62. Venez.  
*squamigera* Linn. Syst. Nat. ii, p. 705; *hastata* Deg. Mem. Ins. iii, p. 209, pl. 32, f. 17-18; *bicolor* Walk. List, p. 492. Cayenne, Surinam, D. Guiana; Braz. Pl. 8, Fig. 4.  
*concolor* Fairm. l. e., p. 253, pl. 4, f. 30; *nigroapicata* Stal, Hem. Rio J., ii, p. 23. Ecuad; Venez.  
*caruata* Fabr. Syst. Rh. p. 13. New Amsterdam, B. Guiana; Macuto, Venez.  
*gracilis* Germ. l. e., p. 29; Kellogg, Amer. Ins. f. 239. Braz.  
*strigilata* Buckt. l. e., p. 57, pl. 8, f. 3. Braz.  
*albidorsa* Fairm. l. e., p. 251, pl. 4, f. 29; *vittifera* Stal, Bid. Memb. Kan. p. 272; "new species" Schel. Ov. Tidj. Ent. xii, p. 5, pl. 10, f. d. Huigra, Ecuad; Kartabo, B. Guiana; Amazons, Braz.  
*ephippiata* Buckt. l. e., p. 48, pl. 5, f. 6; *serratipes* Buckt. l. e., p. 49, pl. 5, f. 9. Amazons, Braz; Oriente, Ecuad.  
*ignidorsa* Walk. List Suppl. p. 124; *sellata* Stal. Stet. Ent. Zeit. xxv, p. 67; *quadrimaculata* Walk. l. e., p. 124; *arcuata* Walk. l. e., p. 125; *costaricensis* Schm. l. e., p. 293. Mex; C. Am; Surinam, D. Guiana; Santarem, Braz; Yaguachi, Ecuad; Chiriqui, Pan.



- binotata** Say, Narr. Long's Exped. App. p. 301; *brevis* Walk. List p. 492; *bifusifera* Walk. List Suppl. p. 125; *curvicorne* Walk. Ins. Saund. Hom. p. 62; *porrecta* Buckt. l. c., p. 51, pl. 6, f. 5; *permutata* V. D. B. B. Ent. Soc. N. H. ix, p. 112. N. Am; Mex; Pan.
- lanceolata** Fabr. Mant. Ins. ii, p. 263; in Coq. Ill. Ins. pl. 18, f. 3; Latr. in Voy. Humb. pl. 16, f. 11; Buckt. l. c., pl. 4, f. 8, pl. 5, f. 1; *longicollum* Stoll, Cig. p. 114, pl. 28, f. 166. Surinam, D. Guiana; Ambato, Ecuad; Colomb.
- quadricolor** Walk. Ins. Saund. Hom. p. 60; *subangulata* Walk. l. c., p. 61; *excelsior* Walk. l. c., p. 61. Mex; C. Am; Venez; Playas, Ecuad.

Subgenus *Campylenchia*

Stal, Hem. Fabr. ii, p. 39, 43.

## KEY TO SPECIES

- 1 (6). Front horn of pronotum longer than half the length of body, concave below; body and legs brown.
- 2 (3). Apex of posterior pronotal process yellow, pronotum black; front horn vertical, slender, apical third strongly curved forward.....  
..... *minans*
- 3 (2). Posterior apex of pronotum concolorous; front horn horizontal, decurved slightly towards summit, dorsum straight to curved summit, superior lateral carinae extended to lateral margins.
- 4 (5). Pronotum black, immaculate, paler posteriorly; front horn gradually acuminate; tegmina brown, not punctate ..... *curvata*
- 5 (4). Pronotum yellow, immaculate; front horn horizontal, decurved toward summit, margins parallel; tegmina pale yellow, tips hyaline ..... *hastata*
- 6 (1). Front of pronotum acutely angulate, conical, not cornute, angle slightly elevated, straight below, dorsum slightly bisinuate; posterior pronotal process slender, apical half almost subulate; pronotum dark ferruginous, paler toward apex; tegmina brown, bases darker, a row of dark punctures each side of basal veins on basal half; body and legs dark brown, basal joint of tarsi yellow. Long. cum teg. 6, pron. 5, alt. 2 mm. Dedicated to Mr. G. H. T. Tate ..... *tatei*

## LIST OF SPECIES

- minans* Fairm. Rev. Memb. p. 252, pl. 4, f. 32; Fowl. Biol. C. A. Hom. ii, pl. 1, f. 11. Mex; Machala, Ecuad.
- curvata* Fabr. Syst. Rh. p. 13; *densa* Walk. List p. 490. N. Am; Colomb.
- hastata* Fabr. Mant. Ins. ii, p. 263; *nutans* Germ. Mag. Ent. iv, p. 28; Fowl. l. c., pl. 1, f. 18; Buckt. Mon. Memb. pl. 5, f. 5. Mex.; Kartabo, B. Guiana; Valencia, Venez; Pan.
- tatei* Godg. (in this revision). Canelos, Ecuad. (*Tate*).

Subgenus *Tritropidia*

Stal, Hem. Fabr. ii, p. 44.

- 1 (2). Pronotum scarlet to orange yellow, yellow pubescent; median carina not foliaceous at base, inferior and superior margin posteriorly of front horn foliaceous, lateral carinae extended from summit to lateral margins behind humerals, not forked, and covered with a black stripe which forks near origin—front ramus extending to middle of metopidium, the other ramus posteriorly to an oblique transverse band; sometimes there are two bands or lateral spots and apex black; tegmina black with median and sub-apical hyaline bands, veins reddish .....*rubrocassis*
- 2 (1). Pronotum fusco-testaceous or piceous, gray pubescent; median carina broadly foliaceous from origin almost to posterior apex, strongly compressed laterally and pellucid, lateral carinae forked below origin—ramus extending to middle of metopidium, posterior ramus obliquely backward; tegmina broad to piceous, apical third subhyaline, veins concolorous.
- 3 (4). Lateral margins of head emarginate below eyes; oblique ramus of lateral carinae abbreviated near middle posterior process; dorsum lurid below the black elevated median carina .....*nimbata*
- 4 (3). Lateral margins of head not emarginate; oblique ramus of lateral carinae extended to middle of lateral margins behind humerals.....  
.....*bifenestrata*

## LIST OF SPECIES

- rubrocassis* Stoll, Cig. p. 67, pl. 17, f. 90; *alticollum* Stoll, l. c., p. 113, pl. 28, f. 165; *galcata* Oliv. Enc. Meth. vii, p. 668; *militaris* Fabr. Syst. Rh. p. 15; *coacta* Schm. Stet. Ent. Zeit. lxxvii, p. 361; *pulchella* Funkh. J. N. Y. E. Soc. xxx, p. 2, pl. 1, f. 2. Surinam, D. Guiana; Kartabo, B. Guiana; Chanchamayo, Peru; Napo R., Cuenca, Ecuad.
- nimbata* Fabr. l. c., p. 15. Brazil; Tena, Ecuad.
- bifenestrata* Funkh. l. c., p. 1. pl. 1, f. 1; Hav. Zool. vi, pl. 1, f. 4. Para, Braz; Kartabo, B. Guiana.

Genus **LEIOSCYTA**

Fowler, Biologia Centrali-Americana, Hom. ii, p. 14.

## KEY TO SPECIES

- 1 (20). Front of pronotum vertical, or inclined forward, summit angulate or briefly cornute.
- 2 (11). Front strongly inclined forward, summit produced in a blunt angle or short horn; dorsum with white or yellow spots or red stripe.

- 3 ( 6). Pronotum destitute of lateral carinæ.
- 4 ( 5). Pronotum dark brown with 3 yellowish white spots, 1 on middle of anterior margin, 1 dorsal, 1 subapical; tegmina ferruginous subhyaline, indistinct brown fascia on apical half.....*trimaculata*
- 5 ( 4). Pronotum ferruginous excepting a small hyaline subapical spot; tegmina ferruginous subhyaline .....*ferruginea*
- 6 ( 3). Pronotum with a lateral carina each side from summit to middle of lateral margins behind humerals, and 1 or more short carinæ each side of metopidium.
- 7 (10). Posterior pronotal process not longer than abdomen; front produced in an angle or short conical horn.
- 8 ( 9). Front and middle tibiæ broad, foliaceous; pronotum testaceous yellow, angulate in front, 3 short carinæ each side of metopidium; posterior process strong, white with a brown dorsal spot, apex black; tegmina dark brown, tips hyaline; tarsi yellow .....*beebei*
- 9 ( 8). Front and middle tibiæ scarcely broadened; pronotum produced in a short conical horn in front, 1 short carina each side on metopidium, posterior process narrow; dark brown, silvery pubescent; tegmina opaque brown, pubescent, small subhyaline spot at base interior apical cell (1 discoidal in the *type*).....*pruinosa*
- 10 ( 7). Posterior pronotal process much longer than abdomen, sinuate, apical part lengthily subulate; pronotum fuscous, a broad reddish stripe covering median carina from summit to tip of posterior apex; front strongly produced forward in a long acute angle or short horn; tegmina concolorous, apices yellowish; tarsi concolorous .....*rufidorsa*
- 11 ( 2). Front of pronotum vertical, summit more or less obtusely angulate, not produced forward.
- 12 (19). Lateral carinæ of pronotum extended from summit posteriorly, abbreviated before reaching lateral margins.
- 13 (14). Dorsum with 2 white spots—1 dorsal, 1 subapical; pronotum black; tegmina fuscous, apices abruptly hyaline .....*nitida*
- 14 (13). Dorsum with 1 white or yellow spot.
- 15 (18). Dorsum nearly straight, highest above head.
- 16 (17). Lateral carinæ extended from summit of metopidium to middle of sides of posterior process; black, lightly pubescent; base of tegmina black, middle paler, apical third sordid hyaline .....*maculata*
- 17 (16). Lateral carinæ extended nearly to middle of lateral margins behind humerals; fuscous, densely golden pubescent; tegmina piceous, opaque, coriaceous, strongly pubescent, apical cells abruptly sordid hyaline; legs entirely pale yellow .....*pallipes*

- 18 (15). Dorsum arcuate antero-posteriorly, highest at middle, lateral carinæ extended almost to lateral margins; rich brown, yellow pubescent; basal fourth of tegmina coriaceous, opaque, pubescent, apical three-fourths sordid hyaline with a faint narrow brown band across bases of apical cells; legs concolorous, flat, tarsi pale yellow ..... *fasciapennis*
- 19 (12). Lateral carinæ curved, extended from summit to middle of lateral margins behind humerals; yellow clouded with brown, pubescent, paler posteriorly, 2 brown spots on dorsum; tegmina brown, opaque, with a dark apical spot ..... *spiralis*
- 20 ( 1). Front of pronotum convex, sloping backward from base; posterior process long as abdomen.
- 21 (26). Base of head with a small tubercle above each ocellus, a depression between them; base of pronotum very briefly horizontal, impressed within, front and middle tibiæ weakly broadened, not foliaceous.
- 22 (23). Immaculate dark brown, a short carina each side of middle; bases of tegmina black, middle third translucent brown, apical third yellowish hyaline ..... *brunnea*
- 23 (22). Piceous, golden pubescent, a yellowish spot on dorsum.
- 24 (25). Size medium; dorsum depressed, slightly sinuate, base of pronotum strongly bisinuate, lateral carinæ extended from near median carina at summit of metopidium almost to lateral margins; tegmina piceous, opaque, a transverse median broken band and apical cells translucent yellow; tarsi pale..... *bituberculata*
- 25 (24). Size small; dorsum not depressed, base of pronotum nearly straight, a smooth transverse line each side above eyes; median carina impressed each side and foliaceous posteriorly, almost united in front, abbreviated before reaching lateral margins; tegmina yellowish brown, bases of first two basal cells and of clavus opaque, punctured, an irregular median band and apical cells hyaline, middle third translucent brown; legs pale yellow ..... *minima*
- 26 (21). Base of head destitute of tubercles; pronotum destitute of lateral carinæ; dull black, minutely punctulate, base of pronotum broadly bisinuate, a smooth scar above each eye, median carina weak anteriorly, foliaceous posteriorly, deeply impressed behind middle of posterior process; basal half of tegmina piceous, large central part brown, apical limbus broad and abruptly white hyaline; legs black, front tibiæ not broadened, middle slightly flattened ..... *nigra*

## LIST OF SPECIES

*trimaculata* Funkh. J. N. Y. E. Soc. xxx, p. 5, pl. 1, f. 6. Iquitos, Peru; Flores, Manaos, Prata, Braz.

- ferruginea* Funkh. l. c., p. 6, pl. 1, f. 7. Flores, Manaus, Braz.  
*beebei* Hav. Zool. vi, p. 239, pl. 2, f. 1. Kartabo, B. Guiana.  
*pruinosa* Hav. l. c., p. 237, pl. 2, f. 5. Kartabo, B. Guiana.  
*rufidorsa* Godg. J. N. Y. E. Soc. xxxvi, p. 37. Baños, Azogues, Chanoguero, Ecuad.  
*nitida* Fowl. Biol. C. A. Hom. ii, p. 14, pl. 1, f. 23. Bugaba, Chiriqui, Pan.  
*maculata* Funkh. Can. Ent. xlvi, p. 360, pl. 24, f. 3. Peru.  
*pallipes* Godg. l. c., p. 39. Tena, Napo R., Cuenca, Ecuad.  
*fasciapennis* Godg. l. c., p. 39. Tena, Napo R., Ecuad.  
*spiralis* Hav. l. c., p. 240, pl. 2, f. 2. Kartabo, B. Guiana.  
*brunnea* Funkh. J. N. Y. E. Soc. xxvii, p. 268. Peru.  
*bituberculata* Godg. l. c., p. 38. Tena, Napo R., Ecuad.  
*minima* Godg. l. c., p. 38. Tena, Ecuad.  
*nigra* Godg. l. c., p. 38. Tena, Ecuad.

Genus **ERECTIA**

Walker, List Suppl., p. 141; *Tropidosecyta* Stal, Hem. Fabr. ii, p. 44.

## KEY TO SPECIES

- 1 (24). Pronotum unicolorous, destitute of spots or stripes.
- 2 (9). Pronotum with 1 lateral carina each side, sometimes short carinæ on metopidium.
- 3 (6). Lateral carinæ extended to lateral margins behind humerals; front of pronotum highest, produced in a blunt point; pubescent.
- 4 (5). Pronotum light brown, produced forward, with 2 or 3 faint ridges passing from lateral carinæ down on metopidium; tegmina opaque yellow .....*immaculata*
- 5 (4). Pronotum brown, subangulate at summit, front not produced forward, destitute of carinæ on metopidium; lateral carinæ abbreviated anteriorly; tegmina opaque brown .....*sucedanii*
- 6 (3). Lateral carinæ distant posteriorly from lateral margins.
- 7 (8). Pronotum highest behind humerals, arcuate from base, piceous brown to black, carinæ and humerals sometimes ferruginous; tegmina concolorous at bases, apices hyaline .....*abbreviata*
- 8 (7). Pronotum produced anteriorly in a short bluntly rounded horn, highest above head, testaceous, apex fuscous, dorsum much depressed behind middle; tegmina hyaline with obscure markings .....*transiens*
- 9 (2). Pronotum with 2 or more lateral carinæ each side.
- 10 (23). Pronotum with 2 lateral carinæ each side abbreviated before reaching middle of lateral margins behind humerals.
- 11 (16). Apex of head rounded, obtuse.

- 12 (13). Front of pronotum advanced some above head, summit broadly rounded, metopidium destitute of short carinæ; yellow tinged with reddish; tegmina opaque yellow; size large .....*punctipes*
- 13 (12). Front of pronotum vertical, not inclined forward, summit briefly rounded; metopidium with several short carinæ above each eye; ferruginous or black.
- 14 (15). Tegmina entirely fuscous .....*uniformis*
- 15 (14). Tegmina abruptly hyaline toward apices .....*sallæi*
- 16 (11). Apex of head acutely angulate; metopidium destitute of short carinæ, lateral carinæ not extended to lateral margins; tarsi pale.
- 17 (22). Posterior pronotal process with an oblique carina each side near apex; front vertical, summit convex; tegmina abruptly hyaline toward apices.
- 18 (19). Size moderately large; piceous to black, gray pubescent; dorsum highest at middle, strongly depressed behind middle where the sides, seen from above, are suddenly narrowed to the short acute apex; superior lateral carinæ extended to middle of sides of posterior process; tegmina piceous, opaque, 3 yellow dots near center, apices broadly white hyaline; head double longer than broad, base broadly arcuate .....*gilvitaris*
- 19 (18). Size small, dorsum highest in front, base of head straight.
- 20 (21). Piceous; head double longer than broad; sparsely gray pubescent; carinæ weak anteriorly, elevated posteriorly, superior lateral pair not quite reaching lateral margins behind humerals or median carina in front; dorsum lightly convex; tegmina opaque brown to piceous with a few scattering yellow dots, apical third hyaline .....*brevis*
- 21 (20). Chestnut brown, golden pubescent; head one and one-half times longer than broad; carinæ strong, subfoliaceous, superior pair distant from median carina in front, extended to middle of sides posterior process; basal third of tegmina brown, middle third abruptly translucent yellow, apical third sordid yellow hyaline .....*pulchella*
- 22 (17). Posterior pronotal process destitute of oblique lateral carinæ near apex; black to ferruginous; tegmina black, opaque, apices hyaline, sometimes mottled with black .....*carbonaria*
- 23 (10). Pronotum with 3 lateral carinæ each side, superior pair extended from median carina in front abbreviated posteriorly, the others short; black, golden subpubescent; tegmina fuscous black, two series of pale dots at middle, apices white hyaline; tarsi white; apex of head acute .....*torva*
- 24 ( 1). Pronotum with spots or stripes.

- 25 (28). Pronotum black, with several slight diverging ridges between base and summit; tegmina concolorous; tarsi pale.
- 26 (27). Metopidium vertical, not inclined forward, with 5 or 6 slight ridges; 2 large triangular yellow spots each side of median carina; size small .....*subtrigona*
- 27 (26). Metopidium inclined forward above head, with 3 short ridges; a pale yellow stripe on anterior half of median carina, 2 pale bands on dorsum; size large .....*longa*
- 28 (25). Pronotum with 1 or more lateral carinæ each side.
- 29 (42). Pronotum with 1 lateral carina each side.
- 30 (33). Front of pronotum projected forward above head, lateral carinæ extended from summit to middle of lateral margins behind humerals; yellow.
- 31 (32). Dorsum of pronotum with a median and subapical white spot, head, body and legs yellow, tegmina opaque yellow.....*binotata*
- 32 (31). Dorsum with a brown spot occupying anterior part, a small blackish dorsal and subapical spot, head, body, legs, and bases tegmina brown with a dark transverse band, tips hyaline.....  
.....*deceptens*
- 33 (30). Front of pronotum vertical or arcuate backward, not projected above head; apex of head rounded.
- 34 (37). Lateral carinæ extended posteriorly to middle of lateral margins behind humerals.
- 35 (36). Pronotum yellow, dorsum with a median and two spots behind it brown, apex black; tegmina hyaline, body and legs yellow.....  
.....*minor*
- 36 (35). Pronotum brown with a median and subapical white spot; lateral carinæ united anteriorly with median carina at summit; bases of tegmina dark brown, coriaceous, spots on costa and apices paler .....*tricotata*
- 37 (34). Lateral carinæ abbreviated posteriorly, not extended to lateral margins of pronotum.
- 38 (41). Pronotum with stripes or bands.
- 39 (40). Pronotum piceous with 2 pale testaceous bands united each side, abdomen and legs testaceous, tegmina slightly clouded with brown toward apices .....*bicolor*
- 40 (39). Pronotum ferruginous with a broad transverse yellow band across middle of dorsum; tegmina dense, basal part black, apical part ferruginous .....*guayanensis*
- 41 (38). Pronotum with spots, destitute of stripes or bands; black, pubescent, a blood-red spot occupying superior part, and yellow subapical spot, tip black; tegmina dull red, apices black, two yellow dots at interior angle .....*ophthalmica*
- 42 (29). Pronotum with 2 or more lateral carinæ each side, front convex.

- 43 (46). Superior lateral carinæ more highly elevated at middle dorsum than median carina, 1 or more short weak carinæ extended on metopidium.
- 44 (45). Superior lateral carinæ extended to or nearly to posterior apex of pronotum, distant from lateral margins; yellow to ferruginous, variously marked with black or yellow; tegmina yellow hyaline with some black dots; legs yellow; head long as broad ..... *gibbosa*
- 45 (44). Superior lateral carinæ extended to middle of lateral margins, pronotum reddish brown, a broad white fascia from summit to humerals, then along lateral margins to and briefly covering carinæ upward, a semicircular white spot on middle dorsum; tegmina hyaline, base brown, a row of black dots across center; legs and tarsi white; head much longer than broad.....  
..... *albipes*
- 46 (43). Median carina more highly elevated at middle than lateral carinæ.
- 47 (50). Superior lateral carinæ extended from summit to middle of lateral margins behind humerals.
- 48 (49). Pronotum high, projecting well forward, superior lateral carinæ not joined in front, inferior pair above humerals semicircular; dark brown, black mark each side in front, yellow brown between superior lateral carinæ; tegmina black at bases, middle brown, apical third yellow hyaline, two rows of light brown dots across center ..... *brunneidorsata*
- 49 (48). Pronotum arcuate from base, superior lateral carinæ united with median carina in front, between them and humerals a short carina each side; dorsum with median and subapical white spot; tegmina yellow brown, two transverse rows black dots on center, apices white ..... *pæcila*
- 50 (47). Superior lateral carinæ extended on sides posterior process, distant from lateral margins.
- 51 (54). Superior lateral carinæ extended from summit to or abbreviated immediately in front of posterior apex; front convex.
- 52 (53). Black or ferruginous red, dorsal carina reddish strongly sinuate at middle, tip black, 2 short weak carinæ above each humeral, another from humerals across metopidium; tegmina concolorous, opaque, punctate on basal half, apical half sordid hyaline; legs concolorous, front and middle tibiæ moderately dilated, tarsi paler ..... *sanguinolenta*
- 53 (52). Testaceous, black between median and superior lateral carinæ, 1 short weak carina each side above humerals, a longer pair from humerals across metopidium with a black stripe above each; tegmina yellowish hyaline ..... *nigrovittata*



- 54 (51). Superior lateral carinæ united in front extend to middle sides of posterior process, median carina subfoliaceous posteriorly; brown to piceous, humerals and median carina from summit pale testaceous almost to piceous apex; densely golden pubescent; tegmina short, broad, opaque brown, two curved rows of pale yellow dots across center, basal half of corium and all of clavus coriaceous, opaque, punctate; tarsi pale yellow .....
- ..... *minutissima*

## LIST OF SPECIES

- immaculata* Funkh. J. N. Y. E. Soc. xxx, p. 3, pl. 1, f. 3; Chaco del Estero Rio Salado, Argent.
- succedanii* Buckt. Mon. Memb. p. 53, pl. 7, f. 2; *neglecta* Hav. Zool. vi, p. 237, pl. 2, f. 4. Kartabo, B. Guiana.
- abbreviata* Fabr. Syst. Rh. p. 23; *bulbosa* Hav. l. c., p. 236, pl. 2, f. 3. Kartabo, B. Guiana.
- transiens* Fowl. T. E. S. Lond. (1894), p. 415. Rio J., Braz.
- punctipes* Buckt. l. c., p. 53, pl. 7, f. 5. South America.
- uniformis* Fowl. Biol. C. A. Hom. ii, p. 14, pl. 1, f. 20. Mex; C. Am; Pan.
- sallaei* Fowl. l. c., p. 14, pl. 1, f. 19. C. Am.; Caldera, Pan.
- gilvitorsa* Godg. J. N. Y. E. Soc. xxxvi, p. 39. Tena, Napo R., Ecuad.
- brevis* Godg. l. c., p. 40. Tena, Napo R., Ecuad.
- pulchella* Godg. l. c., p. 40. Napo R., Ecuad.
- carbonaria* Germ. Rev. Ent. Silb. iii, p. 228; *minuta* Funkh. l. c., p. 5, pl. 1, f. 5. Obidos, Braz.
- torva* Germ. l. c., p. 228. Braz.
- subtrigona* Walk. List p. 485. Venez.
- longa* Walk. l. c., p. 486. Braz.
- binotata* Funkh. Can. Ent. xlvi, p. 357, pl. 24, f. 2. Espirito Santo, Braz.
- decepiens* Fairm. Rev. Memb. p. 254, pl. 4, f. 34. Braz.
- minor* Buckt. l. c., p. 53, pl. 7, f. 3. South America.
- tricostata* Germ. Mag. Ent. iv, p. 24. Braz.
- bicolor* Walk. List, Suppl. p. 141. Santarem, Braz.
- guayanensis* Buckt. l. c., p. 53, pl. 7, f. 4. Guayana, Venez; Amazona, Braz.
- ophthalmica* Fairm. l. c., p. 255. Colomb.
- gibbosa* Deg. Mem. Ins. iii, p. 211, pl. 32, ff. 21-22; *tricarinatus* Fabr. Syst. Rh. p. 23; *bicristata* Fairm. l. c., p. 256, pl. 4, f. 35. Braz; Kartabo, B. Guiana.
- albipes* Funkh. J. N. Y. E. Soc. xxx, p. 1, pl. 1, f. 4. Flores, Manaus, Braz.
- brunneidorsata* Funkh. Can. Ent. xlvi, p. 357, pl. 24, f. 1. Marcapata, Peru; Boliv; Tena, Ecuad.
- pœcila* Germ. l. c., p. 23. Rio J., Braz.
- sanguinolenta* Fairm. l. c., p. 255. Cayenne, D. Guiana; Tena, Ecuad.
- nigrovittata* Fairm. l. c., p. 255, pl. 4, f. 36. Cayenne, D. Guiana.
- minutissima* Godg. l. c., p. 40. Tena, Napo R., Ecuad.

Genus **TYLOPELTA**

Fowl. Biol. Cent. Am. Hom. ii, p. 15.

## KEY TO SPECIES

- 1 (4). Pronotum tricarinate, black.
- 2 (3). Dorsum tricarinate anteriorly; tegmina brown, yellow spotted, two hyaline spots on apical margin ..... *monstrosa*
- 3 (2). Dorsum with a curved carina each side of median carina extended from summit some distance apart half way to posterior apex; tegmina blackish brown, spots across center, subapical spot and apical margins, white ..... *americana*
- 4 (1). Pronotum 5-carinate on dorsum, and subarcuate transverse carina on metopidium; black, tegmina blackish, apical half variegated with white ..... *gibbera*

## LIST OF SPECIES

- monstrosa* Fairm. Rev. Memb. p. 257; *exusta* Buckt. Mon. Memb. p. 55, pl. 7, f. 8. Rio J., Braz.
- americana* Godg. Bul. Ill. Lab. Nat. Hist. iii, p. 469; *brevis* V. D. Stud. N. A. Memb. p. 115, pl. 2, f. 35. N. Am.
- gibbera* Stal, Hem. Fabr. ii, p. 46; Fowl Biol. C. Am. Hom. ii, pl. 2, f. 1; Buckt. l. e., pl. 7, f. 7. N. Am; Mex; C. Am; Pan.

Genus **BOLBONOTA**Amyot and Serville, Hemipteres, p. 537; *Tetraplatys* Walker, List p. 510.Subgenus *Tubercunota*

Goding, Can. Ent. xxv, p. 55.

## KEY TO SPECIES

- 1 (6). Dorsum of pronotum unituberculate; brown to black, tarsi paler.
- 2 (5). Sides of subapical tubercle with a short carina each side; dorsum with 3 lateral carinae above each humeral.
- 3 (4). Subapical lateral carinae oblique, dorsum lengthily bi-impressed; tegmina ferruginous, base of clavus and broad costal margin black, opaque, pale dots on corium, apical margins infusate interiorly, white exteriorly ..... *tuberculata*
- 4 (3). Subapical lateral carinae transverse, anterior lateral carinae short, pronotum rugulose or with numerous irregular short carinae above and behind humerals; tegmina transparent hyaline, veins dark, bases opaque black ..... *inaequalis*

- 5 ( 2). Sides of subapical tubercle destitute of lateral carinæ; dorsum multicarinate; tegmina black, a median fascia and narrow apical margins white hyaline, anal angle fuscous .....*pusio*
- 6 ( 1). Dorsum of pronotum bi-tuberculate, 1st tubercle conical, 2d tubercle usually transverse.
- 7 ( 8). Pronotum with 1 curved lateral carina above each humeral extended side of 1st tubercle, abbreviated posteriorly; black or ferruginous, sometimes carinæ, tubercles, apex, and legs, yellow; tegmina black or ferruginous occasionally white spotted; tarsi brown .....*aspidistræ*
- 8 ( 7). Pronotum with more than 1 lateral carina each side above humerals.
- 9 (12). Pronotum with 2 lateral carinæ above each humeral; black.
- 10 (11). Size very small, finely tuberculate anteriorly; superior lateral carinæ extended to lateral margins behind humerals the dorsum smooth between them and median carina; tegmina hyaline, bases and veins black .....*bispinifera*
- 11 (10). Size large; dorsum minutely tuberculate between lateral carinæ, the carinæ irregular abbreviated posteriorly; tegmina black with yellow dots, sometimes center or entirely yellow .....  
..... *bituberculata*
- 12 ( 9). Pronotum with 3 lateral carinæ above each humeral, black, strongly sculptured; tegmina black, yellow spots or bands, or entirely yellow, small hyaline spot exteriorly .....*corrugata*

## LIST OF SPECIES

- tuberculata* Fabr. in Coq. Ills. Ic. Ins. p. 78, pl. 18, f. 8. Fla., U. S. A.; Huigra, Narangapata, Tena, Napo R., Ecuad.
- inæqualis* Fabr. S. Rh. p. 22; Fowl. Biol. C. A. Hom. ii, pl. 2 f. 7. Braz; Kartabo, D. Guiana; Taboga Is., Pan; Narangapata, Huigra, Bucay, Cuenca, Tena, Napo R., Ecuad.
- pusio* Germ. Rev. Ent. Silb. iii, p. 230. Braz; Huigra, Napo R., Ecuad.
- aspidistræ* Hav. Zool. vi, p. 241, pl. 2, f. 6. Kartabo, B. Guiana.
- bispinifera* Godg. Can. Ent. xxv, p. 55. St. Vincent, W. I.
- bituberculata* Stal, Hem. Rio J., ii, p. 24; *quinquelineata* Buckt. Mon. Memb. p. 65, pl. 10, f. 4. Rio J., Braz.
- corrugata* Fowl. l. c., p. 19, pl. 2, f. 6; Buckt. l. c., pl. 10, f. 8; *minor*. Fowl. l. c., p. 19. Taboga and Pearl Is., Pan; C. Am; Kartabo, B. Guiana; Tena, Napo R., Baños, Narangapata, Ecuad.

Subgenus *Bolbonota*

Am. et Serv. l. c; Godg. l. c., p. 55.

## KEY TO SPECIES

- 1 (12). Dorsum of pronotum more or less sinuate.

- 2 ( 5). Pronotum with small rugosities or lateral bulbs, dorsal carinae very irregular.
- 3 ( 4). Shining black, with 2 large bulbs each side of median carina, a Y-shaped carina between humerals and 1st bulb, lightly depressed before posterior apex; tegmina black, extreme apices hyaline; legs black, tarsi yellow .....*nigrata*
- 4 ( 3). Blackish brown, numerous small rugae anteriorly, destitute of lateral bulbs; tegmina yellow, bases brown with white spots, an apical brown band, exterior angle hyaline; legs fuscous.....*auripennis*
- 5 ( 2). Pronotum with 2 or 3 more or less regular lateral carinae above each humeral, destitute of lateral bulbs.
- 6 (11). Pronotum with 2 lateral carinae above each humeral; small.
- 7 (10). Posterior pronotal process with a subapical lateral carina each side.
- 8 ( 9). Anterior lateral carinae sinuous, converging posteriorly; pronotum black or fuscous, rugulose in front; tegmina black or fuscous, opaque, with paler spots, exterior angle hyaline .....*melæna*
- 9 ( 8). Anterior lateral carinae diverging posteriorly; black, golden pubescent, dorsum slightly sinuate, sharply truncate posteriorly; tegmina brown, pale fusco-varigate apically .....*pusilla*
- 10 ( 7). Posterior pronotal process destitute of subapical carinae; black, densely gray pilose; tegmina blackish brown, white and yellow spotted, apical margins hyaline; legs black, tarsi pale.....*nisus*
- 11 ( 6). Pronotum with 3 lateral carinae above each humeral, middle one smallest, and a subapical carina each side; fuscous with golden pubescence; tegmina pale yellow, bases brown, a subapical brown spot; body black, legs yellow .....*globosa*
- 12 ( 1). Dorsum of pronotum straight or nearly so.
- 13 (16). Anterior lateral carinae irregular.
- 14 (15). Tegmina transparent hyaline, bases black or brown, sometimes ferruginous interiorly; small, black, humerals and dorsum more or less rufo-testaceous; legs reddish .....*rufonotata*
- 15 (14). Tegmina fuscous black with white spots, or fusco-testaceous with bases and tips darker, or yellowish with bases reddish brown, tips fuscous destitute of hyaline spot; large, shining black, anterior carinae crossed by several minute transverse carinae, all carinae much interrupted; legs black, tarsi testaceous.....*insignis*
- 16 (13). Anterior lateral carinae more or less regular.
- 17 (20). Pronotum with 2 lateral carinae above each humeral.
- 18 (19). Very small, dull black, sparingly pubescent; tegmina piceous with pale dots at center, apical margins abruptly hyaline, sometimes central part paler with no spots .....*inconspicua*
- 19 (18). Larger, shining black, not pubescent; tegmina black, center broadly hyaline not including apices .....*cuneata*

- 20 (17). Pronotum with 3 lateral carinæ above each humeral.  
 21 (22). Sordid yellow, golden pubescent, chest fusco-ferruginous; dorsum strongly compressed at base posterior process; tegmina yellow, opaque .....*aurosericea*  
 22 (21). Black or brown, gray pubescent, size variable; tegmina blackish with pale dots which sometimes coalesce over central part, with yellow hairs on bases and veins .....*pictipennis*

## LIST OF SPECIES

- nigrata* Funkh. Can. Ent. xlvi, p. 361, pl. 24, f. 5. Boliv; Tena, Napo R., Ecuad.  
*auripennis* Fairm. Rev. Memb. p. 259. Braz.  
*melœna* Germ. Rev. Ent. iii, p. 229; *flavicans* Fairm. l. e., p. 258. Rio J., Braz; Tena, Mira, Baños, Ecuad.  
*pusilla* Fairm. l. e., p. 258. Colomb.  
*nisus* Germ. l. e., p. 229; Fairm. l. e., pl. 4, f. 8-9. Braz; Napo R., Ecuad.  
*globosa* Fairm. l. e., p. 257; *auro-sericea* Fowl. T. E. S. Lond. (1894), p. 417; *dubiosa* V. D. Can. Ent. xlvi, p. 389. Colomb; N. Am; Narangapata, Ecuad.  
*rufonotata* Fowl. l. e., p. 416; *rubritarsa* Buckt. Mon. Memb. p. 66. Colomb; ? Napo R., Ecuad.  
*insignis* Fowl. Biol. C. A. Hom. ii, p. 17, pl. 2, f. 2-3. Mex; C. Am; Pan.  
*inconspicua* Fowl. l. e., p. 18, pl. 2, f. 5. Mex; C. Am; Narangapata, Huigra, Baños, Ecuad.  
*cuneata* Fowl. l. e., p. 17, pl. 2, f. 4; Buckt. l. e., pl. 10, f. 7. Mex; C. Am; Pan.  
*aurosericea* Stal, Hem. Rio J. ii, p. 24; *lutea* Funkh. Can. Ent. xlvi, p. 260, pl. 24, f. 4. Rio J., Espirito Santo, Braz.  
*pictipennis* Fairm. l. e., p. 258; *atomaria* Walk. List p. 510; *scabricula* Walk. Ins. Saund. Hom. p. 75; *levior* Fowl. l. e., p. 18; *plicata* Buckt. l. e., p. 63, pl. 9, f. 6; *digesta* Buckt. l. e., p. 64, pl. 10, f. 2; *quadripunctata* Buckt. l. e., p. 65, pl. 10, f. 3; *flavopuncta* Buckt. l. e., pp. 63 and 75, pl. 13, f. 4. Cayenne, D. Guiana; Kartabo, B. Guiana; Colomb; Rio J., Braz; Mex; C. Am; Pan; Cachabe, Ecuad; Caracas, Venez.

Genus **GUAYAQUILA**

Goding, Bol. Med. Circ. Guay. xviii, p. 31; Ent. News, xxxi, p. 159.

## KEY TO SPECIES

- 1 ( 4). Ocelli slightly nearer to and even with center of eyes, base of head arcuate; pronotum densely golden pubescent, lightly punctulate, median carina distant from base, obsolete on dorsum.

- 2 ( 3). Pronotum brown; front horn rather long, slender, porrect, longer in ♀, margins broadly flat; posterior process distinctly longer than abdomen, apex briefly subulate; tegmina translucent yellow, apical half costa narrowly piceous.....*vexator*
- 3 ( 2). Pronotum testaceous yellow; front horn strongly ascending, thrice longer than broad at base, margins nearly parallel and narrowly piceous, flat margins narrowed toward base, middle convexly elevated, gradually acuminate, apex slightly longer than abdomen; tegmina yellow hyaline, densely pubescent to bases apical cells, a large elongate blackish spot on apices. Long. 8 mm. ....*olseni*
- 4 ( 1). Ocelli above center of eyes, usually equidistant.
- 5 (12). Base of head arcuate.
- 6 ( 9). Total length 12-13 mm; front horn porrect, slightly ascending; densely pubescent, posterior apex passing abdomen; legs yellow or testaceous.
- 7 ( 8). Pronotum black; front horn not long, very short in some males, acuminate; dorsum sinuate, middle convexly elevated, apex just passing abdomen; tegmina more or less ferruginous; subhyaline; abdomen evenly punctate, apical margins segments shining yellow .....*compressa*
- 8 ( 7). Pronotum fuscous; front horn long, margins parallel, slightly concave at dorsal base, apex distinctly longer than abdomen; tegmina pale yellow hyaline; hind tibiae black spined.....*pubescens*
- 9 ( 6). Total length 9 mm. or less.
- 10 (11). Length 9 mm; pronotum cinnamon brown to piceous, golden pubescent; front horn broadly compressed, longer and more slender in female, porrect; median carina extended from near base, obsolete on dorsum, apex in ♂ long as abdomen, distinctly longer in ♀, gradually acuminate; tegmina uniform yellowish brown, veins pubescent; abdomen brown, apical margins segments paler .....*roreriana*
- 11 (10). Length 7 mm; elongate, pale ferruginous, slightly pubescent; front horn long, strong, suberect; tegmina pale hyaline, two dark spots near center .....*temaxia*
- 12 ( 5). Base of head straight, head fuscous, lateral margins yellow; pronotum sulphur yellow, slightly pubescent, size small; front horn short, fuscous, median carina distant from base, piceous below horn, obsolete on dorsum, apex depressed; tegmina pale yellow hyaline; abdomen pale fuscous, shining.....*sulfurea*

## LIST OF SPECIES

- vexator* Godg. Jour. N. Y. Ent. Soc., xxxvi, p. 43. Napo R., Ecuad.  
*olseni* Godg. new species. Picta, Honduras, C. Am.

- compressa** Walk. List p. 541, (♀); *calignosa* Walk. l. c. Suppl. p. 135, (♂); Fowl. Biol. C. A. Hom. ii, pl. 5, f. 9, (♀); Buckt. Mon. Memb. pl. 28, f. 4, (♀). *maxima* Godg. J. N. Y. Ent. Soc., xxxvi, p. 43; Tobasco, Paramba, Colimes, Ana Maria, Ecuad; Kartabo, B. Guiana; Mex.
- pubescens** Walk. Ins. Saund. Hom. p. 70; Buckt. l. c., pl. 26, f. 9, pl. 27, f. 1; Bahia, Braz; Machala, Ecuad.
- roreriana** Godg. Bol. Med. Cir. Guay. xviii, p. 37, pl. 1, f. 5; Memb. Ecuad. pl. 1, f. 5. Jour. N. Y. Ent. Soc., xxxvi, p. 44. Machala, Narangapata, Ecuad; Almiran R., Pan.
- sulfurea** Godg. Jour. N. Y. Ent. Soc., xxxvi, p. 44. Huigra, Ecuad; San Jacinto, Chira Valley, Peru.

Genus **PHILYA**

- Walker, List Supplement, p. 126; *Azinia* Walker, Is. Saund. Hom. p. 63; *Æchmophora* Stal, Bid. Memb. Kan. p. 279; *Scalmophorus* Fowler, Biol. Cent. Am. Hom. ii, p. 22.

## KEY TO SPECIES

- 1 ( 6). Front pronotal horn bicarinate each side, summit more or less dilated and ridged.
- 2 ( 5). Front horn straight, summit not or very slightly curved.
- 3 ( 4). Tegmina piceous to ferruginous, punctate excepting extreme tips and part of posterior borders which are clear hyaline .....*ascendens*
- 4 ( 3). Tegmina vitreous; pronotum ferruginous to piceous; legs concolorous, tarsi yellow .....*pallidipennis*
- 5 ( 2). Front horn curved upward toward summit; pronotum ferruginous or mottled with black, posterior process longer than tegmina which are dark brown to lurid, costa punctate; legs fuscous, tarsi paler .....*bicolor*
- 6 ( 1). Front pronotal horn compressed, base broad, gradually acuminate to slightly deflexed summit, with rugæ or obsolete lateral carinæ posteriorly near base, destitute of distinct lateral carinæ; pronotum variegated yellow and ferruginous; tegmina sordid hyaline, venation more or less irregular; legs fuscous .....*curvicornis*

## LIST OF SPECIES

- ascendens** Walk. List p. 493; *brunnea* Fallou, Rev. Ent. ix, p. 354. Braz; Colomb; Baños, Pelileo, Ecuad.
- pallidipennis** Walk. Ins. Saund. Hom. p. 63; *recticornis* Stal, Bid. Memb. Kan. p. 279; *vitreipennis* Fowl. Biol. C. A. Hom. ii, p. 21; Buckt. Mon. Memb. pl. 8, f. 1. Chile; Bogota, Colomb; Mex.

**bicolor** Walk. List Suppl. p. 126; Buckt. l. c., pl. 8, f. 2; *elephas* Stal, Hem. Rio J. ii, p. 23; *lituus* Fowl. l. c., p. 21. Constancia, Rio J., Braz; Bogota, Colomb; Mex.

**curvicornis** Stal, Bid. Memb. Kan. p. 279; *recticornis* Fowl. l. c., p. 23, pl. 2, f. 11; Buckt. l. c., pl. 8, f. 5. Bogota, Colomb; C. Am.

#### Genus **HYPSOPRORA**

Stal, Bidrag Memb. Kan. p. 277; *Entophius*, Buckton, Mon. Memb. p. 134.

#### KEY TO SPECIES

- 1 ( 8). Dorsum of posterior pronotal process destitute of elevated tubercles.
- 2 ( 5). Front of pronotum elevated in a long horn or process.
- 3 ( 4). Front process erect, margins subparallel or broadly dilated at middle; tegmina ferruginous, opaque ..... *anatina*
- 4 ( 3). Front process well inclined forward or nearly porrect, constricted more or less below and above middle; tegmina piceous to brown, opaque, posterior margins subhyaline..... *albopicta*  
(My examples merge from *albopicta* to *anatina*.)
- 5 ( 2). Front process short, not more than twice higher than broad, lightly inclined forward.
- 6 ( 7). Black; front process high as broad, summit convex, mucronate; tegmina black, base and costa punctate to beyond middle ..... *tuberosa*
- 7 ( 6). Ferruginous yellow; front process cylindrical, twice higher than broad, summit convex, unarmed; tegmina obscure, apices fuscous, basal half punctate ..... *cylindricornis*
- 8 ( 1). Dorsum of posterior process with 1 or 2 elevated tubercles.
- 9 (14). Dorsum of posterior process unituberculate at middle; front process erect or lightly inclined forward.
- 10 (11). Front horn long, inclined forward, narrowed toward compressed denticulated summit; dorsal tubercle conical; legs dark fuscous ..... *capitata*
- 11 (10). Front process nearly erect, seen from side broad.
- 12 (13). Front process slender from base, gradually broadened from middle, compressed, abruptly recurved, summit truncate and seen from above dilated; dorsal elevation erect, compressed, a small tubercle each side of summit; tegmina yellowish ferruginous, basal half of clavus and costal margin of corium fusco-ferruginous, punctate ..... *coronata*
- 13 (12). Front process cylindrical, summit convex; dorsal tubercle small, conical; tegmina piceous; legs pale yellow..... *pileata*
- 14 ( 9). Dorsum of posterior pronotal process bituberculate.



- 15 (16). Front process erect, stout, cylindrical, summit truncate, 1st dorsal tubercle conical, 2d tubercle larger, rounded; tegmina brown; legs black .....*trituberculata*
- 16 (15). Dorsum of pronotum strongly sinuate, dorsum at front, at middle and posteriorly with elevations more or less tubercular in form, variable in altitude, posterior tubercle broadest; tegmina and legs black .....*nigerrima*

## LIST OF SPECIES

- anatina* Fowl. Biol. C. A. Hom. ii, p. 26, pl. 2, f. 16; Buckt. Mon. Memb. pl. 9, f. 1. Bugaba, Pan.
- albopicta* Funkh. J. N. Y. E. Soc. xxx, p. 7, pl. 1, f. 8. Prata, Braz; Iquitos, Peru.
- tuberosa* Stal, Bid. Memb. Kan. p. 277. Bogota, Colomb.
- cylindricornis* Stal, l. e., p. 277; *funbris* Buckt. l. e., p. 134, pl. 28, f. 6. Bogota, Colomb; Braz; C. Am.
- capitata* Fairm. Rev. Memb. p. 267, pl. 7, f. 29; *w-album* Buckt. l. e., p. 132, pl. 28, f. 5. Colomb; Ecuad.
- coronata* Fabr. Syst. Rh. p. 14; Fowl. l. e., pl. 2, f. 17; Buckt. l. e., pl. 8, f. 7; *varia* Walk. List p. 502. Parintius, Corumba, Braz; Pan; C. Am.
- pileata* Fairm. l. e., p. 266, pl. 7, f. 28. Colomb.
- trituberculata* Stal, l. e., p. 278; Fowl. l. e., pl. 2, f. 15; *aspera* Hav. Zool. vi, p. 242, pl. 2, f. 7. Mex; Pan; Kartabo, B. Guiana.
- nigerrima* Fowl. l. e., p. 25, pl. 2, f. 14; *teter* Buckt. l. e., p. 66, pl. 10, f. 6. Mex; C. Am; Braz.

Genus **SPHONGOPHORUS**

Fairmaire, Revue des Membracides, p. 261.

Subgenus *Sphongophorus*

Stal, Bid. Memb. Kan. p. 273.

## KEY OF SPECIES

- One fuscous species, with front horn long, tricarinate, usually curved backward to form with apex of posterior process almost a semicircle, its direction very variable, direct or multisinuate, summit more or less bilobed passing beyond tip of abdomen; posterior process long extended beyond tip of abdomen and tegmina, apical part curved upward.....  
..... *ballista*

## LIST OF SPECIES

- ballista* Germ. Rev. Ent. Silb. iii, p. 231; Fowl. Biol. C. A. Hom. ii, pl. 2, ff. 18-20; Buckt. Mon. Memb. pl. 14, f. 1; Am. Serv. Hem. pl. 9, f. 5;

Funkh. Biol. Memb. pl. 32, f. 12; *claviger* Stal, Hem. Mex. p. 68; Buckt. l. c., pl. 14, f. 2; *apicalis* Stal, Bid. Memb. Kan. p. 273. Mex; C. Am; Pan; Savannah, San Esteban, Venez; Tena, Huigra, Queveda, Ecuad; Demerara, B. Guiana; Bogota, Colomb.

Subgenus *Cladonota*

Stal, Bid. Memb. Kan. p. 273; *Lecythifera* Fowl. l. c., p. 27.

KEY TO SPECIES

- 1 (14). Front pronotal horn long, passing posterior apex.
- 2 ( 5). Dorsal node of posterior process not constricted near middle.
- 3 ( 4). Dorsal node triangular, occupying a large part of posterior process apically, a denticle extended backward from superior angle and near middle of front horn, inferior angle decurved; front horn undate, compressed, summit truncate.....*mirabilis*
- 4 ( 3). Dorsal node thick, cylindrical, near middle of posterior process, not triangular; front horn rather slender toward summit, curved backward and touching summit of dorsal node .....*falleni*
- 5 ( 2). Dorsal node constricted near middle; front horn undulate, more or less dilated at middle.
- 6 ( 7). Middle of front horn strongly dilated in a large compressed foliaceous plate which touches dorsal node, slender below and above foliole; dorsal node trinodulose.....*foliatus*
- 7 ( 6). Middle of front horn slightly swollen, destitute of a foliole.
- 8 ( 9). Front horn touching summit of dorsal node, summit truncate ..... ♂ *undulatus*
- 9 ( 8). Front horn distant from dorsal node.
- 10 (13). Dorsal node bilobed, dilated each side near convex summit.
- 11 (12). Summit of dorsal node with 2 short conical spines..... ♀ *undulatus*
- 12 (11). Summit of dorsal node destitute of spines.....*ridiculus*
- 13 (10). Dorsal node trilobed, middle lobe broad, strongly compressed, bearing a small tubercular bulb—summit cristiform.....*paradoxus*
- 14 ( 1). Front horn much shorter, not extended to and distant from dorsal node.
- 15 (18). Dorsal node not constricted near middle; front horn gradually narrowed and more or less recurved from base.
- 16 (17). Front horn erect very slightly recurved from middle; posterior apex slightly recurved; dorsal node very small, convex .....*locomotivus*
- 17 (16). Front horn strongly recurved from thick base; posterior apex bearing a small tubercle; dorsal node cylindrical, summit truncate .....*costatus*
- 18 (15). Dorsal node cylindrical, middle constricted, summit produced anteriorly; basal third of front horn stout, middle third

slender, curved backward then abruptly dilated in a quadrangular compressed foliole, terminating in a denticle behind, the foliole touching anterior extension of dorsal node; posterior apex obliquely truncate; tegmina pale ferruginous with a white transverse median band ..... *albofasciatus*

## LIST OF SPECIES

- mirabilis* Fairm. Rev. Memb. p. 261, pl. 4, ff. 5-6. Braz; Venez; Trinidad.  
*falleni* Stal, Hem. Rio J. ii, p. 24. Rio J., Braz.  
*foliatus* Funkh. J. N. Y. E. Soc. xxx, p. 8, pl. 1, f. 9. Obidos, Braz.  
*undulatus* ♂ Walk. List p. 498; *ludicrous* Walk. Ins. Saund. Hom. p. 63; *nodosus* Buckt. l. c., p. 79, pl. 14, f. 4; *latifrons* ♀ Stal, Bid. Memb. Kan. p. 274; Fowl. Biol. C. A. Hom. ii, pl. 3, ff. 6-7; Buckt. Mon. Memb. pl. 15, f. 5. Para, Braz; Napo R., Ecuad; Mex.  
*ridiculus* Walk Ins. Saund. Hom. p. 64; ♀ *inelegans* Buckt. l. c., p. 82, pl. 15, f. 6. Amazons, Braz; Mex.  
*paradoxus* Germ. Mag. Ent. iv, p. 26, pl. 1, f. 1; ♀ Buckt. l. c., pl. 13, f. 3; *facetus* Walk. l. c., p. 64. Para, Constancia, Braz; Napo R., Ecuad.  
*locomotivus* Bred. Soc. Ent. xvi, p. 60. Narangapata, Ecuad.  
*costatus* Buckt. l. c., p. 61, pl. 9, f. 4. St. Vincent, W. I.  
*albofasciatus* Godg. Can. Ent. xxv, p. 54. St. Vincent, W. I.

Subgenus *Lobocladisca*

Stal. Bid. Memb. Kan. p. 275.

## KEY TO SPECIES

- 1 (10). Front pronotal horn erect, very lightly inclined forward, summit slightly recurved.
- 2 (3). Front horn broad, compressed, gradually acuminate from middle, postmarginal tooth at middle long, oblique; dorsal elevation long as front horn, form similar without postmarginal tooth.....*lividus*
- 3 (2). Front horn cylindrical its summit retuse or bifid, postmarginal tooth small, dentiform; dorsal elevation much shorter than front horn.
- 4 (7). Dorsal node or elevation broad at base, convex, not constricted at middle.
- 5 (6). Metopidium convex, front horn elevated from between humerals; summit of dorsal node with an erect spine.....*vexilliferus*
- 6 (5). Metopidium vertical, front horn elevated in front of humerals; dorsal node unarmed .....*machinulus*
- 7 (4). Dorsal node compressed, constricted or coarctate at middle.
- 8 (9). Front horn acuminate, summit briefly bilobed, postmarginal tooth below middle rather long, slender; dorsal node in front of

- middle, one-half altitude of front horn, subcylindrical and narrowed at middle, broader toward summit on which is a small lobule; posterior apex triangularly elevated near tip.....*rigidus*
- 9 ( 8). Front horn compressed, seen from side thick, abruptly coarctate below middle, compressed above middle, postmarginal tooth small, summit bilobate; dorsal node short, middle coarctate, summit retuse, tridentate; posterior apex elevated in an angle .....*lobulatus*
- 10 ( 1). Front pronotal horn strongly recurved at least from middle.
- 11 (12). Front horn slender, nearly cylindrical, postmarginal tooth at middle double longer than broad; dorsal node at middle of posterior process, longer and larger than and not distant from front horn, nearly erect, middle dilated, summit acuminate from middle .....*guerinii*
- 12 (11). Dorsal node of posterior process much shorter than front horn.
- 13 (14). Postmarginal tooth emitted from near base of front horn, summit bifoliate; dorsal node cristiform, one-half length of front horn, dorsum elevated near posterior apex in a rounded lobe .....*bennettii*
- 14 (13). Postmarginal tooth emitted from middle of front horn.
- 15 (16). Dorsal node of posterior process sessile, compressed, convex, situate near apex, summit dilated; summit front horn spatulate, distant from dorsal node, extended behind posterior apex .....*spatulatus*
- 16 (15). Dorsal node of posterior process constricted at middle, not sessile.
- 17 (18). Postmarginal lobe of front horn short, conical, distant from dorsal node whose summit is claviform.....*biclavatus*
- 18 (17). Postmarginal lobe of front horn long, slender, touching summit of dorsal node which is cruciform .....*clavarius*

## LIST OF SPECIES

- lividus* Buckt. Mon. Memb. p. 81, pl. 15, f. 3. Amazons, Braz; Iquitos, Peru.
- vexilliferus* Godg. Can. Ent. xxv, p. 53; *intermedius* Buckt. l. c., p. 80, pl. 15, f. 2. St. Vincent, W. I.
- machinulus* Bred. Soc. Ent. xvi, p. 60. Narangapata, Ecuad.
- rigidus* Stal, Bid. Memb. Kan. p. 275. Bogota, Colomb.
- lobulatus* Stal, l. c., p. 276. Bogota, Colomb.
- guerinii* Fairm. Rev. Memb. p. 262, pl. 4, f. 1; Fowl. Biol. C. A. Hom. ii, pl. 3, f. 8; *bivexillifer* Costa, A. M. Z. Nap. ii, p. 150, pl. 1, f. 11; *dorsalis* Buckt. l. c., p. 80, pl. 14, f. 6. Chiriqui, Pan; Trinidad, W. I; Kartabo, B. Guiana; Minas, Braz; Boliv; Machala, Ecuad.
- bennettii* Kirby, Mag. N. H. (1829), p. 20, f. 5; Fairm. l. c., pl. 4, f. 7. Choco, Colomb; San Esteban, Venez; Trinidad, W. I.

**spatulatus** Fairm. l. c., p. 262, pl. 4, f. 3. Minas, Braz.

**biclavatus** Westw. Int. Clas. Ins. ii, p. 432, f. 11; Dunc. N. L. Ent. i, p. 286, pl. 25, f. 3; Fairm. l. c., pl. 4, f. 4; Fowl. l. c., pl. 3, f. 4; Buckt. l. c., pl. 14, f. 5; *parvulus* Buckt. l. c., p. 80, pl. 15, f. 1. Bugaba, Pan; Mex; Blairmont, New Amsterdam, B. Guiana; Machala, Ecuad; Amazons, Braz.

**clavarius** Fairm. l. c., p. 261, pl. 4, f. 2. Braz; ? Napo R., Ecuad.

#### Genus **NOTOCERA**

Amyot and Serville, Hemipteres, p. 536; Goding, Jour. N. Y. Ent. Soc., xxxvi, p. 41; *Pterygia* Laporte, A. S. E. Fr. i, p. 226 (preoccupied); *Kallipterygia* Kirkaldy, Ent. xxxiv, p. 6.

#### KEY TO SPECIES

- 1 ( 6). Dorsum of posterior pronotal process with 1 node at middle.
- 2 ( 3). Front of pronotum elevated in a short thick erect process, high as broad, summit more or less deeply bifid .....*macquarti*
- 3 ( 2). Front of pronotum elevated above each humeral in a short thick horn divaricate and lightly recurved from bases.
- 4 ( 5). Suprahumerals triquetrous, summits dilated, truncate .....*crassicornis*
- 5 ( 4). Suprahumerals compressed, gradually narrowed from bases, acute posteriorly .....*satanas*
- 6 ( 1). Dorsum of posterior pronotal process with more than one node.
- 7 (22). Dorsum of posterior pronotal process with 2 nodes.
- 8 (17). First dorsal node situate just behind suprahumeral, second node near middle of dorsum.
- 9 (10). Suprahumerals aborted to a small tubercle above each humeral equal to first dorsal node, second dorsal node much larger.....*tuberosa*
- 10 ( 9). Suprahumerals rather short, about two or three times higher than broad.
- 11 (16). Suprahumerals more or less diverging from bases.
- 12 (15). Suprahumerals oblique, broadly diverging from bases.
- 13 (14). Suprahumerals double higher than broad, straight, a distinct tubercle each side near base, summits truncate.....*bituberculata*
- 14 (13). Suprahumerals three times higher than broad, destitute of tubercles near bases, summits subincrassate, subreflexed outward, abruptly acuminate .....*bovina*
- 15 (12). Suprahumerals slightly diverging .....*subsimitis*
- 16 (11). Suprahumerals erect, subparallel, interior side concave, summits nearly touching .....*brachycera*
- 17 ( 8). First dorsal node situate at middle, second node at or near posterior apex of pronotum; suprahumeral very long, slender.

- 18 (21). Suprahumeral strongly diverging and recurved from bases, summits broadly dilated, compressed, subfoliaceous; lateral margins posterior process parallel, apex briefly acuminate.
- 19 (20). Apical third of posterior pronotal process compressed, not dilated each side:
- a. Second dorsal node seen from side broad, high, situate at apex of pronotum, summit acuminate from base ..... ♀ *cruciata*
- aa. Second dorsal node seen from side similar but smaller, situate slightly in front of apex of pronotum, summit truncate ..... ♂ *cruciata*
- 20 (19). Apical third of posterior pronotal process strongly compressed-dilated each side above lateral margins to form a large flat circular disk, the second dorsal node occupying the center; lateral margins of posterior process subarcuate between dorsal nodes ..... *alataruna*
- 21 (18). Suprahumeral straight, slightly diverging and recurved, summits slightly incrassate.
- b. Second dorsal node subtruncate at summit ..... ♂ *tripodia*
- bb. Second dorsal node acute at summit ..... ♀ *tripodia*
- 22 (7). Posterior pronotal process with 3 dorsal nodes, first node situate just behind humerals, second node at middle, third node subapical.
- 23 (24). Suprahumeral very long, strongly divaricate, summits much dilated and truncate ..... *cerviceps*
- 24 (23). Suprahumeral short, dilated, truncate at summit.
- 25 (26). Suprahumeral divaricate ..... *hispida*
- 26 (25). Suprahumeral parallel ..... *quinquetuberculata*

## LIST OF SPECIES

- macquarti** Lap. A. S. E. Fr. i, p. 226, pl. 6, f. 6; *bifida* Fairm. Rev. Memb. p. 267. Braz; Cayenne, D. Guiana.
- crassicornis** Fairm. l. c., p. 264; *maculosa* Walk. Ins. Saund. Hom. p. 65; *punctuosa* Walk. l. c., p. 65; *dæmonica* Buckt. Mon. Memb. p. 71, pl. 11, f. 6. Amazona and Rio J., Braz; Puerto Cabello, Venez.
- satanas** Less. Zool. Ins. p. ?, pl. 56, ff. A-C; Buckt. l. c., pl. 12, f. 1; *arietina* Germ. Rev. Ent. Silb. iii, p. 308; *incognita* Buckt. l. c., p. 75. Rio J., Braz; San Estaban, Venez.
- tuberosa** Fairm. l. c., p. 266. Corientes, Argent.
- bituberculata** Fowl. Biol. C. A. Hom. ii, p. 24, pl. 2, f. 13. Mex; C. Am; Pan.
- bovina** Stal, Hem. Rio J. ii, p. 24; *rubicunda* Buckt. l. c., p. 72, pl. 12, f. 2. Rio J., Braz; Narangapata, Ecuad.
- subsimilis** Walk. List Suppl. p. 128; *hædulus* Stal, l. c., p. 25; *concolor* Buckt. l. c., p. 73, pl. 12, f. 6. Constancia, Rio J., Braz.

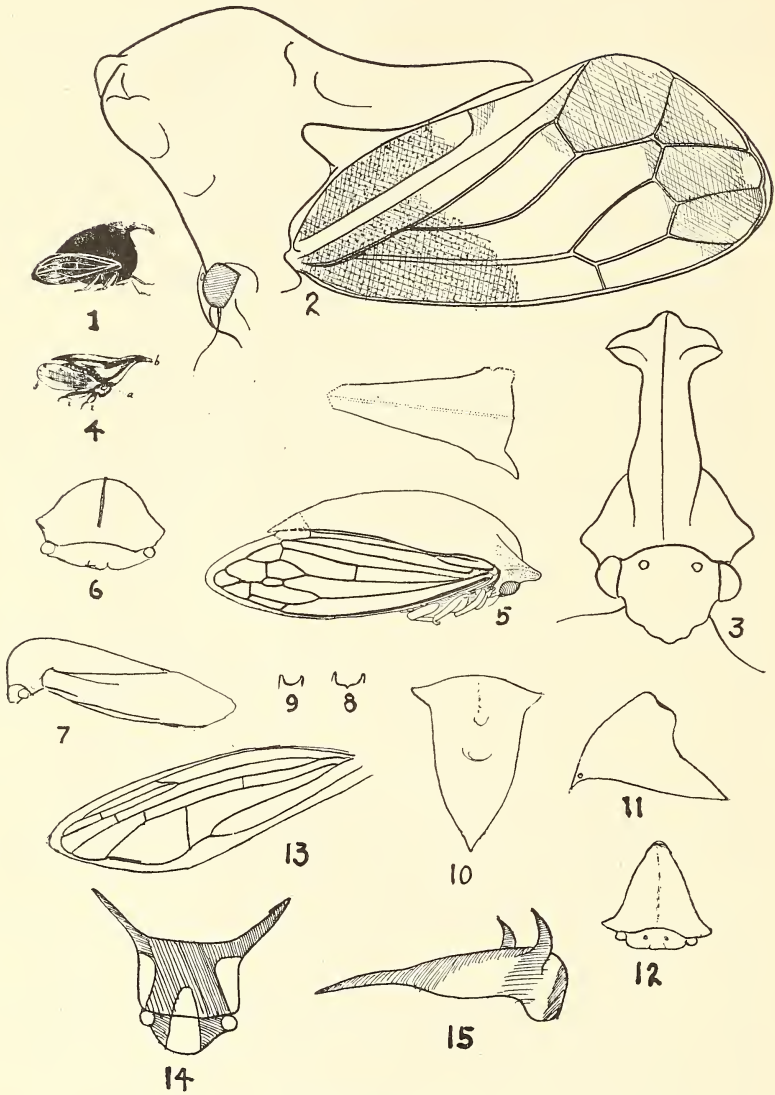
- brachycera** Fairm. l. c., p. 265; *exaltata* Walk. List p. 502; *nox* Buckt. l. c., p. 73, pl. 12, f. 8. Amazons, Rio J., Braz.
- cruciata** Stoll, Cig. pl. 2, f. 8; ♂, Fabr. ♀ Syst. Rh. p. 18; *nigrocrux* Stoll, l. c., p. 61, pl. 15, f. 77; *quadridens* Fairm. l. c., p. 264; *wropigii* Buckt. l. c., p. 72, pl. 12, f. 3. Cayenne, Surinam, D. Guiana; Kartabo, New Amsterdam, Blairmont, B. Guiana; Amazons, Braz.
- alataruna** Godg. J. N. Y. E. Soc. xxxvi, p. 44. Napo R., Ecuad.
- tripodia** Fairm. ♂, l. c., p. 263, pl. 7, f. 30; ♀, *tenuicornis* Buckt. l. c., p. 74, pl. 13, f. 2. Cayenne, D. Guiana; Amazons, Villa Nova, Braz.
- cerviceps** Fowl. l. c., p. 24, pl. 2, f. 12; *cruciatum* Westw. Cuv. An. King. Hom. f. 100b. C. Am; Bugaba, Coldera, Pan.
- hispidia** Fairm. l. c., p. 265; *pehlkei* Schm. Stet. Ent. Zeit. lxxvii, p. 326. Magdalena, R. Colorado, Colomb.
- quinquetuberculata** Fairm. l. c., p. 266. Venez.

Mr. W. E. China, of the British Museum, has examined Walker's type of *Pterygia subminax*, described in JOURNAL OF ENTOMOLOGY, vol. i, page 316 (and forwarded a drawing of it, which is reproduced on plate VIII, Fig. 2), bearing a locality label "Prov. Rio," although no habitat was given with the description. It is evident that the species is *Lycoderes gladiator* Germ.

#### PLATE VIII

Explanation of figures. (Figures of Walker's and Buckton's species drawn by Mr. W. E. China from the types in the British Museum.)

- Figure 1. *Encephyllum cruentatum* (*proboscidea* Burm.) Germ. Photo. U. S. Bur. Ent.
- Figure 2. *Lycoderes gladiator* Germ. (*Pterygia subminax* Walk.); side view, with tegmen.
- Figure 3. *Lycoderes gladiator* Germ. Seen from the front.
- Figure 4. *Enchenopa squamigera* Linn., side view (U. S. Bur. Ent.).
- Figure 5. *Alchisme rubrocostata* Blanch., side view. Dorsal view above. (F. Z. Williams del.)
- Figure 6. *Platycotis humilis* Walk., ♂, front view.
- Figure 7. Same, side view.
- Figure 8. Same, 8th ventral segment of ♀.
- Figure 9. Eighth ventral segment of ♀, *Platycotis vittata* Fabr.
- Figure 10. *Atypa gibbosa* Walk., dorsal view.
- Figure 11. Same, side view.
- Figure 12. Same, front view.
- Figure 13. Tegmen.
- Figure 14. *Hyphinae obesum* Buckt., front view.
- Figure 15. Same, side view.



MEMBRACIDÆ



NOTES ON THE RHYNCHOPHORA OF EASTERN  
NORTH AMERICA WITH DESCRIPTIONS  
OF NEW SPECIES, IV

BY W. S. BLATCHLEY  
INDIANAPOLIS, INDIANA

This is the fourth<sup>1</sup> of a series of articles supplementary to the "Rhynechophora of Northeastern America." That work, prepared by Chas. W. Leng and myself, was issued in 1916. During the three years which have elapsed since the third of these supplements was prepared I have collected extensively in Indiana and the southern half of Florida, especially at Royal Palm Park, a tract of 4,000 acres as yet practically unmarred by civilization, which lies in the extreme southeastern corner of the State. This park includes Paradise Key, an island in the everglades, covered by a dense hammock of 400 acres in which grow many tropical and subtropical trees and shrubs, among them eighty or more indigenous examples of the royal palm, *Oreodoxa regia*, H. B. K., the most magnificent endogen of the western continent, their tufted crowns rising seventy-five or more feet above the tops of the great live oaks and other hard-wood trees of the hammock. Four visits, of two to four weeks each, have been made to the park, and in this hammock, the everglades surrounding it and the adjacent forests of Caribbean pines, all within the limits of the park, I have taken, in March, April and December, 645 species of Coleoptera, exclusive of the Staphylinidae and Scydmaenidae, which have not yet been mounted or studied. Many of these are tropical or subtropical forms, not known elsewhere, except in southern Florida, from the United States, and quite a number have proven new to science. In the park and about Dunedin, on the west coast of Florida, where I have my winter

<sup>1</sup> The other three were published in this JOURNAL, Vol. XXVIII, 1920, pp. 161-178; Vol. XXX, 1922, pp. 95-106, 113-127, and Vol. XXXIII, 1925, pp. 87-113.

home, I have in recent years also found numerous examples of weevils, whose main distribution is much farther northward, and which here reach the southern limits of their range.

In the "Rhynchopora" but few definite station records for the weevils of Florida were given as, up to 1916, but few had been recorded. Many of the older coleopterists, including both Leconte and Horn, were content to put "Fla." or "Florida," after their descriptions, not taking into consideration the fact that the State is approximately 400 miles long, 360 miles across its northern border, and contains an area of 60,000 square miles. Representatives of three distinct faunas, the Austroriparian, Subtropical and Tropical, live within its bounds, and the time has come when more definite and accurate distributional notes than those furnished by the mere name of the State, are needed for the use of future students.

In addition to those species of weevils collected personally, since the third supplement was prepared, I have received many for naming. A number of interesting records have also been published by other writers. Where these extend appreciably the range of any species treated in the Rhynchophora, they are included in the notes which follow. New species which have been described in the last three years, and new introduced forms which have been discovered and recorded are also mentioned, with a brief diagnosis of each where the data was available. It is hoped that in the notes and records thus given in this series of articles, our knowledge of this interesting group of beetles may be kept somewhat up to date, and in permanent form for use in future years.

The numbers before the majority of the species mentioned are the serial numbers of the same species in the "Rhynchophora." Where no number is given the species was not included in that work. The nomenclature, where different from that of the "Rhynchophora" is that of Leng's "Catalogue of the Coleoptera of America North of Mexico," or of monographs of certain groups which have appeared since that "Catalogue" was published. In most instances where a generic name now in use differs from the one used for the same or allied species in the

“Rhynchophora,” the old name in parenthesis follows the new. Unless otherwise stated, the types of the new species described are in my personal collection.

6. *ORMISCUS SALTATOR* Lec.

Additional station records for this little weevil are Sherborn, Mass., June 19 (Frost); Marion Co., Ind., June 9–July 7 (W. S. B.).

16. *TROPIDERES RECTUS* Lec.

Taken in numbers in March and April in the dense hammock on Paradise Key, Royal Palm Park, Fla., by beating bunches of dead leaves and dead branches. Taken also at Chokoloskee, Fla., in March.

22. *ANTHRIBUS CORNUTUS* Say.

Additional Florida stations are Gainesville, Everglade, Cape Sable and Royal Palm Park, February–April. Occurs most commonly in dense moist hammocks.

28. *BRACHYTARSUS STICTICUS* Boh.

Common throughout southern Florida, where it is smaller than in the north and exceedingly variable in marking. The thorax in some examples has the basal two-thirds or more a solid fuscous-black, in others only a few small scattered dark spots are present. The dark spots at base of elytra are often enlarged and merge to form a bar, while those behind middle are sometimes wanting, sometimes merged to form a common sutural blotch.

29. *BRACHYTARSUS TOMENTOSUS* (Say).

Only two examples have been taken in Florida in 16 years collecting, one at Dunedin, the other at Royal Palm Park, both in April by sweeping herbage in low cultivated grounds. In recent years it has been found in numbers, June–August, in Marion, Putnam and Crawford counties, Ind.

## 33. ANTHRIBULUS ROTUNDATUS Lec.

This is the most common Anthribid throughout southern Florida, occurring by hundreds on the vegetation of low moist meadows, December–April.

## 41. EUXENUS PICEUS Lec.

This is evidently a subarctic species. Several have been taken at Dunedin, December and February, while beating on Hog Island and on the mainland along the bay front.

— . *Euxenus ater* new species.

Rounded-oval, strongly convex. Black, rather strongly shining; head, legs and antennæ dark reddish-brown; basal joint of antennæ and extreme tip of beak dull yellow. Head deeply immersed in thorax, its front flat, minutely and sparsely punctate; antennæ set in deep rounded sockets exactly between middle of eyes, their segments as in other members of the genus. Thorax, including the strongly deflexed flanks, nearly twice as broad as long, front margin truncate, broadly curved, hind one feebly sinuate; disk strongly convex, finely, densely and deeply punctate. Elytra at middle one-third wider than middle of thorax, conjointly two-thirds longer than wide, disk convex, with distinct punctures arranged in irregular double or treble rows, separated by interrupted smooth lines. Length .8 mm.

Dunedin, Fla., December 20. One specimen beaten from dead branches in a dense hammock. Evidently more closely related to *punctatus* than *piceus*, but smaller, with dark legs and with both thorax and elytra more densely punctate. It has been compared for me with Leconte's type of *punctatus* by Mr. Banks.

## 47. AULETES ALBOVESTITA Blatch.

The principal food plant of this weevil is apparently the sweet fern, *Comptonia peregrina* L., as Frost sent me three specimens taken from it at Sherborn, Mass., May 3, 1925, and 98 from the same plant September 6. He also reports it as common on the same plant in New Brunswick and Nova Scotia.

## 117. APION UMBONIFERUM Fall.

Two specimens of this large, coarsely pubescent, reddish-brown Apionid were beaten, February 23, from *Viburnum* near Gainesville, Florida. It was described from Maryland and had not

been recorded elsewhere. In the Rhynchophora it was stated that it was "probably only a variety of *puritanum* Fall, but a direct comparison of the two forms now at hand shows that they are very distinct.

H. C. Fall has described<sup>2</sup> three new species of eastern *Apion* since my last supplement was issued. They all belong to Group I, p. 67, of the "Rhynchophora."

— . *APION DILATICOLLE* Fall.

A wholly black species, 2.3 mm. in length, closely allied to *A. pennsylvanicum* but "differing by its larger thorax, more evenly oval elytra, coarsely punctured ventral surface and close striation of the femoral swelling in male." Known from Montclair, Ramsey and Oradell, New Jersey.

— . *APION BISCHOFFI* Fall.

Also a black species, 2 mm. in length, closely allied to *dilaticolle* but with broad elytra and the hind body shorter and more convex. Described from New Jersey, Staten Island, N. Y., and Virginia. This is, in part, the *A. atripes* Smith, the No. 70 of the Rhynchophora.

— . *APION DIFFRACTUM* Fall.

Black with legs brownish-piceous to brownish-red, length 1.5–2 mm. Allied to *finitimum* Fall, but having the femoral swelling of male densely finely striate on its inner face. Like *finitimum* it has the front tibiae of male strongly widened; these two species differing from all others of Group I of the Rhynchophora in this character. Described from New Jersey, Cambridge, Mass., and Cœur d'Alene, Idaho.

132. *PANSCOPUS ERINACEUS* Say.

L. L. Buchanan has recently published<sup>3</sup> a "Review of *Panscopus*," with key to all known North American species. He states that these and other ground-inhabiting beetles "form an

<sup>2</sup> Bull. Brook. Entom. Soc., XX, 1925, 85–87.

<sup>3</sup> Proc. Ent. Soc. Wash., XXIX, 1927, 25–36.

important item in the diet of North American toads," and describes six new species from the northwestern states, three of which were taken from the stomachs of toads. In his key he makes *P. carinatus* Pierce (No. 136 of the Rhynchophora) a synonym of *erinaceus* Say.

— . BRACHYRHINUS (OTIORHYNCHUS) LIGNEUS Oliv.

Several examples of this European species have been received from C. A. Frost. They had been sent him by Prof. A. P. Morse, who in turn had received them from Machias, Maine, where they occurred in numbers, crawling on the rooms of a farmhouse. The insect was named for me by Nathan Banks, who compared it with European examples in the Cambridge collection. Superficially it resembles closely<sup>4</sup> *B. ovatus* (Linn.), but is a paler brown, less shining, with the hind femora unarmed, thorax closely granulate-punctuate, elytral striae more coarsely punctate, intervals more convex, much more rugose, each with a row of rather long inclined setæ. All of the seven species of *Brachyrhinus* at present known from the territory covered by the Leng Catalogue have either been introduced from Europe or are indigenous to both northeastern America and northern Europe. Banks (Ms.) states that they now have in the Cambridge Museum 140 named European species of the genus.

— . TRICHALOPHUS FOVEIROSTRIS Chitt.

This new species was described<sup>5</sup> from Skyland, Page Co., Virginia. It is 9 mm. in length, black, "antennæ and legs dull dark brown, coated with minute scales of varying colors. Elytral striæ rather deep, with punctures large, subquadrate." The unique type is in the collection of Alan S. Nicolay.

186. PHYTONOMUS COMPTUS Say.

A single example was taken by sweeping low herbage near Gainesville, Fla., February 21, 1927. Not before recorded from that State.

<sup>4</sup> So closely, in fact, that Horn (1876, 61) described *ovatus* under Oliver's name. The seventh line at the top of p. 112 of the "Rhynchophora" should read: "Horn, nec Oliver, is a synonym."

<sup>5</sup> Proc. Ent. Soc. Wash., XXVII, 1925, 141.

— . LISTRODERES APICALIS Waterhouse.

This South American weevil, originally described<sup>6</sup> from Monte Video, Uruguay, has been recently taken in numbers on beets and other vegetables at various localities in Louisiana and will probably be found in adjoining states.<sup>7</sup> It is 5–6 mm. in length, thickly clothed above with pale brown scales. The elytra have the third and fifth intervals slightly elevated, and have a post-median cross-bar of dark brown scales behind which the scales are white or nearly so. The genus *Listroderes* differs from *Listronotus* in being more oblong and depressed and in having “posterior evanescent scrobes.” The thorax is much widened in front of middle, and with apical third much flattened.

198. LISTRONOTUS CALLOSUS Lee.

Two females, each 13. mm. in length, were taken December 12, hibernating amidst the roots of a large tuft of roadside grass at Royal Palm Park. This is the first record from Florida.

— . LISTRONOTUS LEUCOZONATUS Chittenden.

This new species, described<sup>8</sup> from Ithaca, N. Y., Washington, D. C., and Ohio, is closely related to *L. appendiculatus*, but is smaller, 4.5–5.2 mm., and both thorax and elytra have a wide lateral stripe of dense yellowish-gray scales, the apical third of elytra also with variegated brown and yellow scales. The female has the elytra produced in minute short, acute points and the fifth ventral transversely concave at base.

199. LISTRONOTUS INAEQUALIPENNIS (Boh.).

One taken at Royal Palm Park, December 15, from beneath a board in the everglade marsh; two, April 5, by sifting weed debris on side of ditch. Also the first definite record from Florida.

<sup>6</sup> Proc. Zool. Soc. London, 1841, p. 123.

<sup>7</sup> See Chittenden, Proc. Biol. Soc. Wash., XXXIX, 1926, 71–74.

<sup>8</sup> Journ. N. Y. Ent. Soc., XXXIV, 1926, 341.

207. *LISTRONOTUS FLORIDENSIS* Blatch.

This has proved to be a common species throughout southern Florida, scores having been taken at Royal Palm Park in April on flowers of arrow-head along the margins of the everglades.

215. *HYPERODES SOLUTUS* (Boh.).

The first known Florida specimen of this well marked species was taken at Royal Palm Park April 4 on flowers of arrow-head. Not before recorded south of the District of Columbia and Kansas.

— *HYPERODES ANNULIPES* Blatch.

A third example of this recently described<sup>9</sup> weevil was taken at Dunedin, Fla., December 15, while sifting grass roots from the margin of a pond. The tibiae, as well as the tarsi, are reddish-brown.

227. *HYPERODES SPARSUS* (Say).

This common northern species has recently been found in some numbers at Dunedin, Fla., where it was swept from herbage along the margins of ditches in April. It has not before been definitely recorded south of Missouri.

231. *HYPERODES NOVELLUS* Blatch.

One sifted from weed debris on the side of a ditch, April 7, at Royal Palm Park, Fla. Described from Dunedin and Sarasota, that State, and not recorded elsewhere.

— *Hyperodes carinatus* new species.

Elongate, subcylindrical. Color a nearly uniform reddish-brown, rather strongly shining, above thinly clothed with rather large dirty white scales, these aggregated to form an irregular patch on sides of thorax, and on elytra forming numerous small spots, arranged in narrow more or less wavy cross lines. Elytra each with a small vague blackish spot in front of declivity and another on middle of flanks. Beak and head densely punctate, each puncture enclosing a small prostrate yellowish scale; front with a distinct deep median fovea; beak almost as long as thorax, its three carinae,

<sup>9</sup> Journ. N. Y. Ent. Soc., XXXIII, 1925, 92.



especially the median one, sharp, prominent. Thorax subcylindrical, as long as wide, slightly narrower toward base, disk rather coarsely and densely punctate. Elytra nearly one-half wider at base than thorax, sides straight to apical third, thence obliquely narrowing to apex; disk with all the intervals narrow, sharply carinate, each with a row of very short, almost invisible inclined setæ; striæ narrow, deep, closely punctate. Ventrals 1 and 2 coarsely, irregularly, not densely punctate, 3-5 more finely punctate. Apical three-fourths of last ventral of male with a wide shallow median impression. Length 3 mm.

Type, a male sifted, March 31, from weed debris on the side of a roadside limestone ditch at Royal Palm Park, Fla. Belongs to Group III, p. 171, of the "Rhynchophora." One of our smallest known species and differs from all others in the narrow, even, sharp carinæ and the peculiar arrangement of scales of elytra.

257. *DERELOMUS BICOLOR* Lee.

Swept by scores in April from the flowers of the silver palm, *Coccothrinax argentea* (Lodd.) at Royal Palm Park, Fla. With the typical form, which has the thorax black, were 20 or more specimens of another, averaging larger and having the entire upper surface dull yellow, with three vague cross-bars of pale yellow across the elytra, one basal, one median, the third preapical. The only evident structural distinction between the two forms is the almost total absence in the pale one of the preapical cusp on the sides of thorax. This is usually prominent in typical *bicolor*. The latter is much more active in the sweep net and clings tenaciously to the forceps when picked up. This the pale one did not do. It is possible that the pale form represents a distinct color variety, as no intermediate specimens were found. Banks reports a single specimen of the pale form in the Leconte series at Cambridge.

266. *DORYTOMUS VAGENOTATUS* Casey.

This species was described from Indiana, and in the Rhynchophora was recorded only from Marshall County, that State. It is now at hand from Starke and Putnam Counties, Ind.; Harrisburg, Pa., June 25 (*Champlain*) and Sherborn, Mass., March

25 (*Frost*). It is probably confused in eastern collections with *D. brevicollis*.

270. *DORYTOMUS SQUAMOSUS* Lec.

Marion Co., Ind., June 9; swept from low herbage along the bluffs of White River. Known heretofore in that State only from Lake County, near Lake Michigan.

— . *NOTARIS BIMACULATUS* (Fab.).

L. L. Buchanan has recently issued<sup>10</sup> "A Short Review of *Notaris*," in which he records this European species from Wisconsin and other northwestern states. It is a black species, 5.5–8.5 mm. in length, with elytral intervals densely granulose and usually with a patch of pale scales behind the middle of the third one. He regards the *N. wyomingensis* Chitt. as a synonym of the Fabrician species.

— . *Smicronyx minutissimus* new species.

Elongate, subcylindrical. Pale reddish-brown, shining; above thinly but evenly clothed with rather large, oblong, dirty white scales, those on legs, beak and thorax arranged transversely, on elytra in a single row on each interval, with those on sides more irregular. Head nude, convex, very finely alutaceous; beak rather stout, as long as head and thorax, its sculpture concealed. Thorax subcylindrical, as long as wide, sides very feebly curved. Elytra at base one-half wider than thorax, sides straight and parallel to apical fourth, thence gradually curved into the obtusely rounded apex; disk very finely striate, sculpture concealed. Under surface densely clothed with oval silvery-gray scales. Length 1.3 mm.

Type, a male taken at Dunedin, Fla., April 20, 1925, by sweeping herbage growing in rich mucky soil. This is by far the smallest of eastern species of *Smicronyx*, its size alone easily distinguishing it from all other members of Group II, p. 210 of the *Rhynchophora*.

— . *Tanysphyrus atra* new species.

Form and size of *T. lemnae* (Fabr.). Black, everywhere strongly shining; thorax with a conspicuous patch of oval silvery-white scales each side of

<sup>10</sup> Bull. Brooklyn Entom. Soc., XXII, 1927, 36.

middle. Elytra with similar but smaller scales, these forming a narrow sutural stripe, an irregular somewhat broken ring on basal half and covering the greater portion of the declivity; femora and under surface, except middle of meso- and metasterna and first ventral, densely clothed with larger oval similar scales. Beak as long as head and thorax, distinctly longer and more slender than in *lemnæ*, its basal three-fourths coarsely punctured, apical fourth or less almost smooth. Thorax and elytra as in *lemnæ*. Length 1.3 mm.

Described from a single specimen received from C. A. Frost, and now in his collection. It is labelled "Cambridge, Mass., V-24-23, Darlington." The shining black color of entire body and all appendages and the distinctly longer and more slender beak, readily separate it from *lemnæ*, the only previously known species of the genus.

The most important paper on our eastern Rhynchophora which has appeared since 1925 is the "Classification of the Nut Curculios of Boreal America," by Dr. F. H. Chittenden.<sup>11</sup> In it, however, except for one sentence on page 130, he wholly ignores the treatment of these weevils by Leng in the "Rhynchophora." They were formerly known under the generic name *Balaninus* Germar and were so treated by Leng, pp. 261-273 of the "Rhynchophora." This name was shown by Pierce<sup>12</sup> to be an isogonotype of *Curculio* Linn., hence this generic name is used by Chittenden. The changes made by him in the specific names used in the "Rhynchophora," and the new species described by him from the territory covered by that work as follows,<sup>13</sup> the page numbers cited in the text of this paper being those of the "Rhynchophora."

### 383. CURCULIO PROBOSCIDEUS Fabr.

The forms *hariolus* and *cylindricollis* Casey (p. 265) are made synonyms of this large chestnut weevil.

<sup>11</sup> Entomologica Americana, VII, N. S., 1927, pp. 129-207, pls. XII-XIX.

<sup>12</sup> Proc. Ent. Soc. Wash., XXVII, 1925, 113.

<sup>13</sup> The names of the new eastern species of Dr. Chittenden are preceded by an asterisk. For their distinguishing characters consult his paper, loc. cit. in footnote No. 11.

## 384. CURCULIO CARYAE (Horn).

This species is retained as treated in the "Rhynchophora" and without synonyms, its host plants, the hickory and pecan, being distinctive.

## 385. CURCULIO RECTUS (Say).

*B. cuneatus* and *sparsellus* Csy. (p. 267) are treated as synonyms of *rectus* by Chittenden.

## 386. CURCULIO AURIGER (Casey).

This specific name has page priority over *algonquinus* Casey. The three forms described by Casey, which are mentioned by Leng (p. 268), viz., *setosicornis*, *macilentus* and *perexilis*, as well as four others proposed by Casey, *mollis*, *strigosus*, *algonquinus* and *acuminatus*, are all made synonyms of *auriger* by Chittenden.

## 387. CURCULIO NASICUS (Say).

The *B. auctus* Casey (p. 273) is made a synonym of *nasicus* and the range, as given by Leng, is extended to include Vermont, Wisconsin, Iowa and North Carolina.

## \*— CURCULIO LONGIDENS Chitt., loc. cit., p. 155.

Described as new from numerous localities in the east and south. Food plants, the acorns of various species of oaks.

## \*— CURCULIO MULTIFASCIATUS Chitt., loc. cit., p. 159.

Described from Wingra Lake, near Madison, Wisconsin.

## 388. CURCULIO PARDALIS (Chitt.).

The *B. virginicus* Casey (p. 270, in part), and the *B. appalachius* Casey (p. 273), are placed as synonyms of *pardalis*.

## \*— CURCULIO VICTORIENSIS FULVUS Chitt., loc. cit., p. 165.

Described from Georgetown, South Carolina. Reared from acorns of *Quercus virginiana*.

— CURCULIO STRICTUS (Casey). Ann. N. Y. Acad. Sci., IX, 1897, 660.

This form, described from New Mexico and therefore not mentioned in the "Rhynchophora," is regarded as a valid species by Chittenden, and under it he places as synonyms the *B. longipes*, *virginicus* (in part), *ordinatus*, *utensis* and *tubulatus* of Casey.<sup>14</sup> Its range is given as extending from Pennsylvania and West Virginia west to Utah and New Mexico. He includes specimens taken by me in Putnam County, Ind., and referred to *nasicus* Lec. Reared from acorns of various species of oak.

— CURCULIO PARVIDENS (Chitt.). Proc. Ent. Soc. Wash., X, 1908, 24.

This form, mentioned on page 272, is retained by its author as a valid species. It occurs in North Carolina, Florida, Mississippi, Alabama and Texas. Reared from acorns of various oaks.

389. CURCULIO CONFUSOR (Ham.).

Retained as treated in the "Rhynchophora" and breeds only on the two species of oaks there mentioned. The known range is extended to Wisconsin, South Dakota and Missouri.

— CURCULIO ORTHORHYNCHUS (Chitt.). Proc. Ent. Soc. Wash., X, 1908, 26.

This form, mentioned on p. 267, is retained as a valid species by its author. The range as given extends from New Jersey west and southwest to Wisconsin and Texas. Breeds in acorns.

390. CURCULIO BACULI (Chitt.).

The range of this species is extended to include Quebec, Ontario, Wisconsin, Florida and Texas. The acorns of eight species of oaks are mentioned as host plants. The *B. curtis* Chitt. (p. 271) is placed as a variety.

391. CURCULIO HUMERALIS (Casey).

This form is retained by Chittenden as a valid species. Although Leng (p. 272) states that it occurs in Georgia and Flor-

<sup>14</sup> Can. Ent., XLII, 1910, 123-127.

ida, both Casey and Chittenden state that it is known from a single male from extreme southern Florida.

392. *CURCULIO OBTUSUS* (Blanch.).

The range of this hazelnut weevil is extended to include Ontario and Manitoba, Canada, Mexico and Guatemala.

\*— *CURCULIO NUMENIUS* Chitt., loc. cit., p. 178.

The range as given includes eastern Ontario, Manitoba, Michigan, northern Indiana, Iowa, South Dakota and Colorado. No host plant is mentioned.

\*— *CURCULIO FUNICULARIS* Chitt., loc. cit., p. 179.

Described from Toronto, Canada, and Las Vegas, New Mexico. No host plant mentioned.

— *CURCULIO IOWENSIS* (Casey), Can. Ent. XLII, 1910, 122.

This form was described from Iowa, and therefore not included in the Rhynchophora. Chittenden gives its range as extending from Rhode Island and New York west to Wisconsin and Kansas and south to North Carolina. Breeds in the acorns of oaks of various species.

\*— *CURCULIO EXILIS* Chitt., loc. cit., p. 182.

Described from a unique female taken at Ottawa, Ontario.

In his paper Dr. Chittenden recognizes forty species of these nut weevils from Boreal America, twenty of them from the area covered by the Rhynchophora, as against ten treated by Leng in that work. Judging from my forty-five years' experience in field collecting, I believe that one-fourth or more of the species at present recognized, especially those breeding on oak, will prove to be synonyms or mere varieties. It will be noted that Dr. Chittenden makes no one of his previously described species a synonym and but one of them a variety.

— *ORCHESTES TESTACEUS* Mul.

C. A. Frost informs me that this red European species has been recently taken by him at Paris, Maine, Emo, Ontario, and New

Brunswick, and that A. S. Nicolay has found it in New Jersey. On account of lack of specimens or description, no brief diagnosis can be given.

441. *ANTHONOMUS UNIFORMIS* Blatch.

This weevil is quite common about Dunedin, January to April, on the foliage and fruit pods of a shrubby St. Johnswort, *Hypericum aspalathoides* Willd. Taken also at Gainesville and Royal Palm Park, Florida, on the same plant.

— *ANTHONOMUS BICOROSTRIS* Blatch.

Three examples of this recently described species<sup>15</sup> were taken at Dunedin, December 22–March 19, by beating dead branches of elder. At Miami and Royal Palm Park, the type and only other known localities, it was found only on the potato tree, *Solanum verbascifolium* L.

448. *ANTHONOMUS XANTHOCNEMUS PICIPES* new variety.

The principal character used by Dietz in his key<sup>16</sup> to separate *A. xanthocnemus* from its close allies was “base of middle and hind thighs and distal half of tibiae and tarsi, honey-yellow.” A weevil received from Frost, labelled “Olive Branch, Ill., IX–5–’23” is evidently a variety of *xanthocnemus* having the legs wholly piceous-brown, and the antennae, except the apical third of scape and basal joint of funicle, of the same hue. The pubescence of the sides of the under surface is also much less dense. Length 3.2 mm.

453. *ANTHONOMUS JUNIPERINUS* (Sanborn).

This little dull yellow Anthonomid has been recently found to occur in numbers, November to April, on Juniper near Dunedin, Fla., but has not been taken by me elsewhere in the State. No previous definite station record for Florida can be found.

480. *PRIONOMERUS CALCEATUS* (Say).

An apparently scarce species in Florida. At Dunedin only two specimens have been taken in fourteen years. They were se-

<sup>15</sup> Journ. N. Y. Entom. Soc., XXXIII, 1925, 97.

<sup>16</sup> Trans. Amer. Ent. Soc., XVIII, 1891, 220.

cured in March and April by sweeping herbage in low wet hammocks.

510. *LIXUS FIMBRIOLATUS* Boh.

Dr. F. H. Chittenden has recently recorded<sup>17</sup> this species from Chevy Chase and Riverdale, Md., where it was found on the pale-leaved sunflower, *Helianthus strumosus* L. Its known range has hitherto been recorded as extending from northern and central Indiana west and south to Utah and Texas.

*Lixus pusio* new species.

Elongate, very slender, sides subparallel. Black, shining, above thinly clothed with very short, prostrate grayish and rust-colored hairs, these in places condensed to form small scattered spots on disk and sides of elytra; tarsi piceous. Antennæ pale reddish-brown, club dusky, densely pubescent with short brownish hairs, joints 2-4 of funicle very short, subequal. Beak scarcely as long as thorax, stout, cylindrical, its punctures fine, dense, linear, rugose, the basal half with a fine but evident median carina. Thorax subconical, but slightly longer than wide at base, its sides straight and converging from base to apex; disk finely rugose with but few scattered coarse punctures and with a fine but distinct median impressed line reaching from apical third to the small but deep basal concavity. Elytra with sides continuous with those of thorax, conjointly two and a fourth times as long as wide at base; tips separately obtusely angled; discal punctures rounded, close-set. Length 7.5 mm.

Type a male from Dunedin, Fla., swept November 25 from herbage growing on the margin of a pond. Belongs to Group I, p. 332, of the "Rhynchophora" and allied to *scrobicollis* Boh., but much more slender. Differs in the sculpture of both beak and thorax, the latter with sides straight and convergent throughout, not narrowed and constricted near apex as in *scrobicollis*.

517. *LIXUS SEXUALIS* Casey.

Leng, in his "Catalogue," records this species only from Texas. Specimens are at hand from Sarasota and Dunedin, Fla., one of which was named by Casey. The Sarasota specimens are recorded in the "Rhynchophora." The one from Dunedin was

<sup>17</sup> Bull. Brooklyn Entom. Soc., XX, 1925, 123.



swept November 24 from tall dead grasses along the margin of a pond.

530. *BARIS SUBÆNEA* (Lec.).

This rather large brownish-bronzed Barid has not hitherto been recorded south of the District of Columbia and Arkansas. A single male was swept March 31 from the flowers of natal grass, *Tricholæna rosea* Nees, near Lake Wales, Fla.

533. *COSMOBARIS SCOLOPACEA* (Germ.).

Two examples of this introduced European Barid were taken June 28, 1927, while sweeping herbage alongside the canal five miles north of Indianapolis. This is the first Indiana record and it has been taken elsewhere from west of the Alleghanies only by Wolcott at Willow Springs, Ill.

534. *BARIS PUNCTIVENTRIS* Casey.

Two specimens are at hand taken in Knox Co., Ind., September 18, which I refer to this species. It was described from Louisiana, Missouri and Indiana without definite station records.

There are in my collection from Indiana and Florida eight species of the genus *Baris* evidently differing from those treated in the "Rhynchophora." Until I have opportunity of studying the types of Maj. Casey, now in the U. S. National Museum, six of these will be held in abeyance. The other two are minute species from Royal Palm Park which differ so widely from any of Casey's descriptions that I describe them as hitherto unknown.

—, *Baris seminola* new species.

Broadly oval. Color a uniform strongly shining reddish-brown, antennæ and legs slightly paler. Beak very stout, strongly curved, one-fifth shorter than thorax, both it and head minutely and very sparsely punctate, the latter also finely alutaceous. Thorax subquadrate, as broad as long, strongly convex, sides straight from base to apical third, thence rounded into apex; disk finely and very sparsely punctate, the punctures separated by two or three times their own diameters. Elytra conjointly oval, about twice as long as broad, widest at basal fourth, thence very broadly and feebly curved to the separately rounded tips; disk deeply striate, striæ with very fine

elongate punctures; intervals feebly but evidently convex, with a single row of very minute punctures, these each bearing a fine, short hair, visible only when viewed from the side under a high powered lens. Pygidium and ventrals relatively evenly and sparsely punctate. Length 2 mm.

A single specimen taken at Royal Palm Park, April 8, 1925, by sweeping roadside herbage. Belongs to Group C. p. 355, of the "Rhynchophora." The brown color, small size, very stout beak and feeble sculpture of entire upper surface form a combination of characters distinctly separating it from any species there or elsewhere described.

— *Baris palmensis* new species.

Elongate-oval. Dark brown, strongly bronzed, antennæ and legs dark reddish-brown. Beak about two-thirds as long as thorax, moderately stout, slightly curved, subcylindrical, sides somewhat flattened, sparsely striate-punctate, distinctly constricted at basal third. Head opaque, densely alutaceous, impunctate. Thorax subconical, scarcely as broad at base as long, sides feebly and broadly curved, more strongly so toward apex, which is only about one-half as wide as base; disk, except on apical fifth, rather coarsely shallowly and evenly punctate, the punctures separated by more than their own diameters. Elytra conjointly oblong, umbones prominent, sides straight and subparallel to apical third, thence converging and rounded into apex; discal striæ fine, minutely punctate, intervals flat, each with a single row of very fine punctures, each puncture enclosing a minute seta. First and second ventrals finely, sparsely and irregularly punctate, third and fourth each with a single preapical transverse row and fifth with two transverse rows of fine punctures. Pygidium coarsely and densely punctate. Length 2.3 mm.

Described from a single specimen taken March 28 at Royal Palm Park, Fla., by beating leaves of cabbage palmetto on Long Pine Key. The small size, constriction of beak and peculiar sculpture of ventrals distinguish this from other known species of Group C of the "Rhynchophora."

570. *PSEUDOBARIS NIGRINA* (Say).

While this common species is mentioned as "ranging over the eastern United States," few definite station records from Florida are available. It is at hand from Jacksonville and is recorded by Schwarz from New Smyrna and by Casey from Key West. It is

apparently scarce in that State, as I have never taken it personally.

— *CENTRINASPIS ARGENTIS* Blatch.

Two examples of this recently described<sup>18</sup> species have since been taken near Indianapolis, July 10 and 28, by sweeping in dense woodland. The types were from Crawford Co., Ind., near the Ohio River.

*Centrinaspis (Centrinus) bracatoides* new species.

Elongate-oval. Black, feebly shining; antennæ and legs reddish-piceous; above thinly clothed with small oval whitish scales which are somewhat condensed on sides of thorax. Beak rather stout, three-fourths the length of thorax, strongly curved, subcylindrical, marked with regular rows of small, rather close-set punctures. Head alutaceous, very finely sparsely and irregularly punctate. Thorax subquadrate, one-third wider than long, sides broadly curved from base to apex which is feebly tubulate; disk subtectiform with sides sloping from the crest or very narrow smooth median line, densely punctate, the punctures round, contiguous, those on sides each bearing a white scale, the middle with only a few scattered scales. Elytra conjointly oval, two-thirds longer and not wider than thorax; sides very broadly feebly curved from base to apex; disk finely deeply striate, intervals concave, the second with two rows, the others with a single row of white scales. Under surface rather finely and sparsely punctate, each puncture enclosing a white scale. Male with middle of first and second ventrals broadly shallowly concave. Length 3 mm.

Type a male, taken at Dunedin, Fla., March 26, by sweeping along the bay front. Resembles *Anacentrus (Limnobaris) bracata* Casey in form, size and arrangement of scales on thorax, the nude central area being distinctive. Other specimens are in the collection of H. C. Fall, Tyngsboro, Mass.

582. *CENTRINASPIS PENICELLA* (Hbst.).

My first Florida specimen of this rather common northern species was taken at Dunedin, April 2, 1926. No published definite station record from the State can be found but Schwarz, in his manuscript notes,<sup>19</sup> mentions it from St. Augustine.

<sup>18</sup> Journ. N. Y. Ent. Soc., XXXIII, 1925, 102.

<sup>19</sup> For a brief account of these "Notes," see footnote p. 419, Can. Ent., L, 1918.

593. *NICENTRUS LINEICOLLIS* (Boh.).

This species occurs in Central Indiana in July and August on the flowers of staghorn sumac, *Rhus hirta* (L.). Framingham, Mass., August 4 (*Frost*).

— *NICENTRUS GROSSULUS* Casey.

This species, omitted in the "Rhynchophora" but mentioned in my first supplement,<sup>20</sup> was present, March 19 and April 21, 1927, by hundreds on the stems and fruit heads of a sedge, *Fimbristylis castanea* (Michx.), growing in a tide-water marsh two miles north of Dunedin. With it on the same plant were numerous specimens of a small Chrysomelid, *Chætocnema robusta* Blatch. Both had been previously recorded from Hog Island, opposite Dunedin, as found on the low fleshy sea-blite, *Batis maritima* L. However, as both sedge and sea-blite grow together, the sedge is doubtless the correct host plant.

— *Anacentrus (Limnobaris) vicarius* new species.

*Male*: Narrowly oval, rather strongly convex. Black, shining, femora dark reddish-brown, tibiæ and tarsi paler. Beak chestnut-brown, one-fourth shorter than thorax, slender, subcylindrical throughout, slightly flattened in apical fourth, feebly curved, minutely and sparsely punctate; antennæ inserted at apical third, scape not reaching eye, joint 1 of funicle subelavate, twice the length of 2. Head minutely and very sparsely punctate. Thorax scarcely wider than long, sides broadly curved; disk slightly constricted near apex, coarsely punctured, the punctures almost contiguous, those on sides each bearing a conspicuous white oval scale, the middle with a rather wide smooth line extending from apex to basal fourth. Elytra conjointly oval, one-half longer than wide at base, sides slightly converging from base to apical third, thence more strongly so into the rounded apex; disk with umbones prominent, smooth, striæ fine, deep, impunctate; intervals flat, vaguely alutaceous, each with a single row of rather large punctures, these punctures near base, on sides and behind middle, each bearing a white oval scale. Under surface coarsely punctate, each puncture with a similar scale; ventrals 2 and 3 with a wide, shallow median impression. *Female*: Larger, more broadly oval, more robust; punctures of thorax finer, more crowded; elytral intervals 3 and 5 each with two irregular rows of scale-bearing punctures; ventrals 2 and 3 not impressed. Length—Male, 2.3 mm.; female, 3 mm.

<sup>20</sup> Journ. N. Y. Ent. Soc., XXVIII, 1920, 169.

Described from two males and one female, taken at Dunedin, Fla., March 21–April 5, by sweeping low herbage along the sides of ditches and ponds. Mr. L. L. Buchanan, at my request, kindly compared it with the types of *A. ornatus* Casey, to which it is evidently closely allied. He reported that species to have the beak much stouter and thicker at base, legs much more slender, and scales of thorax and elytra yellowish and much more abundant. He also stated that *A. ovulatus* Casey, another recently described southern species of the *bracata* group, is a smaller, narrower form with a much longer beak.

**Sibariops (*Limnobaris*) *pellax*** new species.

Elongate-oblong, subcylindrical. Black, feebly shining, antennæ and legs reddish-brown, knees darker. Beak of male as long as thorax, distinctly not strongly curved, above with an entire obtuse median carina; antennæ inserted at apical third, sides behind them densely punctate, in front almost smooth. Head and thorax minutely alutaceous, the former very finely sparsely, irregularly punctate. Thorax subcylindrical, as long as basal width, sides subparallel, feebly converging near apex, which is tubulate; disk at middle finely and rather sparsely punctate, the punctures separated by their own diameters, on sides more densely punctured, the punctures contiguous and in evident rows. Elytra not wider than and twice as long as thorax, sides straight and parallel to apical third, thence broadly rounded into apex; disk finely striate, the striæ impunctate; intervals flat, twice as wide as striæ, each with a single row of minute punctures, these each bearing a very fine prostrate grayish hair. Under surface finely and evenly punctate, each puncture enclosing a minute white scale. Side pieces of metasternum densely clothed with larger scales. Male with middle of first and second ventrals widely and deeply impressed, prosternum concave at middle, with a short obtuse spine in front of each coxa. Length 4 mm.

Type a male taken near Dunedin, Fla., April 17, 1926, while sweeping along the bay front. Belongs to *Limnobaris*, Group B, p. 397, of the "Rhynchophora." Readily distinguished by the color of its legs, the regular rows of punctures on flanks of thorax and the very fine pubescence of elytra. This was also compared by Mr. Buchanan with the types of the species of the genus *Sibariops* described by Casey. He wrote that "it does not agree with any of the numerous forms in the Casey collection."

617. *DIRABIUS (LIMNOBARIS) RECTIROSTRIS* (Lec.).

Weiss and West have recently given<sup>21</sup> an interesting account of the feeding habits of this weevil in New Jersey. They call it the "rush weevil," as there the adults were found in June feeding upon the flower buds and tender developing stem sheaths of the dark green bulrush, *Scirpus atrovirens* Muhl., and the woolgrass, *Scirpus cyperinus* (L.). The eggs were laid singly in cavities made by the female in the stems of the rushes. The larvæ hatch in late June or July, feed upon the pith in the center of the stem, and in September form cells in the pith six or eight inches above the ground, where they hibernate. In May they transform to pupæ and emerge as adults in early June. Only a dozen or so specimens of the beetle have been taken in Indiana, but it might be found commonly on the same rushes if a special search were made.

— *BARINUS ELUSUS* Blatch.

Three or four examples of this prettily marked Barid are taken near Dunedin each spring by sweeping low herbage along ditches, ponds and bay front. It was described from Dunedin and has not been recorded elsewhere.

678. *COELIODES FLAVICAUDIS* Boh.

A single specimen of this prettily marked little Ceutorhynchid was taken April 10, 1926, at Dunedin while sweeping. It has not before been known from Florida, the range as given in the Rhynchophora being "New England and Canada west and southwest to Wisconsin, Colorado and Texas."

*Perigaster alternans* new species.

Broadly oval. Dark piceous-brown, shining; antennæ, tibiæ and tarsi reddish-brown, the tibiæ with a broad fuscous ring at middle; tips of femora and apical margin of elytra also reddish-brown; upper surface thinly clothed with white scales, those on sides of thorax larger and more condensed. Beak scarcely as long as head, very stout, widened in front, thickly and finely punctate and with an obtuse median carina. Front of head flat-

<sup>21</sup> Journ. Ent. Soc. N. Y., XXXII, 1924, 196.

tened, coarsely densely punctate, the punctures of occiput in striae. Thorax at base one-third broader than long, sides converging from base to apex; disk uneven, with but a vague trace of a dorsal channel, the middle third transversely convex, the two apical tubercles very small, acute, the posterior ones obtuse, widely separated; punctures of middle of disk small, contiguous, each enclosing a minute brassy scale, those on sides larger, each bearing a much larger oval white scale. Elytra strongly convex, widest at basal third, the sides thence feebly curved into the separately broadly rounded tips; disk with alternate intervals distinctly wider and higher, the striae with coarse, close-set punctures. Under surface coarsely, not densely punctate, each puncture enclosing a white scale, those on mesosternal side pieces notably condensed. Hind femora annulate with white scales at apical third. Length 2.7 mm.

Type a female sifted from weed debris April 4, 1925, at Royal Palm Park, Fla. Differs from our other two species in its distinctly alternating wide and narrow intervals, and much more coarsely punctured striae of elytra, as well as in the sculpture and uneven surface of the thorax.

### 733. *CONOTRACHELUS SENICULUS* Lec.

Mutchler and Weiss have recently issued<sup>22</sup> an interesting and valuable paper entitled "Beetles of the Genus *Conotrachelus* Known to Occur in New Jersey," in which they call this the "*Amaranth curculio*," and state that it is a root and stem feeder on both wild and cultivated species of amaranth. It is one of the most common species in both Indiana and Florida, the amaranth being a common weed in both states.

### 750. *CONOTRACHELUS ANAGLYPTICUS* (Say).

Fred. E. Brooks, Entomologist Fruit Insect Investigations, U. S. Bureau of Entomology, has recently issued<sup>23</sup> a paper giving the life history of this common weevil. He calls it the "*cambium curculio*," as it feeds on the cambium layer of bark of various kinds of fruit and other trees, thus preventing the healing of wounds. It also lays its eggs in the skin of ripening peaches and in the bolls of cotton. A specimen from Dunedin, Fla., is only 3 mm. in length.

<sup>22</sup> Circ. No. 87, New Jersey Bureau of Statistics and Inspection, 1925.

<sup>23</sup> Journ. Agric. Research, 28, 1924, pp. 377-386, Pls. I and II.

755. *RHYSSEMATUS PALMACOLLIS* (Say).

Taken in recent years at Miami and Royal Palm Park, Fla. Recorded from four other Florida stations in the Schwarz notes, and probably occurs throughout that State.

776. *PARACAMPTUS SUBTROPICUS* Casey.

Two specimens of this rare subtropical species were taken at Royal Palm Park, April 12 and 15, 1927, while beating in the dense hammock. Known heretofore only from Punta Gorda, Fla., the type locality.

780. *PSEUDOMUS INFLATUS* Lec.

This has been supposed to be a strictly subarctic species, but a number of specimens have been taken in the same hammock, which is twelve miles from the nearest point on the coast. Several other forms of insect life, hitherto recorded only from the coast, have also been taken there, indicating that the isolation of this everglade key from the coast is of comparatively recent date.

781. *PSEUDOMUS SEDENTARIUS* (Say).

This scarce Florida species, recorded in the "Rhynchophora" only from Ormond and Enterprise, is at hand from Gainesville and Lakeland. The Gainesville specimen was beaten from holly on February 21.

788. *ACALLES CLAVATUS* Say.790. *ACALLES SYLVOSUS* Blatch.

The first specimens of both these weevils from the west coast of Florida were taken recently at Dunedin, the former one on April 10, 1926, while sweeping ferns in a dense hammock; the latter on April 14, while sweeping along the bay front. Both are very common in company with *A. minimus* Blatch, in the dense hammock on Paradise Key.

— *APTEROMECHUS MICROSTICTUS* Fall, Bull. Brooklyn Entom. Soc., XX, 1925, 88, 123.

This new species was described from St. Petersburg, Dunedin, Miami and Lake Poinsett, Fla. It differs from *A. ferratus* Say



in being a little smaller and narrower and in having intervals 3-5-7 of elytra more narrow and conspicuously elevated. The spots of whitish scales on these intervals in *ferratus* are each replaced in *microstictus* by a single white scale arising from tufts of brown ones. In my collection *microstictus* is at hand from Dunedin and Istokpoga, Fla., and was taken, February-April, by beating the swamp red bay, *Tamala pubescens* (Pursh.), in dense hammocks. *A. ferratus* is in my collection from New Jersey, southern Indiana, Knoxville, Tenn., and Royal Palm Park, Fla.

### 813. CRYPTORHYNCHUS TRISTIS Lec.

Two specimens of this scarce weevil were taken in Marion Co., Ind., July 5, 1926, by beating *Crataegus*.

— *Trichacorynus sulcirostris* new species.

Differs from *T. brunneus* Blatch., the genotype and only other known species, in its larger size and darker chestnut-brown color. Beak broader, above distinctly, widely and shallowly grooved; both beak and head more closely, evenly and deeply punctate, the latter with a small fovea between the eyes. Antennæ as in *brunneus* except that the basal joint of club is almost wholly glabrous, the others densely pubescent with coarse yellow hairs. Thorax with punctures much larger, thicker and more evenly placed, separated by about their own diameters. Other characters as in *brunneus*, the peculiar sculpture of elytra being especially notable. Length 3.5 mm.

Type received from C. A. Frost and labelled "N. Brunswick, N. J., X-8."

### 821. DRYOPHTHORUS AMERICANUS Bedel.

A dozen examples of this peculiar Cossonid were taken December 12, 1925, from beneath loose bark of pine in my lot at Dunedin. They feigned death when uncovered and were so similar in hue to the debris on the under side of the bark that they were very difficult to find. The Sanford record in the "Rhynchophora" is the only previous definite one for the State.

### 846. TOMOLIPS QUERCICOLA (Boh.).

Schwarz listed<sup>24</sup> this species from "New Smyrna and Enterprise, Fla., very rare." Dozier recorded<sup>25</sup> it as taken at light at

<sup>24</sup> Proc. Amer. Phil. Soc., XVII, 1878, 468.

<sup>25</sup> Ent. News, XXIX, 1918, 374.

Gainesville, May 9. I took it at Gainesville, February 7, from beneath bark of a dead magnolia. These are the only records for the State.

— *Pseudopentarthrum fraternum* new species.

Elongate, subcylindrical. Black, shining, antennæ and legs picceous, club and tarsi paler. Beak as long as head, stout, coarsely rugose-punctate. Head alutaceous, finely, sparsely and unevenly punctate and with a distinct frontal fovea. Antennæ as in *simplex*, the basal joint of funicle very large, the club scarcely differentiated from the funicle. Thorax one-third longer than wide, sides broadly rounded, disk finely alutaceous, distinctly constricted near apex, closely not finely punctate, the punctures round, ocellate, separated by about one-half their own diameters. Elytra at base one-third wider than middle of thorax, sides straight and parallel to apical third, thence broadly curved into apex; striæ deeper than in *simplex*, their punctures fine and more serrate than there; intervals narrower and more convex, each with an irregular row of minute punctures. Under surface coarsely and sparsely punctate; ventrals 3-5 more finely so. Length 2.7 mm.

Type taken at Gainesville, Fla., February 21, 1927, while beating holly, farkleberry, etc. Taken also at Dunedin, February 23, by sifting weed debris. Differs from *simplex*, our only other eastern species, in the much narrower, less rounded thorax. In *simplex* the thorax is as wide as long with sides strongly rounded, and the elytra at base are not wider than its middle. In *fraternum* the striæ of elytra are deeper and intervals narrower and more convex. The strial punctures are open on their outer side, thus giving the rows a serrate appearance. The peculiar structure of the antennæ in these two species easily separates them from all other eastern Rhyncholini.

851. *PENTARTHRIUS ATROLUCENS* Casey.

I refer to this species several specimens taken at Dunedin in recent years in January and March by beating dead leaves of cabbage palmetto. It has been recorded only from Enterprise and Biscayne Bay on the east coast.

859. *RHYNCHOPHORUS CRUENTATUS* (Fabr.).

The great majority of the Florida specimens of this, the largest of our eastern weevils, are wholly black above and beneath and

belong to the var. *zimmermanni* Fahr. In the typical *cruentatus*, only occasionally found, the thorax is dull red with a median black stripe, sides broadly margined with black, the elytra black with red spots and under surface wholly piceous. In a third as yet unnamed variety, mentioned by Horn,<sup>26</sup> the thorax is dull red with two median spots black, the elytra in great part red with scattered black spots, and the under surface, except ventrals 2-5, also red. My first example of this last variety was recently received from Royal Palm Park.

Dr. W. D. Pierce has recently shown<sup>27</sup> that the generic name *Sphenophorus* Schön., 1838, used for our corn bill bugs in the "Rhynchophora," and by other authors for the past century or longer, is an isogenotype of *Calendra* Clairv.—Schell., 1798, and will therefore have to be replaced by that name. He shows also that the generic name *Calandra* Clairv. used in the "Rhynchophora" for the grain weevils must be changed to *Sitophilus* Schön., 1838.

#### 864. CALENDRA (SPHENOPHORUS) LATINASUS (Horn).

My second specimen of this rare weevil was taken at Dunedin, March 4, 1926, while sifting weed debris grown in muck soil near the border of a hammock. But three specimens are known, *viz.*, Horn's type, taken in Georgia and my first example from Moore Haven, Fla.

#### 873. CALENDRA (SPHENOPHORUS) VELUTINUS (Lec.).

Up to December, 1924, only two specimens of this scarce species were known, *viz.*, the type from an unrecorded station in Florida, the other from Louisiana in the Horn collection. In that month I was much pleased to take four while sifting the roots of a dense bunch of wire grass growing in a glade in front of the Lodge at Royal Palm Park. In April, 1925, Mr. Fall and I took three others at the same place in the same manner, and in April, 1927, a single specimen was found beneath a gunny sack

<sup>26</sup> Proc. Amer. Phil. Soc., XIII, 1873, 108.

<sup>27</sup> Proc. Ent. Soc. Wash., 1925, 113.

on Long Pine Key, about two miles from the Lodge. It differs from all our other species mainly in the smooth, dark velvety coat which covers the entire upper surface. The males are 11 mm. in length, the females, 13.5–14 mm.

900. *SITOPHILUS* (*CALANDRA*) *RUGICOLLIS* (Casey).

Mr. R. T. Cotton has recently shown<sup>29</sup> that this is the same as the *Calandra shorea* Marshall from India and *Calandra rugosicollis* Hustache from Mauritius. Casey's name has priority over both. Mr. Cotton thinks that the weevil is indigenous to India and was probably introduced in seeds into "southern Florida," the type locality of Casey's specimen.

In the second and third lines of the key on page 466 of the "Rhynchophora," "Head" should be "Thorax," and in the second line "tuberele" should be "tubercles."

<sup>29</sup> Proc. Entom. Soc. Wash., XXVI, 1924, 141.

## LARVAL CHARACTERS OF GENUS DIXA

BY FRANK K. SMITH

This study of the larval characters of the genus *Dixa* was made at Cornell University during 1925 and 1926. Detailed observations were made upon the larva of *D. cornuta* Joh., and later observations of the larvæ of nine other species were made for the purpose of finding characters by which the larvæ of the different species studied could be differentiated. For many of the specimens and many helpful suggestions the writer is very grateful to Dr. O. A. Johannsen.

DESCRIPTION OF THE LARVA OF *D. CORNUTA* JOH.

The larva of *D. cornuta* Joh. is subcylindrical and, in the instar preceding pupation, about six millimeters in length. It is grayish except the head, which is amber with a fuscous ring around the caudal margin, the spiracular and the lateral plates, the tergum of the tenth abdominal segment, and the entire eleventh segment, which may vary from brownish-yellow to light amber. The body, with the exception of the head and the spiracular and the lateral plates, is pubescent, although the short hairs covering the body are much less dense ventrally than dorsally. (Plate IX, Fig. I.)

A dorsal view of the head presents an outline of two fairly regularly curved sides and a concavity caudad into which the conjunctiva joining the head to the prothorax is attached. At the anterior limits of the curved sides are the antennæ. Caudad of these are the eyes, which may be seen either in the ventral or dorsal view because of their lateral location. From the base of the antennæ the cephalo-dorsal margin of the skull gradually tapers to a point in the region between the mouth-brushes. For about the proximal three-fourths of this distance there is a slight concavity on each side. The remaining distal portion consists of a triangular appendage, fastened to the sides of which are

the mouth-brushes. From underneath this region, along each side, the more ventrally located maxillary palpus, maxilla, and mandible project.

On the dorsal surface of the head capsule are a few constant setæ. A pair is located, one on either side, midway between the base of the antenna and the caudo-lateral margin of the capsule; a second pair, one each near the base of each antenna; a third, one each mesad a short distance from each member of the preceding pair; a fourth, one each at each distal angle of the prolonged dorso-cephalic portion of the skull and just caudad of the respective caudal angle of the labrum; a fifth, one each slightly mesad of each member of the preceding pair. (Plate IX, Fig. I, also Plate X, Fig. XL.) In the figures the pairs are designated respectively *f*, *g*, and *h* in Plate IX, Fig. I and *j* and *i* in Plate X, Fig. XL. Besides these setæ, others seen from the dorsal view will be discussed in connection with the appendages upon which they occur.

The triangular labrum which bears the mouth-brushes is represented by 2 in Plate X, Fig. XL. Each mouth-brush (Plate X, Fig. XL, 1) consists of a cluster of very densely arranged long coarse hairs. The distal ends of these taken collectively present much the appearance of the sweeping surface of a broom. Near the cephalic end of the base of each mouth-brush and to either side of the dorsal surface of the labrum there arises a long bluntly ending seta (Plate X, Fig. XL, *m*) which extends forward to the distal ends of the mouth-brushes. Near the caudal end of the base of each mouth-brush and on the dorsal surface of the labrum is a short clavate seta (Plate X, Fig. XL, 1) about equal in length to the basal width of the brush. Mesad a short distance from each of these clavate setæ is a relatively long seta of the usual type. (Plate X, Fig. XL, *k*.) Each antenna has only a single segment with a relatively broad base. It extends forward a distance approximately equal to the distal limits of the mouth-brushes and is heavily spined upon the distal half. As seen under high magnification the distal end is slightly rounded, though blunt at the extreme tip which is fringed with short spines. There is a small seta on the outer margin one-

fourth of the distance from the distal end and a brush of hair on the inner margin covering approximately the second fourth of the antenna from the distal end. (Plate IX, Fig. III.)

The general outline of the ventral surface of the head is about as in the dorsal aspect with the exception that the cephalic margin, which is not greatly extended forward, presents three rounded triangular projections—a mesal one and one on each side. (Plate IX, Fig. III.) From beneath the cephalic margin—viewing the specimen ventrally—the mouth parts extend. From beneath the mesal projection the “hypopharynx” extends, on each side of which is a maxilla. From underneath the inner margin of each maxilla a row of long mandibular hairs or cilia extend mesally and curve toward the dorsal extension of the skull. Finally, from underneath all these parts—when viewed ventrally—the labrum and long mouth-brushes extend cephalad.

There are a few setæ characteristic of the ventral region of the head, exclusive of its appendages. (Plate IX, Figs. II and III.) The best developed pair is located one on each side of the mesal line and in the occipital region at the junction of the head with the conjunctiva (Plate IX, Fig. III, n); a second pair, one on either side about two-thirds of the distance caudad between the base of the antenna and the caudal margin of the head. (Plate IX, Fig. III, o); and a third, one each at the apex of each of the lateral projections of the cephalic margin of the ventral surface of the head capsule. (Plate IX, Fig. III, u.) A group of three is arranged in the form of a triangle slightly ventrad of the base of each antenna and of these the one caudad is much smaller. (Plate IX, Fig. III, s.) Besides these setæ of the ordinary type there are three pairs of clusters of setæ, each cluster like a bundle of fagots and arising from a common puncture. A pair of such clusters is located, one at each end of the base of the mesal projection of the ventro-cephalic margin of the head capsule (Plate IX, Fig. III, t); and a second pair, one each near the middle of the inner side of each lateral projection of the ventro-cephalic margin of the capsule. (Plate IX, Fig. III, t'.) The structures upon which a third pair of such clusters is located has not been definitely determined. It seems that one

of this pair is located in each of the lateral fossæ between the dorsal and ventral cephalic extensions of the skull—the fossæ in which the bases of the mandibles and the maxillæ have their articulation. (Plate IX, Fig. III, t".)

The eyes and the antennæ, because of their lateral position, have the same relative location in the ventral as in the dorsal aspect.

Some mouth parts are much better observed from the ventral than from the dorsal aspect. The uppermost of these (viewed ventrally) are the maxillæ (Plate IX, Fig. III and Plate X, Fig. I.) They are thin, colorless, membranous flaps, only slightly thickened towards the outer margin, and fitted distally with numerous small hairs recurved mesally and at their inner bases with numerous short straight hairs. From the outer margin of the base of each arises a two-jointed palpus of which the basal segment is not more than one-fourth as long as the distal one and lacks spines, but bears a short seta on the outer distal surface. The second segment enlarges slightly and gradually towards the tip and tends to become rounded at the distal end, although, as seen under high magnification, the extreme tip is truncate and fringed with short spines. The distal four-fifths of the second segment is spiny, but the spines are stronger and more obvious upon the distal half.

Dorsad of the maxillæ and closely united to them at their bases are the mandibles. (Plate X, Fig. IV and Plate IX, Fig. III.) The mandible is greatly thickened towards its outer margin and tapers distally to a point. Due to the gradual increase in width toward the outer portion of the mandible its base is triangular in outline with the apex pointing mesally. Only a small portion of the mandible near its inner base is strongly chitinized and typically mandibular in form, having two well-defined apical teeth, (Plate X, Fig. IV, 1). The apex of the more membranous portion is fitted with a small chitinized tooth. Along the strongly curved outer surface, a short distance from the apex, is a depression from which arises a lanceolate spine or claw, equal to or greater than half the length of the mandible. (Plate X, Fig. IV, 2.) On the dorsal surface of the



membranous portion, a short distance from and parallel to its inner margin is a row of long hairs or cilia extending dorsally and curving mesally so as to meet similar structures of the opposing mandible. (Plate X, Fig. IV, 3.) About the middle of the convex outer surface are two setæ, a long one (Plate X, Fig. IV, v), slightly ventrad, and a short one (Plate X, Fig. IV, z), slightly dorsad.

From the ventral wall of the cephalic end of the pharynx arises the so-called "hypopharynx." (Plate IX, Fig. III, 3.) Its base is strengthened by a strong triangular chitinous loop which serves perhaps as a base for its attachment to the wall of the pharynx. This chitinous base may be seen, in the cleared specimen, through the mesal projection of the ventro-cephalic margin of the head capsule. The "hypopharynx" runs cephalad and curves dorsad and its distal cephalic margin is fringed with a number of short blunt spines—arranged superficially as a rake.

The ventral surface of the dorso-cephalic prolongation of the head gradually slopes in a caudo-ventral direction from the mouth-brushes to the dorsal wall of the pharynx. (Plate IX, Fig. I and Plate X, Fig. XL.)

#### THE THORAX

The head is connected to the thorax by means of a relatively long conjunctiva. (Plate IX, Fig. II.) The setæ located on the ventral side at the junction of this conjunctiva with the occipital region of the skull have already been described.

The prothorax is shorter than the mesothorax. In width it is equal to the abdominal segments. (Plate IX, Fig. I.) As seen in the dorsal aspect four setæ are observed in a line across the middle of the segment, two of which are on each side of the mid-dorsal line. These two pairs are so small as to require fairly strong magnification in order to observe them upon the pubescent surface. Each of these pairs is perhaps homologous to two of a group of three small setæ occurring in relatively similar position upon each of the succeeding thoracic segments and each of the abdominal segments from one to eight, inclusive. What has become of the third seta is a matter of conjecture.

However, in the arrangement of the groups of three in the other segments mentioned it is noticed that the inner member of each group of three has a tendency to stand more or less apart from the other two. The other two members are relatively close together. The general arrangement of these groups of three and the fact that the two which occupy a similar position upon the prothorax stand relatively well apart indicates that one of the outer two members of the group of three is apparently absent in this segment. It is possible that the dorsal one of the two short setæ near the long lateral seta, shown in the ventral view of the cephalic margin, is a member of this group of three which has migrated forward. (Plate IX, Fig. I and Fig. II.) However, this sort of condition implies a degree of separation of the outer two of the triad which is not approached in any of the other segments.

The ventral surface of the prothorax has, as already alluded to, a long seta on each side near the cephalic margin with a small seta on each side of it and close to its base. (Plate IX, Fig. II.) There is also another on each side of the mid-ventral line near the cephalic margin. Between each of these and the long lateral seta of its respective side is a group of four, extremely close together at their bases. Still laterad between each group of four and the long lateral of the respective side is another long seta. So the order of long setæ along the cephalic margin of the prothorax is 1-1-4-1-1-4-1-1. The long setæ of the cephalic margin, fourteen in number, extend well beyond the distal ends of the mouth-brushes when the former are pressed flatly against the body. In the natural position these setæ extend cephalo-ventrad.

The mesothorax widens regularly towards its caudal margin. This widening is especially noticeable as the larva approaches the pupation period. On the dorsal surface to either side of the mid-dorsal line is a group of three small setæ. (Plate IX, Fig. I.) Laterad and slightly cephalad of each of these groups is a seta of intermediate length. Like the well-developed setæ of the prothorax these also extend cephalo-ventrad. On the ventral surface in a line extending across the mesothorax about

one-third of the distance caudad of the cephalic margin are four setæ separated by rather uniform intervals—two on each side of the mid-ventral line. (Plate IX, Fig. II.) Slightly caudad of a point midway between each of these pairs is a group of four setæ, arising from as many punctures, extremely close together and spreading apart in a somewhat stellate manner.

The metathorax is much shorter than the mesothorax and gradually widens from its caudal towards its cephalic margin. Viewed laterally the distension of the meso- and metathoracic segments is not so pronounced. The arrangement of the setæ on the dorsal surface of the metathorax is essentially similar to that of the preceding segment. (Plate IX, Fig. I.) Likewise there is a similarity on its ventral surface to that of the preceding segment, with the exception that instead of four setæ stellately arranged on each side there is a pair of setæ which arise from punctures that are very close together. (Plate IX, Fig. II).

#### THE ABDOMEN

The first and second abdominal segments are so alike in structure and arrangement of setæ that they will be considered together. On the ventral surface about one-third of the distance caudad of the cephalic margin is a pair of prolegs, one on each side of the mid-ventral line. They are fleshy lobes equipped at the distal ends with rows of densely fitting claws, which curve toward the cephalic surface of the prolegs. (Plate IX, Fig. II.) The triads of setæ on the dorsal surface are in their typical position and arrangement as shown in the figure. (Plate IX, Fig. I.) Laterad of each of these triads is a pair of longer setæ located in a transverse line with reference to each other. Homologues of these pairs are present also on the abdominal segments from the third to the seventh inclusive. They possibly occur also on the eighth, but the homologies of this segment because of its specialization are not so evident. On the ventral surface of the second abdominal segment there is a transverse row of four setæ in a position similar to the transverse rows of four on the meso- and metathoracic segments. On the second

abdominal segment the setæ are rather uniformly spaced. A pair is between the bases of the prolegs—one on each side of the mid-ventral line and a seta is laterad of each proleg. On the corresponding surface of the first abdominal segment we have a condition homologous to that of the second except instead of one there is a pair of setæ laterad of each proleg. However, the constancy of these extra setæ may rightly be doubted inasmuch as there were specimens in which they could not be definitely located. In a few they were quite distinct. On each of these segments there is a pair of setæ laterad and slightly caudad of the outer members of the transverse rows of four. These pairs perhaps have homologues in the pairs caudad of the outer setæ of the ventral transverse row on the metathorax.

While mention has been made of the homologues of setæ, we might consider a few which have no obvious homologues. The stellate group of four on the ventral surface of the mesothorax is such. These may be composed of two setæ homologous to the ventro-lateral pairs on the metathorax and the abdominal segments plus two other setæ independently developed. (Plate IX, Fig. II, *c* and *c* + 2.) In like manner the group of four long setæ on the ventral surface of the prothorax may consist of two homologous to the lateral pairs mentioned above plus two independently derived. Furthermore, if such is the correct interpretation of the homology of this group, it has not remained caudad of the transverse ventral row of four but has migrated to the cephalic margin of the segment. (Plate IX, Fig. II, *c* + 2.) If this group of four on the prothorax may be interpreted in this manner, it is much more evident that the four long setæ of the prothorax which arise separately—not clustered—on the ventro-cephalic margin should be considered as homologues of the transverse rows of four on the segments, which have been discussed. The long laterals on the dorsal surfaces of the second and third thoracic segments and slightly ventrad on the first may be considered as homologues. (Plate IX, Fig. I, *b* and *b* - 1; Fig. II *b*.) If this point of view is correct, perhaps we should consider that the lateral pairs on the abdominal segments, one to seven, represent a prototypic condition; and that in the place of the single

lateral seta on each of these thoracic segments there was formerly a pair, as occurs at present upon these abdominal segments. Indeed, it may be that the short seta on each side of the ventral surface of the prothorax represents one of this pair of homologues, while the short seta dorsal of the long lateral of the same segment represents one of the group of three of which there are homologues on the dorsal surfaces of other segments, thoracic and abdominal, to and including the eighth abdominal. (Plate IX, Fig. 1, a, and Fig. II, b.) There is, nevertheless, some doubt as to whether the two short setæ of the cephalic margin of the prothorax are constant. In some specimens they were quite distinct, while in others they had either been broken off or were lacking. These remarks will give some idea of the probable homology of these more or less problematical setæ.

The third and fourth abdominal segments constitute a region of the body in which flexing occurs during locomotion. There are neither prolegs, locomotory plates, nor long setæ upon these segments. On the ventral side we have three pairs of setæ which can be rather readily homologized with three pairs upon the preceding segment by reference to the figure. On the dorsal side we have setation very homologous also to that of the preceding segment. (Plate IX, Figs. I and II.)

The fifth, sixth, and seventh abdominal segments are of quite homologous setation and each is fitted with a pair of ventral spinous plates used in locomotion. The arrangement of the setæ upon the dorsal surfaces is so similar to that upon the preceding segment that no comments are necessary in this particular. (Plate IX, Fig. I.) On the ventral surfaces the two pairs of mesal setæ are separated rather widely by the paired plates of spines—otherwise these setæ of the ventral surfaces are arranged as in the preceding segment. The inner pairs of setæ increase in length from the fifth to the seventh segments inclusive—the innermost member of each inner pair upon the seventh extends well beyond the tips of the ciliated lateral plates. On these segments—five to seven—the innermost of each outer pair of setæ is the longer. In these segments and the others the ventral setæ are longer than the dorsal, and those nearest the

mid-ventral line are longer than those more lateral. The spiny plates of each segment consist of from five to eight spines—each varying in length from the very short lateral to longer ones at the center. The plates of each pair are separated by a chitinized area shaped as in the figure. (Plate IX, Fig. II.)

#### THE CAUDAL REGION

The caudal region consists of four segments of very complex nature.

The eighth abdominal segment bears on each side of the mid-dorsal line and upon its caudal margin an ear-like flap which extends laterally. These will, hereafter, be referred to as the spiracular plates. At the proximal end of each plate and on its cephalic margin is a concavity in which the spiracle is located. At the distal end and slightly cephalad on the margin is a very slight indentation from which a short bar or line, apparently of chitin, extends meso-caudad for a short distance across the plate. The dorsal surface of each plate is concave and the margin is fringed with a thick row of hairs or cilia which are somewhat greater in length toward the disto-caudal angle. The spiracles are circular and in the preserved specimen, at least, have a few short lines radiating from the center toward the circumference. (Plate X, Fig. XXIX, 3.) These may represent a closing device. Between the spiracular plates and the mesal line is a small, chordate, chitinized area. Cephalo-laterad of this area on each side is a group of three branched, scale-like or palmate setæ which have a similar location and arrangement with reference to the segment and each other as do the groups of three small setæ on the dorsal surfaces of the more cephalic segments. Because of these conditions these groups of palmate setæ are believed to be the homologues of these setæ arranged in triads upon the segments more cephalad. (Plate X, Fig. XVIII.) The other setæ of this segment (number eight) and their location are as in the preceding segment and readily homologized, with the exception that the innermost of the inner pair on the ventral surface is represented by two setæ in this segment. There is thus an extra seta so that the inner pair of

other segments is represented in this segment by three setæ, which extend to or beyond the point of the last segment. (Plate IX, Fig. II, d + 1.)

The ninth segment is still more specialized than the eighth. Viewed from the dorsal aspect two more or less boat-shaped plates are attached one on each side, and extend caudally in the dorsal plane of the body. These structures have been referred to by Doctor Dyar as the ciliated respiratory tubes, but we shall refer to them as lateral plates, a term used by Tonnoir. The upper surfaces of the structures are concave and the entire margin of each is fringed by a dense row of long stiff plumose hairs or cilia. (Plate X, Fig. XXII.) The hairs toward the distal ends of these plates show a considerable shortening. From underneath the fringe of hair a chitinized point extends caudad. On the dorsal surface of each plate and near the basal inner margin is a knob or tubercle bearing a long seta which extends cephalo-dorsad. (Plate IX, Fig. I.) On the ventral side of each near the outer caudal margin is a smaller seta which points caudo-ventrad. (Plate IX, Fig. II.) Between the bases of these plates is an area of the tergum of the segment which is strongly chitinized and thus serves perhaps to give rigidity and support to the plates. The row of hairs on the outer margin of each plate is continued cephalad from the base to the cephalic margin of the segment to a point just caudad of the base of the spiracular plates. In this manner the hairs of the lateral plates are connected in a continuous row with those of the spiracular plates. The more obvious structures of the ventral side are two ridge-like structures—one on each side. (Plate IX, Fig. II.) Each ridge is fitted with a row of scale-like spines of which most are triradiate. At the mesal end of the ridge is a triradiate spine much larger than the others. This row of spines or scales has been termed the pecten. Between this pecten and the cephalic margin of the segment is a more strongly chitinized area extending dorso-laterad to the outer basal margin of the plate. Cephalad of the pecten a short distance is a minute seta.

The tenth abdominal segment is conical with the apex of the cone directed caudally. The dorsal surface is chitinized more

than the ventral and lacks setæ. On the extreme caudal end of this segment the chitinized area of the dorsal surface extends latero-ventrad and surrounds the ventral portion of that region. From the cephalic margin of this chitinized ventral area about twelve to fifteen spines of more or less branched nature extend caudad for a distance equal to the length of the area. (Plate X, Fig. III, 1.) Between the base of this chitinized area and the more membranous portion is the anus. Pressure in this region upon an alcoholic specimen frequently forces out four anal gills which in the living specimen are retractile. (Plate X, Fig. VI, 1.) The spines which have been mentioned apparently serve as guards for the gill chamber. About midway along the lateral region of this membranous ventral portion on each side is a triangular chitinous plate with an apex pointing cephalad. From this plate three setæ arise and extend well to the caudal tip of the body. (Plate IX, Fig. II.) If these have homologues among the other setæ of the larvæ they may be considered homologous to the three long setæ on each side of the ventral surface of the eighth segment. There is not much evidence to bear out such a conjecture other than the presence of two of the three on the eighth segment upon a chitinized plate, the similar location of the three upon this ninth segment, and the fact that the extra strain put upon this third during swimming by the force of the water, due to its more caudal position, has perhaps led to its inclusion upon the chitinized base with the other two. This last development is a further step in supporting the bases of the long setæ. Such a tendency was observed in the basal supports of the long setæ in the ventral surface of the eighth segment.

The eleventh is quite simple, though of a very different form as compared with the other segments. It is clavate with a small spine-like structure, which is more or less chitinized toward the tip, located at its dorso-caudal extremity. The ventral portion of the caudal end of this segment has a rather rounded outline, as compared with the dorsal portion of this end. The spine-like structure at the caudal end of this segment is not a spine in the sense that its chitin is continuous with the segment at the point



of attachment, for it may be easily and smoothly broken off. Near the distal end of this segment and on the ventral surface to each side of the mesal line arise two very long setæ. A similar seta arises slightly dorsad of each of these two on each side of the distal end. Because of the number being equal, the location similar, and the degree of development about equal to the ventral setæ of the preceding segment, these caudal setæ are thought homologous to them. (Plate IX, Figs. I and II.)

In the study of this larva a few small setæ were found from time to time for which a constancy of occurrence could not be determined. These have not been included in the figures showing setation. The lettering of the setæ represented in the plates indicates the probable homologues by giving the same letter to homologous setæ of the different segments.

#### COMPARATIVE STUDY OF LARVAL CHARACTERS

The preceding description of the larvæ of *Dixa cornuta* Joh. has a greater significance when the characters described are seen in comparison with those of the larvæ of other species. A study of nine species besides *D. cornuta* Joh. has been made. Two of them were unidentified larvæ, from California; *D. alicia* Joh., from the same state; four unidentified larvæ, from New York; *D. modesta* Joh. from New York; and *Dixa fusca* Loew, from Ithaca, New York. For materials necessary for the study of all these species except *D. cornuta* Joh. and *D. fusca* Loew, the writer is indebted to Dr. O. A. Johannsen. Each of these ten species, including *D. cornuta* Joh., shows characters which may be considered as specific.

The species examined may be divided into two groups, for each of which there are numbers of very definite characters. The structural differences marking each group off from the other are very definitely and closely correlated. The species within each group have fewer and less-marked characters by which they may be separated than do the groups.

The parallel columns on the following pages indicate the numerous and well-marked differences of the two groups. *Dixa*

*cornuta* Joh. may be considered as the type for one of the groups; *D. modesta* Joh. for the other group.

## GROUP 1

1. No coronæ on abdominal segments 2-7 inclusive.
2. Long prothoracic setæ. (Plate IX, Fig. II.)
3. Locomotory plates relatively strong and long.
4. Long setæ on each side of last two pairs of locomotory plates.
5. Long ventral setæ on eighth abdominal segment. (Plate IX, Fig. II.)
6. Spiracular plates not distinctly ovoid. (Plate X, Fig. XXIX.)
7. Prespiracular scales palmate and much branched. (Plate X, Fig. XVIII.)
8. Scales or spines of pecten with multiple pointed projections. (Plate X, Figs. IX-XIV.)
9. An acute point at apex or distal end of lateral plate. (Plate IX, Figs. I and II.)
10. Three long setæ from a triangular chitinized plate extend ventro-caudad from each side of the eleventh abdominal segment. (Plate IX, Fig. II.)

## GROUP 2

1. Such are present. (Plate X, Fig. XXXIV.)
2. Relatively short prothoracic setæ.
3. Such plates shorter and weaker.
4. Short setæ on each side of these plates. (Plate X, Fig. XXXV.)
5. Short ventral setæ on this segment. (Plate X, Fig. XXXV.)
6. Ovoid spiracular plates—rather convex on caudal as well as on the cephalic margin. (Plate X, Fig. XXX.)
7. Such scales not palmate, and more slightly branched. (Plate X, Fig. V.)
8. Such scales or spines simple. (Plate X, Figs. VII and VIII.)
9. No such point present. (Plate X, Figs. II, XXXVI, and XXXVII.)
10. All three of these setæ not well developed. Where specimens could be observed of the better developed of the group were found to arise from the distal end of a line of chitin which extends meso-caudad from the margin of the chitinized dorsum of the segment. (Plate X, Fig. XLI.)

- |  |   |
|--|---|
| 11. Caudal segment extends well beyond the apices of the lateral plates. (Plate IX, Fig. I.) | 11. Caudal segment much shorter. (Plate X, Figs. XXXVII and XXXVII'. Also (Plate X, Fig. II.) |
| 12. Hairs on caudal segment distinct. (Plate IX, Fig. I.)                                    | 12. Hairs on caudal segment slight or absent. (Plate X, Fig. II.)                             |

To Group I belong *D. cornuta* Joh., *D. aliciae* Joh., *D. fusca* Loew, species A, species B, and species E. The larva of the first has been described, and below the more important characters of the larvæ of the other species are noted.

*D. aliciae* Larva. Antennæ are with well-developed setæ on outer margin about a third of the length from the distal end, a bunch of hairs on the inner surface of each near the distal end, and finer spines than in *D. cornuta* Joh. (Plate X, Fig. XXXIX.) Teeth of the chitinized area of the mandible are separated by a relatively wide gap, and the second tooth is more prominent than the corresponding tooth of *D. cornuta* Joh. (Plate X, Fig. XXI.) Ventral prothoracic setæ are in the order 1-1-1-4-1-1-4-1-1-1. Locomotory spines are slightly more developed than in *D. cornuta* Joh. The pecten scales commonly have two strong radiating spines and a few weaker ones. (Plate X, Fig. IX.) The caudal segment is shaped as that of *D. cornuta* Joh. This species is from California.

*D. fusca* Larva. The order of the ventral prothoracic setæ of this species is 1-1-1-4-1-1-4-1-1-1. The outer two of the group of three on the dorsal surface of the prothorax are not inconspicuous as in *D. cornuta* Joh. (Plate IX, Fig. I.) Each antenna is similar to that of *D. cornuta*, with a few coarse inner hairs, strong spines over distal half, and a small seta on outer margin a fourth of the distance from the distal end. (Plate X, Fig. XXXVIII.) Extra inner ventral setæ are not only on the eleventh abdominal segment as in *D. cornuta*, but also on the eighth, ninth and tenth abdominal segments. The last of the ventral plates is weaker than the preceding pairs. The pecten scales have eight or nine spines. (Plate X, Fig. XI.)

The dorsum of the head is fuscous; the lower part yellowish-brown. The species is from Ithaca, New York.

\* *Species A Larva*. Only one tooth is in the heavily chitinized portion of the mandible. (Plate X, Fig. XIX.) The antennæ are of the type figured for *D. cornuta*, i.e., each has a slightly developed seta on the outer margin, is strongly spined, and has a bunch of a few coarse hairs on the inner distal margin. The prothoracic setæ of the ventral side are in the order of 1-1-4-1-1-4-1-1. The relatively short truncate anal segment is with a narrow and acute spur at the apex. (Plate X, Figs. XXIV and XXVII.) The scales of pecten are commonly with two or three well-developed spines. The species is from New York.

*Species B Larva* is similar to that of *D. cornuta* in arrangement of setæ and in most of its characters. However, it differs in a few well-marked characters. The mandibular teeth are similar to those of species A. (Plate X, Fig. XIX.) Like this species it also has a truncate anal segment with a relatively long point. (Plate X, Fig. XXVI.) But it may be readily separated from this species by the markedly greater length of this segment, which is from one and a fourth to one and a third times as long as the anal segment of larva of species A. It may also be distinguished by the fact that the apical spur of this segment is longer and broader at its base than it is in species A. The species is from New York.

*Species E Larva* is similar to *D. cornuta* Joh. in general arrangement of setæ except that the ventral setæ of the prothorax are in the order 1-1-2-1-1-2-1-1. A fuscous area is cephalo-ventrad of the margin of the eye. The species is from California.

To Group II belong *Dixa modesta* Joh. and Species C, D. and F. They are briefly characterized below.

*Dixa modesta Larva* has short ventral prothoracic setæ in order 1-1-4-1-1-4-1-1. Coronæ are present on the dorsal surfaces of the abdominal segments two to seven inclusive. (Plate X, Fig. XXXIV.) The antennal seta is distinct, but there is no group of antennal hairs. The antennæ are spined, but the palpi are minutely so. The spines of the locomotory plates are well

separated from each other and are weak. The pecten consists of simple strong spines. The pre-spiracular setæ are not palmate, but more like those figured in Plate X, Fig. V. The distal ends of the lateral plates are heavily infuscated and have a very faint indication of a spur or tooth at the apex. The caudal segment is very finely pubescent and unless greatly magnified seems bare. The distal end of the caudal segment does not extend beyond the apex of the lateral plates. (Plate X, Fig. II.) The species is from New York.

*Species C Larva.* This is similar to *D. modesta*. The palpi and the antennæ are weakly spined. The spiracles are as those figured on Plate X, Fig. XXX. No indication of spurs are at the apices of the lateral plates. The distal end of the anal segment extends slightly beyond the apices of the lateral plates. (Plate X, Figs. XXXVI, XXXVII, and XXXVII'.) The species is from New York.

*Species D Larva* has a triangular infuscated area at the lateral base of the head. (Plate X, Fig. XVII.) The antennæ and the palpi are fuscous. No strong terminal spine is at the inner end of the pecten, which is composed of deeply fuscous simple spines. Coronæ are present. The prespiracular setæ are as in *D. modesta*. The setæ of the caudal segment are arranged in three pairs, each differing greatly in length from the other two. (Plate X, Figs. XXXI and XXXII.) A specimen from California was studied.

*Species F Larva* has a wavy chitinized band at the lateral base of the head capsule, which broadens from the dorsal to the ventral surface. (Plate X, Fig. XV.) This larva is similar to that of *D. modesta* but has a caudal segment extending somewhat beyond the apices of the lateral plates and is without even the slightest indication of a tooth at the apex of the lateral plate. The tergum of the tenth segment has a triangular dark chitinized area between the bases of the lateral plates, and the basal margins of the lateral plates are infuscated. The spines of the locomotory plates differ from those of *D. modesta* in being closer together. The third pair of plates is not well developed and is fitted with short spines. Two specimens from New York were studied.

## KEY TO LARVÆ OF TEN SPECIES

- A. Coronæ on abdominal segments, 2-7; setæ of prothorax and caudal region greatly reduced in length; apex of lateral plates without spur or tooth.
- B. Caudal segment not extending past the apices of the lateral plates; a slight indication of an apical spur or tooth at apex of lateral plate .....*modesta*
- BB. Caudal segment extending past the apices of the lateral plates; not even an indication of a tooth or spur at apices of lateral plates.
- C. Lateral basal infuscated area at the base of the head in the form of a band slightly widened at center. (Plate X, Fig. XVI.)  
Species C
- CC. Lateral basal infuscated area in form of a triangle. (Plate X, Fig. XVII.) .....Species D
- CCC. Lateral basal infuscated area of head in the form of a wavy band, broadening from the dorsal to the ventral surface of head capsule. (Plate X, Fig. XV.) .....Species F
- AA. No coronæ on abdominal segments; setæ of prothoracic and caudal regions well developed; apical spur or tooth at apex of each lateral plate.
- B. Ventral prothoracic setæ in the order 1-1-4-1-1-4-1-1.
- C. Caudal segment not truncate but gradually rounding to the point where the caudal spine attaches; the basal portion of mandible does not have a prominent second tooth; common type of pecten scale triradiate .....*cornuta*
- CC. Caudal segment truncate and coming to point abruptly in the apical spine; basal portion of mandible with a prominent second tooth; common type of pecten scale may or may not be triradiate.
- D. Caudal segment short, with apical spine narrow and acute. (Plate X, Figs. XXIV and XXVII.) .....Species A
- DD. Caudal segment long, with apical spine broader and less acute. (Plate X, Figs. XXIII and XXVI.) .....Species B
- BB. Ventral prothoracic setæ not in order 1-1-4-1-1-4-1-1.
- C. Heavy fuscous crescent cephalo-ventrad of the eye: ventral prothoracic setæ of the order 1-1-2-1-1-2-1-1 .....Species E
- CC. Fuscous crescent lacking; order of ventral prothoracic setæ 1-1-1-4-1-1-4-1-1-1.
- D. Common type of pecten scale with two strong spines and a few smaller; teeth of chitinized area of mandible are separated by relatively wide gap; second tooth prominent. (Plate X, Figs. IX and XXI.) .....*aliciæ*
- DD. Common type of pecten scale, eight- or nine-spined; an independently developed seta not only on ventral surface of

eleventh abdominal segment but also on eighth, ninth, and tenth. (*D. cornuta* has this only on the eleventh. Plate IX, Fig. II.) .....*fusca*

For species C and D use has been made of color characters only. Inasmuch as the specimens of these species were not in good condition, other characters could not be found. However, the fuscous band, which has been used to separate the species, persisted in all preserved specimens examined. Inasmuch as it occurs here in a markedly different type, it was thought to be a specific character. The setæ of the caudal segment of each of these specimens were broken off, and because of lack of knowledge of their character the writer was unable to use the caudal setæ of species F as a distinguishing character of that species by which it could be separated from *Dixa modesta* Joh., as was the case with Species D. (Compare Plate X, Fig. II with Plate X, Fig. XXXII.)

#### SUMMARY

(1) The following structures of the *Dixa* larvæ furnish taxonomic characters: mandibular teeth; antennal spines, hairs, and setæ; infuscated areas of the occipital region; the order of long ventral prothoracic setæ; length of setæ of caudal region; presence or absence of supposedly independently derived setæ upon the ventral surfaces of the fifth, sixth, and seventh abdominal segments; prespiracular setæ; length of spines of locomotory plates and the distance between them; the form of the spiracles and the spiracular plates; spurs at distal ends of the lateral plates; chitinous base from which the ventral setæ of the tenth abdominal segment arise; the caudal segment, e.g., its length, shape, amount of pubescence, length of setæ, its extent beyond tips of lateral plates, and shape of spine-like structure at its distal end; types of scales in pecten; and the presence or absence of coronæ upon the dorsal surfaces of the second to the seventh abdominal segments, inclusive.

(2) The larvæ studied are separable into two groups upon the basis of twelve rather definitely correlated characters. The species within each of these groups are separable by a much smaller number of characters than are these groups.

## EXPLANATION OF PLATES IX AND X

Plate IX, Fig. I, illustrates a dorsal view of the larva of *Dixa cornuta* Joh. Only the setæ are labeled. Homologues of the different segments are labeled with the same letter. For example, *a* represents the groups of three small dorsal setæ, on each side of the mid-dorsal line; *b*, the dorso-lateral pair. In case one seta of the dorso-lateral pair is lost the remaining seta is labelled *b-1*. The letters *f*, *g*, and *h* represent setæ of the head to which reference has been made in the body of this paper. The remaining setæ of the head and those of the abdomen caudad of the eighth abdominal segment are labeled elsewhere.

Plate IX, Fig. II, illustrates the ventral view of this larva. The caudal setæ are not figured at full length. The same system for the labeling of homologues of the various segments has been used as in the preceding plate. In the instance that a group of setæ apparently has members which have arisen independently, as in group *c* of the mesothoracic segment, the group is indicated by its usual letter followed by the plus sign and a number representing the setæ which have arisen independently. The letter *b*, perhaps, represents the dorso-lateral group which on the prothorax has moved ventrad; *e*, ventro-lateral pairs; and *d*, ventral pairs to each side of the mid-ventral line. The figure *1* represents one of the four prolegs (two pairs) and *2*, one of the locomotory plates of spines. Setæ and structures of this aspect of the head and of the abdomen caudad of the eighth abdominal segment are indicated elsewhere.

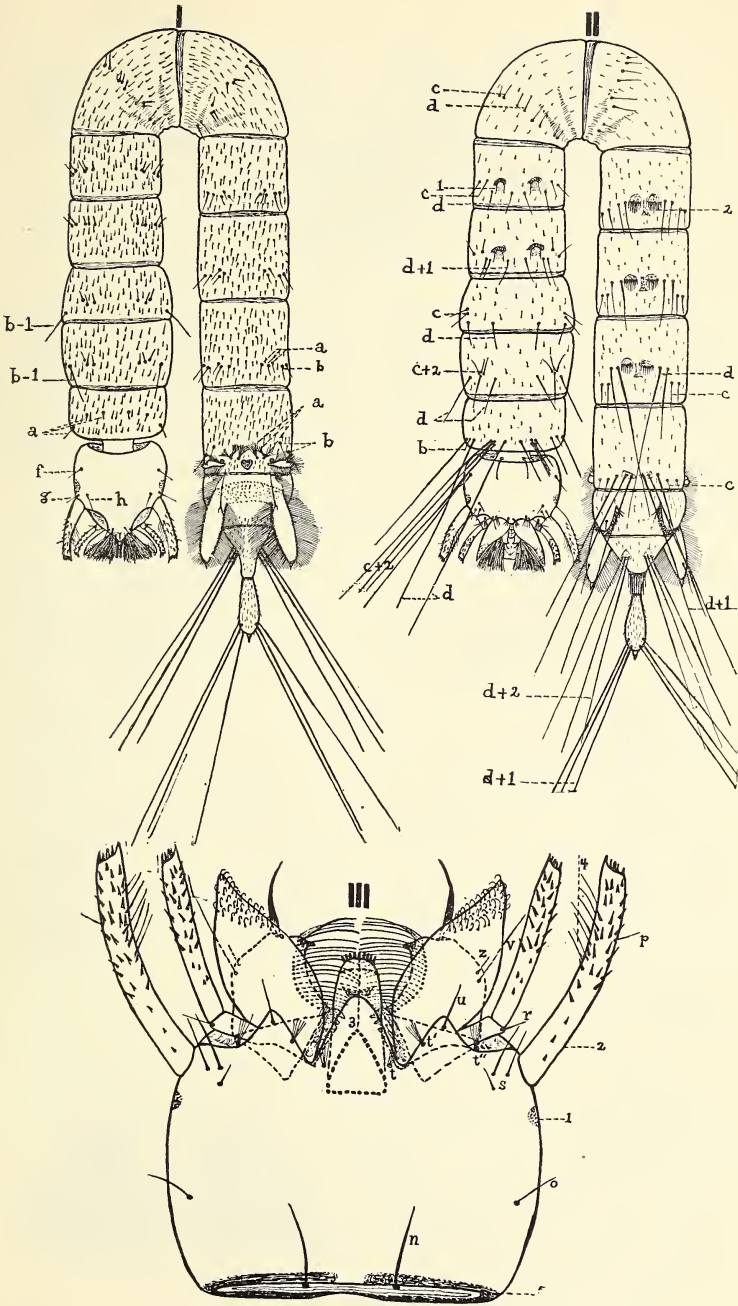
Plate IX, Fig. III, represents the ventral view of the head of this larva with the labrum and mouth-brushes, which would project from beneath the cephalic end, removed. The dotted lines represent structures which lie underneath other structures. A study of Figs. I and IV of Plate X will be of assistance in the interpretation of this figure. As in preceding figures the letters indicate setæ, and these are referred to in the body of the paper. The structures not labeled here are labeled in the figures of the mouth parts on Plate X. Of the other structures 1 represents the eye; 2, an antenna; 3, the "hypopharynx," which runs cephalad and curves dorsad, fitted with rake-teeth-like spines on the cephalic margin of its distal end; 4, bunch of antennal hairs; 5, deeply infuscated area at the base of the head capsule of which a diagram of the lateral view is given in Fig. XVI of Plate X.

Plate X contains figures of some structures of *Dixa cornuta* in greater detail than Plate IX gives them, and there also are many figures, in this plate of structures, which are of taxonomic importance. Fig. I represents the maxilla of *D. cornuta* larva; 1, the palpus; 2, recurved hairs at the apex; and 3, straight hairs at inner basal angle. Fig. II represents the ninth, tenth, and eleventh abdominal segments of *D. modesta* larva (line of segmentation between the tenth and eleventh segments is not figured). 1, illustrates a small seta cephalad of the pecten; 2, a slightly pointed condition of the heavily infuscated apex of the lateral plate; 3, inner spine of

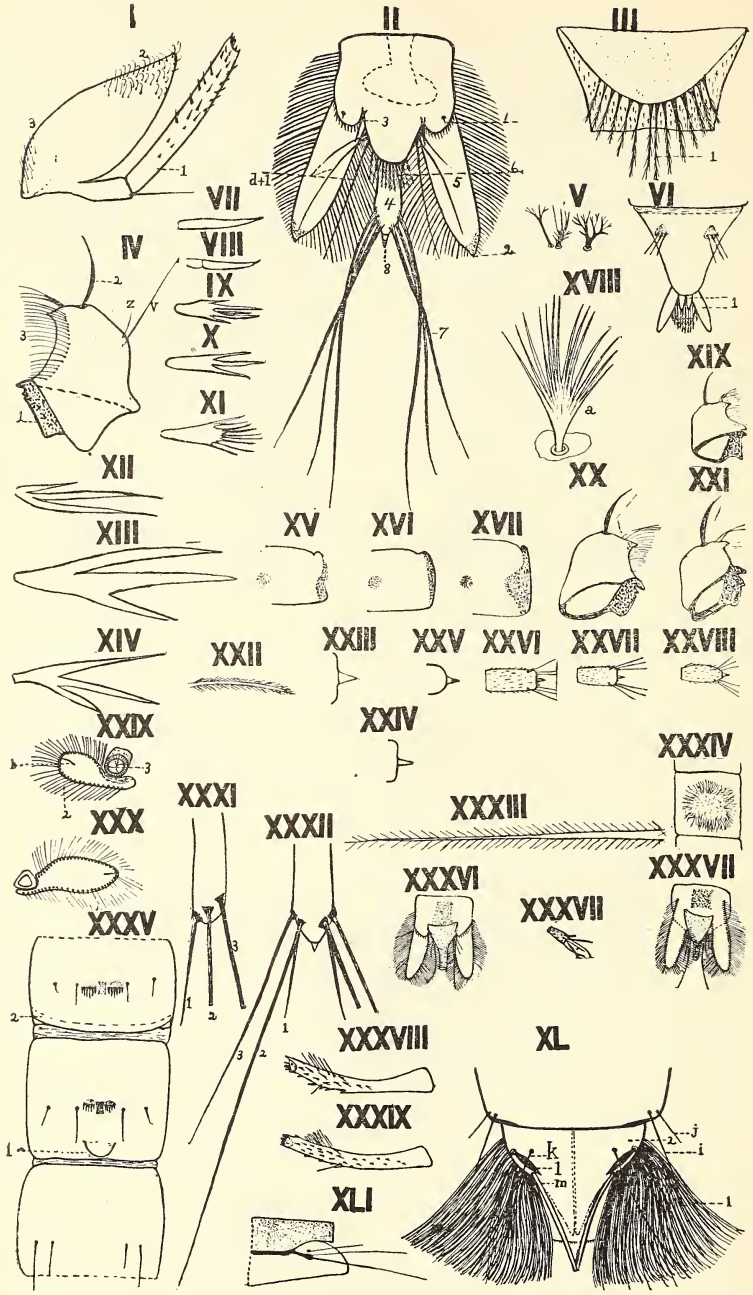


pecten; 4, anal segment; 5, lateral plate; 6, guards of the gill chamber; 7, anal setæ; 8, caudal spur;  $d+1$ , setæ homologues to the setæ  $d+1$  of the tenth abdominal segment of the larva of *D. cornuta*. Fig. III represents the caudal end of the tergum of the tenth abdominal segment as seen from the ventral aspect with the sternum removed. 1 illustrates the gill-chamber guards. This drawing is from the larva of *D. fusca*. For relationship of these structures to retracted anal gills observe Fig. VI. Fig. IV represents the dorsal view of the mandible of *D. cornuta* larva; 1, is the more strongly chitinized portion of the mandible; 2, the apical spine or claw; 3, the mandibular row of cilia; and  $z$  and  $v$  are setæ on the outer margin, the smaller slightly dorsad and the larger slightly ventrad. Fig. V is a group of pre-spiracular setæ as found in larva of species D. Fig. VI is the ventral aspect of the tenth abdominal segment of the larva of *D. cornuta* (long setæ not shown at full length); 1, retractile anal gills, four in number. Dorsad of the gills are the guards to the gill chamber for which a constant number was not determined. (See Fig. III.) Fig. VII is the common type of pecten spine found in *D. modesta* larva; Fig. VIII, the inner pecten spine of the same species; Fig. IX, the most common type of pecten spine of *D. alicæ* larva; Fig. X, the common type of pecten spine found in *D. cornuta* larva; Fig. XI, the common type of pecten spine found in *D. fusca* larva; Fig. XII, the inner pecten spine of *D. alicæ* larva; Fig. XIII, the inner pecten spine of *D. cornuta* larva; Fig. XIV, inner pecten spine of *D. fusca* larva. Fig. XV is a diagram of infuscation at base of head capsule of larva of Species F, as seen laterally; Fig. XVI, diagram of the corresponding area and aspect in *D. cornuta* larva; Fig. XVII, diagram of same area and aspect for larva of Species D. Fig. XVIII represents a palmate pre-spiracular seta of larva of *D. cornuta*. Fig. XIX is the ventral aspect of the mandible of Species A larva; Fig. XX, ventral aspect of mandible of *D. cornuta* larva; Fig. XXI, ventral aspect of mandible of *D. alicæ* larva. (Setæ along outer surface not figured in these mandibles.) Fig. XXII illustrates the densely plumose condition of the cilia of the lateral plates of *D. cornuta* larva. Fig. XXIII is an enlarged outline of the dorsal aspect of the extreme tip of the caudal segment of Species B larva; Fig. XXIV, same for larva of Species A; Fig. XXV, same for larva of *D. cornuta*. Fig. XXVI is the anal segment of Species B larva (dorsal); Fig. XXVII, same for Species A larva; Fig. XXVIII, same for *D. cornuta* larva. Fig. XXIX represents the spiracular plate and spiracle of *D. cornuta* larva; 1, a chitinized line; 2, cilia; and 3, apparently a closing device of the spiracle. Fig. XXX represents the type of spiracular plate in *D. modesta* larva. Fig. XXXI represents the lateral view of a portion of the caudal segment of larva of Species D; Fig. XXXII, the ventral aspect of the same structure. Fig. XXXIII represents the sparsely plumose condition of the caudal setæ of the larva of *D. fusca*. Fig. XXXIV illustrates the corona of hair on the tergum of the third abdominal segment of Species C larva. Fig. XXXV is

an outline of the ventral aspect of abdominal segments, six, seven, and eight, as in the larva of Species D; 1 represents a tubercular papilla caudad of the last pair of plates of locomotory spines, and 2, a long raised ridge across the caudal portion of the sixth segment. It should be noticed that the spines of the seventh segment are not well developed and also that the setae *d* of the eighth segment do not have extra setae with them as in *D. cornuta* larva. Fig. XXXVI is the caudal region of larva of Species C (ventral); Fig. XXXVII, the preceding in dorsal view; Fig. XXXVII', portion broken from the anal segment of the preceding (aspect not determined). Fig. XXXVIII represents the antenna of *D. cornuta* larva; Fig. XXXIX, the antenna of *D. alicia* larva. Fig. XL represents the cephalic portion of the dorsal prolongation of the head of *D. cornuta* larva. Of the structures shown, 1 illustrates the mouth-brush; 2, the labrum; *i*, *j*, and *k*, setae of the normal type; *l*, a clavate seta; and *m*, a large, long seta, truncate at the distal end. Fig. XLI represents a lateral view of the tenth abdominal segment of the larva of Species D.



DIXA



THE NORTH AMERICAN SPECIES OF HYDRO-  
THASSA WITH NOTES ON OTHER CHRYSOMELIDÆ AND A DESCRIPTION OF  
NEW SPECIES AND A VARIETY (COL.)

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Four North American species of *Prasocuris* are listed in the catalogues, but only one of these, *phellandri*, which also occurs in Europe, properly belongs in this genus. The other three and a new species described below are congeneric with the European species of *Hydrothassa*.

The two genera, *Prasocuris* and *Hydrothassa*, are closely related and differ only in form and in the presence or absence of a fine, elevated line at basal margin of prothorax. The species of *Prasocuris* are rather narrow and elongate and have a fine elevated line at basal margin of prothorax which is absent in the species of *Hydrothassa*, and the form in these is shorter and more oval.

The color and markings are nearly alike in all our species and similar to those of the European *hannoverana*. They are black, with or without more or less distinct aeneous tint, while the European species are more decidedly blue or greenish-blue. The markings consist of a large spot of variable size on the disk of prothorax, on the elytra a common sutural vitta, strongly dilated at the scutellum and on each side a broad lateral vitta, narrowing towards base. Apparently the markings in our North American species are less variable than in *hannoverana*, of which three color variations are recognized. The only noteworthy variation known to me is a specimen of our common *vittata* from Vermont in which the sutural vitta is largely confluent with the lateral black vitta but the marginal interval in its entire length remains pale, also the base and a very short line at base and a longer one at apex—the remnants of the usual pale discal vitta.

The females generally have the humeral callus prolonged for a short distance, forming a short, carina-like elevation.

KEY TO THE NORTH AMERICAN SPECIES OF HYDROTHASSA

1. Row of punctures on the pale, last elytral interval entire from base to apex and extending inwardly to or nearly to the second stria; black lateral vitta on each elytron not reaching the base, discal and marginal pale vittæ united at base .....2  
 Row of punctures on the last elytral interval obliterated at or slightly behind middle; black lateral vitta on each elytron reaching the base; subsutural and marginal pale vittæ not united at base .....3
2. All elytral intervals impunctate, form narrower and relatively more elongate, size smaller, 3-4 mm. ....*vittata*  
 Some of the elytral intervals more or less distinctly punctate, form broader and size larger, 4, 5-4, 75 mm. ....*obliquata*
3. Elytral epipleuræ with a single row of punctures close to the internal margin and occasionally a few scattered punctures near base; sides of prothorax nearly parallel or slightly convergent from about apical third to base, form rather elongate oval .....*boreella*  
 Elytral epipleuræ with confused double rows of punctures; prothorax wider, sides distinctly divergent from about apical third to base; form more regularly oval .....*ovalis*

**Hydrothassa vittata** Olivier.

This well-known, common and widely distributed species is recorded also from Oregon in Leng's catalogue, but this remains to be verified. This species is rather narrower and more elongate, especially the males, than any other North American or European species.

**Hydrothassa obliquata** Crotch.

This species has a wider distribution than is recorded. It is known to me from Massachusetts, Forest Hills (Parshley); Illinois; Indiana; Manitoba; Miami (Wallis), and Rosebank (Wallis).

It is larger and more robust than the other species. The punctation of some of the elytral intervals is variable: some specimens have the punctures more numerous, others have only a few punctures, the lateral rows of punctures are more or less regular, but occasionally confused with those of the intervals.

**Hydrothassa boreella** new species.

Color and maculation as in our other species, but the lateral black vitta on each elytron extending to base; discal and lateral pale vittæ not united at base; legs generally black, tibiæ at apex more or less pale; form of *obliquata*, but much smaller. Head sparsely punctate, a little denser anteriorly. Prothorax about one third wider than long, sides nearly parallel from base to about apical third, thence gradually narrowing to the anterior angles; surface sparsely and irregularly punctate, a little denser in the lateral impressions. Elytra elongate oval; intervals smooth, impunctate; serial punctures moderate; row of punctures on the pale interval next to the lateral margin obliterated at or behind middle; metasternum sparsely punctate, abdomen feebly and more finely punctate. Length 4 mm.

Manitoba: Husavick, July (Roberts in Coll. Wallis).

Alberta: Edmonton, June, July (Carr); Cypress Hill, June (Carr), Wostock, October (Carr).

British Columbia: Middy Creek, Indian Meadow, August (Hopping).

The type is a specimen from Edmonton in the Museum collection, paratypes in the collections of Messrs. Hopping, Carr, Wallis and Frost.

This species is closely allied to *ovalis* but the elytra are less regularly oval, the prothorax is narrower and more or less parallel-sided behind, the head apparently larger and the elytral epipleuræ have only a single row of punctures very close to the internal margin.

**Hydrothassa ovalis** Blatchley.

This species is known so far only from Indiana. Its form is more regularly oval than any of our other species or any of the European species known to me. The form, larger prothorax, with sides diverging behind to the basal angles, apparently smaller head and epipleuræ with a confused double row of punctures will separate it from *boreella*. The black spot on prothorax is also larger, but that may be variable.

**Leptinotarsa haldemani** Rogers.

In the Leng catalogue this species is recorded from Mexico and Texas, the latter locality, however, with a question mark.

The species was described by Rogers from Fredericksburg, Texas, and I have specimens before me from New Braunfels and San Antonio, Texas.

**Zygogramma thoracica** Jacoby.

I have a specimen, taken with specimens of *continua* (*fasciati-pennis* Jac.) in Arizona, which is apparently intermediate between the latter and *thoracica*. The head in this specimen is black posteriorly, the legs are in great part black with metallic tint and the prothorax at base obscurely black, otherwise it agrees with the description of *thoracica* and except coloration does not differ from *continua*. *Z. thoracica* was described from a single specimen from Durango City, Mexico.

**Calligrapha amelia confluens** new variety.

The metallic-green sutural, subsutural and the arcuate stripe near the latter on each side of the elytra broadly confluent, forming a pattern similar to the one seen in *rhoda* and *scalaris*, but the arcuate stripe next to the subsutural is usually not produced laterally at apex as in these two species and the sutural interval is more or less pale, generally for a short distance below middle, but is very rarely nearly entirely pale or entirely metallic. The humeral lunule is not broken up into several spots but is very heavy as in *scalaris* and *rhoda*. The sub-basal spot enclosed by the humeral lunule as in *amelia*. Length 7-8 mm.

Portaupique, Nova Scotia (Frost, on Alnus); Casco Bay, Maine, September (Engelhardt); Monmouth, Maine, June (Frost); Massachusetts.

This form looks superficially like *rhoda* but is slightly more elongate, and the color of prothorax and elytral markings are mostly bluish-green.

Two specimens of the small series collected by Mr. Engelhardt at Casco Bay are somewhat intermediate between the variety *confluens* and typical *amelia*. In both the lower branch of the short, arcuate stripe next to the subsutural is detached; in one of these specimens the sutural interval is almost entirely pale, in the other this interval is pale in about a little more than apical half.

**Calligraphaalni** new species.

Very near *philadelphica* but the markings on the elytra generally heavier, the humeral lunule very often confluent with the lateral spot, the two spots



within the humeral lunule usually connected apically; the arcuate stripe next to the subsutural entire or nearly so; the sutural and subsutural intervals, the punctures and often the intervals between these more or less dark reddish. The prothorax is dark olive to brownish and the femora occasionally more or less infusate or piceous.

Sherborn, Massachusetts (Frost) on *alnus*; Stowe, Vermont (Engelhardt); Mammouth, Maine (Frost) on *alnus*; Peterborough, Ontario; Westchester Lake, Nova Scotia (Frost).

Type in the Museum collection, paratypes in the Museum collection and that of Mr. Frost.

The markings of *alni* are nearly as in *amelia* and both feed on the same plant, but the latter species has the suture always metallic green, the prothorax slightly narrower, less dull and bluish-green and the spot enclosed by the humeral lunule is generally solid and more or less lunate—in *alni* U-shaped when the usual two spots are confluent apically.

The reddish color of the elytra seems to be more persistent in *alni* than in other species in which, according to Knab, the red color seen in sexually mature specimens disappears after death. Old specimens of *alni* collected in different localities in 1907, 1913, 1915, 1916, and 1921 show as much of the red color as those collected as recently as 1927.

This species is quite close to *philadelphica* except being a little more robust and having the elytral markings heavier. I would have made *alni* a variety of that species, but followed Knab and others in deference to their opinion that different food plants indicate also different species. *C. philadelphica* is said by Knab to occur only on *Cornus*.

### **Calligrapha incisa** Rogers.

Of this species, which is recorded from Kansas and Nebraska, I received lately, through the kindness of Mr. Wallis, a specimen collected at Wawunessa, Manitoba (R. D. Bird).



## SOME EARLY AMERICAN PAPERS ON ENTOMOLOGY

BY HARRY B. WEISS  
NEW BRUNSWICK, N. J.

Although some of the colonists of America were interested enough in entomology to collect and send insects to European entomologists for study, it was only when they began putting their observations on paper that a real beginning was made.

Apparently the first American to publish on American insects was the botanist, John Bartram, whose accounts of wasps and dragon flies appeared in the "Philosophical Transactions" (London) in the shape of letters to Peter Collinson. According to Hagen's "Bibliotheca Entomologica," Bartram's insect papers were: "An account of some very curious Wasp-Nests made of clay in Pennsylvania" (Philos. Trans. 1745, Vol. 43, No. 476, pp. 363-366); "Descriptions of the great black Wasp from Pennsylvania" (Philos. Trans. 1750, Vol. 46, No. 493, pp. 278-280); "Observations on the Dragon-fly, or Libella of Pennsylvania" (Philos. Trans. 1750, Vol. 46, No. 494, pp. 323-325; 400-402); "Observations on the Yellowish-Wasp of Pennsylvania" (Philos. Trans. 1763, Vol. 53, pp. 37-39). After Bartram's death in 1777, the editor of the Philadelphia Medical and Physical Journal, which lasted only six years, published a manuscript of Bartram's entitled "Additional Observations on the Cicada septendecim" (Phila. Med. and Physic. Journ. 1804, Art. 15, pp. 56-59). Article 16 of the same journal carried a paper by Charles Reichel on "Some particulars concerning the locust of North America," this having been written, according to the editor's note, at Nazareth, Pennsylvania, August 2, 1793.

On March 11, 1768, Moses Bartram, a native of Philadelphia, read before the American Philosophical Society (Philadelphia), the oldest scientific organization in the United States and founded by Franklin in 1727, a paper on "Observations on the

native Silks (sic) Worms of North America," which was printed in the Transactions, Vol. 1, Sect. 2, pp. 224-30, 1771, ed. 2, Vol. 1, pp. 294-301, 1789. In this paper Bartram describes at length his breeding experiments with caterpillars, which he raised originally from cocoons collected by him along the banks of the Schuylkill. He tells how he kept the food fresh and moist in water and suggests the use of a special feeding trough for any one inclined to breed them in numbers. He says nothing about unwinding the cocoons or the quality of the silk.

In the same volume (Trans. Vol. 1, Sec. 2, pp. 205-17) there is a paper by Colonel Landon Carter, of Sabine-Hall, Virginia, transmitted by Colonel Lee, entitled "Observations concerning the Fly-Weevil, that destroys the wheat, with some useful discoveries and conclusions, concerning the propagation and progress of that pernicious insect, and the methods to be used to prevent the destruction of the grain by it." Col. Carter's paper is quite interesting and apparently he was frequently puzzled by the adaptability of the insect and its ability to survive under certain conditions. According to the succeeding paper in the Transactions (Vol. 1, Sect. 2, pp. 218-223), "Same Subject, by the Committee of Husbandry," Col. Carter's "Fly-Weevil" proves to be the European Angumois grain-moth which the committee recorded as occurring from Carolina into Virginia, Maryland and the lower part of Delaware.

Concerning the earliest descriptions published in America, Mr. C. W. Leng in his "Catalogue of the Coleoptera of America, North of Mexico" (p. 444), suggests that these probably appeared in the early volumes of the Medical Repository which flourished from 1797 to 1824, under the senior editorship of Samuel Latham Mitchill. In volume 2, number 2, pp. 174-177, 1798, of this journal there was printed "An Account of a Species of Cantharis, found in Bucks County, Pennsylvania; including Observations on its Medical Qualities," by Isaac Chapman, physician. In part Doctor Chapman states: "Two or three years ago, William Smith, an intelligent person in my neighborhood, informed me, that one day, as he was at work, he accidentally mashed an insect on his shoulder, which in a short time,

produced a complete vesication; and it appearing to be the insect here described, I was determined to gather some of them, and give them a trial in my practice; which, however, I neglected doing until last summer.

“This insect has a very near resemblance, in outward form, to the *Meloe (vesicatorius) alatus viridissimus nitens, antennis nigris* (Linn.), or Spanish Flies, as they are commonly called; but is rather smaller than even those brought from Spain, and of a very different colour: the head is of a very light red, with black antennæ; the elytra, or wing cases, are black, margined with pale yellow, and a stripe of the same colour extends along the middle of each of them; the tarsi have five articulations, the mouth is armed with jaws and furnished with palpi.”

Chapman then tells how he found them in potato patches, on beets, garden purslane, etc., doing considerable damage, and describes his experiments in powdering the beetles and applying the powder to some of his patients, with the results that “good blisters” were always raised. He was of the opinion, as a result of his investigations, that “every part of the insect is endowed with an equal, or nearly equal, degree of their quality.” He concludes by discoursing on the methods of collecting the beetles and the advantages, to this country, of collecting them here instead of importing them.

In volume three of the *Medical Repository* (pp. 213-214, 1800), under the title “Chemical News; communicated in a Letter to Samuel L. Mitchill, M.D., Professor of Chemistry in Columbia College, New York, by James Woodhouse, M.D., Professor of Chemistry in the University of Pennsylvania, etc., dated Philadelphia, August 22, 1799,” Doctor Woodhouse, in addition to submitting notes on various chemical matters, has the following to say under “Of American Blistering Flies:”

“I have discovered two other blistering meloes besides that described in the *Medical Repository*. The one I would call *Meloe clematidies*, as it is particularly fond of several species of this plant. It is larger than the one described by Doctor Chapman, and the female is nearly twice the size of the male. The head, thorax, elytra and antennæ are black: the elytra only

edged with white. The abdomen is of a light ash-colour. The upper part of the abdomen, under the wings, is marked by two longitudinal streaks of a bright clay-colour. The *asters* are sometimes black with these flies, and the leaves are entirely destroyed by them.

“The other I would call *Meloe nigra*, the *Pennsylvanica* of Linnaeus. It is not more than half the size of Chapman’s fly. The whole of it is black. It feeds upon the *prunella vulgaris*, or self-heal, and *ambrosia trifida*, or stick weed.

“I applied a small blister of these flies to my skin, and lost the plaister in half an hour. In twelve hours after, a fine blister was produced. A watery extract of the flies blistered in six hours. Distilled in a retort, they yield an acid, whose properties have not yet been examined.

“Besides these three kinds of meloe, there is another found in this country, mentioned by Calm, and called by Linnaeus *Meloe majalis*; but it is not yet known whether it will blister; for Shoepf expressly asks the question, ‘An mel. vesicatorio (cantharid. officinal.) substituendus?’

“We then know for certainty of three kinds of indigenous blistering flies—meloe Chapmani, meloe clematidis, and meloe nigra. *Meloe majalis*, doubtful.”

According to Leng’s “Catalogue,” Woodhouse’s *chapmani* is a synonym of *Epicauta vittata* Fab., his *clematides* a synonym of *Epicauta cinerea* (Forst.), and his *nigra*, a synonym of *Epicauta pennsylvanica* (DeG.). Another early paper on these insects was “An account of the American cantharis or Meloe Americæ” by Nathaniel Dwight, which appeared in the Memoirs of the Connecticut Academy of Arts and Sciences (M. V. 1, pt. 1, pp. 99–102, 1800).

Woodhouse was a chemist and a physician and apparently not particularly interested in insects. He was professor of chemistry in the University of Pennsylvania from 1795 until his death in 1809, and was appointed to that chair when Joseph Priestley declined to accept it. As a surgeon in the U. S. Army, he accompanied General St. Clair’s expedition against the western Indians in 1791. He was also the author of various books on chem-

istry and contributed to the scientific and medical journals of his time. According to one account, he was apparently the first to demonstrate "the superiority of the Lehigh anthracite coal in Northampton County, Pennsylvania, over the bituminous coals of Virginia for intensity and regularity of heating power."

In addition to the papers on insects mentioned above and previous to the time when Say became active, various other entomological accounts appeared in the publications of the American Philosophical Society, and the Philadelphia Medical and Physical Journal. These dealt with peach-tree borers, silk worms, chicken lice, honey-bees, cicadas, the Hessian fly, the bee moth and insects injurious to pine trees. Considering that the country was almost entirely rural at that time, these subjects reflect the occupational interests of the inhabitants.

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## PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF JANUARY 3, 1928

A regular meeting of the New York Entomological Society was held at 8 P. M. on January 3, 1928, in the American Museum of Natural History; President Henry Bird in the chair, with twenty members and nine visitors present.

Mr. Mutchler for the Nominating Committee reported their recommendation that the present officers be reelected.

There being no other nominations the secretary on motion, duly seconded and carried, cast one affirmative ballot unanimously reelecting present officers.

Mr. Davis, in accepting the treasurership for the twenty-fifth year, thanked the members for their approval but urged the propriety of his being excused at the end of his term.

Mr. Bird expressed his gratification in the progress the society had made and in the efficiency of the treasury under the management of Mr. Davis. He referred also with satisfaction to the election of Henry Fairfield Osborn as president of the A. A. A. S.

The President appointed the following committees: Program: Messrs. Mutchler, Weiss and Hartzell; Auditing: Messrs. Bell, Janvrin and E. K. Schwarz; Field: Messrs. Nicolay and Shoemaker; Delegate to the Council of the Academy: Wm. T. Davis.

Dr. Leonard, before delivering his address on "The European Corn Borer, its History and Spread," spoke of the "New York State List of Insects" which may be expected about March 1 and of the Fourth International Entomological Congress to be held in Ithaca during the week of August 13. He then showed with lantern slide illustration, the area under quarantine, the character of the damage done by the corn borer and the measures recommended for checking its ravages, principally designed to deprive the larvæ and pupæ of shelter. The mature caterpillars hibernate in the stubble remaining after the corn is cut. Thorough ploughing in of this stubble, after raking and burning as much of it as possible, leaves a perfectly clean field for operations in the spring. He showed also parasite cages and quarantine lines; but pointed out that even with an appropriation of \$10,000,000 from Congress there was little hope of eradicating the pest. The problem was to discover by experiments on a large scale clean-up measures that could be adopted by farmers without prohibitory expense.

In the discussion which followed it was brought out that the pest was probably introduced in imported broom corn and that it apparently flour-

ished best where tender vegetation of moist localities furnished food for the young larvæ. Mr. Davis spoke with disapproval of the operations of burning gangs on Staten Island, even Virginia Creeper having been destroyed by their ill-judged zeal. Messrs. Angell, Engelhardt, Chapin and Bird added some notes from their personal experiences and Dr. Leonard closed with some facts to show how surprisingly resistant an animal was the corn borer which he characterized as the "Boringest Bug he ever saw."

#### MEETING OF JANUARY 17, 1928

A regular meeting of the New York Entomological Society was held at 8 P. M. on January 17, 1928, in the American Museum of Natural History; President Henry Bird in the chair, with twenty-four members and six visitors present.

The president spoke of amendments to be proposed to the Entomological Code by which after 1930 the naming of a genotype for any new genus would be compulsory; and an inadequate description for any new species would invalidate the name proposed.

Mr. Howard Notman, with the help of about 140 lantern slides, described a collecting trip of 13,158 miles, beginning April 22, 1927, in Brooklyn and ending September 27, 1927, in the Adirondacks. The journey was made in his own automobile without any companions and permitted him to collect about 11,800 specimens at fifty-one localities in North Carolina, South Carolina, Florida, Texas, Arizona, California, Nevada, Utah and Colorado, of the most varied character. The shores of the Atlantic, the Gulf, and the Pacific were included; swamp holes in the southeastern states, arid regions in the southwest; the great forests of the Sierra Nevada, and the snow fields at 11,000 feet elevation were among the illustrations shown. Particular attention was paid throughout to the Carabidæ and especially the genus *Bembidion*; and it was shown by many instances that some degree of moisture was necessary to their existence. In seeking localities favorable to them, many other families were found especially Chrysomelidæ of the genus *Donacia*, water beetles of many families, and Staphylinidæ. Mr. Notman did not devote much time to the species he found, but among the special captures noticed was a long series of *Ochthebius* found in an inland gully near San Diego.

The pictures were exceedingly interesting in the great variety of environments they exhibited and many were beautiful as pictures. Some personal details brought out in the discussion following Mr. Notman's address were the temperatures encountered up to 110° at times, the absence of trouble with the automobile and the friendliness of the people met with.

#### MEETING OF FEBRUARY 7, 1928

A regular meeting of the New York Entomological Society was held at 8 P. M. on February 7, 1928, in the American Museum of Natural History;

President Henry Bird in the chair, with twenty-two members and three visitors present.

Mr. Hall, for the Executive Committee, reported the following recommendations:

In the matter of the donation of funds to help meet the expense of entertaining the entomologists attending the Entomological Congress, to be held at Ithaca, N. Y., some date in August next, it is the recommendation of the Executive Committee that the sum of \$150 be appropriated by the New York Entomological Society; and that the treasurer be herewith empowered to draw from the general fund of the Society this amount and forward same to the proper representative of the Cornell Entomological Society, known specifically as the "Jugatae."

On motion by Mr. Sherman seconded by Mr. Hartzell the recommendation of the Executive Committee was adopted.

Mr. Hartzell stated that the Boyce Thompson Institute would probably be prepared to join in defraying the expense of local entertainment of entomologists from abroad who might pass through New York in August. Mr. Sherman said that he and other members would doubtless also wish to join in such entertainment. On motion the Executive Committee was requested to investigate the feasibility of holding a special meeting in August or of otherwise meeting the ideas expressed.

Prof. C. R. Crosby, Ithaca, N. Y., was elected a member of the Society on nomination by Dr. Leonard, the by-laws being suspended to avoid the usual proceeding.

Mr. Mutchler exhibited the Zoological Record for 1926, Insect portion, bought for the Society library.

The president exhibited an advance copy of the "New York State List of Insects," with praise for the editor, Dr. Leonard, and satisfaction in the important part taken by members of the Society in the preparation of the work.

Dr. Sturtevant delivered an interesting address on "The Mating Habits of the Diptera." After referring to the habit of the females in certain families of eating the males, Dr. Sturtevant passed to cases in which the males approached the females only when the latter were eating. Then to cases in which the male brought food to the female in courtship, which food in the case of *Empis poplita* is encased in a frothy balloon. The balloon in other cases may be a fake, elaborately constructed but containing no food, and may be used by a second male. The habits of *Hilaria* and *Rhamphomyia* were discussed and quotations from Aldrich and from Wheeler's translation of Jacobsen were read, especially on the courtship dances of *Drosophila* and *Dolichopodidae*.

In *Drosophila* Dr. Sturtevant gave the results of his own experimental work, with the conclusion that the mating habits were known for such a small percentage of the species of Diptera that much more observation and

experiment were needed, especially in connection with *Dolichopodidæ* in which secondary sexual characteristics are strongly developed.

Dr. Sturtevant's remarks were discussed by Dr. Melander and Mr. Bromley, each adding details on the subject from their field observation.

Dr. Philip Garman read a paper on "The Oriental Peach Moth," illustrated by lantern slides.

#### MEETING OF FEBRUARY 21, 1928

A regular meeting of the New York Entomological Society was held at 8 P. M. on February 21, 1928, in the American Museum of Natural History; President Henry Bird in the chair, with twenty members and twenty visitors present.

Mr. D. D. Leonard delivered an address, illustrated by lantern slides and numerous specimens, on "The Story of Silk and Its Problems." The total value of raw silk imported was stated at \$450,000,000 as an indication of its importance, and a date of 1700 B. C. was given as a suggestion of the antiquity of this industry of which about 75 per cent. is centered in Japan. From this starting point Mr. Leonard proceeded to describe the processes of raising the *Bombyx mori* and the problems more or less successfully met by the growers. These included various diseases attacking the larvæ, irregularity in the diameter of the fibre, and in the cleanliness and neatness of its preparation. An exhibit of fabrics made from reeled silk, spun silk and mixtures thereof closed the story.

Mr. Leonard's remarks were discussed by Messrs. Angell, Bird and Mutchler.

Mr. Notman exhibited a species of staphylinid beetle, allied to the European *Syntomium æneum*, which he had found in the Adirondacks on three occasions, viz.: Mt. Hopkings trail on fungus at an elevation of about 2,500 feet, Mt. Skylight, 5,000 feet, and Mt. Marcy, 5,300 feet, under vegetable debris. The Alaskan *Syntomium confragosum* was discussed in comparison; and the resemblance, in some respects, of the genus to *Stenina* was noted.

Mr. Frank Johnson exhibited some rare *Morpho* butterflies from Venezuela.

#### MEETING OF MARCH 6, 1928

A regular meeting of the New York Entomological Society was held at 8 P. M. on March 6, 1928; President Henry Bird in the chair, with twenty-two members and thirteen visitors present.

Mr. D. D. Leonard, of the General Silk Importing Co., 440 Fourth Ave., New York City, was elected a member.

Mr. Bromley spoke under the title "Observations on Feeding Habits of Certain Robber Flies." After a general account of the size and habits of the Asilidæ and an enumeration of the common names which have been applied to them, including hornet flies, hawk flies, bee killers, bee panthers, pathfinders, talking flies and snory Joes, Mr. Bromley spoke of the disputed

habit of the larva of *Mallosphora*, whether phytophagous or carnivorous, and the individual tastes of the adults of various species. He described also the different forms of ovipositor and the strong resemblance of some adults to aculeate Hymenoptera. He ended with an interesting account of a conflict between a female *Deromyia* and a hornet. Dr. Melander, commenting upon Mr. Bromley's studies, recalled the commendation of C. W. Johnson about 1915 on them. He then spoke of some of his observations, describing the sleeping habits of one species on Sage Brush in the desert region of the State of Washington, where he had since found 100 fast asleep, all males. He spoke also of the dimorphic males of *Diotrepa*, called *sackeni* and *rivalis*, found on a lake shore in northern Idaho, and of the so-called "ghost trees" on Mt. Rainier, on which the very active *Cyrtopogon* and *Dasyllis* were numerous but hard to catch.

*Diotrepa*

Dr. L. O. Kunkel, of the Boyce Thompson Institute, made an address on "Insects in Relation to the Aster Yellow Disease" in which it was shown that the leaf-hopper, *Cicadula sexnotata*, was the carrier of the disease. The entire subject was reviewed showing the thoroughness with which it had been studied.

Mr. Bird exhibited an illustration in color of the moth *Papaipema placida* made by Mr. Ernest Shoemaker, with the moth itself, stating that it was fortunate that the society, having possessed an artist like Mr. Joutel, had now also one of Mr. Shoemaker's skill.

Mr. Leng exhibited a rare beetle from Australia, *Paussoptinus laticornis* Lea, received from Dr. Walther Horn, of Berlin.

Mr. Bromley exhibited some robber flies from the collection of Mr. Davis, each of them associated with the insect it had attacked and called special attention to *Mallosphora nigra*.

On motion by Mr. Notman, the President was requested to convey to Dr. Leonard and the authorities of Cornell University the Society's appreciation and thanks for the publication of the New York State List of Insects.

Miss Dobroschky spoke of the Bermuda List as probably the next to appear.

Mr. Hallock, present as a visitor, spoke of his official studies on Scarabæid beetles on Long Island, especially the Japanese beetle, the Asiatic beetle and the Oriental beetle, the latter recently introduced.



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### VARIATION IN JUNONIA LAVINIA (LEPIDOPTERA, NYMPHALIDÆ)

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The Buckeye, *Junonia* or *Precis lavinia*, with its forms, is the most striking case of geographical variation in the whole American butterfly-fauna, on account of its wide distribution and the number and brilliancy of its forms. The present account is far from complete, but will outline the situation and call attention to the places where further study is needed.

For this protean species, *lavinia* Cramer seems to be the oldest name. It was based on a specimen from Surinam, but it happens that Surinam is a meeting place of northern and southern forms, and typical *lavinia* is not typical of any of the well-marked races of the species. I suppose it should be used of one or another of the races, but it happens to be such an exact blend of the principal northern and southern forms that I am not using it as a subspecies name.

Leaving out of account a few local forms of limited distribution, the species as a whole can be divided into three well-marked series of geographical forms, which may be called roughly the North, Central and South American types. The first two of these have a peculiar relation. They meet both in Mexico and in the Greater Antilles. In Mexico they evidently interbreed, and material from northern Mexico (Sinaloa and Durango) is usually intermediate in character, but in Cuba they exist side by

side without blending; apparently two stocks have reached Cuba by different routes (via North and South America) and have become so distinct on the way that from the Cuban point of view they would seem to be real species. In other words, we have here species caught in the very act of formation.

The North American series may be called *J. l. coenia* Hübner. It varies somewhat, locally, but it is not necessary to divide it at present. It may be characterized as follows:

Ground umber brown, even, without green overlay; markings clean-cut, more sharply defined than in any other form; fascia across apex of cell of fore wing broad, white, crossed with fine black veins, but without any tawny or red sealing; with a white crescent before the lower eye-spot, which is narrowly if at all connected with the upper part of the fascia; subapical fork of fascia obsolete. Upper ocellus of hind wing exceptionally large, with some violet sealing on its inner half, *enclosed in a definite red semicircle*. Hind wing beneath variable in tint, usually pale with fine dark lines, rather than bands, the ocelli inconspicuous, not black. In its normal state the red crescent is absolutely distinctive of this form, and is a primitive character, appearing in several old-world species. There is a suffused black form (*nigro-suffusa* B. & McD.) where the white markings are all covered, and the black may occasionally obliterate even the red crescent. In such extreme specimens the form is difficult to separate from the corresponding South American form, but such specimens are very rare. Massachusetts to California, south to Sinaloa and Durango, Mexico, and occasionally even to near Mexico City, but Mexican specimens usually show a tendency to show characters of *zonalis* or *genoveva*; also from Cuba and Isle of Pines. Seasonal dimorphism is moderate, but there seems some variation in the color of the under side.

The second group of forms occupies Central America from Sinaloa and Durango, Mexico, where they intergrade with *coenia*, to Peru and northern Brazil, and also the Antilles. As a whole they are marked by a transverse fascia more or less tinted with tawny or pinkish, but not deep orange, and sometimes reduced to a series of diffuse spots or lost in blackish suffusion. They do not have any metallic green suffusion, or only

faint traces in occasional specimens. This form is strongly dimorphic, and I believe seasonally, though my dates are too incomplete to be quite sure, and the two races of the paler (dry) form do not coincide with those of the dark form. Of this series the most characteristic form is the usual wet phase, *zonalis* Felder (*occidentalis* Fld.?).

Ground gray-brown, just as in form *coenia*, or with a little tawny dusting at the base. Fore wing with a broad and conspicuous white fascia across the apex of the cell, more or less edged and shaded with pinkish tawny, or even suffused with this color (var. *incarnata* Fld.); outer upper fork of fascia tawny, shading into brown at the costa, but well developed and conspicuous; lower end of fascia also well developed and extending practically to anal angle. Upper ocellus well developed, with more or less distinct white spots above it, the first of them often developed into an imperfect ocellus, but no dark dots in the lower interspaces; lower ocellus large, and normally completely surrounded with a tawny ring, which is not narrowed where it joins the main part of the fascia. Hind wing with a narrow tawny submarginal band or none. Fore wing below with the fascia conspicuous and crossing the subterminal lines to the outer margin, the white spot above the upper ocellus almost always ocellate. Hind wing below broadly shaded with red-brown from the postmedial line to beyond the ocelli, and frequently suffused with red-brown. Postmedial line preceded by a straight, narrow pale shade, which is frequently conspicuous. Ocelli always black, and ringed with yellow and black, as on the upper surface, frequently heavily scaled with blue. Frequently with a third large ocellus in cell R.

The typical condition of this form is easily recognized. It is what has commonly passed for *genoveva* (for instance, in Holland's "Butterfly Book," Pl. 20, Fig. 9, and in the "Biologia Centrali-Americana"). The type locality is Colombia. It is also found with some variation widely distributed in Mexico and Central America and in the West Indies, where each island seems to have some peculiarity. It reaches north to Mazatlan, Mexico, where transitions to *coenia* are more common, and to Inagua, Bahamas. Cuban specimens are usually much like mainland

ones, but those from San Domingo, Porto Rico and St. Thomas have very large ocelli. From present knowledge this and the pale form seem curiously divided between the West India Islands—*genoveva* is rare on Jamaica, Porto Rico and St. Thomas, but seems less rare in San Domingo; I have seen only *zonalis* from St. Kitts, Antigua, Guadeloupe and Sta. Lucia, and mainly the form *incarnata* from Dominica. *Zonalis* is relatively rare on Trinidad and appears absent from Barbados. My males from Grenada approach *zonalis*, but the only female is an extreme *genoveva*. From Venezuela I have not seen *zonalis*, though it should occur, and it is replaced by variant forms in the Guianas. *Zonalis* was included in Felder's original conception of *occidentalis*, but I have preferred to use a well founded name to a confused and doubtful one.

**J. l. oriana** Kby., the usual wet form in British and Dutch Guiana, is close to *zonalis*, differing only in having a narrower pale fascia across the fore wing. I have such specimens from Kartabo, British Guiana, and from Paramaribo, Surinam. One or two of my specimens show traces of green iridescence, and the original figure of *lavinia* shows fully developed iridescence, but has the pattern of this form, which perhaps should not be separated from *l. lavinia*. I have a single such specimen from Curaçao.

Form *evarete* Cr. This is similar to *zonalis*, but the under side is deep umber brown without eyespots, evidently approaching form *constricta*. I have such specimens with transitions to the preceding, taken at Paramaribo just at the change from dry to wet season, and a dwarf from Margarita Island.

This completes the list of wet forms from the central zone, except for a form of limited distribution in British Guiana, which I will discuss along with the sand-barrens forms. The following appear to be the corresponding dry forms.

**J. l. basifusca** Weymer.—This is obviously a development of *zonalis*, which, so far as we know, is confined to western Ecuador. It is distinguished by the combination of conspicuous light yellow outer markings and obsolescent blackish bars in the cell. So far as known to me in all other forms not wholly suffused with blackish, the bars in the cell are conspicuous. It may pos-

sibly intergrade with *constricta* in southwestern Colombia, from which I have not seen material.

*J. l. z.* form *constricta* Felder. Similar to *zonalis*, but with the upper inner fork of the fascia very narrow, hardly if at all wider than the ring surrounding the eyespot, and with the outer fork obscure, giving a certain resemblance to the Australian species *vellida*. Under side reddish brown, powdery, with eyespots obscure or absent.

In its typical condition this is a rather distinct form, and usually contrasts well with *zonalis* specimens from the same region. It connects rather with some of the Guiana strains, *arenosa* and *evarete*, though instantly distinguishable except from the large aberrant specimens of *arenosa*, and they are much less brilliantly colored. Its distribution is curious; primarily Colombia and Cuba, in both of which places it associates with *zonalis* forms with small eyespots. I have seen it (not typical) from Yurimaguas, in northern Peru, and from Panama and Jamaica (where *zonalis* seems to be the only normal form). *Zonalis* in the rest of its area either exists alone, so far as we know, or is associated with a form that has a close resemblance to the Surinam *genoveva*.

*P. l. l.* form *genoveva* Cramer. Upper side pale, the wings longer than in typical *lavinia*, at least in mainland males. Under side typically straw color, with the markings mainly of fine and waved transverse lines; eyespots obsolete below.

This form, or perhaps rather group of forms, is distinguished from other central forms mainly by its general pale color and by its lack of green from *negra*, etc. The female is sometimes very pale, with the general ground really tawny, and occasionally shows the discal spot of the hind wing as in the old-world species, but usually only as a fine outline. Island specimens tend to be shorter-winged, especially females, and I thought at one time that the palest island forms might be separated, but wherever I have series, individual variation is so large as to make it unsafe. In the Antilles *genoveva* occurs erratically to judge by present knowledge: Hayti, San Domingo, Jamaica (rare), Porto Rico and St. Thomas (rare), Trinidad. On Barbados it seems to be the only form, but wet-season specimens average darker.

Dry females are a decided tawny yellow, and standing by themselves would be taken for a distinct species approaching *vestina*. It also was taken in the wet season at Grenada, so there also it is likely to be the only form. On the mainland it is the dry form at Paramaribo, and I have seen it from Venezuela and Honduras, though in intermediate country *constricta* seems to replace it.

In the Guianas there is a series of belts of barren and generally sandy savanna extending roughly east and west. These zones have been sampled entomologically at Zanderij, Surinam, and on the Potaro in British Guiana, from Kaieteur well toward Roraima. They seem to be occupied by a special series of *lavinia* forms of striking character; one the smallest of all the forms, one the blackest (aside from single aberrant specimens of *coenia*) and the third with the most extensively developed bright tawny areas. The first of these is evidently a dry form, with an upper side approaching *constricta* and the under side of *genoveva*, and the third is obviously a wet form with the color scheme of *zonalis incarnata*, or *hubneri* (except the lack of green). It is not clear to which form the black one is attached, but the under side and female seem nearest *zonalis*. We may name these three forms *arenosa*, *nigralis* and *vivida*.

**J. l. arenosa** new race.

Expanse typically 33-40 mm. (aberrant specimens up to 48 mm.). Upper side olivaceous brown, about the color of male *genoveva*, with the area between and beyond the tawny bars in the cell perceptibly paler, and a well-marked dark postmedial band, angled out on veins  $M_2$  and  $M_3$ , and concave above and below. Bars in cell bright tawny, fascia of a narrow cross-band at the end of the cell not more than twice as wide as an interspace and a pale circle around the large lower eye-spot of about the same width, both crossed by dark shades on the veins. A dark crescent below the eye-spot as usual, and a dark shade-line connecting the two eye-spots and running up from the upper toward the costa, where it is lost in dark ground. Before this last line is a distinct double, whitish costal spot, and beyond it and continued outside the upper eye-spot to connect with the band encircling the lower eye-spot is a somewhat darker band, not usually distinct above  $R_5$ . Border dark, as usual with broken pale filling. Hind wing similar, usually without traces of a discal bar, with a continuous submarginal band tangent to the outer sides of the eye-spots. Border of a triple dark line, enclosing two pale lines, the outer obscure. Light markings straw color in male, in

the female more or less suffused with tawny, especially the portions beyond the ocelli and the band on the hind wing. Under side essentially as in *genoveva*: straw color, the hind wing with wavy and somewhat diffuse darker transverse lines. Cell of fore wing largely filled with three large tawny, dark-outlined patches, the spaces between them pale straw color, and with some tawny below cell, especially in the female. Upper eye-spot of fore wing minute, lower large and conspicuous, hind wing usually with two well-marked and fully formed eye-spots. Postmedial band as above, usually blackish and strongly contrasting, a blackish subterminal band cut with pale veins, from  $M_2$  to inner margin, and less strongly on whole width of hind wing. Hind wing frequently with a transverse red-brown shade before eye-spots, and both wings typically with black points between eye-spots.

Zandarij, Boven Para District, Surinam, abundant on the sand-barrens (mingled with a small proportion of aberrant forms) in April. Also in American Museum of Natural History from Kaieteur, Potaro River, British Guiana, July 20 and August 8, the latter specimens larger than any but two of the Zanderij ones. Cornell University, type no. 889.

**J. l. vivida** new variety.

Expanse 40–50 mm., larger than typical *arenosa*, though hardly larger than specimens from the same region. Ground deeper, nearly as dark as normal in form *zonalis*; bands as in *arenosa*, but better developed, especially the band across beyond the apex of the cell; and all deep bright tawny (cinnamon rufous of Ridgway) averaging not quite as dark as *hubneri* but richer than in *zonalis*, even in fully colored *incarnata* forms. Spots above upper eye-spot white, as usual. Inner line in the dark border yellowish, about as in *arenosa* and decidedly paler than the tawny markings, the outer line suffused but traceable on fore as well as hind wing. Under side of the *zonalis* type, but much paler than in normal *zonalis*, the ground yellowish but strongly shaded and banded with brown, forming a broad band before the eye-spots of the hind wing, with a straight pale band before it and a decidedly tawny subterminal band beyond. Fore wing strongly shaded with tawny, especially about the upper eye-spot.

Irong River to Roraima, British Guiana. Aug. 6–14, 1911. Type no. 890. Types in American Museum of Natural History; paratypes in C. U.

This is likely to be the wet form of *arenosa*. Besides the type series I have a slightly aberrant specimen from Republick, Surinam, Mar. 28. This specimen is much darker beneath, approaching *oriana*, and closely matches some specimens from the Uaupes

River on the edge of Colombia. *Vivida* is really intermediate between *arenosa*, *zonalis* and *hubneri*, the large area of tawny on the hind wing also commonly occurring in *hubneri*, though generally of a deeper tint.

**J. l. nigralis** new aberration.

Smoky black, the tawny bars in the cell only faintly paler, and outlined with deep black, the eye-spots and marginal markings also traceable, and the usual yellow ring about the eye-spots of the hind wing most distinct. Under side black-brown, the usually tawny bars in and about the cell represented in mahogany brown, the eye-spots rather well marked and normal, and the deeper chocolate brown transverse fascia of the hind wing rather easily traced, suggesting *zonalis*. Female also blackish, but with all the markings rather distinctly traceable, the fascia as in *arenosa*, but dirty brown and less extensive, the band across beyond the cell, of separate palish spots as a rule. Under side of fore wing with medial area heavily shaded with brown, leaving a contrasting pale angulate postmedial line beyond the usual blackish one, which is inconspicuous. Hind wing largely dark brown, but with a blackish band through the three eye-spots and a red-brown band before it, preceded by a pale postmedian band; subterminal region also pale, crossed by a wavy dark line.

Kaieteur, British Guiana, with the larger phase of *arenosa* and tending to intergrade with it. Type no. 891. Types in American Museum of Natural History; paratypes in C. U.

This may be an aberration rather than a distinct form, but was taken in series. It tends strongly to lose its markings, especially on the hind wing beneath. One specimen from Irong-Roraima, Aug. 15, has the under side of the hind wing red-brown, practically without markings. One female from Kaieteur also is practically var. *evarete*. I think like *evarete* this is a transition form at the turn of the seasons, but it may turn out to be the wet form most closely corresponding to *arenosa*.

The third and southern group of forms reaches from near the southern boundary of Colombia on the west, and from the mouth of the Amazon on the east, south to the limit of the species. These forms may also be divided into a dark and a pale type, which appear from our present very limited knowledge to be rather forms of wet and dry areas than seasonal, but at the only place where I have seen a representative series from various months, Bolivia, both forms occur together with a partial sea-



sonal separation. They also occur together in Bahia and at Pará. I have also a single specimen of *hubneri* from the lower Amazon, where *pallens* (s.l.) is the normal form. The dark forms seem rather apt to lose the green tint from the hind wing, especially in the female, but such specimens usually differ from material of the central group in the deeper color of the tawny markings, and from all except form *vivida* and its transitions from the Uaupes region, by the well-developed tawny on the hind wing. The pale form shows practically the coloring of *genoveva*, but rarely loses the green; the male at least may be distinguished by the much more deeply concave outer margin of the fore wing (Holland, "Butterfly Book," Pl. 20, fig. 8), while the female is not far from the male of *genoveva*.

The oldest valid name for a member of this series seems to belong to a moderately pale form, *negra* Felder, which has page priority over the other Felder names except the unrecognizable *occidentalis*; but on account of its transitional character I have preferred the well-characterized name of *pallens*, from the same work. Felder distinguishes in all, four forms with this coloring, on locality and small differences of coloring. With the present material I cannot distinguish these, and am treating all as one form, ranging from Venezuela and the hills of Guiana to Argentine. By its description *infusata* Fld., seems distinct, but the specimens I have seen from Bahia are normal *negra* and *hubneri*.

**J. l. pallens** Felder. Ground clay color, more or less dusted and suffused with fuscous, with the disc of the hind wing strongly overlaid with green. Tawny spots of fore wing strongly outlined with blackish, and postmedian sinuate band contrasting. Fascia broad, clay-colored, more or less tinted with light tawny, broadly connected with the wide area about the lower eye-spot. Subterminal pale band of hind wing conspicuous, and tawny when the fascia of the fore wing is shaded with tawny. Under side of hind wing clay-color, the transverse markings generally fine and somewhat wavy, though as a rule less complex than in form *genoveva*. Postmedial region more or less shaded with red-brown; ocelli usually distinct, though a little blurred. Disc of fore wing more or less shaded with light tawny, especially below the cell. Type locality Venezuela.

The type material of *negra* seems to have been transitional, and is compared with "*lavinia*" (*hubneri*, *evarete* ♂ Hubner, Samml. figs. 1, 2) but is described as markedly paler than *hubneri*. It may really be a form approximating true *lavinia*, which seems to have been unknown to Felder, but I have matched it approximately with the darker specimens of this form from Manaos. Felder's second name, *hilaris*, from Paraguay, is compared with "*genoveva*" (apparently *oriana*, as Hubner's *evarete* ♀, figs. 3, 4 is cited), but the pale under side and green overlay indicate this form. A specimen in our collection from Jujuy, Argentina, may be considered equivalent. *Junonia pallens* Fld. from Venezuela and *J. divaricata* from Surinam are northern names, and may be represented by specimens from Zanderij and Kwakoe Gron, Surinam, and Mackenzie, Demerara. My specimens from these localities are broken, and may be migrants from a little farther south. Felder also gives Cuba as a locality for *divaricata*, but I have never seen a green specimen from the Antilles and suspect some confusion. Finally, *J. infusata* Fld. is said to be distinguished by the light brown fascia; it was described from Bahia, where the normal pale form is not unlike all from southern Guiana to Argentine. It may be an aberration.

**J. l. hubneri** Kirby (*evarete* Hubner, ♂, not Cramer, *lavinia* auct. in part, not Cramer). Ground blackish, deeper than most other forms, and much deeper than the *negra* series of forms; heavily overlaid with green. Fore wing with the fascia well marked, but wholly deep tawny (11'i, cinnamon rufous of Ridgway) much darker than in *incarnata*, and somewhat darker as a rule even than *vivida*; the fork across beyond the end of the cell about 2 mm. wide, as in *lavinia*, but the outer fork no darker, almost as conspicuous, preceded by the usual small white spots above the upper ocellus, and followed by a pale submarginal stripe. Lower ocellus in the original figure outlined with the tawny, but solidly in contact with the blackish base in normal specimens. Hind wing with a deep tawny submarginal fascia, followed by a conspicuously paler and duller marginal stripe. Fore wing beneath with the ground toward the base tawny as usual in dark forms, the two tawny bars in the cell concolorous with the ground about them, unlike the *genoveva-pallens* group;

fascia tawny, hardly paler than on the upper side, its outer fork gradually fading out into the light wood-brown ground of the apex. Hind wing wood-brown, heavily overlaid with fuscous, but with a reddish tint in the postmedial region. Ocelli well developed, but not contrasting in color.

This form, together with the next two, seems to cover the most habitable parts of South America. It is not clear whether there may not be an interruption of their distribution in the region of Jujuy, Argentina, where pale forms seem to occur alone. It runs far north on the east side of the Andes, to the R. Napo at least, but is replaced by a form of *zonalis* at Iquitos. My two most northern specimens, from Puerto Bermudez and the Rio Napo, have the lower ocellus of the fore wing wholly outlined with tawny, as in the type figure.

**J. l. huacapistana** new race.

Similar to *J. l. hübneri*, but on the average a little smaller (43-49 mm.). Tawny area of the fore wing considerably extended, the inner fork of the fascia being over 3 mm. wide, and the whole fascia, measuring on  $M_3$ , being about 6 mm. wide; ocelli larger, those of the hind wing with more conspicuous violet scaling. Under side more tawny, the tawny base and post-medial fascia being continuous.

Huacapistana, Rio Tarma, Peru, at about 8000 ft. June 1-2, 1920. Specimens from San Juan, in the Cerro de Sal, east of the Andes, at about 5000 feet, are substantially the same form, but typical *hubneri* occurs in the Chanchamayo valley, in between. C. U. type no. 893.

This form is an alpine variant of *hubneri*, occurring about at tree-line on the east side of the Andes. I am characterizing it in the hope that it may turn out a useful index-type in recognizing faunal zones.

**J. l. lima** new race.

Similar to *J. l. hübneri*, but smaller and darker, normally with brilliant green iridescence, but occasionally dull, especially in the female. Upper side almost wholly of the dark ground, with only a narrow submarginal band of brown, darker than in the other forms, and normally showing no tendency to surround the lower ocellus. Inner fork more or less completely and sometimes widely, separated from the rest of the band, appearing as a third

fascia parallel to the two in the cell. Ocelli about as in typical *hubneri*, smaller than usual in *huacapistana*, the upper one with white spots above it. Under side of fore wing mostly fuscous, though with the usual tawny base, and with the outer fascia reduced as on the upper side. Hind wing dull powdery fuscous, with less red-brown shading than the other forms, the ocelli obsolete. Expanse 40–50 mm. C. U. type no. 892.

This is the form from the west side of the Andes, at Lima, Peru. It was also taken at Chosica and Matucana. The smallest specimens were certainly dwarfed by lack of food, as they had eaten every scrap in the vicinity of Lima, but I believe that even when normal they would average smaller than *hubneri*. There is a good deal of variation in the amount of tawny above, and the hind wing may or may not have a submarginal band. The larva is similar to *coenia*.

#### *Geographical Synopsis*

United States: *Coenia* only.

Northern Mexico (Sinaloa and Durango): *coenia*, *zonalis* and transitionals. One specimen from Sinaloa approaching *constricta*.

Mexico City: *coenia* (a specimen of *hubneri* probably mislabeled).

Central America: *zonalis* and *genoveva* (a specimen of *hubneri* probably mislabeled).

Panama: *zonalis* and transition to *constricta*.

Bahamas: *coenia* (Nassau); *zonalis* (Inagua).

Cuba: *zonalis* and *constricta* (intergrading); *coenia* (not intergrading).

Isle of Pines: *coenia*; *constricta* (*zonalis* not seen).

Jamaica: *zonalis*, occasional *genoveva*, one transition to *constricta*.

Hayti to St. Thomas: *zonalis* with very large ocelli; *genoveva*.

St. Croix, St. Kitts, Antigua, Guadeloupe, St. Lucia, Dominica: *zonalis* only, in Dominica mainly of form *incarnata*.

Barbadoes, Grenada: *genoveva* only.

Trinidad: *zonalis* and *genoveva*, partly at least seasonal.

Curaçao: *zonalis* and *lavinia*.

Colombia: *zonalis* and *constricta*.

Venezuela: *genoveva* and *pallens*, both without locality data and presumably from different districts.

Coast of Guiana: *oriana*, *genoveva* and transitions; *lavinia*, type only.

Barrens of Guiana: *arenosa*, *vivida*, *nigralis*, with strays of *oriana*, and transitions, and *pallens*.

Hill country of Guiana: presumably *pallens*.

Western Ecuador: *basifusca*.

Eastern Ecuador (R. Napo): *hubneri*.

Upper Amazon (Iquitos): *zonalis*.

Upper Amazon (R. Uaupes): transitions to *vivida*.

Middle and lower Amazon: *pallens* (*hubneri* occasional at Pará, and *genoveva* seen with a label of northern Pará).

West side of Peru: *lima*.

Temperate Peru (east of Andes): *huacapistana*.

Subtropical Peru: *hubneri*.

Bolivia: *hubneri* and *pallens*.

Bahia: *hubneri* and *pallens* (type loc. of *infuscata*).

Minas, Matto Grosso (Corumbá), Rio and Uruguay: *hubneri*.

Paraguay: *pallens* (Felder).

Jujuy, Argentina: *pallens*.

Upper Cauca valley, Colombia: *vestina*.

Alpine Ecuador and Peru: *v. livia*.

Lake Titicaca and Tucuman: *vestina* forms.

#### KEY TO FORMS

1. Ocelli of hind wing in a tawny area, not surrounded by yellow and black rings (*vestina*).....2
1. Tawny band of hind wing touching outer side of ocelli only, or wholly beyond them, the ocellus itself with a yellow and then a black outer ring (*lavinia*) ..... 3
2. Of normal size (toward 50 mm.); ocelli of hind wing black with blue centers ..... **v. vestina**
2. Dwarfed; ocelli of hind wing blind, mere black spots.....**v. livia**
3. Ocellus of hind wing with a red crescent (reduced to a few mahogany scales in very dark suffused aberrations).....**coenia** 4
3. Ocellus of hind wing normally with blue or violet scaling, but without red .....6
4. Postmedial band cream white, conspicuous, all markings normal.  
*typical form*
4. All markings suffused with black .....5
5. Surviving markings and especially rings of eye-spots, broad and suffused.....**ab. schraderi**

5. Surviving markings fine and clean-cut, the red ring of the eye-spot often nearly lost.....ab. **nigrosuffusa**
6. Disc of hind wing with metallic green overlay<sup>1</sup>.....7
- <sup>1</sup> This character frequently fails in single specimens especially along the border zone of central and southern forms. Dark forms that should have the green overlay always have the tawny markings of a deep tawny (Ridgway's cinnamon rufous) and can thus be recognized even without locality labels; most of them also have a tawny submarginal band on the hind wing which is also rare in central forms except *vivida*. In the pale phases southern (properly green) forms have strongly excavate outer margin of the fore wing, the excavation being 2 mm. deep in normal-sized specimens (Holland, Pl. 20, fig. 8), while the central types have an excavation only about half as deep (Holland, fig. 9); sex for sex the anal angle is also more extended in the southern race, but the difference is almost intangible in the female.
6. Disc of hind wing without metallic overlay.....10
7. Ground of upper side black-brown, of under side brown, with broad darker shading.....8
7. Ground of upper side clay color, sometimes heavily shaded with fuscous, of under side mostly clay color.....**pallens**
8. Tawny markings of upper side dark, reduced, the portion at the end of the cell nearly or completely separated from the outer part of the fascia; hind wing beneath with ocelli obsolete.....**lima**
8. Tawny markings somewhat lighter, the fascia complete, Y-shaped; under side of hind wing with two small but well-marked ocelli.....9
9. Fascia 4 mm. wide, measured on vein  $M_3$ .....**hubneri**
9. Fascia 6 mm. wide, measured on  $M_3$ .....**huacapistana**
10. Ground of upper side blackish, without a contrasting fascia, or only a little as a series of separate vague spots.....**nigralis**
10. Ground dark, obliterating the spots in the cell, the fascia contrastingly pale straw yellow.....**basifusca**
10. Both spots in cell and fascia conspicuous.....11
11. Dark forms: ground above fuscous, below considerably shaded with brown, and usually mainly brown, with a contrasting, nearly straight paler postmedian band, when paler with the markings tending to be rather even and in broad bands.....12
11. Pale forms: ground above usually more or less shaded with fuscous on a clay-colored base; under side straw color or clay color, with the markings fine, and wavy or confused, without any broad areas of darker color (in *arenosa* the upper side is usually dark, but the under side shows the characteristic pale ground and fine pattern).....18
12. Under-side of hind wing suffused with deep red- or black-brown, with markings obscure and ocelli absent.....13
12. Under side with conspicuous dark postmedial area, bearing well-marked ocelli .....14

13. Fascia broadly ringing the lower ocellus of fore wing, the part across the end of the cell hardly broader; subterminal band on hind wing normally also well-marked..... **constricta**
13. Lower ocellus not strongly separated from the dark base, the fascia across the apex on the other hand conspicuous, usually without subterminal tawny on hind wing..... **evarete**
14. Submarginal band of hind wing and Y-shaped fascia of fore wing both bright tawny and conspicuous..... **vidua**
14. Submarginal band of hind wing obscure, the markings of the fore wing flesh color or more or less white..... 15
15. Disc of hind wing conspicuously green, the fascia largely white and contrasting with the dark ground..... **lavinia**
15. Disc of hind wing with at most faint traces of green..... 16
16. Fascia across fore wing at end of cell broader, averaging 4 mm. broad. **zonalis** 17
16. Fascia much narrower, averaging 2 mm. broad..... **oriana**
17. Fascia almost evenly flesh color..... ab. **incarnata**
17. Fascia largely white, shaded with flesh or tawny..... *typical*
18. Small (under 40 mm.). Upper side dark, with contrasting narrow clay-colored fascia, generally cut into spots by dark veins, and at its widest, beyond the cell, not twice as wide as an interspace; the female only with a little tawny..... **arenosa**
18. Large. (over 45 mm.). Upper side lighter fuscous in male, often of a washed-out tawny color in female, the submarginal band of hind wing broad and tending to suffuse into the ground; fascia across fore wing at end of cell much broader, and usually shaded with tawny. **genoveva**<sup>1</sup>

## CHECK-LIST

- |                              |                               |
|------------------------------|-------------------------------|
| 1. <b>vestina</b> Felder     | CENTRAL FORMS                 |
| a. <i>vestina</i>            | b. <b>zonalis</b> Felder      |
| b. <i>livia</i> Staudinger   | <i>genoveva</i> auct. nec Cr. |
| 2. <b>lavinia</b> Cramer     | form <i>constricta</i> Felder |
| NORTHERN FORMS               | <i>occidentalis</i> Fld. in   |
| a. <i>coenia</i> Hübner      | part                          |
| ab. <i>nigrosuffusa</i> B. & | c. <b>lavinia</b> Cramer      |
| McD. <i>negra</i> auct.      | normal form <i>oriana</i>     |
| nec Fld.                     | Kirby                         |
| ab. <i>schraderi</i> Gunder  | <i>evarete</i> ♀ Hbn. nec Cr. |

<sup>1</sup> In *J. infusata* of Felder no mention is made of green overlay; I have assumed it will show the characteristic wing-form of other southern forms, even if the green is really absent; it should be distinguishable from either *pallens* or *genoveva* by the light brown fascia.

- genoveva* Fld. nec Cr.  
 ab. *evarete* Cr.  
 form *genoveva* Cramer  
*lavinia* auct.  
 d. *basifusca* Weymer  
 e. *arenosa* Forbes  
 form *vivida* Forbes  
 ab. *nigralis* Forbes  
 SOUTHERN FORMS  
 f. *hubneri* Kirby  
*lavinia* Fld. nec Cr.
- evarete* Hbn. ♂ nec Cr.  
 form *pallens* Fld.  
*lavinia* Holland nec  
 Cr.  
*negra* Fld.?  
*occidentalis* Fld.  
 in part  
*hilaris* Fld.  
*divaricata* Fld.  
 ab. ? *infuscata* Fld.  
 g. *lima* Forbes  
 h. *huacapistana* Forbes





FORBES: DISTRIBUTION OF FORMS OF *JUNONIA LAVINIA*.



OBSERVATIONS AND REMARKS ON THE SLAVE-  
MAKING RAIDS OF THREE SPECIES OF ANTS  
FOUND AT URBANA, ILLINOIS\*†

BY M. R. SMITH

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During the summers of 1925 and 1926, three species of slave-making ants were encountered at Urbana, Illinois, two of which were the facultative slave-makers, *Formica sanguinea* subsp. *subintegra* Emery and *Formica sanguinea* subsp. *rubicunda* Emery, and the third, the true slave-maker, *Polyergus rufescens* subsp. *breviceps* Emery. The two former species are called facultative slave-makers because the ants can subsist without the aid of slaves, that is, their colonies are sometimes slaveless, whereas *Polyergus rufescens* subsp. *breviceps* Emery is entirely dependent on its slaves for food, the rearing of its young and the construction of its nests.

Most of the notes presented here deal with the raids and habits of *Formica sanguinea* subsp. *subintegra* Emery. A colony of this species was very accessible for study, since it was located on the lawn in front of the Natural History Building of the University of Illinois and not over seventy-five yards from the writer's office.

*Formica sanguinea* subsp. *subintegra* Emery

This ant is perhaps the most common of our eastern *sanguineas*. It occurs at low elevations throughout the area from Canada to Georgia, and westward to the Dakotas and Kansas. The workers can be readily distinguished from their nearest relatives by their distinctly brown-colored gasters and their thick, blunt petioles.

\* Extract number two of a thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Entomology in the Graduate School of the University of Illinois, 1927.

† Contributions from the Entomological Laboratories of the University of Illinois, No. 124.

The workers also have rounder heads and smaller bodies than the other species of *sanguinea*.

In the vicinity of Urbana, the common slave of *subintegra* is the black, field or lawn ant, *Formica fusca* var. *subsericea* Say, one of our most common ants not only at Urbana but throughout most of the United States. Wheeler (1913) records the following species of ants as slaves of *subintegra*: *Formica fusca* var. *subaenescens* Emery, *F. cinerea* var. *neocinerea* Wheeler, *F. neogagates* Emery, *F. neogagates lasioides* var. *vetula* Wheeler, *F. pallide fulva schaufussi* Mayr and var. *incerta* Emery, and *Formica pallide fulva nitidiventris* Emery and its variety *fuscata* Emery. It can be seen from this list that *subintegra* makes slaves of a large number of species of ants, all of which belong to the genus *Formica*.

During two consecutive summers, fifteen raids by these ants were witnessed; eleven of which took place in 1925, and the remaining four in 1926. The data relative to these raids are shown in Table 1.

TABLE 1

Showing details of various raids made by the ants, *Formica sanguinea* subsp. *subintegra* Emery, on colonies of the slave-species, *Formica fusca* var. *subsericea* Say, all raids having taken place from the same colony of the slavemaker.

Month and Day	Hour	Weather Conditions	Distance between Nests	Success of Raid	Time Lasted	
					Hours	Minutes
1925						
July 2	5 P. M.		25 feet	Good		
July 10	12 M.		20 "	Poor		
Aug. 7	4.30 P. M.	Cloudy—muggy				
Aug. 8	1.40 P. M.		70 "	Good	1	40
Aug. 10	3.50 P. M.	Misty—rain	48 "			
Aug. 11	11.55 A. M.	Raining—gently				
Aug. 13	12.10 M.	Clear—warm	98 "	Good	1	20
Aug. 15	4.45 P. M.		150 "			
Aug. 21	11.45 A. M.	Clear—warm				
Aug. 22	4.25 P. M.	Clear—warm				
Aug. 31	11.30 A. M.	Clear—warm	35 "	Good		
1926						
July 8	11 A. M.	Cloudy—cool				
July 13	2.05 P. M.	Clear—cool	38 "	Poor		
July 14	12.15 P. M.	Cloudy—cool	35 "	Good		
July 17	2.05 P. M.	Clear—warm	110 "	Good		

The earliest raid observed took place on July 2, 1925, at which time the *subintegra* workers ransacked a healthy colony of the *subsericea* and drove not only the workers from the nest but also eleven females, ten of which were alate. This is mentioned to support the theory that the raids very probably do not take place until the sexed individuals of the slave-species are mature. If the workers of *subintegra* should raid the nest of the slave-species early enough to obtain the sexed pupæ, these pupæ when carried to the *subintegra* nest would upon obtaining maturity probably endanger the life of the colony of *subintegra*, hence the delay upon the part of the slave-makers in carrying out these raids. Not only have alate females of *subsericea* been found as early as July 2, but also alate females of *subintegra*. Alate females were found in the *subintegra* nest as late as July 13, although at least two raids had previously taken place from this colony.

That *F. subintegra* workers raid the nests of the slave species in their vicinity time and again is proven by the fact that during the summer of 1925, eleven raids were witnessed, and there were probably many others which took place unknown to me. I do not believe that hunger is the sole motive which drives these ants to raid the nests of the slave-species, for the *subintegra* workers raided too often to have exhausted the food supply which they obtained from previous raids.

The conflicts that took place between the two species were indeed mild affairs, which in nearly every case resulted in few deaths on either side. The *subsericea* workers, if time permitted, seized their brood and fled from the nest at the approach of the *subintegra* workers. If sufficiently hard pressed by the raiders, they would even desert their brood and flee to the nearby grass and leaves where they hid while the raiders entered their nest and appropriated any larvæ, pupæ or callows that could be found. The *subintegra* workers when transporting a *subsericea* callow would catch it by the dorsum of the thorax and carry the ant with its ventral surface facing the ground. *Subintegra* workers were even seen to carry some of the *subsericea* callows down into their nests. There is a probability that the *subsericea* callows might reach maturity within the nests of the slave-makers and be accepted by them, especially if the callows were young enough

not to have acquired the *subsericea* nest odor. The custom of carrying callows of the slave species to their nests is a strange habit and one difficult to explain. The only plausible reason that occurs to me is that the workers of *subintegra* are unwilling to return to their nests, empty-handed, so to speak, and hence seize the *subsericea* callows rather than go back to their nests with nothing to show for their efforts.

In several of the raids, the *subsericea* workers offered strong resistance, but this was usually easily overcome by the robust raiders who pounced upon them and not only attempted to pull off their appendages but squirted formic acid on their bodies and wounds. Sometimes as many as three or four *subintegra* workers were observed to attack a single *subsericea* worker.

No one has ever seen the workers of *Polyergus* raid in the morning, but this does not apply for the *subintegra* for they raid at nearly all hours of the day. I have observed raids which took place as early as eleven o'clock in the morning and as late as five o'clock in the afternoon. The majority of these raids, however, occurred between the hours of eleven o'clock in the forenoon and two o'clock in the afternoon, at which time the temperature was probably as high as it is during any part of the day. Wheeler (1916) has noted that *Polyergus* females have made raids with their sister workers, but nothing like this has been observed for *subintegra* or *rubicunda*.

The type of weather is apparently of little importance in determining the raids, for raids have been observed to occur in all types of weather—during misty rains, or on cloudy, muggy days, but most generally on clear, sunny days.

In some of the raids certain *subintegra* workers have been noted to return to their nest with other *subintegra* workers in their mouths. In such cases the transporting ant locked mandibles with the transportee and the latter curled up in such a manner that its ventral side was next to that of the ventral side of the transporter. Why these ants should carry one another is also another perplexing question which has not yet been solved. Whenever I captured a pair acting in this peculiar manner and examined the transported ant, invariably I found it in an apparently healthy condition and as capable of locomotion as the

ant transporting it. This precludes the supposition that the ants were injured, or possibly sick; hence I am led to conclude that the transported ant is either stubborn and refuses to return to its nest or else that the carrying instinct is so well developed in the *sanguinea* worker that rather than return empty-handed she carries home a worker of her own species. I have also observed this act of phoresy for *Formica fusca* var. *argentea* Wheeler, a non-slave making ant. Wheeler has suggested that in the case of the non-slave-making ants such habits may be due to the fact that the transporting ant knows the trail and the transportee does not, or else that the transportee does not wish to change its location and the transporter does.

While the raids of the *subintegra* workers were in progress their slaves usually remained at home with their brood, or else foraged for food in the vicinity of their nest, or in exceptional cases accompanied the slave-makers, though they did not take any active part in the raiding. In only one case have I found a *subsericea* slave-worker returning to the nest of the *subintegra* with a pupa of the raided species in its mouth. This instance was so unusual that it can be considered exceptional. Some writers state that the slaves in the *subintegra* nest show much excitement over the return of the raiding *subintegra* workers and the brood which they carry. This has not been observed by me, although it may occur.

While some of the raids were in progress, a Nemesis in the form of a flicker, *Colaptes auratus* Linn., stood by the side of the trail and picked up some of the *subintegra* workers as they passed in procession. No other predators for either species were observed except a gamasid mite which was found quite commonly on the larvæ, pupæ and callows of the slave species.

The colony of *subintegra* mentioned in this discussion occupied the same nesting site for at least three years and very probably longer. A change in the nesting site of these ants is undoubtedly initiated by a lack of *subsericea* nests for them to raid.

*Formica sanguinea* subsp. *rubicunda* Emery

This ant, although a close relative of *F. subintegra* and very similar to it in general appearance, can easily be recognized in

the worker caste by the distinctly black-colored gaster and by the broad petiole with sharp superior margin.

*F. rubicunda* is by no means as common an ant as the foregoing species, being found more sporadically in the area from Canada to North Carolina and westward to Colorado. Wheeler (1913) states that its slaves are other *Formica* belonging to the following species: *F. fusca* var. *subsericea* Say, *cinerea* var. *neocinerea* Wheeler, *neogagates* Emery, *pallide fulva schaufussi* Mayr and its variety *incerta* Emery.

I encountered only three nests of this species at Urbana. One of these, which the ants occupied jointly with their slaves, *F. neogagates* Emery, was a very inconspicuous nest in a garden. As a raid was not in progress at this time no notes were made concerning the ants or their nests.

The second nest was discovered on July 18 at 5.10 in the afternoon, at which time the ants were raiding the nest of a species of *Aphænogaster fulva* var. about eighteen feet from their nest. The *rubicunda* workers after having left their nest crossed a lawn, a graveled driveway, and a portion of the lawn on the adjoining lot. Here they were found taking brood from the nest of the *Aphænogaster* which occurred in the soil beneath some shrubbery. The majority of the *Aphænogaster* workers had been driven from their nest, but a few found in the vicinity of it were trying their best to repulse the attacks of the bold and robust *rubicunda* workers. The sight was somewhat amusing, as the *Aphænogaster* workers appeared very slender and delicate beside their antagonists, for whom it was clearly seen they were no match. I picked up several of the *rubicunda* workers, which bit my fingers savagely, squirting formic acid into the impressions made by their mandibles.

The nest of the *rubicunda* was found to be a small earthen mound about five or six inches high and two to three feet in diameter, which stood out rather conspicuously on the grassy lawn where it was located.

July 15 another *rubicunda* nest was observed which might have been overlooked had I not seen the workers trailing back to their nest with the stolen brood of the slave-species in their mouths. This nest was well concealed beneath a clump of grass



in a lawn. At 1.05 o'clock in the afternoon, the workers were busily engaged in raiding the nest of the ant, *Formica pallide fulva nitidiventris* var. *fuscata* Emery, which was located in the soil near the base of an old stump and about twenty-four paces from the *rubicunda* nest. The bewildered *fuscata* workers were seen running around in the grass in front of their nest, and offering not the least resistance to the *rubicunda* workers, who were securing an extremely large amount of brood. While the raid was in progress other *rubicunda* workers were noted returning to their colony with pupæ and callows of a species of *Formica fusca* (probably *subsericea* Say), which they had obtained from a nest to the west of their own.

Of at least twenty or more raids which I have seen conducted by *Formica rubicunda* and *Formica subintegra*, this is the first time that I have ever witnessed two forays proceeding from the same colony, and at the same time, on two entirely different species of ants. Wheeler (1910) states that colonies of the slave-making species are sometimes found to contain two different species of slaves, but he does not record having seen a raid like the one just described.

*Polyergus rufescens* subsp. *breviceps* Emery

The so-called occidental Amazon is one of the prettiest and most graceful-looking ants to be found in the vicinity of Urbana. The workers are light yellowish-red in color, with highly polished bodies which glisten in the sunlight in such a manner that the ants are a very beautiful spectacle when on a raid.

This ant has been found to range from California eastward to Illinois and southward to New Mexico. Although it is not a rare ant at Urbana, it is by no means a common species. During my residence there I encountered only two nests of this ant, and had a friend give me specimens from a third nest within the city limits.

Wheeler (1913) states that its slaves are the following species of *Formica*: *fusca* var. *argentea* Wheeler, *fusca* var. *subsericea* Say, *cinerea* var. *neocinerea* Wheeler. At Urbana, *subsericea* seems to be the common slave, probably because it is one of our most abundant species of *Formica*. *F. argentea*, although occur-

ring here also, is by no means as common an ant as *subsericea*.

At 4.10 on the afternoon of June 27, 1925, I located a raid of this species which was being carried out on the black lawn ant, *F. fusca* var. *subsericea* Say. The beautiful slave-makers were first observed as they emerged from the obscure nest of the slave-species located in the grass near the edge of the sidewalk. Nearly every *breviceps* worker bore a pupa of the slave-species, which it was carrying with alacrity to its nest. The raid must have been under way for some time, for the *subsericea* workers had fled from their nest and left their brood exposed to the mercy of the marauders. The *breviceps* workers were returning to their nest in a file, which at some places was only one worker broad and at other places ten to twelve workers broad. This trail led across a street, in which many automobiles were passing to and fro and undoubtedly killing many of the ants, yet the raid continued in spite of such disturbances. I trailed the ants back to their nest which was found on the east side of a house, in the soil just beneath the ledge of a basement window. This nest was at least seventy-five yards from that of the *subsericea* colony, which it was raiding.

On questioning the owner of the house as to the length of time that the ants had been under his observation, he stated that he had observed the colony of *Polyergus* when he moved into the house five years previously and that he believed the ants had been there for sometime before he moved in.

On July 16, 1926, a raid by this species was observed between 4.30 P. M. and 5.05 P. M. This raid by a second colony of *breviceps* was on another nest of the same slave-species. The nest of the slave-species was found to be sixty paces to the south of that of the *breviceps*. The raid resulted as usual in the slave-makers securing a large amount of brood with but little opposition from the slave-species.

At 5.05 P. M., July 21, 1926, I went to the nest of the colony of *breviceps* mentioned above to see what was taking place. This nest was located in the soil beneath the ledge of a basement window, on the west side of the old Agricultural Building of the University of Illinois. At this time, only a few stray workers of *breviceps* could be seen above the surface of the ground.

Hoping to locate some of the ants, I began to remove some of the dirt from around their nest. Almost immediately the yellowish-red workers began pouring forth, appearing to be in much of a rage. Some of them settled on the handle of a trowel that was lying on the ground, and so firmly did they fasten their mandibles into the wood, that when I gave the trowel a very sharp shake, I could not dislodge the ants. For a few minutes the ants ran around on the ground in a more or less aimless way although a few of the workers would occasionally stop and touch each other with their antennæ, whereas others rubbed the sides of their bodies against the ground in such a manner that it gave me the impression they must be stridulating. At any rate, it was only a short time until the ants set out in a concerted mass for a *subsericea* nest which lay ninety-five paces distant. In going to this, the ants had to cross a large amount of thick grass, a cement walk and some tilled soil. While on the march they kept in a rather compact file about twenty feet long and not over four inches wide. After a comparatively short time they succeeded in reaching the *subsericea* nest. When a sufficient number were present, they poured into the nest of the slave species and in a few seconds were victoriously emerging with larvæ and pupæ of the latter. Most of the *subsericea* had fled from their nest on the approach of the *breviceps* workers, and those which were left were immediately pounced upon and dispatched by the slave-makers. The *breviceps* workers set off for their nest in a very brisk and decided manner, covering the entire distance of about 237.5 feet in thirty-eight minutes, or at an average speed of about 6.5 feet per minute. Wheeler (1916) found that the workers of this species could travel 5 feet per minute over the mountainous soil in California. The speed at which the ants travel and also the deliberateness of their manner is most striking when *breviceps* is compared with the species of *sanguinea* discussed above. Hastening to the *breviceps* nest to examine it before the slave-makers returned, I found there only a very few *breviceps* workers but many workers of the slave-species.

As mentioned above, *Polyergus breviceps* differs from the species of *sanguinea* in several respects. Raids by this species are apparently never made in the forenoon, at least they have

never been observed. It is believed that the raids are initiated by certain temperature requirements which do not reach an optimum until the afternoon. Another peculiarity of these ants is that the alate or dealate females may join in the raids which the workers are making on the slave-species. No one, however, has even seen the females return to their nest with brood appropriated from the nest of the slave-species. In California, Wheeler watched the females leave on the raids, but he did not see them return to their nest. One is naturally led to wonder if these females secure immediate adoption in the nest of the disconcerted slaves and fail to return to their own nest, or do they join the raid in order to locate the nests in which they hope to secure adoption later?

The founding of colonies by the females of the species of *Polyergus* and those of *sanguinea* does not differ much in detail. Wheeler has shown that a fertile female of either form seeks out a nest of the slave-species and attempts to secure adoption in the nest. In the case of the *sanguineas* the female attempts to appropriate the brood of the slave-species, and when the slave-workers attempt to rescue the brood from her the female kills the workers. It is not clear whether she slays the female of the slave-species also, or whether this female is later slain by her workers, as is the case with some of the other species of ants. Whatever may be the method employed, the *sanguinea* female, if successful, rears the slave brood to maturity, and these alien workers in turn rear her young, so that in the course of time the colony becomes a mixed one. When the colony is of sufficient size, the *sanguinea* workers then begin to seek out nests of the slave-species and to raid them, appropriating the brood of the slaves as their mother before them has done. The *sanguinea* workers, although able to make slaves, have by no means lost their power to rear young or to construct nests when the necessity arises; hence the species cannot be considered obligatory slave-makers as are the species of *Polyergus*. The latter are not only dependent on their slaves for food, but also for the care of their young and the construction of their nest. The female of *breviceps* when she enters a slave nest secures adoption only after she has slain the female of that colony. That the workers of

*breviceps* or either of the two species of *sanguinea* mentioned here should seek to appropriate brood of certain slave-species is not surprising, when we consider that they are only acting in the same manner as their mother before them did. The habits of the slave-making species are very similar to those of the temporary parasitic ants, the only difference between the two being that the temporary parasitic ants never make dulotic raids on their host species.

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## A GEOGRAPHICAL INDEX OF THE CATALOGUES AND LOCAL LISTS OF NEARCTIC COLEOPTERA<sup>1</sup>

BY MELVILLE H. HATCH

If keys and their accompanying revisions and monographs represent the highest type of coleopterological literature, local lists represent the lowest type. They offer, too, a bibliographic problem of peculiar difficulty. Whereas original descriptions and synonymical studies, no matter how scattered, are cited in our regional catalogues, and these as well as redescriptions and the various types of biological and life-history studies are cited in the *Coleopterorum Catalogus*, the faunal list remains an unexplored limbo. A biological or habitat note on a species, if published separately, receives due notice; if included as a part of a local list, it is likely to be ignored. To cite a reference to a species in a local list often requires as much or more space than the entire original mention, and to cite all references to all local lists would extend the specific bibliographies beyond the scope either of practicality or utility. Yet, in its totality, the information to be derived from literature of this type is often useful in working out the distribution or ecology of the species. It is with the hope of facilitating reference to this type of literature that the present index is prepared. It is founded on the most excellent bibliography by Hamilton and Henshaw<sup>2</sup> from which the data for some of the earlier lists are taken.

The lists are arranged under the six major political divisions of the Nearctic Region: Alaska, Canada, Greenland, Lower California, Newfoundland, and the United States. Those pertaining to Canada and the United States are further arranged alphabetically under provinces or states. Therefore, in ascertaining the extant literature on any region, the reader must refer not only to a particular province or state but to the citations under

<sup>1</sup> A contribution from the Zoological Laboratory of the University of Washington.

<sup>2</sup> A list of some of the catalogues and local lists of North American Coleoptera, *Psyche* VI, 1891, p. 160-162, 188-193, 205-209.

“Canada” or “United States,” as the case may be, and to the citations under “General.” When I have been able to examine the paper personally, there is indicated in parentheses following the citation (1) the geographical limits of the list if other than those of the region under which it is listed, (2) the approximate number of species listed, (3) systematic limitations set on the list, (4) the type of information given about the species, for which the following symbols are adopted: A, locality data; B, dates of capture; C, habitat data; D, general distributional data.

In determining the limits to be placed on the index, the following have been omitted: (1) general systematic catalogues of world-wide scope; (2) catalogues of species accompanying keys; (3) collecting notes, those in proceedings of societies and those involving only a few species, especially where the species are not tabulated in list form; (4) notes on economic insects. The last are of considerable importance, but their proper organization can properly be left to the economic entomologist. The index derives its value in great measure from its selectivity, but the number of species listed or the length of the list will serve as an index of the list's significance.

I am indebted to Mr. Jos. I. Beaulne for assistance in regard to certain of the Canadian lists.

The following are the largest lists from restricted localities.

District of Columbia	2975	Staten Is.	1600	Grimsby	1290
Cincinnati	2265	Buffalo	1468	Ottawa	1003

For comparison, some of the larger European lists from similarly restricted areas are given.

Hamburg	2977	Dorset	2020	Cumberland	1797
n. w. Tyrol	2352	Suffolk	1982	Nottingham	1400
Oxford	2070	Norfolk	1934		

The following are the largest lists from states, etc. The Michigan figure was compiled from the existing lists from the state, but the author has 800 or 1000 species to add to it represented by scattered records or specimens in his collection. The Florida figure was compiled by Schwartz in 1878, and Blatchley writes me that the assemblage of scattered records would more than double it.



New York	4546	s. California	2197	Florida	1457
California	3417	New Mexico	2148	Lower California	720
Kansas	3300	s. w. Pennsylv-		Alaska	600
New Jersey	3178	vania	2095	Labrador	169
Indiana	2954	Iowa	2065	Pribilof Is.	61
Michigan	2695	Connecticut	1825	Greenland	33
Colorado	2264	Quebec	1810		

For comparison, the number of species listed from various foreign countries is given below.

Mex., C. Am.	18029	Canary Is.	1007	Kermadec Is.	38
Australia	16660	Madeira Is.	661	Jaluit Is.	25
Italy	13000	Porto Rico	520	Salvage Is.	24
Germany	6000	Jamaica	308	Ascension Is.	11
New Zealand	4430	Azores	212	Kerguelen Is.	9
British Is.	3300	St. Helena	203	Tristan da Cunha	6
West Indies	3152	Chatam Is.	106	South Georgia	4
Argentina	3032	Tahiti Is.	100	Heard Is.	2
Corsica	2748	Tierra del Fuego	85	New Amsterdam	1
Hawaiian Is.	1288	Gallapagos Is.	73	St. Paul Is.	1
New Caledonia	1139	Falkland Is.	44		

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## RECORDS AND DESCRIPTIONS OF NEOTROPICAL CRANE-FLIES (TIPULIDAE, DIPTERA), V

BY CHARLES P. ALEXANDER

AMHERST, MASS.

The preceding part under this general title was published in 1928 (Journal N. Y. Entomological Society, 36: 47-59). A considerable proportion of the species discussed at this time are from Chile, collected by PP. Jaffuel and Pirion. One interesting species of *Austrolimnophila* was collected by Doctor Michaelsen in Patagonian Tierra del Fuego and kindly sent to me for determination by Doctor Kröber. The striking new species of *Epi-phragma* was collected in Chiriqui, Panama, by Doctor F. M. Gage. One species is based in part on the extensive collections made by Parish in British Guiana in 1913. I am very greatly indebted to Doctor Crampton for the gift of certain interesting species of crane-flies that he received from Mrs. Gillott and Mr. Duurvoort. I wish to extend my deepest thanks to all of the above-named entomologists who have aided so materially in the progress of this study. Except where stated to the contrary, the types of the new forms are preserved in my collection.

### Genus *Limonia* Meigen

#### *Limonia* (*Zelandoglochina*) *setulipennis* new species.

General coloration obscure fulvous, the præscutum margined sublaterally with brown; rostrum short, the labial palpi only a little longer than the labrum; thoracic pleura with a broad brown longitudinal stripe; wings with macrotrichia in the distal cells; *Sc* short; male hypopygium with the dorsal dististyle a sickle-shaped rod, the outer margin with appressed denticles; rostral prolongation of the ventral dististyle bearing a single spike-like spine close to its outer end.

Male.—Length (excluding head) about 4.5 mm.; wing 6 mm.

Female.—Length (excluding rostrum) about 5 mm.; wing 5.6 mm.; rostrum alone 0.8 mm.

Rostrum (♀) relatively short, the fronto-clypeus approximately one-half the remainder of the head, the labrum only a little shorter than the labial palpi; maxillary palpi 4-segmented; rostrum and appendages dark brown.

Antennæ moniliform, dark brown throughout, the individual segments oval with a short glabrous apical pedicel, the outer segments more elongate-oval. Head dark brown.

Pronotum dark brown, obscure yellow behind. Mesonotal præscutum obscure fulvous, the sublateral portions of the sclerite broadly dark brown, the usual lateral stripes clearer yellow, the usual interspaces represented by vague narrow dusky lines; scutum yellowish brown, darker near the suture; scutellum brown, margined with testaceous yellow; postnotum brownish yellow. Pleura buffy yellow, with a broad, conspicuous brownish-black longitudinal stripe extending from the propleura across the anepisternum, pteropleurite and ventral pleurotergite, passing immediately below the root of the halteres to the abdomen. Halteres black, the base narrowly but conspicuously yellow. Legs with the coxæ and trochanters light buffy yellow; remainder of legs dark brown, the femoral bases a little brighter. Wings with a dusky tinge, the stigma darker brown; circular brown marks at origin and fork of *Rs*; cord and outer end of cell *1st M*<sub>2</sub> narrowly seamed with brown; apical cells and outer ends of the Anal cells, especially cell *1st A*, darkened; veins dark brown. Conspicuous macrotrichæ in the cells of the wing beyond the cord, including all except the bases of cells *R*<sub>2</sub>, *R*<sub>3</sub>, *R*<sub>5</sub>, *2nd M*<sub>2</sub>, *M*<sub>3</sub> and *M*<sub>4</sub>. Venation: *Sc* short, *Sc*<sub>1</sub> ending shortly beyond origin of *Rs*, *Sc*<sub>2</sub> opposite this origin; free tip of *Sc*<sub>2</sub> and *R*<sub>2</sub> in alignment; basal section of *R*<sub>4+5</sub> weakly angulated; *m-cu* at or just before the fork of *M*.

Abdomen dark brown, the hypopygium obscure yellow; basal sternites a little brightened caudally. Male hypopygium with the ninth tergite having a deep U-shaped median notch, the lateral lobes obtuse, with elongate setæ. Ventral dististyle small, fleshy, the rostral prolongation long and stout, with a single spike-like spine close to its outer end. Dorsal dististyle a strongly curved sickle-shaped rod, the outer margin on middle third with appressed denticles. Female with the subterminal segments brownish yellow; ovipositor reddish horn-color, the base of the sternal valves blackened.

Habitat.—Chile.

Holotype, ♂, Concepcion, October, 1927 (Jaffuel & Pirion).

Allotopotype, ♀.

Paratopotype, ♀.

***Limonia (Zelandoglochina) torticornis* new species.**

General coloration of thorax yellow, the præscutum with a brown median stripe; dorso-pleural region dark; rostrum very short; maxillary palpi 4-segmented, longer than the rostrum; femora yellow with a dark brown subterminal ring; wings with *Sc* relatively long; male hypopygium with the dorsal dististyle lacking; ventral dististyle with the rostral prolongation long and slender, with a rudimentary seta-like spine only.

Male.—Length (excluding rostrum) about 7.5–8 mm.; wing 7.7–8.3 mm.; rostrum about 0.8–0.9 mm.

Female.—Length (excluding rostrum) about 7 mm.; wing about 8 mm.; rostrum about 0.8 mm.

Rostrum only about one-half the length of the antennæ, brownish black, the tip of the labrum pale; maxillary palpi 4-segmented, a little longer than the labial palpi. Antennæ brownish-black throughout; flagellar segments of peculiar shape, the outer face at base a little produced and bearing a group of setæ, the inner face at near midlength slightly produced and provided with a pair of setæ; apical pedicels of the individual segments short. Head dark brown, pruinose, the occipital region paler.

Pronotum brownish yellow. Mesonotal præscutum brownish yellow with a brown median stripe that is divided near the suture, suffusing the scutal lobes; median area of scutum and scutellum whitish; postnotum brown, paler medially at base. Pleura yellow with a brown dorsal stripe extending from the propleura and base of fore coxæ to the postnotum; dorso-pleural region pale. Halteres dark brown, the base of the stem restrictedly pale. Legs with the coxæ yellow, the fore coxæ darkened; trochanters yellow; femora yellow with a conspicuous dark brown subterminal ring that is about twice as wide as the pale apex beyond; tibiæ and tarsi yellow, the terminal segments darkened. Wings with a yellowish ground-color; stigma brown; restricted brown seams arranged as follows:  $Sc_2$ ; origin of  $Rs$ ; along cord and outer end of cell  $1st\ M_2$ ; less distinct marginal clouds at the ends of the longitudinal veins; veins dark brown, the costal region paler. Venation:  $Sc$  relatively long,  $Sc_1$  extending to about two-fifths the length of  $Rs$ ,  $Sc_2$  close to its tip;  $Rs$  angulated and, in cases, spurred at origin; free tip of  $Sc_2$  and  $R_2$  pale and in transverse alignment;  $m-cu$  close to the fork of  $M$ .

Abdomen dark brown, the bases of the proximal sternites broadly paler; in cases, the bases of the tergites are paler than the caudal margins; hypopygium obscure yellow. Male hypopygium with the ninth tergite only gently emarginate. Basistyle with the ventromesal lobe extended into a slender finger-like lobule. Ventral dististyle small, the rostral prolongation very long and slender, unarmed or with a weak, seta-like spine only. Dorsal dististyle lacking. Gonapophyses broad, appearing as flattened mitten-shaped structures, the palm truncated across apex. Aedeagus with a laterally directed lobe on either side at apex.

Habitat.—Chile.

Holotype, ♂, Marga-marga, September 10, 1927 (Jaffuel & Pirion).

Allotopotype, ♀.

Paratopotypes, 3 ♂ ♂, 5 ♀ ♀, August 15, 1926 (F. Jaffuel); several ♂ ♀, September 11–23, 1926; paratypes, ♂ ♀, Concepcion, October 10, 1927 (Jaffuel & Pirion).

***Limonia (Zelandoglochina) tenuipalpis* new species.**

General coloration of thorax fulvous, the præscutum with a black median stripe; pleura chiefly brownish black, pruinose; rostrum very long; maxil-

lary palpi 2-segmented; antennæ ( $\delta$ ) strongly nodulose; wings with *Sc* short; male hypopygium with the rostral prolongation of the ventral dististyle bearing two long slender spines.

Male.—Length (excluding rostrum) about 4.5–5 mm.; wing 5.5–6 mm.; rostrum about 3–3.2 mm.

Female.—Length (excluding rostrum) about 4.5–5.5 mm.; wing 6–6.8 mm.; rostrum about 3–3.2 mm.

Rostrum unusually long for a member of this subgenus, if bent backward extending about to one-fourth the length of the abdomen, black throughout; maxillary palpi short, 2-segmented; labial palpi extremely long and slender, longer than the antennæ. Antennæ brownish black throughout, strongly nodulose ( $\delta$ ), the individual flagellar segments with the inner face very strongly produced, the outer face less conspicuously so; terminal glabrous pedicels of the segments about one-half the length of the segment; outer segments with the basal enlargements oval, the terminal segment elongate. In the female, the antennæ are shorter, with the moniliform appearance less conspicuous. Head dark brown, the surface pruinose; genæ and occiput sometimes more ochreous.

Pronotum dark brown. Mesonotal præscutum dark reddish fulvous to obscure yellow, with a broad, black median stripe; lateral stripes sometimes vaguely indicated; scutum similar, the mesal portions of the lobes darkened; scutellum and postnotum more testaceous yellow. Pleura chiefly brownish black, the sternopleurite more reddish brown, the surface sparsely pruinose. Halteres with the stem obscure yellow, the knobs dark brown. Legs with the coxæ brownish testaceous; trochanters obscure yellow; femora brownish yellow, brighter basally, the tips darker; tibiæ brown, the tips and the tarsi darker brown. Wings with a grayish tinge, the oval stigma darker brown; very vague and restricted dark seams along the cord, outer end of cell *1st M*<sub>2</sub> and along vein *Cu*; wing-tip almost insensibly darkened; veins brownish black. Venation: *Sc* short, *Sc*<sub>1</sub> ending about opposite the origin of *Rs*, *Sc*<sub>2</sub> at its tip; cell *1st M*<sub>2</sub> subrectangular; *m-cu* close to the fork of *M*.

Abdomen black, the hypopygium obscure yellow; basal sternites a little variegated with obscure yellow. Male hypopygium with the ninth tergite low, the caudal margin subtruncate to very gently emarginate. Basistyle relatively stout, the ventro-mesal lobe large. Ventral dististyle large and fleshy, larger than the basistyle, the rostral prolongation relatively short, provided with two very long gently curved spines that are longer than the prolongation itself. Dorsal dististyle a gently curved black rod, its tip acute. Gonapophyses with the mesal apical angle relatively inconspicuous, a little widened outwardly. Ovipositor with the tergal valves long and slender, only gently upcurved.

Habitat.—Chile.

Holotype,  $\delta$ , Marga-marga, September 23, 1927 (Jaffuel & Pirion).

Allotopotype, ♀.

Paratopotypes, numerous ♂ ♀, September 7-23, 1927; *paratypes*, 5 ♂ ♀, Concepcion, October 13, 1927 (Jaffuel & Pirion).

***Limonia (Zelandoglochina) parvispinosa* new species.**

General coloration of thorax fulvous, the pleura with a narrow black longitudinal stripe; rostrum elongate; wings with the stigma distinct; *Sc* short; male hypopygium with the ninth tergite only slightly emarginate; rostral prolongation of ventral dististyle bearing two slender spines that are closely approximated at origin.

Male.—Length (excluding rostrum) about 4.8 mm.; wing 6.6 mm.

Female.—Length (excluding rostrum) about 6.5 mm.; wing 7.5 mm.; rostrum about 3.5 mm.

Head of male lost. Rostrum (♀) very long and slender, black throughout; maxillary palpi 2-segmented. Antennæ black throughout, nodulose, the apical pedicels short. Head variegated brown and buffy, the surface a little pruinose.

Thorax light fulvous, with a relatively narrow black longitudinal stripe on the dorsal pleurites, extending from the cervical region to the abdomen; postnotum more or less darkened medially. Halteres dark brown, pale at base. Legs with the coxæ testaceous; trochanters greenish testaceous; remainder of legs brown, the tibiæ and tarsi passing into brownish black. Wings subhyaline, the oval stigma brown, conspicuous; very vague dusky seams along the cord and outer end of cell *1st M*<sub>2</sub>; veins brownish black. Venation: *Sc* short, both *Sc*<sub>1</sub> and *Sc*<sub>2</sub> approximately opposite the origin of *Rs*; *R*<sub>3</sub> deflected rather strongly to the wing-tip, narrowing the cell; cell *1st M*<sub>2</sub> large, rectangular; *m-cu* near the fork of *M*.

Abdomen black, the proximal sternites a little brightened basally; hypopygium obscure yellow, the tips of the ventral dististyles dusky. Male hypopygium with the ninth tergite relatively short, the caudal margin subtruncate or only slightly emarginate. Basistyles relatively short and broad, the ventro-mesal lobe large. Ventral dististyle large and fleshy, much larger than the basistyle, the rostral prolongation relatively short and slender, provided with two slender, slightly unequal spines of relatively small size, placed close together at near midlength of the prolongation. Dorsal dististyle a curved rod, the tip suddenly narrowed into a spine. Gonapophyses with the mesal-apical angle conspicuous, dusky, the extreme tips suddenly narrowed into a minute black point. Ovipositor with the valves long and relatively slender, the tergal valves gently curved.

Habitat.—Chile.

Holotype, ♂, Concepcion, October, 1927 (Jaffuel & Pirion).

Allotopotype, ♀.

Paratype, 1 ♂, Malleco, January, 1928 (A. Pirion).

In its general appearance, *L. (Z.) parvispinosa* is most similar to *L. (Z.) tenuipalpis* new species and *L. (Z.) multinodosa* Alexander, differing from all described species by the combination of elongate rostrum, short *Sc* and the structure of the male hypopygium.

***Limonia (Dicranomyia) alboapicalis* new species.**

General coloration reddish brown, the præscutum with three darker brown stripes; femora pale brown, the tips broadly and conspicuously whitened; wings subhyaline, the stigma and weak seams along the cord and outer end of cell *1st M*<sub>2</sub> brown; abdomen dark brown, the segments conspicuously ringed caudally with obscure yellow; male hypopygium with the spines of the rostral prolongation placed at the apex or nearly so.

Male.—Length about 7 mm.; wing, 8 mm.

Female.—Length about 8 mm.; wing, 9.5 mm.

Rostrum brownish black, about one-third the length of the remainder of the head; palpi brownish black. Antennæ with the basal segment light brown, the remaining segments dark brown with the extreme bases restrictedly pale to produce a weak bicolored appearance; flagellar segments oval. Head dark brown, paler beneath and behind.

Pronotum elongate, dark brown above. Mesonotum reddish brown, the præscutum with three darker brown stripes; scutal lobes dark brown; median region of scutum and the scutellum paler; postnotum dark brown, sparsely pruinose. Pleura dark reddish brown, the anepisternum darker; dorso-pleural region chiefly dusky. Halteres elongate, dark brown, the base of the stem narrowly pale yellow. Legs with the coxæ brown, the fore coxæ darker brown; trochanters greenish testaceous; femora pale brown, the bases lighter, darkened outwardly, the tips broadly and conspicuously whitened; tibiæ and tarsi brown, the latter still darker apically. Wings subhyaline, the oval stigma brown; a dusky cloud at fork of *Rs*; narrow and scarcely evident brown seams along the cord and outer end of cell *1st M*<sub>2</sub>; veins pale brown. Venation: *Sc* short, *Sc*<sub>1</sub> ending about opposite the origin of *Rs*, *Sc*<sub>2</sub> a short distance from its tip; *Rs* only feebly arcuated, about one-third longer than the basal section of *R*<sub>4+5</sub>; *m-cu* at the fork of *M*. In the female, *Sc*<sub>1</sub> is slightly longer than in the male.

Abdomen dark brown, the segments ringed caudally with obscure yellow to produce a conspicuous annulated appearance; hypopygium dark, the penultimate segment uniformly pale. Male hypopygium with the ninth tergite narrow but relatively long, the caudal margin with a deep V-shaped median notch. Basistyle with the mesal lobe obtuse. Ventral dististyle a large oval fleshy lobe, the rostral prolongation relatively short and stout, the two conspicuous spines placed close to its outer end; spines subequal, gently curved, the tips acute; outer spine at extreme apex of prolongation, the inner spine a little removed from this tip. Dorsal dististyle curved, narrowed to



the cultriform apex. Gonapophyses broad, the mesal-apical lobe broad-based, gently curved.

Habitat.—Chile.

Holotype, ♂, Perales de Marga-marga, February 23, 1927 (A. Pirion).

Allotopotype, ♀, February 25, 1927 (A. Pirion).

It is possible that the single female specimen of *L. (D.) vernalis* (Philippi) with conspicuous pale abdominal rings should be referred to the present species (Verh. zool.-bot. Ges. Wien. 15: 612–613; 1865).

### Genus *Austrolimnophila* Alexander

#### *Austrolimnophila michaelsoni* new species.

General coloration grey, the præscutum with three broad rufous stripes, the median one with a shallow anterior split; wings subhyaline, with a relatively heavy brown pattern that is confined to the vicinity of the veins;  $R_{2+3}$  about one-third longer than  $R_3$ ; cell  $M_1$  deep; *m-cu* shortly before mid-length of cell *1st M*<sub>2</sub>; abdominal segments dark rufous brown, the caudal margins grayish.

Female.—Length about 9 mm.; wing, 10.2 mm.

Rostrum obscure ochreous; palpi dark brown. Antennæ brown, the flagellar segments elongate-oval, with verticils that do not exceed the segments in length; antennæ of moderate length only, if bent backward extending about to the wing-root. Anterior vertex light grey, the posterior vertex and occiput more infuscated, leaving the posterior orbits narrowly light grey.

Pronotum grey, the lateral regions of the scutellum more rufous. Mesonotal præscutum light grey with three broad rufous stripes that are nearly confluent behind; median stripe split by a gray line for about the cephalic fifth; lateral stripes crossing the suture and suffusing the scutal lobes; median area of scutum and base of scutellum damaged by the pin; posterior portion of scutellum and the postnotum yellowish brown. Anepisternum light grey, the remainder of the pleura pale ochreous. Halteres relatively elongate, pale yellow, the knobs darker. Legs with the coxæ and trochanters pale; remainder of legs broken. Wings subhyaline, with a relatively heavy brown pattern distributed as follows: A rectangular area at origin of *Rs*, including cell *Sc*, extending caudad almost to vein *M*; a continuous seam along the cord, extending from the costa to the fork of *M*; similar seams on *m-cu* and the outer end of cell *1st M*<sub>2</sub>; stigma oval; small circular spots at fork of  $M_{1+2}$ , tip of  $R_3$  and extreme apex of wing; veins pale brown. Venation:  $E_2$  about two-thirds  $R_{1+2}$ , the latter subequal to  $R_{2+3+4}$ ;  $R_{2+3}$  about one-third longer than  $R_3$  alone; cell  $M_1$  deep, about four times its petiole;

cell *1st M*<sub>2</sub> long and narrow, *m-cu* shortly before midlength. All veins beyond cord nearly straight or weakly sinuous, not deflected strongly caudad at tips.

Abdominal tergites dark rufous brown, the caudal margins of the segments narrowly grayish; sternites similar, the caudal margins more broadly grayish. Ovipositor with the tergal valves slender, rather strongly upcurved; basal shield of sternal valves dark rufous brown, the tips conspicuously yellow.

Habitat.—Patagonia.

Holotype, ♀, Usthuaia Wald, southern Tierra del Fuego, November 15, 1892 (W. Michaelsen).

Type in the Natural History Museum, Hamburg.

Named in honor of the collector, Dr. W. Michaelsen.

### Genus *Epiphragma* Osten Sacken

***Epiphragma gaigei*** new species.

General coloration dark fulvous brown; halteres dark brown; legs yellow; wings yellow, more brownish yellow posteriorly, variegated with whitish-subhyaline window-like spots.

Male.—Length about 13.5 mm.; wing 14.5 mm.

Rostrum brownish black; basal segments of palpi light brown, the two terminal segments brownish black. Antennæ relatively short, if bent backward ending some distance before the wing-root; scape black; first flagellar segment elongate, dark fulvous; remainder of flagellum brownish black, the segments long-cylindrical, with verticils that are approximately as long as the segments. Head dark brown, the anterior vertex brighter; occipital region weakly corrugated.

Pronotum deep fulvous-brown. Mesonotal præscutum deep fulvous brown, including the usual præscutal stripes; two paired subtriangular black spots near the posterior end of the median stripe, at about their own length before the suture; lateral stripes less evidently darkened; scutum chiefly light brown, the median area behind darker reddish; scutellum dark brown; postnotum brown, variegated with two darker spots before the posterior end. Pleura dark yellowish brown, vaguely variegated with darker. Halteres dark brown, only the extreme base of the stem brightened. Legs with the coxæ brown; trochanters obscure brownish yellow; remainder of legs yellow, unmarked. Wings with a very strong yellow tinge, brighter on the cephalic half, more brownish yellow on the posterior half; anterior cells variegated with yellowish marks, of the radial and posterior cells whitish and very conspicuous; a dark brown blotch in the outer end of cell *R* and across the anterior cord; narrow brown seams on *h* and the supernumerary crossvein; the pale yellow areas in the costal region include extensive markings before and beyond *h*, a narrow area before the origin of *Rs* and an extensive one

surrounding the supernumerary crossvein; the most conspicuous of the fenestrate white spots are as follows: Post-arcular in both cells *R* and *M*; near outer end of cell *R*, connected with a slightly larger spot in cell *M*; center of cell *1st M*<sub>2</sub>; near base of cells *M*<sub>1</sub>, *2nd M*<sub>2</sub>, *M*<sub>3</sub> and *M*<sub>4</sub>; two areas near base and two smaller ones near outer end of cell *Cu*; the above white marks are narrowly bordered by dusky; a series of more yellowish marginal spots in the ends of all the cells, largest in cell *1st A*, there being two in cell *2nd A*; veins brown, brighter in the costal region. Venation: Supernumerary crossvein in cell *C* very oblique in position; *Rs* angulated and short-spurred at origin; *m-cu* a little less than its own length before the fork of *M*.

Abdominal tergites dark brown, the sternites brighter.

Habitat.—Panama (Chiriqui).

Holotype, ♂, in a deep cañon about one mile from Boquete, altitude 4700–5000 feet, March 19–27 (F. M. Gaige).

Type in the collection of the University of Michigan.

I take great pleasure in naming this beautiful species of *Epi-  
phragma* in honor of the collector, Dr. F. M. Gaige.

#### Genus *Elephantomyia* Osten Sacken

##### *Elephantomyia tarsalba* new species.

General coloration black; head and humeral region of the præscutum paler; legs black, the tips of the tarsi snowy-white; wings strongly suffused with blackish, the stigma and costal region still darker.

Male.—Length (excluding rostrum) about 6 mm.; wing, 4 mm.; rostrum, 4.8 mm.

Female.—Length (excluding rostrum) about 5.8 mm.; wing, 4.3 mm.; rostrum, 4 mm.

Described from alcoholic specimens.

Rostrum relatively long and slender, as shown by the measurements. Antennæ dark brown, the second scapal segment a trifle paler; flagellar segments with long conspicuous verticils on all the segments, longer on segments eight to fifteen. Head pale yellowish brown.

Mesonotum dark brown, the lateral and humeral regions of the præscutum more ochreous. Pleura dark brown. Halteres dirty white. Legs with the coxæ brown; trochanters obscure yellow; femora black, the bases restrictedly pale; tibiae black; basitarsi with the proximal two-thirds to three-fourths black; remainder of tarsi snowy-white. Wings strongly suffused with blackish, the stigma and costal region still darker; veins black. Venation: *Sc* relatively short, *Sc*<sub>1</sub> ending shortly before the fork of *Rs*, *Sc*<sub>2</sub> at its tip; cell *1st M*<sub>2</sub> relatively large; *m-cu* at from one-fifth to one-third the length of cell *1st M*<sub>2</sub>, subequal to the distal section of *Cu*<sub>1</sub>.

Abdomen of female black; of male dark brown, blackened subapically. Ovipositor with the tergal valves long and slender, gently upcurved to the acute tips.

Habitat.—Dutch Guiana.

Holotype, ♂, Paramaribo, January, 1928 (L. A. Duurvoort); through Dr. G. C. Crampton.

Allotopotype, ♀.

Paratopotype, ♂.

In its general appearance, *Elephantomyia tarsalba* is curiously like *Helius albitarsis* (Osten Sacken). One wing of the paratype has cell *1st M*<sub>2</sub> open by the partial atrophy of *m*.

### Genus *Gnophomyia* Osten Sacken

#### *Gnophomyia flagrans* new species.

Belongs to the *luctuosa* group; color black, the thorax orange; wings with a blackish suffusion; abundant macrotrichiae in the cells beyond the cord.

Female.—Length about 9 mm.; wing, 8 mm.

Described from an alcoholic specimen.

Rostrum, palpi and antennae black; flagellar segments oval, the outer segments narrower and more elongate, all segments short-pedicellate. Head black.

Pronotum black. Mesonotal praescutum fiery orange, the remainder of the notum and pleura more yellowish orange. Halteres black, the knobs more brownish. Legs black, the middle coxae a little brighter at base. Wings with a blackish suffusion, the prearcular region, cells *C* and *Sc*, the stigma and a seam along vein *Cu* darker; cells *2nd M*<sub>2</sub>, *M*<sub>3</sub> and *M*<sub>4</sub> with the central portions, cells *Cu* and *1st A* with the distal portions a little paler than the ground-color; veins brownish black. Abundant macrotrichiae in the cells beyond the cord and in the outer ends of the cubital and anal cells. Venation: *Sc*<sub>2</sub> close to tip of *Sc*<sub>1</sub>; *Rs* long, gently arcuated; *R*<sub>2</sub> subequal to second section of *R*<sub>1</sub>; inner ends of cells *R*<sub>4</sub> and *R*<sub>5</sub> in oblique alignment.

Abdomen brownish black, the pleural membrane paler.

Habitat.—Costa Rica.

Holotype, ♀, near Cartago (Mrs. A. G. M. Gillott); through Dr. G. C. Crampton.

The related species of the *luctuosa* group have the thorax wholly black (*funebri* Alexander, *luctuosa* Osten Sacken,

*melancholica* Alexander and *pammelae* Alexander) or black and orange (*leucoplaca* Alexander).

### Genus *Gonomyia* Meigen

#### ***Gonomyia* (*Lipophleps*) *gillottæ* new species.**

Belongs to the *manca* group; general coloration dark brown, the pleura variegated with pale; scutellum pale; wings with a strong dusky tinge; male hypopygium with one of the dististyles produced into a very long, needle-like rod; phallosomic structure with a flattened plate that is trifid at apex.

Male.—Length about 3 mm.; wing, 3.6 mm.

Types preserved in alcohol.

Rostrum and palpi black. Antennæ black throughout. Head dark, only the occipital region restrictedly pale.

Pronotum pale. Mesonotum dark brown, the scutellum pale. Pleura extensively pale, with two brown stripes, the more dorsal extending from above the fore coxæ, most extensive on the anepisternum and dorsal portions of the sternopleurite, behind this point much narrower and apparent only along the suture to the base of the haltere; ventral stripe including the fore coxæ and ventral portions of the sternopleurite and meron. Halteres pale. Legs long and slender; fore coxæ dark, the remaining coxæ and trochanters paler; remainder of legs dark brown. Wings with a strong dusky tinge, the prearcular and costal regions more yellowish; stigmal region a little darker; veins brown. Venation:  $Sc_1$  ending just before the origin of  $Rs$ ,  $Sc_2$  some distance from its tip;  $Sc_1$  alone nearly as long as  $m-cu$ ;  $Rs$  only gently arcuated;  $m-cu$  close to the fork of  $M$ .

Abdominal tergites dark brown, the sternites yellow. Male hypopygium with the outer lateral angle of the basistyle a little produced and here provided with a dense group of long setæ. Dististyles two, one a very long, needle-like rod arising from a broad base, narrowed very gradually into the long sinuous acicular spine; second style shorter, appearing as a narrow subrectangular blade, the apex produced into a flattened knife-like point, in addition to several powerful setæ of various sizes on the distal third; surface of the blade with microscopic setulæ. Phallosomic structure with a long slender median spine and a flattened rectangular plate, the apex of the latter tri-spinous, the lateral spines much longer than the small median point.

Habitat.—Costa Rica.

Holotype, ♂, near Cartago, October, 1927 (Mrs. A. G. M. Gillott); through Dr. G. C. Crampton.

Paratopotype, ♂, in the alcoholic collection of Dr. Crampton.

This interesting *Gonomyia* is named in honor of the collector.

**Gonomyia (Lipophleps) duurvoorti** new species.

Belongs to the *manca* group; antennæ black throughout; pleura striped longitudinally with dark brown; male hypopygium with the dististyle single, unarmed except for a powerful fasciculate seta; ædeagus elongate; gonapophysis single, terminating in an acute black spine borne at right angles to the apex of the apophysis.

Male.—Length about 3.4 mm.; wing, 3.5 mm.

Described from alcoholic specimens.

Rostrum obscure yellow; palpi black. Antennæ black throughout, the second scapal segment enlarged; flagellar segments linear, with elongate verticils on about the basal eight or nine segments. Head dark brown, restrictedly yellow before the antennal fossæ.

Mesonotum dark brown, the scutellum pale; postnotal mediotergite pale laterally. Pleura pale, striped with dark brown, the more dorsal stripe appearing as a small spot on the propleura and a much larger spot on the anepisternum and dorsal sternopleurite; ventral stripe occupying the ventral sternopleurite, meron and coxæ. Halteres dusky, the knobs pale. Legs with the coxæ dark, the fore coxæ pale except at base; trochanters dark brown; remainder of legs brownish black. Wings with a strong dusky tinge, the costal region paler; cell  $Sc_1$  a trifle more yellowish; veins brown. Venation:  $Sc_1$  ending shortly before the origin of  $Rs$ ,  $Sc_2$  some distance from its tip,  $Sc_1$  alone being a little longer than  $m$ ; cell  $1st M_2$  closed; *m-cu* at or before the fork of  $M$ .

Abdominal tergites dark brown, the sternites and lateral margins of the tergites obscure yellow; hypopygium obscure yellow. Male hypopygium with the lateral lobes of the tergite conspicuous, relatively slender, provided with seven or eight powerful spines, the basal one largest, the spines thence becoming smaller distally and finally merging into setæ. Basistyle elongate, slender; a single dististyle, this roughly oval in outline, unarmed except for a single powerful fasciculate seta and additional smaller normal setæ. Phallosomic structure asymmetrical, consisting of a long slender ædeagus that juts far beyond the other elements of the hypopygium; only a single well-developed gonapophysis, this appearing as a flattened yellowish blade, the face carinate, at apex bearing an acute straight black spine at right angles to the apex of the apophysis.

Habitat.—Dutch and British Guiana.

Holotype, ♂, Paramaribo, Dutch Guiana, December, 1927 (L. A. Duurvoort); through Dr. G. C. Crampton.

Paratopotype, ♂; paratype, ♂, Bartica, British Guiana, February 5, 1913 (H. S. Parish).

I take pleasure in naming this species after the collector, Mr. L. A. Duurvoort. The paratype was part of the type-series of *G. (L.) inermis* Alexander (Trans. Amer. Ent. Soc., 40: 242–243; 1914).

**Gonomyia (Lipophleps) tergoimbriata** new species.

Male.—Length about 3.3 mm.; wing, 3.6 mm.

Generally similar to *G. (L.) inermis* Alexander, with which it was confused in the original diagnosis of the latter (Trans. Amer. Ent. Soc., 40: 242-243; 1914). The description of the male hypopygium in the above reference pertains to the present species.

Thoracic pleura only vaguely marked with darker. Male hypopygium with the lateral lobes of the ninth tergite slender, directed toward one another, the mesal margin with a dense fringe of long reddish setæ but without spines, as in certain allied forms. Dististyle single, fleshy, unarmed except for setæ. Phallosomic structure relatively stout, the ventral surface set with numerous powerful setæ.

In true *inermis*, the dististyle is somewhat similar, being armed only with two powerful fasciculate setæ. The phallosome is entirely distinct in structure, the aedeagus being greatly flattened, pale, the two gonapophyses very different from one another, the longest appearing as a slender chitinized arm, at apex dilated into a head which is further produced into a blackened beak-like spine, the whole structure somewhat resembling the head and neck of a swan; the second apophysis is pale, the apex narrowed and terminating in an acute black spine.

Habitat.—British Guiana.

Holotype, ♂, Bartica, December 24, 1912 (H. S. Parish).





BEES OF THE SUBFAMILY ANTHIDIINÆ, INCLUDING SOME NEW SPECIES AND VARIETIES, AND SOME NEW LOCALITY RECORDS

BY HERBERT F. SCHWARZ

The present paper is based in large part on specimens, admirably mounted for purposes of study and accompanied by floral records, that were generously placed at my disposal by Professor P. H. Timberlake of the Graduate School of Tropical Agriculture and Citrus Experiment Station, University of California. To Professor Timberlake I am indebted, too, for many valuable suggestions embodied in this paper. His collection was supplemented by contributions of material from Professor J. C. Bradley of Cornell University, Professor H. A. Scullen of the Oregon State Agricultural College, Professor O. A. Stevens of North Dakota Agricultural College, and Mr. Frank M. Jones. Specimens from the Pacific Coast largely predominate in the material loaned, but certain of the inland states—such as Arizona and Idaho—are also represented, and the discussion in the following pages leads occasionally to species even more remote geographically. The drawings accompanying this paper were made by Mrs. E. L. Beutenmüller, well known for her graphic renderings of insects, batrachians, and reptiles.

*Anthidium cognatum* Cresson, a Synonym of *A. maculifrons* Smith

New Records from Arizona and Mexico

On a recent visit to the British Museum (Natural History Division) I had an opportunity, thanks to the courtesy of Dr. J. Waterston, of examining the type of *Anthidium maculifrons* Smith. To the description of Smith is appended the locality designation: United States.<sup>1</sup> In 1878 Cresson described a bee

<sup>1</sup> Dalla Torre's expansion of this statement into "Western United States" (Cat. Hym., X, p. 464) is doubtless due to Cresson's record of putative specimens of *maculifrons* from Texas and Utah. All other *Anthidium* from

from Georgia as *Anthidium cognatum*, adding by way of summary:

“Allied to *maculifrons* Smith, but the shape of the apical segment of the abdomen is very different, that of *maculifrons* and *mormonus*, described below, being almost exactly alike.”

The allusion to *mormonus* proves almost to a certainty that Cresson confused *maculifrons* with some other species, for the male of *maculifrons* has a pygidium very different from that of Cresson's *mormonus*, the type of which I have also examined. In 1864 Cresson interpreted as *maculifrons* two females from Texas and one from Utah. The supplementary description that Cresson gives of these insects suggests that they were not *maculifrons* but *porterae* Cockerell, which has been reported from both of these states. This circumstance makes it all the more doubtful whether Cresson had the male of the true *maculifrons* before him when he drew comparisons between it and his own *cognatum*.

In my opinion *cognatum* Cresson is no other than *maculifrons* Smith.

In 1900 Cockerell reported that specimens of *Anthidium cognatum* had been collected by Townsend in the Organ Mountains of New Mexico and also in Fillmore Canyon of that state. I have before me a single male specimen collected by Professor Bradley in the Pajarito Mountains, Nogales, Arizona, on August 31, 1927, that on the basis of its structure is clearly allied to *cognatum*. Yet it differs from the specimens from the southeastern United States in having abdominal maculations almost identical with those that characterize *porterae*, the emarginations above on each of the lateral halves of the bands on segments 2-5 being abrupt, narrow, and deep. Atlantic seaboard specimens in the American Museum, on the other hand, have broad emarginations on the bands of these segments, suggesting a four-spotted condition in which each pair of spots is connected by a fine line. This, too, is the condition described in Cresson's allotype of *cognatum* from Georgia, and it is the condition, likewise, in Smith's type

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the United States described by Smith in the Catalog of Hymen. Insects, 1854, were from Georgia and the chances favor, therefore, that the locality of *maculifrons* was also in the Eastern United States, probably Georgia.

of *maculifrons*. In further differentiation the Arizona specimen has a medianly interrupted band on the hind tibiæ instead of a basal spot, and slightly broader and more triangular lateral lobes on the pygidium.

This Arizona specimen resembles individuals of a large series of bees from Mexico that in the British Museum (Natural History Division) have been assigned to *maculifrons*. By far the larger number of these are from Chilpancingo, Guerrero, 4600 feet, collected by H. H. Smith (Godman-Salvin Collection, 1911-1924) in October, but specimens taken by the same collector are represented in the British Museum from the following localities as well: Acaguizotla, Guerrero, October, 3500 feet; Venta de Zopilote, Guerrero, October, 2800 feet; Tepetlapa, June, 3000 feet. My note made in the British Museum regarding these specimens reads as follows:

“The males from Guerrero are four-spotted on segment 1 and many of them also on segment 2. To a few of them the description of *cognatum* given in my key (Amer. Museum Novitates No. 253, p. 10, March 1, 1927) would apply: ‘The inner maculations on abdominal segments 3-5 connected with the outer maculations by thin bands of yellow.’ But others have lateral interruptions on bands 3-5 of the abdomen that more nearly resemble the V-shaped interruptions of *porterae*. To the associated females from Guerrero the characters given in my key would not apply. Only segment 1 is as a rule four-spotted in these females while the lines connecting the inner with the outer maculations, instead of being long, are distinctly narrow links. In some of the specimens there is on the apical tergites merely a sinuous emargination of the bands above, much as in those of the female of *mormonum* (= *blanditum*) and its allies. In fact, if it were not for the distinctive structure of the male, one would hardly recognize these insects as a variety of *maculifrons* (= *cognatum*).”

Are they, however, even a valid variety of that species? If the peculiarities in the maculations were constant, one would feel greater confidence in delimiting a western form of *maculifrons* distinct from that of the eastern seaboard of the United States. But even in Mexico specimens inseparable from the eastern form may be found. There is such a specimen (a male)

in the U. S. National Museum from the Federal District of Mexico, collected by L. Conradt; and in the entomological laboratory of the Natural History Museum in Paris I came upon a similar specimen taken by L. Digueu in 1903 in the State of Jalisco.

*Anthidium maculosum* Cresson and its Synonym *A. americanum*  
Friese (= *maculatum* Smith nec Panzer)

Among Anthidiine bees sent me by Professor Bradley is a specimen of this species from Atzacapozalco, Mexico. Some time ago (Amer. Mus. Novitates, Number 253, p. 3, March 1, 1927) I raised question whether *maculosum* is not the same insect that Smith designated as *maculatum* and Friese renamed *americanum*. The definite evidence that *maculosum* occurs in Mexico, from which *maculatum* was described, lent additional support to this interpretation, and finally all doubts were dispelled through an examination of the type of *maculatum* Smith in the British Museum.

*Anthidium edwardsii* Cresson  
New Record from Idaho

This species, hitherto known from California, Oregon, and Washington (reported as *hesperium*, *tricuspidum*, and *depressum*), extends into Idaho as is evidenced by a female from Star, collected on August 4 by D. A. Wilbur and sent me for determination by the Oregon State Agricultural College.

Variability of *Anthidium aridum* Cockerell

A large series of insects, comprising no less than twenty-four females and twenty-four males, have been loaned by Professor Timberlake. They are all from one locality—Big Pines Camp, Los Angeles County Park,<sup>1</sup> California, and were taken by him July 11–17, on *Phacelia heterophylla* and *Phacelia ramosissima*,

<sup>1</sup> "This locality," writes Professor Timberlake, "is on the desert side of the San Gabriel Mountains, and overlooks the Rock Creek region. The elevation of the camp is about 6,800 feet, but collecting was done a few hundred feet both above and below this level."

two of them in copulation. While all are apparently one species, they present an almost bewildering diversity in their maculations and even structurally, not to mention differences in the color of the ventral scopa. They are believed to be *A. aridum* Cockerell, hitherto known only from the male.

All of the male specimens have a yellow stripe on the scape (though sometimes faint), the axillæ unmaculated, the abdominal bands beyond that on segment 1 uninterrupted or merely subinterrupted medianly—distinguishing features set down in Cockerell's original description. The maculations on the tegulæ and tubercles, as well as the broadly interrupted stripe on the scutellum, are also present in all of these males. But the mesonotum is sometimes immaculate, sometimes with stripes merely on each side of its anterior margin, and sometimes with these stripes and in addition stripes above the tegulæ. In some of the male specimens there are maculations on the femora (in no case, however, extending beyond the apical half); in others the femora are immaculate. The maculations on the tibiæ, too, are far from being standardized. Sometimes they cover very nearly the entire outer surface of the joint; in other instances they are stripe-like, and in one specimen at least the stripe is interrupted on the front and middle tibiæ, while on the hind tibiæ it shrinks to a basal and faint apical spot. The pygidium is sometimes maculated, sometimes not, and its structure too is variable, the divergence of the lateral lobes basally and their convergence apically being much less emphatic in some specimens than in others. Nevertheless, there is usually traceable, if the central spine be eliminated from consideration, a simulation of a half moon (though not so markedly so as in *A. palliventre* = *A. californicum*), while in all of the specimens the apical half of the lateral lobes is more or less decidedly angulated.

Even more variable than the males are the females. While the males have the ventral hairs grayish white in conformity with those of other parts, the females more often have a predominance of black hair in the ventral scopa. Sometimes this takes the form of a large apical to central area of black hairs sharply bordered at the side by white hairs and more broadly and less defi-

nately at the base by white hairs with black tips. But there are degrees of intergrade from this condition to a ventral scopa completely white except at the very tip of the venter.

In contrast to the males all of the female specimens have the axillæ maculated and most of them have the scape immaculate. The mesonotum of the female presents in its ornamentation all phases of variability from well-formed bisymmetrical L-shaped stripes extending along the anterior and lateral borders to a completely immaculate condition. The maculations of the legs are on the average rather fuller than in the male. Almost invariably the front and middle femora have a stripe, confined to the apical half. The tibiæ are completely maculated or broadly striped externally, but the stripe on the front and middle tibiæ has a tendency to terminate abruptly before the apex is reached. The hind basitarsi are yellow, the front and middle pairs concealed by pubescence.

It is in the maculations of the head, however, that the greatest variability appears. Typically the females have the mandibles mostly yellow, the clypeus yellow except for the apical rim and a more or less extensive area of black at the base, and well-developed cuneiform lateral face marks filling the space between the clypeus and the inner orbit of the eye. But while the maculation of the mandibles is fairly constant, the amount of yellow on the face shows many degrees of intergrade from the condition above described to one characterized by the absence of lateral face marks and the reduction of the yellow on the clypeus to a spot on each side. The resulting combination of maculated mandibles with the absence of maculations on the sides of the face thus ceases to be the exclusive prerogative of the females of *A. palmarum*.

The band of segment 1 of the abdomen is in the females of *aridum* very slightly interrupted, the resulting halves usually taking the form of two mesad-pointed acute triangles instead of the four-spotted condition typical of segment 1 in the male. The bands on segments 2-5 are continuous, being merely notched at the middle and more or less sinuously emarginate above on the sides. Segment 6 is usually wholly yellow except for a small rounded black spot in a depression at each side near the base,

but in two of the females the yellow area is bisected by a thin line of black. The females of *A. mormonum* and some of its allies likewise have segment 6 prevailing yellow, but, instead of the black rounded spots above referred to, these females have inward- and downward-slanting black lines that invade the yellow at the base of segment 6. To be emphasized, too, is the much more curvilinear contour of this segment in *mormonum* and the insects closely affiliated with it.

Exceedingly close to these females believed to be *aridum* are the females from Flagstaff, Arizona, which were taken at flowers of *Iris* by F. C. Pratt and which Professor Cockerell believed to be *Anthidium pondreum* Titus (Proc. U. S. Nat. Mus., XL, pp. 248-249, 1911). Professor Cockerell assigned these specimens to *pondreum* because he associated with them four males from the same locality that he believed to be *pondreum*. Through the courtesy of the United States National Museum one of the males and one of the females from Flagstaff identified by Professor Cockerell were recently sent me. They are, in my estimation, insects of two different species. The male is, I believe, *pecosense*, which Professor Cockerell reported from the same region. It can be differentiated structurally from the females believed by him to be *pondreum* perhaps most readily by the sculpturing of the propodeum. In *pecosense*, male as well as female, the basal part of the triangular enclosure is covered by a band-like stretch (interrupted in the middle) of rather large punctures laid on a tessellated surface. The entire apical part of the enclosure beyond these basal bands and even the break between the bands at the middle of the base are covered by a dense fine tessellation that in places seems grouped into microscopical ridges running now subparallel to one another, now convergingly or even confluent. In contrast, what Professor Cockerell designates the female of *pondreum* has the basal part of the triangular enclosure of the propodeum covered by punctures that are laid on a surface virtually devoid of tessellation and these punctures extend broadly far down toward the apex. However, the apical region itself of the enclosure is entirely devoid of both punctures and tessellation, presenting a polished appearance that at once serves to differentiate it from the corre-

sponding surface in the male from Flagstaff. This condition applies not only to the female of *pondreum* as interpreted by Cockerell but also to the males and females from Big Pines Camp that I have assigned to *aridum*.

The affiliation of the females from Flagstaff believed by Professor Cockerell to be *pondreum* with the females from Big Pines Camp is much closer than might at first seem to be the case. Professor Cockerell's conclusions were based on two females only, but through the kindness of the United States National Museum I have had the privilege of examining six additional females from Flagstaff that were taken at the same flower (*Iris*), by the same collector (Pratt) and in the same month and year (June 9-12, 1909) as the specimens studied by Professor Cockerell. The maculations of these six reveal the variability that so often becomes manifest within a single species of the Anthidiinae when even moderately large series of these insects are available, and recall the caution of Friese (*Die Bienen Europa's*, 1898, p. 89): "Hier mag auch noch erwähnt werden, dass auf die gelben Zeichnungen des Körpers wenig Gewicht zu legen ist, da ausserordentliche Veränderlichkeit in der Ausdehnung derselben sich bei einer Art zeigt."

These six additional specimens indicate that the yellow of the thorax is not in all cases "confined to a stripe above each tegula" and the femora are not in all cases "black without the large yellow stripes." In fact, only in one of the six specimens mentioned is there no maculation on the front margin of the mesonotum, while in another specimen there are even L-shaped bands rimming the mesonotum. All of the specimens have maculations on the femora (confined as in the putative females of *aridum* to the apical half).

Points of differentiation between the females here assigned to *aridum* and Professor Cockerell's putative female of *pondreum* are rather tenuous and to some extent overlapped by the variability indicated within each group. In all of the specimens from Flagstaff, however—and this applies not only to those taken by Pratt but also to two specimens from the same locality taken respectively by Ashmead, July 21, 1897, and by Barber and



Schwarz—there are rather large emarginations laterally at the base of the otherwise yellow tergite 6 in contrast to the imbedded spots in the otherwise yellow tergite 6 of the females believed to be *aridum*. The Flagstaff insects all have light scopa, with sometimes a touch of black at the apex, in contrast to the usually more extensive black scopa of the insects from Big Pines Camp. In all the specimens from Flagstaff the band on tergite 1 has lateral emarginations, usually posteriorly, in contrast to the usually unemarginate condition of this band in the specimens from Big Pines Camp. Also, more often than not a triangle of black occupies the central region of the clypeus in these Arizona specimens (though in two of them shrunken to a black W at the base of the clypeus) whereas in the California specimens the yellow of the clypeus is usually more pervasive. In the much more essential matter of structure, and especially in the structure of the last tergite, the insects from the two localities seem to be alike.

*Anthidium mormonum fragariellum* (Cockerell)

Professor Timberlake has supplied the following floral records for the females represented in his collection: Yosemite Valley, June 27, 1926, two specimens on *Lotus nevadensis*; Big Pines Camp, Cal., July 11–13, 1927, two specimens on *Phacelia ramosissima*, one on *Phacelia heterophylla*, one on *Lotus davidsoni*; Coffee Camp, Cal., June 8, 1925, one on *Lotus scoparius*; San Jacinto Mts., July 14, 1912.

A large series of males from the same localities have floral records corresponding to those of the females.

*Anthidium placitum* Cresson

The following locality and floral records are of interest in connection with a series of females taken by Professor Timberlake: Big Pines Camp, Cal., July 11–17, 1927, on *Cordylanthus nevinii*; Mt. San Antonio, Aug. 23, 1920, on *Cordylanthus filifolius*, at an elevation of 4,800 feet, and Aug. 23, 1920, also on Mt. San Antonio, with the notation “on wet soil by creek.”

Two of the males (= *A. bernardinum*) collected by Professor Timberlake on Mt. San Antonio duplicate the data for the females

from that locality. Other males were taken at: Big Pines Camp, Cal., July 12-17, 1927, on *Phacelia heterophylla*; San Jacinto Mts. (col. A. J. Basinger), Sept. 2, 1923.

*Anthidium permaculatum* Cockerell

In 1924 Professor Cockerell described this species (Proc. Cal. Acad. Sci., 4th Series, Vol. XIV, p. 349) on the basis of two specimens from Oregon. Later I described (Amer. Mus. Novitates, Number 252, Feb. 28, 1927) certain specimens from Wyoming, Utah, and Idaho as *niveumtarsum*, stating at the time: "These specimens have been designated as a new species, but it is very possible that they are not entitled to such rank, having perhaps merely varietal importance. They are apparently very closely allied to *permaculatum*." I then went on to note certain characters that seemed to differentiate *niveumtarsum* from *permaculatum*.

Since then I have obtained through the kindness of Professor H. A. Scullen a large series of bees (fourteen females and three males) from localities in Oregon. These are assignable to *permaculatum* but show sufficient variability to bridge practically all of the distinctions that I was inclined to believe separated *niveumtarsum* from *permaculatum*. In none of the specimens, however, are the inner spots on segment 1 of the abdomen larger than the outer marks (as noted by Professor Cockerell) and in many of them the four-spotted condition of segment 1 is replaced by a medianly interrupted band with posterior emarginations laterally.

In a few of the specimens there are L-shaped bands rimming the mesonotum, in others these bands are broken, but in a majority of instances there is merely a stripe above the tegulæ. In like manner the stripes on the femora may be present or absent, the hind basitarsi may be maculated or not, and the clypeus may present the condition of being wholly maculated except for a median longitudinal ribbon of black or of being mostly black with merely a small spot at each side. The apical rims of the abdominal segments are closely punctated in all of the specimens. Cockerell has noted that the clypeus of the

female is bidentate on each side. In the male the clypeus has a strong median curvilinear emargination. In only one of the three male specimens is the pygidium maculated.

With the exception of one specimen, a male, secured by W. J. Chamberlin at Sparta, Baker Co., on July 2, 1922, all of the specimens from Oregon before me were collected by Professor Scullen. Two specimens, bearing date of July 16, 1927, were caught at Burns, at an elevation of 4,150 feet; twelve were taken July 17, 1927, at Glass Buttes, fifty-seven miles west of Burns; another specimen was obtained the same day as the above, fifty-three miles east of Bend; a single specimen from Wildhorse Canyon, Steens Mts., was collected at an elevation between 4,270 and 6,000 feet on July 5, 1927.

*Anthidium tenuifloræ* Cockerell

Two males and a female of this species were collected by Professor Timberlake, July 11, 1927, on *Lotus davidsoni*. A third male was caught, July 13, 1927, on *Epilobium californicum*. The specimens are from Big Pines Camp, California.

Form close to *Anthidium tenuifloræ* subsp. *yukonense* Ckll.

From Mount Hood, Oregon

Four specimens—two males and two females—taken by Professor Scullen, August 19–21, 1927, on Coopers Spur, Mount Hood, Oregon, at an elevation of 6,000 feet, occupy a position somewhat intermediate between Cockerell's subspecies and true *tenuifloræ*. The males share with Cockerell's type the unusual condition represented by the immaculate first tergite. The second tergite is, however, in these specimens four-spotted, not "with only small lateral spots," and the sixth tergite has two small comma-like maculations. The accompanying females have the first tergite more fully maculated than is indicated by Cockerell and have vestiges of maculation on the sixth tergite.

These specimens seem to represent a transition from *tenuifloræ* proper to the form recognized by Cockerell as *yukonense*. The markings noted by Cockerell for *yukonense* other than those on the abdomen, as well as the white hair of the thorax, are

shared by several specimens from Colorado which I have interpreted to be true *tenuifloræ*.

***Anthidium clypeodentatum* var. *lutzi*, new variety**

A female *Anthidium* from California that is the property of the Los Angeles Museum is structurally so similar to the females of *A. clypeodentatum* Swenk that it seems the part of conservatism to assign it to the same species to which Swenk's insect belongs, although, were it not for the variability that I have noted in the structure of the clypeus of *clypeodentatum*, I should feel tempted to make the California specimen a distinct species. The apical margin of the clypeus in this specimen is distinctly denticulate only along the sides, the median part of the margin being merely faintly irregular due to microscopic ridges. In other structural respects the insect accords with what I have interpreted to be *clypeodentatum*. At the least this specimen is entitled to varietal recognition, for, in contrast to the subdued ornamentation of *clypeodentatum* proper, it is rather conspicuously arrayed. The maculations are deep yellow and are distributed as follows:

Mandibles except apex and extreme base, entire clypeus except for an irregular intrusion of black at the middle of the base and the middle of the apex, lateral face marks completely filling the space between the clypeus and the eye and truncated at the level of the base of the antennæ, a minute spot at the apex of the scape, a heavy, backward-directed subrectangular spot above the summit of each eye and a minute spot above each of the lateral ocelli. The mesonotum bordered by heavy L-shaped bands that are nearly confluent with the maculations on the axillæ and scutellum, the latter with a neatly defined separating area of black posteriorly. The tubercles yellow and the tegulæ with a large yellow maculation anteriorly and a smaller one posteriorly. A small spot on the mesopleura. The hind coxæ with a touch of yellow; all of the femora striped beneath; knee spots on the middle and hind legs; all of the tibiæ and basitarsi externally yellow (on the tibiæ there is a reddish hyaline spot near the apex). All of the tergites banded: the band on seg-

ment 1 medianly interrupted but without lateral emarginations; the bands on the subsequent segments merely subinterrupted or emarginate medianly but with emarginations on each side above that slant slightly laterad, though much less markedly so than in specimens of *clypeodentatum* proper that have come to my attention. Tergite 6 with two incompletely enclosed black spots in a broad field of yellow, and with the serrations on the truncate sides of the apex and the central bifid process brownish black.

The female was collected presumably by Doctor Davidson and bears on its label a "W." Professor Timberlake, to whose forethought I am indebted for the opportunity of examining this specimen, interprets the "W" as standing for Mt. Wilson. With this specimen are associated: three males, two of which are marked with a "W" like the female; a third that lacks a label but is presumably from the same locality as the previous two; and a fourth from Dulzura, California, that is discussed under the heading of *psoralea* in the Canadian Entomologist, Vol. 60, pp. 214-215, 1928. This male, which was taken June 20, 1917, by Mr. W. S. Wright, has been made the allotype of the new variety. The description follows:

Male.—Length 11 to 12 mm. Black with yellow markings. Head about the width of the mesonotum, and approximately three-quarters as long as it is wide. The eyes, pale green, converging below. The mandibles with the apical tooth elongate, slightly falciform, and with the median tooth and inner tooth much less strongly developed. The clypeus convex with a glistening median longitudinal carina; the apex of the clypeus only very slightly emarginate along its middle, almost straight. The punctation on the head and thorax dense except for a narrow polished rimlike area half encircling each of the ocelli and impunctate shiny spots on each side of the mesonotum at the level of the tegulae. The propodeum shiny, with fairly large, for the most part sparse punctures along its base that become more closely grouped at the sides, the entire apical region of the triangular enclosure being devoid of punctures and rather polished. The basal tergite with coarse, somewhat indistinct, fairly dense punctation. The remaining tergites with relatively finer punctures that are, however, irregular both in size and distribution. Viewed from certain angles some of these punctures seem elongate and blotchy due doubtless to the faintly striate character of the surface on which they are laid, particularly along the sides of the tergites. The rims of the segments are more densely punctured than the basal portions. Tergite 6 armed on each side with a straight to slightly curved (as distinguished

from a hook-like) spine. The median spine of the pygidium long and slender, terminating nearly on a level with the relatively broad lateral lobes. Each of these lobes has near its inner extremity a sharp emargination, with the result that there is a small mesad-pointed extension on the inner tip of each lobe. This is the most characteristic structure in the male. The last segment of the venter has a backward-pointing, rather elongate ferruginous process medianly and on each side a downward-directed angle that is due to the sharp bend of the contour.

The genitalia of this insect are rather like those figured by Miss Ruth Isensee<sup>2</sup> for *Anthidium pondreum*, though the identity is not quite so complete as in the case of *cockerelli* described elsewhere in this paper. The volsellæ especially seem slightly different, broader than in Miss Isensee's drawing for *pondreum*, but the sagittæ and stipes are virtually the same.

Grayish to white hair on face, pleura, legs (except inner surface of basitarsi) and abdomen beneath; the scape with a conspicuous brush of light hair. The vertex, thorax above, and dorsum of abdomen with ochraceous hair (these parts gray in one of the specimens).

Deep yellow are the following: Mandibles except tridentate apex and extreme base, clypeus, sides of face to level of base of antennæ, stripe on scape in front (this stripe is reduced or absent in the paratypes), large backward-directed stripe-like spot above each eye. Stripe on each side of the anterior margin of the mesonotum, tubercles entirely yellow except on their anterior face, tegulæ in front, small spots on axillæ (absent in one of the paratypes), larger and more stripe-like maculations on scutellum that converge but fail, due to a broad separating area of black, to unite posteriorly. Legs maculated as in the female, except that the dots on the hind coxæ seem to be lacking and that the male specimens among themselves show variability in the development of the stripes on the femora (those on the front femora being in two of the paratypes absent or spot-like). The bands on tergites 1-2 and usually 3 medianly interrupted but decreasingly so, those on 4 and 5 merely emarginate medianly. The emarginations on each side above (which on tergite 1 sometimes produce a four-spotted condition) have a stronger laterad orientation than is the case in the female above described, though a laterad orientation has been noted in females of *clypeodentatum* proper. Tergite 6 with two large suboval inner spots and two smaller outer maculations (type) or with a band that may present the extremes of almost complete entirety on the one hand, or on the other almost complete penetration by the lateral emarginations (paratypes). Tergite 7 is in the type wholly black, in the paratypes with a maculation of variable size on each of the lobes.

This variety has been named *Anthidium clypeodentatum lutzii* in honor of Doctor Frank E. Lutz, Curator of Entomology in

<sup>2</sup> Ruth Isensee, "A Study of the Male Genitalia of Certain Anthidiine Bees." *Annals, Carnegie Museum*, XVII, Nos. 3-4, June 27, 1927.

the American Museum of Natural History, who has been the inspiration of my entomological work through a decade of close association.

The relationship of *clypeodentatum* to *psoraleæ* still continues to puzzle me. The inclination to associate Swenk's female with Robertson's male is strengthened by the discovery in southern California of insects belonging to these supposedly different species that yet show virtually the same direction of variability. The stumbling block is still the female that Robertson associated with the male of *psoraleæ*. Some of the differences between this female and *clypeodentatum* I attempted to reconcile in the Canadian Entomologist, Vol. 60, pp. 214-215, but an outstanding point of difference still remains: the six-toothed condition of the mandibles in *clypeodentatum* and the seven-toothed condition of the mandible as described for *psoraleæ*.

Generalization is usually perilous, but the highly maculated variety above described seems to lend support to the impression that the Anthidiinæ of California, and particularly those of southern California, tend to show a richness and fulness in their ornamentations that often differentiate them from their close relatives in the states to the north, just as a tendency to red manifests itself in the Anthidiinæ of Florida.

#### *Anthidium palmarum* Ckll.

Males of this species were collected by Professor Timberlake at Riverside, March 21 to May 26, on various species of *Phacelia*—*ramosissima*, *distans*, and *hispida*. On *P. hispida* also was taken a male from Owens Valley, caught twelve miles from Olancho on the road to Darwin, May 2, 1927. Yet another male was secured April 30, 1927, in the Mohave Desert, south of the Arawatz Mountains, on *Aster tortifolius*. A female was taken April 2, 1927, at Palm Springs, California—the type locality of the species—visiting *Phacelia crenulata*.

#### *Anthidium xanthognathum* Cockerell

The records for this rather rare insect, known thus far only from the type and paratype, are extended through the capture

of two specimens by Professor Timberlake at Riverside, California—the one on May 26, 1925, taken while it was “resting on ground with wad of pale pollen probably from *Lotus scoparius*;” the other on May 27, 1925, on *Lotus scoparius*. A third specimen was caught by E. P. VanDuzee in San Diego County, California, May 19, 1913 (collection of Cornell University). The specimens have the markings of Professor Cockerell’s variant from Soboba Springs, California.

*Anthidium paroselæ* Cockerell (?)

New Record from Arizona

With some hesitation there are assigned to *Anthidium paroselæ* Cockerell instead of being described as a new species four specimens—two males and two females of rather distinctive structure. These were caught by Professor Bradley at S. Carlos, Arizona, May 12–13, 1913. The females have the entirely yellow clypeus, bright yellow maculations, yellow and ferruginous legs, and partly ferruginous flagellum indicated in Professor Cockerell’s key (Bulletin of Denison Univ., Vol. XI, 1898, p. 62). The associated males of these San Carlos females run to *paroselæ* in Professor Cockerell’s later key (So. Cal. Acad. Sciences, Vol. III, 1904, pp. 56–58).

In 1900 Professor Cockerell, writing in Ann. Mag. Nat. Hist. (7) V, described the male allotype of *paroselæ* as having a pygidium “much as in *Porteræ*.” The lateral lobes of the pygidium in the insects before me are rather bluntly triangular whereas in *porteræ* they are rather broadly rounded, almost subtruncate. The description of 1900 goes on to say that the last ventral segment is not spined. As comparison is drawn throughout to *porteræ*, I have assumed that this statement was made by way of emphasizing the absence in *paroselæ* of the large median spine on the apical ventral segment that is so characteristic of *porteræ*. Strictly speaking, the statement “not spined” would fail to apply to the males from San Carlos, as they have on each side of their apical sternite a tooth with a spinelike tip.

Some of the other structural features of these San Carlos insects seem worthy of emphasis. The head in the female is



unusually broad, reaching well to the level of the outer rim of the tegulæ. The reflexed brownish-hyaline apical edge of the clypeus is in this sex not in the least emarginate but broadly rounded at the middle and slightly irregular at the sides (but without evidences of distinct teeth). The antennæ of the female are very short, about equal to the distance from the vertex to the apex of the clypeus but falling far short of spanning the width of the head. The punctation is rather fine, dense on the vertex and thorax above, sparse on the abdomen, especially the basal portion of the several tergites. Segment 6 is angulated on each side but without evidence of lateral teeth, the broad apical portion widely angulate to subtruncate.

In the male the head is distinctly broader than long, extending on each side beyond the mesonotum but not, as in the case of the female, quite reaching to the outer extremity of the tegulæ. The clypeus is not in the least emarginate along its apical middle, differing in this respect from many other male *Anthidium*. The antennæ of the male are distinctly longer than the head, about equal to the width of the head. The punctation is, as might be expected, like that of the female. The lateral teeth of segment 6 are straight. The lateral lobes of the pygidium are subtriangular with a slender median spine between. The terminal segment of the venter has a shiny raised apical portion that is flat to slightly concave above but of rounded somewhat U-like outline as it encroaches upon the base. This raised portion occupies more than half of the segment and terminates on each side in a broad, outpointing tooth with rather spinelike tip.

The insects are even smaller than Professor Cockerell specifies—in the case of the females approximately 8 mm. as against “about 10 mm.” indicated for the type, and in the case of the males  $9\frac{1}{4}$  mm.

The structural characters above noted seem to separate these insects rather decidedly from *porterae* and it is still open to doubt, therefore, whether they are correctly assigned to *paroselaë*, which, judging from Professor Cockerell's description, resembles *porterae* at least superficially. Only comparison with the type material could determine whether they are specifically distinct.

If they be *paroselæ*, they are the first record of that insect from Arizona, all of the previous records being from New Mexico.

### ***Anthidium cockerelli*, new species**

A single male, taken by Professor Timberlake, April 19, 1925, near Oasis, California, as it was visiting *Cercidium torreyanum*, has genitalia like those figured by Miss Ruth Isensee for *A. pondreum* Titus. It is open to doubt whether in other respects it resembles *pondreum*. Its markings are cream-colored instead of "deep yellow." It has no maculations on the "anterior portions of mesothorax," or on the axillæ. The lateral halves of the abdominal bands have deep and rectangular emarginations; they are not merely "notched." The pile is whitish to gray, in no place "ochraceous." Finally the venter is "polished" only on the last segment and restrictedly on the basal portion of the other segments, the apical portions being broadly punctate. Other possible differences are brought out in the description that follows:

Male.—Length 10 mm. Black with cream-colored markings. Head considerably broader than long; the pale green eyes converging below. Apical contour of clypeus very faintly bilobed due to a slight nick-like emargination at its center—somewhat intermediate in type between the apically rounded to truncate clypeus of the putative *paroselæ* males from Arizona and the apically emarginate clypeus of many other species. Labrum with two tuberculate prominences. Punctures relatively fine: at the base of each of the abdominal tergites sparse and scattered, on the apical rims arranged here and there in rather chain-like groupings with usually more than the width of a puncture separating one string from another. (*A. pondreum* is described as "closely punctured.") The pygidium also very similar to that of the putative *paroselæ*, the lateral lobes a little less pointed, a little more vaguely triangular than in that insect. The last ventral segment of *cockerelli* is, on the other hand, rather different from that of the Arizona specimens believed to be *paroselæ*. The carina-like boundary that separates the apical and basal portions of this segment does not bulge out broadly and rather gradually as it approaches the base but in contrast is rather straight in outline except at its middle, where it is abruptly V-shaped. This forward-pointing V-shaped projection in the outline is symmetrically opposed by a ferruginous, slightly bifid but otherwise similar V-shaped, backward-pointing extension at the middle of the apical extremity of the sternite—a development lacking in the putative *paroselæ*. Lateral teeth are present on this

sternite but they are little developed and decidedly obtuse. The sternite resembles rather closely that of specimens of *collectum* before me except that the lateral teeth are in *collectum* much more developed and spine-like. The propodeum is covered along the base of the triangular enclosure with large, rather vague and sparse punctures that thin out toward the middle. The large apical region of this enclosure is devoid of punctation and polished.

So similar in some of its structural features to the putative *paroselæ*, yet rather different in others, *cockerelli* departs from it sharply in the color and character of its maculations. The following parts are cream-colored: mandibles except teeth, clypeus except two basal black spots, cuneiform marks filling space between clypeus and eye and terminating at level of base of antennæ, spot above each eye, large spot in front and small spot behind on otherwise ferruginous tegulæ, two widely separated stripes on the scutellum (but in the only specimen before me not on the axillæ), spot on the hind coxæ, stripes from end to end on the front and middle tibiæ, basal and apical spots on the hind tibiæ, all of the metatarsi externally. The abdominal maculations are also cream-colored. On all of the segments the bands are broadly interrupted in the middle and, except on the seventh, deeply and rather squarely emarginate above on each lateral half. So deep is this emargination that on segments 1-3 it has completely cut through the maculations, resulting in a four-spotted condition. The flagellum shows a tendency to be somewhat ferruginous and its third joint is brightly so within.

The insect is covered with fairly long grayish to white hair, that is at no point so concealingly dense and matted as on the face of the putative *psoraleæ* or of *rohweri*. Bristle-like hairs fringe the apical border of some of the abdominal maculations, especially those on segments 4-5.

This insect is named in honor of Professor T. D. A. Cockerell, whose extensive studies on the Anthidiinæ are only a few of the many accomplishments that have resulted from his tireless researches in different fields of biology. A *Heteranthidium* has been previously named for Professor Cockerell but it has been relegated to the synonymy. In the belief that *Anthidium* is sufficiently distinct from *Heteranthidium* and the other pulvilli-bearing forms to survive as an independent genus, the name of *cockerelli* is here revived.

*Anthidium rohweri* Schwarz

New Record from California

A single male of this species taken by Professor Timberlake north of Indio, April 23, 1927, as it was flying about *Larrea*,

represents the first record of this insect from California. Subsequently there was sent me a specimen caught April 15, 1928, by W. H. Thorpe "on muddy ground." The locality record for this specimen reads: Salton Sea, near Fish Springs, Colorado Desert, California.

*Anthidium atripes* (Cresson) for *Anthidium emarginatum*  
*atripes* Cresson

Cresson described this putative variety of *emarginatum* on the basis of a single male. I have recently examined his type and in my estimation it is not a variety of *emarginatum* but a distinct species. Cresson's description does not include several of its distinguishing characteristics. Especially to be noted is the fact that it is largely covered with black hair instead of the light hair so characteristic of the vast majority of the males of *Anthidium*. Structural features worth recording are a deep curvilinear emargination on the clypeus and the sparsity and fineness of the punctures on the apical rims of the several segments of the abdomen.

In his paper contributed to Proc. Cal. Acad. of Sciences (Vol. XIV, No. 15, 1925, p. 354) Professor Cockerell has associated with *atripes* as its female an insect from Meadow Valley, California, that accords, I find, with what I subsequently described as *longispinum* (Amer. Mus. Novitates, No. 253, March 1, 1927, p. 6). It seems to me that *longispinum* is structurally too different from *atripes* to rank as its mate. In contrast to *atripes* the rims of the segments of *longispinum* are covered with densely crowded punctures, while the punctation at the base of the several segments is also dense and even somewhat coarse compared to the sparsely dotted, rather polished surface of this basal portion in *atripes*. Moreover, it would be unusual if a female with light ventral scopa such as characterizes *longispinum* were the mate of a male that is dark-haired both above and below on the abdomen. Where differences occur between the sexes of *Anthidium*, it is usually the female that has the darker ventral scopa. The putative affiliations of *longispinum* will be discussed under the heading of *Anthidium banningense*. At this point I desire, however, to describe what I believe to be the true female

of *atripes*, based on a single specimen taken by Professor Timberlake on July 11, 1927, at Big Pines Camp, California, as it was visiting *Lotus davidsoni*.

Female.—12 mm. Black with a few cream-colored maculations and with predominantly black pile. Head slightly wider than long, the eyes converging below. The mandibles sexdentate; the apical contour of the clypeus slightly reflexed, faintly serrate along its middle, becoming strongly so on each side, with the penultimate lateral teeth rather prominent. The punctation dense but rather fine on the abdomen; the punctures on the apical rims of the segments tend to arrange themselves chain-wise with often several times the width of a puncture separating one chain from another. Viewed from above the contour of segment 6 is rounded, without marked angulation or lateral teeth.

No maculations on the face. A backward-directed cream-colored oval spot above each eye and maculations of the same color as follows: tubercles, tegulæ except for a large blackish-brown pupil, a stripe on each side of the anterior margin of the mesoscutum, an oval spot on each side of the scutellum, medianly interrupted bands on segments 1-2 that are anteriorly emarginate on each lateral half, large clavate median maculations on segment 3, small oval median maculations on segment 4. Segments 5-6 as well as the legs immaculate.

The pubescence throughout deep black except for gray hairs from the level of the antennæ to the top of the head (interspersed with a tuft of unbranched black hairs in the region of the ocelli), and gray hairs on the thorax above, behind the wings, on the part of the mesothorax and metathorax immediately beneath the wings, and on each side of tergite 1.

In its close approach to an immaculate condition, in its dark ventral and dorsal pubescence, and in the fine and sparse punctation of its abdominal rims this female seems much closer to *atripes* than does the previous claimant, *longispinum*.<sup>3</sup>

<sup>3</sup> Since writing the above I have received through the kindness of Professor Timberlake a male and a female belonging to the Los Angeles Museum. These were collected by Doctor Davidson presumably in Bear Valley, San Bernardino Mountains, California, and confirm the impressions previously arrived at. The female from Bear Valley differs from the female

*Anthidium banningense* Cockerell and its female, *Anthidium longispinum* Schwarz

The claim of *longispinum* to rank as the female of *atripes* is no longer tenable in view of the discovery of the true mate of *atripes*. With what insect shall we then associate *longispinum*? I am convinced it is the female of *banningense*. *A. banningense* has exceptionally few maculations on the legs and *longispinum* is devoid of maculations on these parts. The apical rims of the abdomen are in both densely punctured. The pygidium of *A. banningense* is much like that of the males of *A. maculosum* and *A. maculifrons*, and these two species are the only ones before me that in the female sex have spines on the apical segment comparable in length and acuteness to those of the putative female of *banningense*. (For a comparative study of the pygidia of these insects the reader is referred to Plate XII.)

As further evidence in sustaining my contention I would mention the locality records cited by Professor Cockerell (Proc. Cal. Acad. Sci., 4th Series, Vol. XIV, 1925, pp. 354-6) for his "atripes" females (= *A. longispinum*) and those cited for his *banningense* males. All of the places where "atripes" females

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just described only as follows: the axillæ as well as the scutellum are maculated, and the band on tergite 1 has imbedded black spots instead of emarginations above on each side. These slight differences might well be due to variability within the species.

The male differs from the type in having maculations on each side of the anterior margin of the mesonotum and on the scutellum. Not merely tergites 6 and 7 but tergite 5 as well are immaculate. Unlike the female, both the type and the male from Bear Valley have grayish white hair on the face in the region below as well as above the antennæ, but the hair on the cheeks is blackish brown. As in the female, the dorsum of the thorax is in these males covered with gray pile; the gray pile on the pleura extends farther down than in the female. The male specimen from Bear Valley has whitish pile on tergites 1 and 2. The rest of the abdomen, both above and below, like the legs is covered with black pile, according with the type. Structurally the two specimens seem alike. The pygidium, more easily studied in the Bear Valley male than in the type, is a little like that of *palliventre* (= *californicum*). The lateral lobes are of about the same width in both species, but those of *palliventre* are incurved at the apex and lack one or more serrations along their inner edge, distinguishing characteristics of the Bear Valley male at least.

were found can be matched in his record by places where *banningense* was taken. In fact, there is only one place where a catch of *banningense* was not paralleled by one of "*atripes*."

Confirmatory data are supplied in the locality records of the new material before me. Among Professor Bradley's specimens are a male of *banningense* and a female of *longispinum*, both taken at Klamath Lake, Oregon, July 20, 1927. Among the specimens loaned by Professor Scullen are a series from Wildhorse Canyon, Steens Mts., Oregon, which he secured July 5, 1927, at elevations ranging from 4270-6000 feet. The males are *banningense*; the females, *longispinum*.

In the collection of Professor Timberlake there are four male *banningense*, unaccompanied, however, by females of *longispinum*, from the following localities: Nevada County, California, and Big Pines Camp, California, July 12-13, 1927. The specimens from the latter place were taken on *Phacelia heterophylla*.

*Callanthidium illustre* (Cresson)

New Record from New Mexico

This species, described from Nevada and reported from various localities in California, extends into New Mexico as is evidenced by specimens from Jemez Springs. These were secured July 5, 1913, by John Woodgate and are now in the collection of Cornell University.

*Callanthidium conspicuum consonum* (Cresson)

for *Anthidium illustre consonum* Cresson

Cresson described *consonum* as a variety of *illustre*, misled apparently by the fact that *consonum* shares with *illustre* the L-shaped marks on the mesoscutum. But, as other species illustrate when abundant material is available, such markings are apt to be highly variable and should not in my estimation take precedence over structural differences. Structurally *consonum* belongs with *conspicuum*, having like that species six teeth on the mandibles of the female, whereas *illustre* has seven. The inner teeth on the apex of segment 6 of the abdomen are slightly less rounded, rather more acute, than in *illustre*. Finally a median ribbon of black, absent in *illustre*, bisects segment 6 of the females

of *conspicuum* and *conspicuum consonum*. Along the center of this ribbon is traceable a glistening carina.

Two female specimens collected by Professor Timberlake, July 14, 1927, at Big Pines Camp, California, at an elevation of 7400 feet agree fairly closely with the type of *consonum*, although in neither is the carina just mentioned so distinct as in the type. Both of these specimens were taken at *Castilleia plagiotoma*. A male from the same locality, taken on the same day as the females but at *Cordylanthus nevini*, is almost certainly the same species as they.

The assignment of *consonum* to *conspicuum* rather than *illustre* derives additional support from this male, which in Professor Cockerell's key (Ent. News XX, p. 262) runs to *conspicuum*. However, this male, contrary to Professor Cockerell's specimens, agrees with the female of *consonum* in having L-shaped marks on the mesoscutum and the band about the head uninterrupted on the vertex. This justifies the retention, temporarily at least, of the varietal name *consonum*. A larger series is required to decide whether the variety is constant or not.

*Anthidiellum ehrhorni* Cockerell and its Undescribed Female.

Professor Cockerell described this insect from a male taken in the Mohave Desert, California, and later reported the species also from Grossmont, near San Diego, California. A male of this species was taken at Furnace Creek, California, May 1, 1927, by Professor Timberlake. With this male I associate four females, one of which was collected in San Bernardino County, California, by E. J. Vosler, and three by Professor Timberlake at Palm Canyon, California, April 5, 1925, and at Riverside, California, May 26, 1925, and June 10, 1926. Professor Timberlake's specimens were taken respectively on mesquite, *Lotus scoparius*, and *Stephanomeria virgata*.

In its maculations the female of *Anthidiellum ehrhorni* is deceptively like *Anthidiellum robertsoni* Ckll., sharing with that species the immaculate clypeus, the lateral face marks terminating at the level of the base of the antennæ, the occipital band extending without interruption from slightly beyond the summit of one eye to slightly beyond the summit of the other eye, the



marks on the tubercles, on the fore part of the tegulæ, and on each side of the anterior margin of the mesonotum, the stripe on the outside of the fore and middle tibiæ, and the basal spot on the hind tibiæ (sometimes there is a spot in addition at the apex). Instead of having merely the scutellum maculated, as is usual in *A. robertsoni*, the female of *ehrhorni* has the axillæ as well as the scutellum heavily banded, in this respect agreeing with its male. The bands on segments 1 and 2 of the abdomen also reveal the affinity of these females and serve to differentiate them from *A. robertsoni*. In both sexes of *A. ehrhorni* the maculations on tergite 1 are not confined to a spot at each side, as is usual in the male and female of *A. robertsoni*, but take the form of a medianly interrupted arcuate band that is narrow inward but greatly thickened at each of its lateral extremities. In fact, it is much like the band on tergite 2 of *A. robertsoni* except that the median interruption is broader. The band on tergite 2 of both sexes of *A. ehrhorni*, while also medianly divided, is, on the other hand, much thicker and heavier, the lateral halves being only slightly emarginated posteriorly. On tergites 3-5 the median spots are well developed but the lateral maculations in the females under consideration are either inconspicuous or absent. Tergite 6 of the female has two median maculations much like those of the corresponding sex of *A. robertsoni*; in one of the females of *A. ehrhorni*, however, these maculations do not find place.

While in its maculations and its size the female of *A. ehrhorni* is much like that of *A. robertsoni*, its structure is distinctive and readily enables one to separate it from *A. robertsoni*. Especially to be noted are two structural peculiarities: (1) The prolongation apically of the clypeus, the edge of which projects, slightly uptilted, to cover rooflike the inner quarter or third of the mandibles. In profile the clypeus is thus gradually, not abruptly, concave on its apical half, suggestive in this respect of the female of *Heteranthidium bequaerti*. (2) The prolongation of the apex of segment 6 medianly with an emargination of variable width that is rather suggestive of the similar structure in the female of *Anthidium clypeodentatum*. (Fig. 2B of Plate XII represents a specimen with rather broad emargination). Other structural differences are: the mandibles of the female of *A. ehrhorni* have

large, relatively sparse punctures basally on a practically smooth, shiny surface and minute dense punctures and striations apically; in *A. robertsoni* the mandibles are more striately punctate at the base and virtually impunctate, although microscopically roughened, at the apex. In *A. ehrhorni* there are no marked irregularities in the inter-ocular region other than the punctation, whereas in the female of *A. robertsoni* well-developed, semi-impunctate ridges separate the lateral ocelli from the anterior ocellus. In *A. ehrhorni* the apical rim of tergite 4 is relatively regular in outline; in *A. robertsoni* this segment is rather strongly down-bent in outline at each of its lateral extremities. To these structural differences others might be added, but the enumeration has supplied, it would seem, sufficient characters to facilitate the differentiation of the two species.

*Anthidiellum notatum* (Latreille) and its Allies

Two females taken in southern Arizona by F. H. Snow, August, 1902, and now in the collection of Cornell University, agree in all details with the female from New Mexico that Professor Cockerell described as *gilense* except that one of them has spot-like maculations on tergite 6.

Structurally these Arizona insects are very similar to the females of *notatum* and of *robertsoni* but, apart from differences in the maculations (rather slight as between these specimens and *notatum*), they are separable at once because of their greater size. They are very close, too, to what Swenk has indicated as the female of *boreale* Robertson. They have, however, yellow maculations on their red legs in agreement with *notatum* and *gilense*, whereas Swenk's putative female of *boreale* has "wholly clear red" tibiae and tarsi.

In the United States National Museum there is a large series of *Anthidiellum* from Kerryville, Texas, one specimen of which, as representative presumable of the entire group, bears the designation *gilense* in Professor Cockerell's handwriting. Some of the females lack the maculations on the sides of the clypeus, in this respect approaching *robertsoni*. All of them have red legs with yellow stripes on the anterior and middle tibiae, and

a basal spot on the hind tibiæ. Their axillæ are maculated as well as their scutellum.

The males accompanying this series from Kerryville lack a median carina on segment 6, which Robertson specifies for *boreale* and which I find present on that segment also in California males of *robertsoni*. The Kerryville males thus approach in this respect *notatum*. However, it seems to me that too much stress should not be laid on the presence or absence of a carina on this segment. As pointed out later on in this paper, p. 403, considerable variability in respect to this structure may exist even within a single species. As the pygidium of the male seems to be identical in *notatum*, *gilense*, *boreale*, and *robertsoni* and the presence or absence of the carina is of questionable significance, it seems to me that the last three should be considered varieties of *notatum* rather than independent species.

#### Cells of *Anthidiellum notatum rufimaculatum* Schwarz

Through the kindness of Mr. F. M. Jones, the American Museum of Natural History obtained two cells collected by him during a sojourn at the Royal Palm Park, Florida. From one of them a female of *Anthidiellum notatum rufimaculatum* had emerged and the other cell subsequently yielded a male of this species. The cells have been depicted by Mrs. E. L. Beutenmüller and appear as Fig. 1A (the cell of the male) and Fig. 1B (the cell of the female) on Plate XII.

A certain difference in the workmanship of these two cells is apparent. Not only is the cell from which the male emerged larger but its surface is of a different character. Whereas the cell that held the female is throughout prevailing smooth with only now and then minute irregularities, the cell of the male is here and there rugose in comparison, with lumps of resin jutting from its surface. The difference in the workmanship is especially noticeable at the base of the necklike extension: the cell that contained the male has in this region deep folds or channels that are in contrast to the ridgeless smooth surface of the corresponding area in the cell that yielded the female. A funnel-like expansion at the end of the necklike extension characterizes

the cell of the male specimen; the near absence of such a funnel-like expansion in the cell of the female may be due to injury rather than to imperfect development.

These differences are probably merely differences of technique, signifying no more than a difference of degree in skill on the part of the artisan. They are noted here merely as facts without any desire to claim that a difference of architectural method is applied in the case of the abode of the male from that used for the housing of the female. More nest material would be needed to justify such a conclusion.

The cell proper measures in the case of the male about 11 mm. in length, in that of the female about 9 mm., while the necklike extension adds in each instance another  $1\frac{1}{2}$  mm. Fabre states that both *septemdentatum* and *bellicosum*, European Anthidiinæ that build their cells in empty snail-shells, assign to the male the larger quarters near the orifice of the shell, while "the less spacious back room contains a female." It is doubtful, however, whether a similar disparity in size as between the cells of the male and the female obtains regularly in *Anthidiellum notatum* var. *rufimaculatum*. Of the specimens of this bee that have come to my attention it is more often the male than the female that is the smaller, and that in the economy of nature might therefore seem destined to content itself with the smaller cell. In the case of a European species of this genus, *Anthidiellum strigatum* Panzer, both Kirschbaum (Jahrb. d. Nassauisch. Vereins f. Naturkunde, Vol. XXV, 1871, pp. 446-447) and Schlechtendal (Jahresber d. Vereins f. Naturkunde in Zwickau, 1872, pp. 12-15) state or imply that the cells observed by them were of the same size.

According to these and other authors *A. strigatum* attaches its cells to a stone, arranging them in a row, one cell next to the other and similarly oriented. The cells of *notatum rufimaculatum*, on the other hand, seem to be placed singly and on vegetation. The cell containing the female was attached to a scrub palmetto near the tip of one of the divisions of the leaf; the cell from which the male emerged was fastened to a pine-needle. Other cells, similarly placed, were noted by Mr. Jones. All of

the cells which came under his observation were in the open pine woods; no cells were noted in the vegetation of the hammock.

Since the above was written I have secured through the kindness of Professor Timberlake a cell from which a male of *Anthidiellum ehrhorni* emerged. The cell was obtained on a mesa ten miles south of Yuma, Arizona, on January 19, 1928, and the insect emerged on March 8. It is interesting to note that this cell was attached to a bush and that its architecture is in important respects similar to that of *A. notatum rufimaculatum*. There is a necklike extension at the free end of the cell as in *rufimaculatum* and there are evidences of channeling as the neck is approached, though the folds are not so well marked as in the cell of the male of *rufimaculatum*. At its upper end the cell of *ehrhorni* has an almost barrel-like truncation, from the center of which juts forth the neck, as contrasted with the almost conelike slope of this portion in *rufimaculatum*. There are no knoblike irregularities on its surface, such as those noted for the cell of the male of *rufimaculatum*. The length of the cell including the neck is somewhat more than 9 mm. The neck itself is about 1 mm. in length but, as its tip seems slightly mutilated, it may originally have been longer and possibly even with a funnel-shaped termination. The enclosed cocoon is parchment-like and of a deep brown, almost matching that of the cell itself.

*Dianthidium parvum* and Some of the Smaller Western Representatives of the Genus *Dianthidium*, Including One New Species (*D. dubium*) and Two New Varieties (*D. ulkei riparii* and *D. parvum swenki*).

In 1878 Cresson described his species *parvum* on the basis of a female of rather restricted maculations that was obtained from Colorado, and with it he associated a male from the same state that like the female bore apparently no specific locality record although both the specimens had this in common: they were taken by the same collector, Ridings. The description of the male leaves some doubt as to the actual character of the insect. The apical segment is said to be "shaped much as in *interruptum*." The *interruptum* referred to is a species of

Say, later renamed *sayi* by Cockerell because of the prior use of *interruptum* by Fabricius for an Old World species. In *sayi* the pygidium is truncate with the median tooth projecting beyond the level of the broad, rather square-cut lateral lobes, constituting a brief interruption in an otherwise unbroken straight apical contour. Whether this is the type of pygidium that Cresson had in mind when he said "shaped much as in *interruptum*" or a more nearly tridentate pygidium, presently to be referred to again, in which the central tooth is clearly separated from the still fairly broad lateral lobes and ends on a level with them, will probably never be known, for Cresson's allotype is lost. Furthermore, there is no certainty that Cresson's male and female were correctly associated.

In 1900 Cockerell assigned to *parvum* males having the pygidium truncate, thus by implication accepting Cresson's statement as applicable in full to the *sayi* type of pygidial structure. Later, in 1909, Cockerell revised his opinion and assigned to *ulkei* specimens previously referred to *parvum*. Of the *ulkei* male he says: "The seventh segment of the male abdomen is broadly truncate, yellow with the edge hyaline, the lateral corners rounded, and the small median projection not bounded by notches." He does not say anything about the pygidium of *parvum*, but the implication at least is that it is different from *ulkei*. Swenk, in 1914, differentiated the male of *ulkei* from the male of *parvum* as follows: "The male of *ulkei* differs at once from *parvum* ♂ in the quite different pygidium, *parvum* having distinct notches at the sides of the median apical tooth which are lacking in *ulkei*." Swenk's impressions were based on a large series of insects, some of them bred from cells he had collected, and his interpretation of the male of *parvum* is probably, therefore, more to be relied upon than the interpretation of Cresson, who had only one male before him and that possibly not from the same locality in Colorado as his female type.

The description of *ulkei* was based on a single female from Utah, which both Professor Cockerell and Professor Swenk have assumed—and I think correctly—is essentially the same insect as that found in states to the eastward, Professor Cockerell recording it from Colorado and New Mexico, Professor Swenk

from Nebraska. Professor Swenk collected a large series of insects from various localities in the last mentioned state that he assigned to *ulkei*. They showed great variability in their ornamentation and because of this he widened the conception of *ulkei* to include females that approached rather closely the insect of limited maculations represented by the type of *parvum*. It is not quite clear from Professor Swenk's account whether each of the several localities in Nebraska represented by his specimens offered this intergrading diversity but, in view of the fact that he rejected the possibility of local races and treated all of his specimens as members of one group, I have assumed that no differentiation between the specimens of this locality and that was possible.

The Pacific Coast specimens of *ulkei* that have come to my attention present, however, rather clearly marked fixity of ornamentation as between this locality and that, and raise question whether valid varieties of *ulkei* are not involved. All of the eighteen undermaculated specimens of *ulkei* from California that I have examined come from one locality, Riverside, where they were secured by Professor Timberlake, nor are there among the specimens from this locality any that would be assignable to the more highly maculated group. Furthermore, I have had before me a series of six males and two females, taken by Professor Scullen at Three Sisters, Oregon, Aug. 7-15, 1926, at elevations ranging for the most part from 4,650 to 4,700 feet. All of these insects are of the undermaculated group of *ulkei*.

Recognition of the specimens from Riverside as a variety receives additional justification through the circumstance, pointed out to me by Professor Timberlake, that their punctation differs from that of the fully maculated and the more restrictedly maculated specimens of *ulkei* from Colorado. As he states in a letter: "This Riverside form is so readily distinguished by the sculpture, especially of the mesoscutum, which is quite shiny between the punctures but dull subrugosely punctured in *ulkei*, that I would not hesitate to treat it as distinct, unless I had evidence of intergradation in this respect as well as in maculation."

For the Riverside specimens I propose the name *Dianthidium ulkei riparii*. The punctuation of these specimens is, as Professor Timberlake points out, especially distinctive on the thorax above, but the punctuation of the vertex also is somewhat finer than in Rocky Mountain specimens and the punctuation of the abdomen is a little sparser.

The specimens from Three Sisters, Oregon, incline in their punctuation rather to the inland or Rocky Mountain group of *ulkei* with subrugosely punctated mesoscutum. Though they are consistently undermaculated, I think it advisable to withhold designating them yet another variety of *ulkei* in deference to the observations of Professor Swenk, which were based on a much larger series of *ulkei* from Nebraska.

The undermaculated females of *ulkei* (including those of *ulkei riparii*) have the abdominal bands emarginate on each side behind; the fully maculated females lack such emarginations on at least segments 3-5. I emphasize the character of the bands rather than the other maculations because both the type of *ulkei* and what are, I believe, the females of Cockerell's *davidsoni* have bands of a similar character. These putative females of *davidsoni* usually have the clypeus wholly yellow (with rare exceptions the clypeus of *ulkei* is merely more or less broadly maculated with yellow on each side) and segment 6 largely yellow (in the great majority of cases this segment is in *ulkei* either two-spotted or immaculate). How tenuous this distinction may become is indicated, however, by the presence among the *davidsoni* females from California of individuals that bear the earmarks of *ulkei*, while from Glenwood Springs, Colorado, there is a female that comes within the definition of *davidsoni*. On the basis of the female, it is to be doubted, therefore, whether *davidsoni* is even a well separated geographic race of *ulkei*.

The male of *davidsoni*, as represented by Cockerell's type (No. 9653) in the U. S. National Museum, has a truncate pygidium like that of the male of *ulkei* and the male of *ulkei riparii*. Like the female of *davidsoni* it usually shows a greater richness in the abdominal maculations than is the case in the majority of specimens of *ulkei*. Particularly may be noted the maculation of segment 6, which, as Cockerell indicates, is "yellow except the



overlapped base, a median basal pointed process, and two transverse subapical marks" (in all of these respects suggestive of the females associated with it). On the other hand, the distinction is not absolute. A California male before me with otherwise well maculated abdomen lacks the markings indicated for segment 6, while a male from Glenwood Springs assigned to *ulkei* might equally well qualify as  *davidsoni*. Certainly the gap between *ulkei* and  *davidsoni*, bridged here and there as it is by aberrant specimens in each supposed group, is much narrower than that which separates these two from the undermaculated group within *ulkei*, one division of which, following Professor Swenk, I have, temporarily at least, permitted to remain merged with *ulkei* proper because of structural similarity with the type, the other division of which, differentiated especially by its finer and more distinct thoracic punctation, I have given varietal rank as *ulkei riparii*. Certainly, if  *riparii* is made merely a variety of *ulkei*, the much less easily differentiated  *davidsoni* cannot claim independent rank, and I suggest that it, too, be made a variety of *ulkei*. The virtual identity of the pygidium and also of the genitalia in *ulkei*,  *riparii*, and  *davidsoni*, supplemented by other characters, seem to justify the treatment of these insects as members of one closely related group. (The pygidium and genitalia of *ulkei riparii* have been depicted as Fig. 2A and Fig. 2B respectively of Plate XIII. The genitalia are correctly represented from the angle from which they were drawn, but more often the stipes appear bent, even hooklike, at the extremity.)

Yet another series of specimens from California lent by Professor Timberlake present the anomaly of being structurally like  *parvum* as above outlined, while in their maculations they closely approach the richness of ornamentation indicated for  *davidsoni*. This is the insect two male specimens of which have been placed in the United States National Museum under  *davidsoni* and regarding the puzzling character of which I commented in an earlier paper (Amer. Mus. Novitates, No. 226, Oct. 9, 1926, pp. 10-11). They differ structurally from the type of  *davidsoni* (No. 9653) in having a tridentate pygidium of the  *parvum* type instead of a truncate pygidium. While this structural difference in the male is determinative for that sex, certain supplementary

differences, more or less constant, may be noted. In the California males before me that accord structurally with the type of *davidsoni* the posterior emargination of the bands on segments 3 and 4 or the presence of imbedded black spots in the yellow of these segments are rare occurrences. In the series that has the pygidium of *parvum* such imbedded spots or shallow posterior emarginations can be noted almost invariably in the case of the bands of these as well as of the other segments.

The abdominal bands of the putative females of the *parvum*-like males show a much less pronounced tendency toward posterior emargination than is the case in their mates, but even in the females, at least a slight deepening of the coloration, linelike or specklike, near the apex of each lateral half of the bands, even to the inclusion of those on segments 3 and 4, suggests a vestige of the condition that obtains in the male. In the females that I have associated with *davidsoni* even these feeble earmarks of a posterior emargination are absent on segments 3 and 4 in all but two out of fourteen specimens. In the putative females of the *parvum*-like males the tendency for the halves of the band on the apical segments to coalesce does not seem so strong as in the corresponding sex of *davidsoni* and, if it manifests itself, usually takes the form of an only partially completed coalescence on segment 6. These attempted distinctions in the females are admittedly tenuous.

The most pronounced line of cleavage seems to be the ornamentation of the face, the wholly or largely yellow clypeus of the *davidsoni* females being in rather sharp contrast with the minute triangle of yellow that is tucked away in each lateral extremity of the clypeus in the females of the other group. In this connection it may be recalled that the female of the true *parvum* has the clypeus either wholly black or with much restricted maculations.

For this group, which is so like in structure to *parvum* and so similar in its markings to *davidsoni*, I propose the name *Dianthidium parvum* variety *swenki* in recognition of the valuable work that Professor Myron H. Swenk has done upon the Anthidiinae and other groups of bees. Like *Dianthidium parvum baculifrons* Cockerell the female of this variety has a mark in front of the anterior ocellus, but the black part of the clypeus broadens rather

than narrows apically, the hind tibiæ like the other tibiæ are yellow instead of merely basally so, the sixth segment has conspicuous maculations instead of being entirely black, and the general appearance of the insect, with its maculated mesopleura and maculated under sides of front and middle femora, is so much more like *ulkei* and *ulkei davidsoni* than it is like the type of *parvum* (female) in the Academy of Sciences in Philadelphia that, were it not for the structural characters in the associated male, one would think it had no affiliation with *parvum*.

Assignable to *provancheri* because of their yellow markings rather than to *pudicum* are a series of nine males—all from Riverside, California—that are in agreement essentially with the type specimen (No. 9033) at the U. S. National Museum. Variability is shown by these specimens especially in the maculation of the hind tibiæ, some of the specimens transcending the limit of variability noted by Titus in having the hind tibiæ externally entirely yellow. But that they are all one species cannot, I think, be doubted in view of their structural similarity, their identity of locality, and the fact that the maculations of the hind tibiæ intergrade from extreme to extreme. A more troublesome instance of variability is the presence of a well developed median longitudinal carina on segment 6 of some of the specimens, a feeble indefinite carina in others, and no carina at all in yet a third subdivision. I do not find any correlation between this structural variability and the variability of the maculations.

I prefer to consider *provancheri* a variety of *pudicum*. Both Cresson's type of *pudicum*, a male, and the type of *provancheri* Titus, likewise a male, have a median longitudinal carina on segment 6, and in both the maculations on the third tibiæ are confined to the base and apex. I can see no important difference except that the maculations of *pudicum* are cream-colored, those of *provancheri* yellow, and this seems to me to have no more than varietal significance.

At this point it seems appropriate to discuss *Dianthidium consimile* Ashmead. A wrong impression seems to prevail as to the character of *consimile*, based on the supposition that Ashmead's description applies in part to the male, in part to the female. But Ashmead indicates that it is based on the female and exami-

nation of the type (No. 16698) in the United States National Museum leaves no doubt that every character mentioned in his description is substantiated by the specimen—a female from Los Angeles, California. This female has a completely maculated clypeus. It presents in other words a condition—very rare in the female sex—that is shared by the females associated with *dauidsoni*. From the female of that insect it seems to separate itself, however, through the posterior emarginations laterally on its abdominal bands and through the lack of a well developed subapical tooth on the mandibles. The rather smooth apical edge of the mandible may possibly be due to wear but among Professor Timberlake's specimens are four having mandibles of this character and at the same time maculations identical with or closely approximating the type of *consimile*. In three out of four of these the clypeus is largely or wholly yellow, in only one is it medianly traversed by a ribbon of black. In all of these specimens there are posterior emarginations on the abdominal bands. I believe these specimens should all be designated *consimile*.

It seems to me probable that *provancheri* is the male of *consimile*. Reasons have already been advanced for making *provancheri* merely a variety of *pudicum*. Females of *pudicum* before me have the same type of mandible, with a relatively smooth straight edge beyond the apical tooth, already indicated for *consimile*, so that the claims of that species to rank as a member of the *pudicum* group seem strengthened to that extent.

Ashmead's description of *consimile* is appended to a description of its nesting habits by Davidson. There is nothing to indicate that Ashmead had more than a single specimen of *consimile* before him, and that a female. Associated with *consimile* at the United States National Museum is, however, a male taken by Carl F. Baker and marked Cala. 2350. I included the characters observed in this male in a key (Amer. Mus. Novitates, No. 226, Oct. 9, 1926), believing at the time, in the absence of other evidence, that it was correctly associated with *consimile*. If, however, *consimile* and *provancheri* be different sexes of the same insect—or indeed even apart from this premise—this male, while in many respects close to "*provancheri*," is entitled to independent specific rank.

This male agrees well with certain males supplied by Professors Bradley, Scullen, and Timberlake in which a strong tendency toward red or at least reddish brown may be noted on the apical rims of the abdominal segments. Segment 2 like segment 1 is in this proposed new species usually 3-spotted, the result of a coalescence medianly of the normally divided halves of the band and the complete penetration of the band laterally by the emarginations. The middle tooth of the pygidium is of somewhat variable length, not always "fully twice the length of the lateral lobes," as indicated in my key (Amer. Mus. Novitates, No. 226, Oct. 9, 1926), but usually it is longer than that of *pudicum* and "*provancheri*." Its genitalia differ slightly from the condition in the *pudicum* group, especially in respect to the sagitta, as an examination of the figures on Plate XIII will indicate. The last sternite lacks the rather strong emargination that I have noticed in specimens of *pudicum consimile* (= *provancheri*).

Seven females, much like the type of *consimile*, except that they have a ribbon of black traversing the clypeus, and reddish staining on the apical rims of the abdominal segments, are associated with the males just discussed. Five of these have the lateral halves of the band on tergite 2 completely subdivided by the posterior emargination, presenting a condition like that above indicated for the male.

It had been my first intention to describe this group as merely a variety of *pudicum* but the structural differences, though slight, seem to make a specific separation from *pudicum* desirable. I, therefore, name it *Dianthidium dubium*. It may be mentioned that the color of the maculations in *dubium* ranges from pale to strong yellow. Possibly varietal distinctions may ultimately seem justified on this basis, duplicating what has been done in the case of other closely related insects within the Anthidiinae, but until a large number of specimens from many localities is available, such fine splitting seems premature.

Of the males of *D. dubium* one was collected by Professor Timberlake on June 24, 1926, in the Yosemite Valley on *Lotus*; three by Professor Scullen on Oregon Mt., Josephine Co., Oregon, July 5, 1925; one by Professor Bradley at Three Rivers, Cali-

foria, Aug. 13, 1927, and a second specimen from the same locality by Culbertson; and the remaining five have the designation State Insectary, California, and were possibly collected in the mountains east of Sacramento. One of these bears the following entry on the label: "Reared from nest on Sweet Birch, Dutch Flat, California, May 19, 1912, Branigan, Col."

The association of the females with the males on the ground of their maculations receives additional support from the fact that the locality records for the two sexes closely correspond. Thus the females were taken at the following places: one by Professor Timberlake at Three Rivers, California, June 10, 1925, while visiting the flowers of *Pentstemon*; five by Professor Scullen on Oregon Mt., Oregon, July 5, 1925; and one reared from nest on Sweet Birch, Dutch Flat, California. The reared pair from Dutch Flat have been made the holotype (♂) and allotype (♀) of *D. dubium*.

A few specimens remain as an unassimilated residuum. I cannot place them with any assurance, yet hesitate to complicate things by giving them even varietal rank. There are two males which were obtained from "cemented gravel nest" collected on Mt. Lowe, Cal. They have genitalia much like those of *D. dubium* but they do not show the tendency toward reddish-brown noted in the abdominal markings of that insect. There are also a male collected June 27, 1926, in the Yosemite Valley on *Monardella lanceolata*, a female with corresponding data, and two females from Mount Diablo, California, taken Sept. 22, 1912. The male has the pygidium of *pudicum* but abdominal maculations much more nearly like those of *D. parvum swenki*. The female with corresponding data has mandibles like those of *D. pudicum consimile* but its abdominal bands are of the fully developed type associated with *D. parvum swenki* and *D. ulkei davidsoni*. The two females from Mt. Diablo have the abdominal bands emarginate behind on each side and as such might seem to belong to *D. pudicum consimile* but they are so much larger than the four females here consigned to *consimile* and in general appearance seem so much closer to the puzzling female from the Yosemite Valley that it seems wiser to place them tentatively with her.

Professor Timberlake's careful floral records, supplied in the case of practically all of his specimens, and other data are summarized herewith:

The group designated *ulkei riparii* consists of five males and twelve females, all taken in 1925 at Riverside. The dates for the males are June 1, July 1, July 7, July 8, August 21; those for the females, May 29, June 1, June 2, June 4, June 17, June 19, July 1, July 2, July 26, August 21. Two pairs in copulation were collected on July 1 and August 21, respectively. The undermaculated specimens of *ulkei* from Oregon—six males and two females—were caught by Professor H. A. Scullen at Three Sisters, the males between August 8–15, the females, August 13–15. Professor Timberlake's records indicate that *Gutierrezia sarothræ* was the plant most favored by both sexes. Females were taken also at *Stephanomeria virgata* and *Senecio douglasii*. One of the copulating pairs was caught on *Heterotheca grandiflora*. Both of Professor Scullen's females, on the other hand, and one of his males were taken on a species of *Aster*.

Of the specimens of *ulkei* that constitute a more or less distinct variety under the name of *davidseni* six males were taken in 1927 between July 15 and 17 at Big Pines Camp, California, and eleven females at the same locality between July 13 and 17. Two additional females were collected at Mt. San Antonio, California, August 22, 1920—the one at 4,800, the other at 5,000 feet—and a third was taken in the San Jacinto Mountains, California, on July 14, 1912. Professor Timberlake's floral records for this *davidseni* group are as follows: On *Erigeron stenophyllus* all of the seventeen specimens from Big Pines Camp; on *Eriogonum fasciculatum* and the flower of an *Aster* species the two specimens taken on Mt. San Antonio.

Of *parvum* var. *swenki* there are sixteen males and seven females in the collection of Professor Timberlake. Of these three—all males—were taken at Big Pines Camp, California, July 13–17, 1927, on *Erigeron stenophyllus*. All of the remaining specimens were collected at Riverside, California, the males on *Gutierrezia sarothræ*, the females with two exceptions also at this plant. The two exceptional cases are recorded from *Heterotheca grandiflora*. The dates for the Riverside males are: May 25,

May 29, June 1, June 4, June 8, June 18, July 8, September 9, September 11, September 22. For the females the dates are May 29, July 2, July 9, July 10, August 4, September 9, September 26.

There are four females assignable to *consimile*, or preferably *pudicum* var. *consimile*, and there are ten males of *pudicum provancheri*, which is here associated with *consimile* as its male. Two of the females were caught on *Gutierrezia sarothræ* (May 27, 1925 and September 23, 1925), the third on *Trichostema lanceolatum* (August 11, 1924), and the fourth on *Lotus americanus* (August 12, 1926). Six of the males were taken on *Gutierrezia sarothræ*, May 27 (two specimens), May 29, June 1, July 9, September 14—all dates in the year 1925. Two of the males were taken on April 27 and September 22, 1926, while visiting *Lotus scoparius*. Yet another male was collected July 22, 1927, on *Eremocarpus setigerus*. All of the males thus far mentioned like the associated females were caught by Professor Timberlake at Riverside. A single male from Mt. Lowe, California, was obtained from a "cemented gravel nest." In this male the lateral lobes of the pygidium are relatively wider than in the other specimens.

### *Dianthidium concinnum* (Cresson)

#### New Record from Colorado

A female specimen bred from one of several cells that Cornell University obtained from Mr. G. H. Gilbert on October 11, 1895, is assignable to *D. concinnum*. I have compared it with Cresson's type. The nest material was obtained from the "underside of a stone in eastern Colorado, 10 miles south of Laramie, altitude about 4,200." This is, I believe, the first published record of the occurrence of *concinnum* in that state; all but one of the other records—and that doubtfully reported—have been from Texas. The following information regarding the specimen and the cells associated with it has been supplied through the kindness of Professor Bradley from data in the files of Cornell University. It is not indicated by whom the record was kept:

"14 Apr. '96. The cocoons have been kept in a tumbler in my desk all winter. I have kept them moist as possible. Opened one to-day and found a recently formed pupa.



"5th May '96. One cocoon found open and *bee*(?) was emerging. Pinned it. The pupa of 14th April not yet become adult; it may be dead.

"1st June '96. The bee emerged from cell in which pupa was found 14th April '96. Pinned the bee. Occupants of the cells rotted. Pinned the piece containing the cells as there are no more to emerge."

*Paranthidium texanum* (Cresson)

From Kansas

Two females of this species, taken at Blue Rapids, Kansas, and kindly loaned by Professor O. A. Stevens, constitute what I believe is a new record, the bee having been previously reported from localities in Texas.

*Heteranthidium occidentale* (Cresson) extends into Mexico

In the collection of the Paris Museum are two unidentified specimens—a male and female—from État de Puebla (environs de Tehuacan), Mexico, collected by L. Diguët, 1903, that belong to this species and extend its range into Mexico.

***Heteranthidium timberlakei*, new species.**

Male.—12 mm. Black with yellow maculations. The head somewhat wider than long, about the width of the mesonotum. The inner orbits of the eyes parallel. The clypeus mildly convex, about twice as long measured at the apex as it is wide and with a rather straight apical contour armed along the middle by about five subequal serrations or teeth, much as in *H. occidentale* and *H. zebratum* males. The supraclypeal area with large, shiny punctures in contrast to the smaller, denser, somewhat striate character of the punctation (partly concealed under heavy gray pile) in the region between the antennæ. The region between the lateral ocelli and the eye with somewhat smaller and slightly denser punctation than the region above the ocelli. The spaces between the punctures substriate and shiny.

The thorax above covered with small but exceedingly dense punctation, appearing granular and opaque in contrast with the tegulæ, which, while covered with a fine and even dense punctation, present nevertheless a shiny appearance. The punctation of the tegulæ presents a condition somewhat intermediate between the dense, rather opaque punctation on these parts in *H. occidentale* and even in *H. zebratum* on the one hand and the semi-punctate condition in *H. bequaerti* and *H. larrea* on the other. The pro-

podium with rather coarse, somewhat cancellate punctation along the base of the triangular enclosure (briefly interrupted at the middle) but with the apical region of the enclosure impunctate and with the punctation outside of the enclosure of somewhat the same character but sparser than that at the base.

The abdominal punctation dense and rather blurred on tergites 1 and 6. Tergites 2-5 with relatively sparser punctation from tergite to tergite. In each of these tergites, too, the punctation is notably sparse at the base—much sparser than in the apical region of the tergite preceding it. The punctures have a tendency to group themselves in irregular chains, those of a particular chain often being in direct contact with one another but separated in turn from another chain by sometimes one or more times the diameter of a puncture. The basal middle of the tergites relatively impunctate, that of tergites 4 and 5 polished and shiny. The narrow depressed area just beyond the maculated portions of each tergite roughened with cancellate punctation that gives way abruptly to a smooth, slightly reflexed apical rim. Segment 6, viewed in profile, has a rather straight, not convex contour. The pygidium is gently convergent to subtruncate along its apex except for a median tooth-like projection. A longitudinal carina, that proves to be rather concave when the segment is viewed in profile, traverses the tergite, ending in the above-mentioned tooth. The venter is deeply concave, almost pit-like, as the apex is approached—a structural peculiarity shared in varying degrees by several of the males of the genus *Heteranthidium* and even by some of the males of *Paranthidium*. The depression is most profound along the middle of the penultimate sternite, although a low carina-like to subtuberculate prominence near the apex of this sternite protrudes from the shiny depth. On each side of the middle of the sternite that precedes the penultimate is a comb-like fringe of stiff black recumbent hairs, as different in character as they are in color from the rather plumose grayish-white pubescence on the rest of the venter. In the type and one of the paratypes the hair inclines to golden on the vertex, thorax above, on the apex of the abdominal maculations, and strongly so on the under side of the basitarsi; the rest of the hairs are grayish-white to ochraceous. In the other two paratypes the pile is more uniformly grayish-white, except for the inside of the basitarsi.

The wings are subhyaline to light brownish, the upper half of the marginal cell traversed by a darkish streak. In the males and in one of the females the second recurrent vein, instead of conforming to the standard venation of *Heteranthidium* by being interstitial with the second transverse cubital, shows a condition somewhat intermediate between the venation of *Heteranthidium* and *Dianthidium*. In all other respects, however, these insects ally themselves with *Heteranthidium* and it is there, in my estimation, that they undoubtedly belong. A similar departure from the normal has been noted by Professor Cockerell in the venation of specimens of *Anthidium pecosense* from Flagstaff.

The yellow maculations in the male are as follows: Mandibles except black teeth and a fine line of black along the outer side (seen only when the insect is held with the full face showing), entire clypeus except apical margin (which is black in type, but brownish hyaline in paratypes), lateral face marks (which are broadly triangular to a little above the antennæ and then continue line-like along the inner margin of the eye to the level of the anterior ocellus), a narrow supraclypeal band (absent in one of the paratypes), stripes on the scape in front (only faintly indicated in one of the paratypes and absent in another), a stripe extending downward behind each of the eyes but usually with a very broad interruption at its middle. A small maculation near the middle of the outer rim of the tegulæ and in the case of two of the paratypes a spot of yellow on the rather blunt tubercles. Thorax otherwise usually devoid of maculations in the male but in one of the three paratypes before me there is a line on each side of the mesonotum above the tegulæ and a small spot on the axillæ. The hind coxæ broadly yellow beneath (not so in one of the paratypes), the hind trochanters with a spot near the apex. All of the femora striped beneath; conspicuous knee spots on the middle and hind legs. The front and middle tibiæ externally with large yellow areas at the base and apex that are connected by a thin stripe of yellow on the anterior margin of the joint and by another stripe running lengthwise down the middle of its external face, two elongate black marks in a field of yellow being the resulting condition on each of these tibiæ (in one of the paratypes the connecting stripes fail to extend the full length of the tibiæ). The hind tibiæ have a large oval black mark imbedded in the middle of a field of yellow, supplemented by a much smaller black mark at the apex. The rather straight third tibial spines that taper to a point and are finely pectinate along their inner margin, are reddish yellow and transparent. All of the basitarsi are externally wholly yellow except at the extreme apex. The abdominal bands very similar to those of *zebratum*, the bands on tergites 1-4 extending in a sweeping curve from one lateral extremity to the other and tapering toward the middle. The bands on these segments are progressively broader, that on tergite 1 being so attenuated that in the type and one of the paratypes a slight median interruption has resulted. In the type and paratype in question, too, this band has slight lateral emarginations above, recalling a condition more usual in *H. occidentale*. Tergites 4 and 5 are wholly yellow except for the black apical rims and a rather large black V-shaped area at the base, which in the case of tergite 4, at least, gives to the maculations a rather rounded outline above. Tergite 7 of the type, yellow except for two imbedded black spots, the median tooth, and a narrow apical rim of black (this is the condition also in one of the paratypes while the other two have the yellow reduced to absent). Sternites 2 and 3 of two of the paratypes with a yellow spot at each lateral extremity; in the type these sternites are immaculate.

Female.—Size 13 mm. The apex of the clypeus of somewhat more rounded outline than in the male, serrated rather evenly along most of its

length. The eyes virtually parallel. The abdominal punctation more uniform, rather finer and denser than in the male, with the median basal region less impunctate and less shiny; but this may be an individual rather than a sexual difference. The venter of the usual female type.

The pile grayish white to ochraceous, the yellow tinge being more or less prevalent and easily noticeable without the aid of the microscope on the ventral scopa. The last sternite, however, has shorter hairs of a deep gold to copper hue, much like the color of the hair on the basitarsi.

The maculations in some ways rather unexpectedly different from those of the male. The prolongation of the marks on the sides of the face are not merely line-like but relatively broad and slightly inbent along their inner contour. The yellow on the mandibles is more restricted. The supraclypeal band, usual in the male, has in the female shrunk to a median spot. The bands behind the eyes, usually interrupted in the male, are in the female continuous to the summit of the eye, but the entire vertex is in both sexes immaculate. In sharp contrast to the immaculate condition of the mesonotum, axillæ, and scutellum, usual in the male, the female has all of these parts maculated, the mesonotum bearing large L-shaped maculations at its antero-lateral angles and the axillæ and scutellum being conspicuously marked with a total of four large oval spots—of which the two on the axillæ are slightly smaller than the two on the scutellum. The mesopleura of the female with a large area of yellow in contrast to the immaculate pleura of the male. The tegulæ with a band rimming the outer anterior half; the tubercles with merely a spot of yellow. The hind coxæ are strongly maculated. There are well developed stripes on the front and middle femora beneath and a vestigial stripe near the apex of the hind femora; the middle and hind knees are maculated. The tibæ are externally yellow except for their apices and a more or less narrow black streak posteriorly on the front and middle pair and anteriorly on the hind pair. The basitarsi and tibial spines colored as in the male. Similar to those of the male are also the bands on the tergites, except that the band on tergite 1 is in the specimens before me neither emarginate laterally above nor interrupted and that tergite 6 is wholly yellow except for a black spot-like intrusion on each side at the apex.

From *zebratum* the male of *timberlakei* is most readily differentiated by the relatively straight as contrasted with convex contour of tergite 6 when viewed in profile, and by the more truncate character of the apex of the pygidium, that of *zebratum* being sharply angular, with the sides of the apex rather shoulder-like and prominent in contrast to the absence of such formations in *timberlakei*. If the absence of maculations on the scutellum be a constant character, this alone may serve to differentiate *timberlakei* males from those of *zebratum*. Only one of the four males

of *timberlakei* before me has even a vestige of maculation on the axillæ and none of them is maculated on the scutellum. In *zebratum* males the scutellum and usually also the axillæ are maculated. The absence of maculations on the mesonotum, observed in three out of four of the male specimens, is, on the other hand, an easy way of differentiating *timberlakei* males from those of *occidentale*. Structurally, the male of *timberlakei* can be separated at once from *occidentale* through the presence of the strongly protruding median tooth on the pygidium, the pygidium of *occidentale* being in contrast slightly bilobed to subtruncate at its apical middle. It is not likely that the male of *timberlakei* will be confused with any species other than *zebratum* or *occidentale* unless it be with the still undiscovered male of the insect presently to be described (*H. subtimberlakei*). Comparison of the genitalia of *timberlakei*, as figured in the accompanying cut, with those published by Miss Ruth Isensee (Annals of Carnegie Mus., Vol. XVII, Nos. 3-4, 1927) for *H. occidentale* and *H. zebratum* will bring out other points of difference.

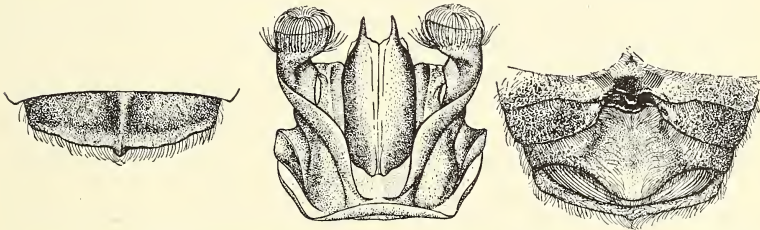


FIG. 1. Pygidium, genitalia, and view of apical ventral segments of *Heteranthidium timberlakei*, new species.

The female may be differentiated from the corresponding sex of *zebratum* and *occidentale* by the presence of the large maculation on the mesopleura, by the fuller maculation of the legs and by the contrast offered between the color of the pile on the last sternite and that of the sternites preceding, the coloration of the ventral scopa in *zebratum* and *occidentale* being uniform throughout.

The six specimens—four males and two females—on which the above descriptions are based were taken by Professor Timberlake

at Riverside, California, April 28–May 5, 1928. The two female specimens and one of the males were taken on *Chaenactis glabriuscula*, the remaining three males on *Encelia farinosa*.

The present species is named in honor of Professor P. H. Timberlake, to whom I am indebted not only for the opportunity of examining his fine collection of California Anthidiinae—many of them already identified by him—but also for suggestions and interpretations that invariably have been of great helpfulness.

**Heteranthidium subtimberlakei**, new species.

Very close in certain respects to *H. timberlakei* is what I am designating as *subtimberlakei*, based on a single female specimen taken in Nevada County, California. Superficially it is much like the females of *timberlakei* just described. The facial maculations are the same except that the supra-clypeal spot is wanting in *subtimberlakei*. The maculations behind the eyes are the same except that, instead of terminating at the summit of the eye, they are continued rather broadly in *subtimberlakei* to the outer ocelli. In both species there are the rich ornamentations on the mesopleuræ, the L-shaped bands bordering the mesonotum, the maculations on tubercles and tegulae. In *subtimberlakei*, however, there are no maculations on the scutellum, only on the axillæ—a condition shared, nevertheless, by one of the males of *timberlakei*. The maculations of the tibiae are of similar character to those of *timberlakei*, but the stripes on the under side of the femora are lacking and only on the hind basitarsi is there a stripe, the fore and middle basitarsi being immaculate. The abdominal bands are of the same type as those of *zebratum*, uninterrupted, extending from extremity to extremity of the tergite in a sweeping curve that is gradually attenuated toward the middle. As in *zebratum* and *timberlakei* the apical tergites of *subtimberlakei* have increasingly broad bands, but segment 6 of *subtimberlakei* departs from the female allotype and the single female paratype of *timberlakei* in having merely two spots instead of the almost completely yellow tergite 6 mentioned for *timberlakei*.

While these differences in the maculations of the two species are not very striking and may possibly be bridged by intermediates when series from other localities become available, they are supplemented by one or two important structural differences which are less easily reconciled. Especially to be noted in *subtimberlakei* is the unusual upward convergence, even though slight, of the eyes and the relative narrowness of the eyes as contrasted with the width of the cheeks.

I have compared the present specimen with females of *H. occidentale*, *H. zebratum*, *H. fontemvitæ*, *H. bequaerti*, *H. dorsale* (*harbecki*), *H. ridingsii*, *H. crassipes*, *H. larreae*, and *H. timberlakei*, selecting the types of these species where available. None of these have the eyes unmistakably con-

vergent above, as indicated for *subtimberlakei*. In *H. ridingsii* and *H. crassipes* of our Southeast the eyes are distinctly convergent below. In the other two species of the Southeastern United States, *H. dorsale* (*harbecki*) and *H. fontemvitæ*, there is a slight downward convergence. In *H. bequaerti*, *H. occidentale*, *H. zebratum*, and *H. timberlakei*—all Western—the inner margins of the eyes are virtually parallel to each other, while in another Western species *larrea*, they converge below.

*H. subtimberlakei* has a V-shaped, almost impunctate depression in the supraclypeal area, but as in *H. timberlakei* a slight depression in this area may also be noted, the difference is mainly one of degree. The punctation on the tegulae and on the abdomen is a shade finer in *subtimberlakei* than in the females of *timmerlakei*, with a closer approach to an immaculate condition in the basal region of tergites 3, 4 and 5.

The pile of *subtimberlakei* is yellowish white to light golden on the face, vertex, thorax above, venter and dorsum of abdomen, and legs; the hairs on the inner surface of tarsi and the short hairs on apical sternite (at least in some lights) are more deeply golden.

## PLATE XII

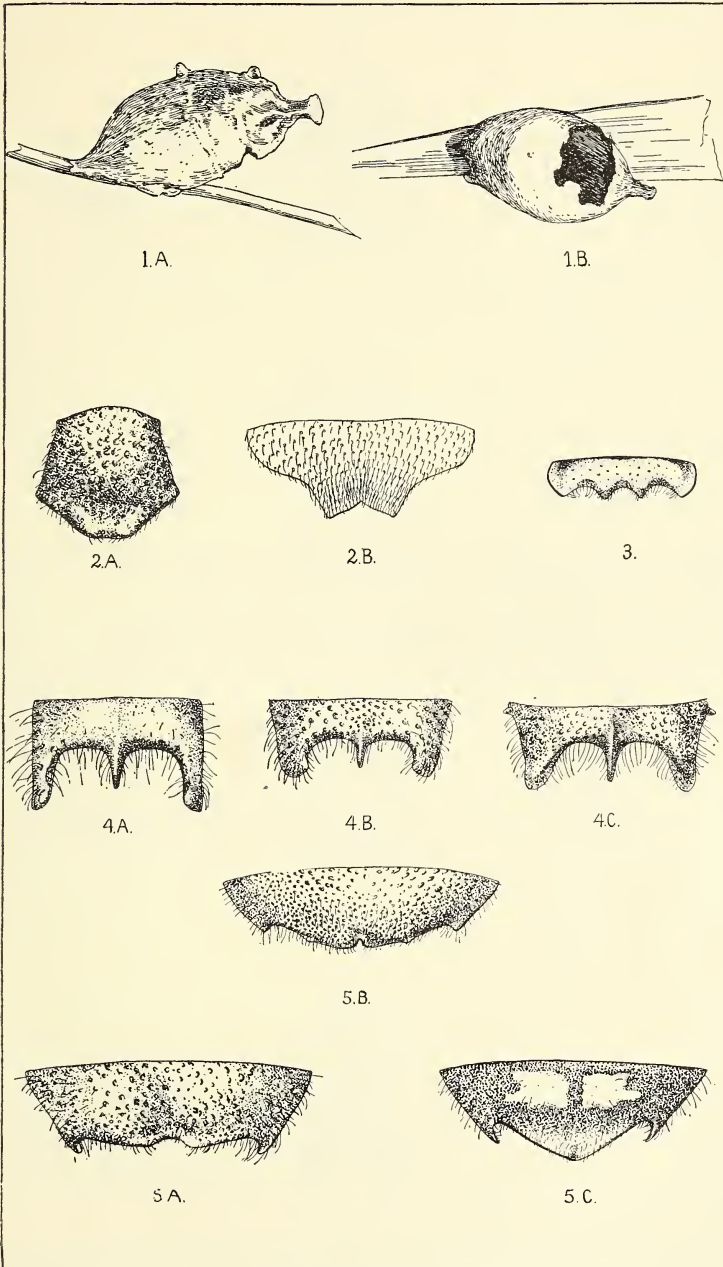
Cells of *A. notatum rufimaculatum*: 1A, cell of ♂; 1B, cell of ♀.

Clypeus (2A) and pygidium (2B) of *A. ehrhorni* ♀. 3. pygidium of *A. ehrhorni* ♂.

Pygidium of ♂ of *maculosum* (4A), *maculifrons* (4B), *banningense* (4C).

Pygidium of ♀ of *maculosum* (5A), *maculifrons* (5B), *banningense* (5C).





ANTHIDIINÆ

## PLATE XIII

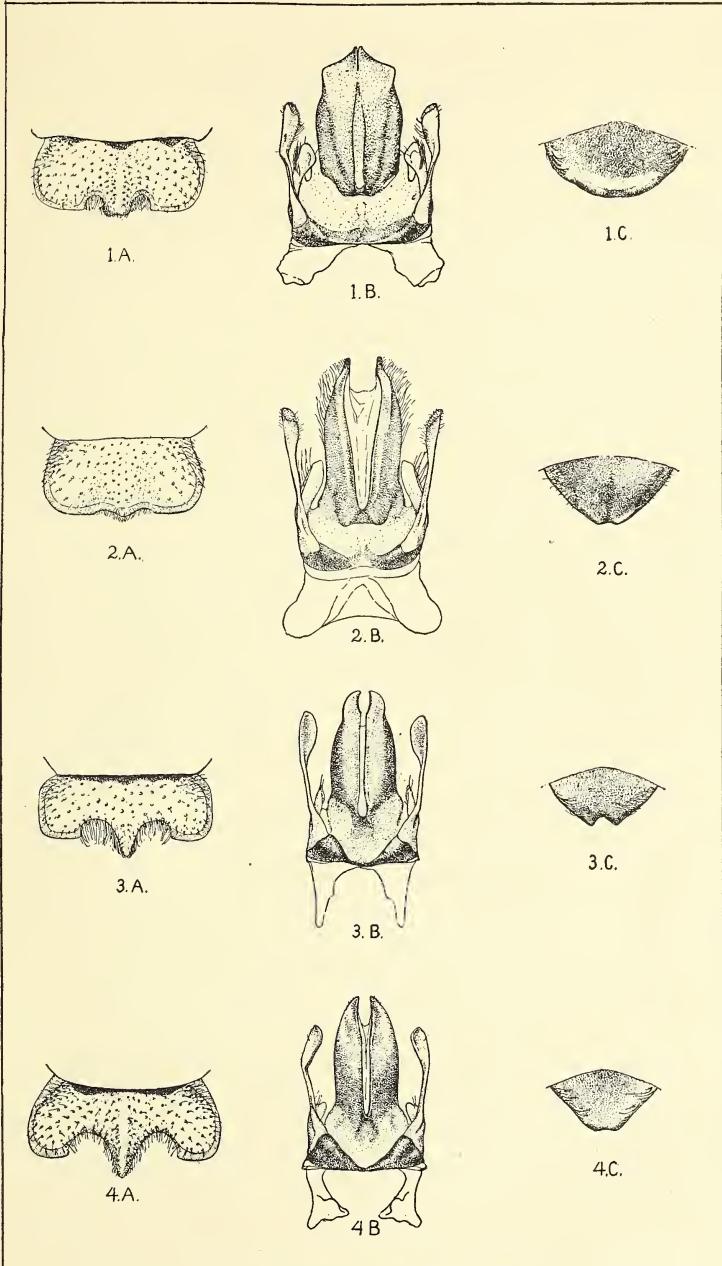
Pygidium (left), genitalia (middle) and apical sternite (right) of ♂ of:

*Dianthidium parvum* var. *swenki*, new variety (1 A.B.C.).

*Dianthidium ulkei* var. *riparii*, new variety (2 A.B.C.).

*Dianthidium pudicum* var. *consimile* (Ashmead) (3 A.B.C.).

*Dianthidium dubium*, new species (4 A.B.C.).



ANTHIDIINÆ



## NOTES ON SOME WOOD ENGRAVERS OF NORTH AMERICAN INSECTS

BY HARRY B. WEISS AND GRACE M. ZIEGLER

Upon turning over the pages of books on North American insects, particularly the early ones with their drawings, good, bad and indifferent, we have often wondered about the men who engraved the wood-blocks for the illustrations. Were they interested in natural history as such, with its attention to details, accuracy and the like, and did they appreciate the importance of markings and characters which entomologists usually want accentuated, or did they just engrave insects along with other subjects that happened to come their way? As anonymity appears to be their portion, especially in entomological circles, our chief aim has been to try to unearth some facts about these engravers who could either ruin or improve the work of the entomological artists. Our unearthing process has not been nearly so successful as we had hoped to make it, nevertheless the following notes, sketchy and thin as they are, represent an effort to do some justice to a group of craftsmen whose work deserves more attention in connection with the history of entomology than has been accorded it heretofore.

The art of wood-block illustration is an old one, dating from China in the ninth century or before, and in western Europe from the time paper was less expensive than parchment, although before that time wood-blocks were used for printing designs upon fabrics. Regardless of its interesting subsequent development and spread, the scope of these notes precludes anything on the history of wood engraving. Moreover, adequate writings on this subject are available.

In America the history of wood engraving begins with Dr. Alexander Anderson (1775-1870), a physician who abandoned medicine for engraving and who made his own tools and was the first to engrave on wood in this country. He engraved the illustrations in Webster's "Elementary Spelling-Book," the plates

for an edition of Shakespeare's plays, and numerous wood-blocks for the American Tract Society, Bewick's "Birds," business cards, primers, newspapers, chap books, bibles, diplomas, scientific papers, etc. At first he used both wood and metal, but after about 1820, his illustrations were cut almost entirely in wood. Some of his subjects included insects. For example, his "Diary," under the date March 27, 1795, contains the following entry:

"At 4 in the after-noon I call'd upon Dr. Mitchell, who wishes me to sketch a representation of the male and female canker-worm from some of the insects which he delivered to me."

Then, under April 1, we find the following: "I took the delineation of the Insects to Dr. Mitchell, who agreed to my proposal of offering it, with a paper of his on the subject, to Sword's for insertion in the Magazine. I accordingly deliver'd it to him."

On April 9, the record states, "After tea I went to Mr. Sword's and agreed to engrave a small plate of the Canker-worms for the Magazine." And on April 15, the entry records that Dr. Anderson began to engrave the canker-worm plate, and finished and delivered it on the same day. This, however, was a metal cut, but in view of the diversity of Anderson's subjects, it is not unlikely that he later engraved some insects on wood.

The first half of the nineteenth century in America was unproductive with respect to entomological articles illustrated by woodcuts, and it was not until after 1850, at which time Harper's New Monthly Magazine was established, that we find insects taking their place among the numerous illustrations which adorned the pages of an increasing number of magazines and newspapers. Thus in volume 13 of Harper's (pp. 618-627) we find an anonymous article on "Insects and Insect Life" with entomologically poor woodcuts of flies, butterflies, beetles, caterpillars, mole cricket, praying mantis and leaf insect, all unsigned. In volume 19 (pp. 178-189) are found ridiculous woodcuts illustrating "The Flea," and in the same volume (pp. 323-337, 1859) are grotesque illustrations of the katydid, cicada and grasshopper ("Musicians of our Woods"). And it would be possible to enumerate further many early papers on insects in which the woodcuts vary from fair to mostly terrible, although perhaps the

artists deserve their share of the blame. Nearly all of these early woodcuts of insects are unsigned. The illustrations are not remarkable for their accuracy either with respect to proportion or markings, and apparently neither artist nor engraver was interested in entomology or in presenting truthful delineations. In "The Burrowers at Home" (Harper's, vol. 32, pp. 421-439, 1866), "Some Curious Homes" (Harper's, vol. 33, pp. 161-169), and "More Curious Homes" (Harper's, vol. 33, pp. 273-285), some of the wood engravings are signed by Pearson. In "Living Lamps," by Charles F. Holder (Harper's, vol. 66, pp. 181-192) which deals with phosphorescent animals, including fire flies, lantern flies, etc., only one of the insect woodcuts is signed—that of lantern flies, by Schultz.

By 1870, the two publishing houses of Harper and Brothers and Frank Leslie employed approximately one hundred of the four hundred or so engravers in the country. In 1869, Harper and Brothers employed steadily thirty-five engravers, and the house of Frank Leslie an average of sixty. With the commercialization of wood engraving as such publishing activity demanded, it is small wonder that both artists and engravers did not have the time or inclination to be painstakingly exact with their insect work.

However, while Harper's was turning out poor insect engravings, Henry Marsh in the early sixties was working on the 278 blocks which in 1862 furnished most of the illustrations for the third or "Flint" edition of Dr. Thaddeus W. Harris's "Insects Injurious to Vegetation." These excellent delineations are more highly appreciated in engraving circles than they are in entomological ones, although Walton has said that they "are among the very best that ever have been produced in American works on entomology," the figures of the Bombycine moths "never having been equalled in any subsequent work." The drawings for Harris's work were made by Antoine Sonrel and John Burekhardt under the supervision of Prof. Louis Agassiz.

Mr. W. J. Linton ("The History of Wood Engraving in America," London, 1882), discussing the influence of English engravers upon the art in America, spoke disapprovingly of delicacy of line, minuteness, etc., when such characteristics were

without meaning, and deplored the tendency to imitate steel engravings. Marsh's insects, however, are not included within such disapproval. Of these Linton said, "Here the fineness is not a weak endeavor to hide bad work, nor from ignorance of what was meant. The insects, drawn from nature by Sonrel and Burckhardt, needed most absolutely exact rendering, to the representation not only of form and color, but of difficult textures also; and the engraver, Henry Marsh, was therefore fully justified in his microscopic treatment. No such book had been done before, nor will it ever be surpassed (though some similar cuts—moths, etc.—engraved by Mallory, in 1869, for the *St. Louis Entomological Journal*, are nearly if not quite as good). It is work not only of patience and remarkable eyesight, but also of true artistic skill showing, too, in the comparison of the steel plates with the woodcuts, that there are powers of expression in wood which cannot be equalled by the rival process. . . . Surely, when I exclaim against fine work, it is not such fine work as this."

Woodberry, in his "History of Wood Engraving" (New York, 1883), praises Marsh's insects also, saying, however, that the cuts in the published volume were not printed with the success they deserved and that Marsh's "marvellous rendering of insect life . . . can never be forgotten by any who have been fortunate enough to see the artist-proofs."

Both Linton and Woodberry, especially the former, said that Marsh was encumbered by his entomology to the extent that his later work, except his engravings after LaFarge, which required minuteness of treatment in order to carry out the fanciful spirit of the drawings, suffered from "over-refinement" and a "beetle or butterfly texture."

However, regardless of the "minuteness" of his later work, his beetles are hard and rigid, his butterflies are clean and dainty, and his moths have that soft, downy appearance so natural to them. From an entomological standpoint, the defects, if any, from which his later work suffered, were not too great a price to pay.



In Scribner's for July, 1879, some of Marsh's blocks from Harris were used to illustrate an article entitled "Summer Entomology," by Edward A. Samuels.

Biographical details concerning Henry Marsh seem to be unrecorded. Mr. Sidney L. Smith, of Boston, with whom Marsh roomed for many years, first met him about 1865. Mr. Smith states that he was of a retiring disposition, and not being able to sleep, spent his nights reading, that he had a very able mind, was twice married, and during his last days became quite hermit-like in New York, where he could be seen only by appointment. Mrs. A. W. Drake informs us that she knew Marsh slightly during the later years of his engraving for *The Century Magazine*, and recalls him as a shy and solitary figure with a "personality as refined and delicate as some of his exquisite work."

Mr. Timothy Cole remembers hearing much about Marsh back in the late sixties and early seventies and occasionally seeing his work at that time. According to Mr. Cole, Marsh lived in Boston and worked principally for Boston publishing houses. Bond and Chandler, engravers of Chicago, but formerly of Boston, told Mr. Cole that Marsh worked in a quite disorderly room, where the ash from his stove piled up on the floor. Mr. Marsh made lots of money, and bought a beautiful house in Boston, the interior of which LaFarge decorated at a cost of \$10,000, a respectable sum in the seventies. According to the *New York Times* of January 20, 1913, he died November 12, 1912.

Marsh engraved after LaFarge, Homer Martin, Nast, Brennan, Riordan, etc., and some of his engravings, such as "Robinson Crusoe" (after Nast, *Riverside Magazine*, vol. II, New York, 1868), and "The Wolf Charmer" (after LaFarge, *Riverside Magazine*, vol. I, 1867) are frequently favorably mentioned.

Another wood engraver whose work almost equalled that of Marsh, but who apparently engraved fewer insects than Marsh, was Francis S. King. In *Harper's New Monthly Magazine*, vol. LIX, p. 385, 1879, the illustration entitled "Butterflies" in W. Hamilton Gibson's article "Snug Hamlet and Home Town" was engraved by King. Linton wrote of this as good, but not equal to Marsh's work, and was of the opinion that sufficient contrast between the butterfly texture and the flower texture was

lacking. However, King's other work is highly praised, and Linton does not criticise his fineness. Woodberry, however, places King's butterflies on a par with those of Marsh. An entomologist will have no difficulty in recognizing them as *Papilio glaucus turnus* and *Anosia plexippus*, exquisitely done, against a faint background of goldenrod and other flowers.

King was born in Maine in 1850, and his first drawings were natural history ones copied from an "Illustrated Natural History" of the period. In 1870 he came to New York, where he studied wood engraving, working for J. W. Orr and later establishing his own office. He engraved after Church ("The Fog," "The Battle of the Sirens," "The Sorceress"), William Hamilton Gibson and others, and seemed to have a fondness for landscapes, birds and fishes. Some of his work appeared in *St. Nicholas*, *Harper's Weekly*, and *Hearth and Home*, and all of it is characterized by "precision of line." He died in Newark, New Jersey, July 19, 1913.

In the same article (Snug Hamlet and Home Town), there is a woodcut showing two caterpillars on a twig, called "Professor Wiggler." These were done by Filmer, whose landscapes are so frequent in "Picturesque America."

William Baxter Closson, painter and engraver, occasionally engraved insects also. In his artistically done "Night Moths" (*Printing Art*, vol. 31, 1918, pp. 118-122) he did not delineate the insects so that they are recognizable. This, however, is not a criticism, for to have done so would have spoiled the effect.

Concerning the St. Louis "Entomological Journal" referred to by Linton as containing woodcuts of insects by Mallory, nearly as good as those of Marsh, it was impossible for us to locate a publication bearing that title, and we are of the opinion that Linton meant "The American Entomologist, edited by Walsh and Riley and published in St. Louis from September, 1868, to August, 1869. Commencing with volume II, the title was changed to "The American Entomologist and Botanist," and the editors to Riley and Vasey (Sept.-Oct., 1869, to Dec., 1870). Ten years later volume III appeared under the title of "The American Entomologist," 2nd Series, edited by Riley (Jan. 1880 to Dec. 1880, New York). In the first two volumes, and the

third, too, it is rare to find a signed wood engraving. For the most part they are good, and Linton's "Mallory" may have done them. Riley's first annual "Report on Noxious, Beneficial and Other Insects of the State of Missouri" (1869) and later ones also, contain good insect work, but with few exceptions the cuts are unsigned. On page sixty-three of Riley's first Missouri report, a well-known cut of the codling moth is signed by W. Mackwitz.

Woodcuts were borrowed then, as zinc etchings and other cuts are borrowed now, and one finds the same cuts appearing in several contemporary journals and reports.

Townsend Glover's reports contain numerous woodcuts of insects, some of which, however, are quite small and insufficient. None of them are signed. Many of the excellent woodcuts of economic insects which appeared in the early reports of the United States Department of Agriculture were drawn and engraved by Otto Heidemann, who came to this country from Germany in 1873 and established an engraving office in Baltimore. He moved to Washington in 1876, and from then on supplied numerous illustrations for government publications. In 1883 he was appointed engraver in the United States Department of Agriculture, and practiced his art until photo-engraving submerged it. In 1898 he became an assistant in the Bureau of Entomology and an authority on Hemiptera. He died in Washington, D. C., November 17, 1916.

One cannot help marvelling at the versatility of some of the older entomologists, who were at once artists, engravers and entomologists, a versatility which may have been in part the outgrowth of conditions during their times, but which nevertheless existed. One does not ordinarily think, for example, of Dr. George H. Horn as an engraver, yet this outstanding coleopterist at one time engraved his own plates, although not on wood. In the "Transactions of the American Entomological Society," vol. V, plate 1, figuring outlines of abdominal segments, antennæ, tips of elytra, etc., was drawn and engraved by Dr. Horn. It is not artistic in any sense, as Dr. Horn recognized and so stated, but it is useful in helping the student to distinguish sexual differences of the species.

A. S. Packard's "Guide to the Study of Insects" (sixth edition, New York, 1878) contains over six hundred, for the most part, excellent woodcuts, some engraved expressly for the book and many borrowed from Harris's "Insects Injurious to Vegetation" and from the American Entomological Society, Boston Society of Natural History, American Naturalist, etc. As usual, signatures are missing, the only exception being Fig. 521a of the grape *phylloxera*, which is signed Wittenberg and Sorber Sc. St. Louis. Many of the illustrations in Packard's "Guide" were later used in his "Our Common Insects" (Boston, 1873). In his "Half Hours with Insects," (Boston, 1877) there are 261 wood engravings, one of which, a full page tropical scene of a termite nest entitled "Insects as Architects," is signed by Laplante. Packard's "The Injurious Insects of the West, A Report on the Rocky Mountain Locust," etc. (Salem, 1877), contains sixty-seven woodcuts. In the "Fifth Report of the U. S. Entomological Commission" (Washington, 1890), by the same author, only two of the cuts are signed, one, of the imported elm leaf beetle, by Heidemann, and one, of the "great elm leaf beetle," by H. H. Nichols. In Comstock's "Report of the Entomologist of the United States Department of Agriculture for the year 1879," and in Riley's part of the "Annual Report of the United States Department of Agriculture for the year 1878," five or six of the illustrations on the plates are signed by Nichols as engraver. Nichols's name also appears on Marx's figures of the larvæ and adults of the grapevine beetle, on page 353 of Lintner's "Seventh Report on the Injurious and Other Insects of the State of New York" (Albany, 1891).

The illustrations in Samuel H. Scudder's "Brief Guide to the Common Butterflies of the Northern United States and Canada" (New York, 1899) were in part borrowed from Harris, Riley and Packard. Of ninety-seven figures, thirty-six were originally engraved by Marsh. In Scudder's "Butterflies of the Eastern United States and Canada" (Cambridge, 1899, 3 vols.), of the butterflies in black, two plates of Nymphalidæ, and one plate of Lycaenidæ, Papilionidæ and Hesperidæ were printed from electrotypes made from the original woodcuts engraved by Marsh for the third edition of Harris's work. One plate of Nymphalidæ

and Lycaenidæ and one plate of Papilionidæ and Hesperidæ were electrotyped and printed, from woodcuts engraved by John Andrew and Son. These are very good. John Andrew, according to Fielding, was a wood engraver who worked in New York and Boston for the publishers during the latter half of the nineteenth century.

In "Butterflies, Their Structure, Changes and Life Histories" by Samuel H. Scudder (New York, 1881), some of the illustrations are electrotypes from the original woodcuts made by Marsh for Harris's work. In addition a half dozen woodcuts by Messrs. Andrews were photographically reproduced. "Insects at Home" by J. G. Wood (New York, 1872), which deals with British insects, contains seven hundred woodcut figures by G. Pearson. William Saunders' "Insects Injurious to Fruits" (Philadelphia, 1883), was illustrated with electrotypes mostly made from woodcuts used previously in the works of Glover, Harris, Riley, Packard, Walsh, and in reports of the United States Commissioner of Agriculture. Some, however, were drawn and engraved expressly for the book by H. H. Nichols, of Washington; Worthington G. Smith, of London, England; H. Faber & Son and Crosscup and West, of Philadelphia, and P. J. Edmunds, of London, Ontario. The illustrations are excellent throughout.

In "A Manual for the Study of Insects" (Ithaca), by John Henry Comstock and Anna Botsford Comstock, may be found the admirable wood engravings of Anna Botsford Comstock. The preface states that "Nearly all of the wood-cuts have been engraved from nature by the Junior Author. As the skill which she has attained in this art has been acquired during the progress of the work on this book, some of the earlier-made illustrations do not fairly represent her present standing as an engraver. But it does not seem worth while to delay the appearance of the book in order to re-engage these figures; especially as it is believed that they will not be found lacking in scientific accuracy. The generous appreciation which the best engravers have shown towards the greater part of the work leads us to hope that it will be welcomed as an important addition to entomological illustrations."

Subsequent books on insects by these authors contain additional wood engravings by Mrs. Comstock, who, according to Mr.

Frank Weitenkamp, studied at the engraving school for women at Cooper Institute, New York City, which was established in 1859 and continued until 1890 or 1891. Mrs. Comstock's entomological activities are so well known that it would be superfluous to repeat them here, and besides a brief biographical sketch may be found in the recently issued fourth edition of "American Men of Science."

In passing, mention may be made of the scientifically inaccurate woodcuts of various insects, such as the ant-lion, dragonflies, beetles, etc., illustrating Schele de Vere's "Low Life in Nature," published in Scribner's Monthly in 1871 (Nov., vol. III, No. 1, pp. 54-61). Other poor insect work appeared in the issues for December, 1877, and August, 1879.

The use of wood engravings for illustrative purposes in entomological publications has passed, in fact, it passed some years ago, and considering present-day photo-mechanical methods, it is not likely ever to be revived. And entomologists no longer need to be so versatile, at least not in the same directions as their predecessors.

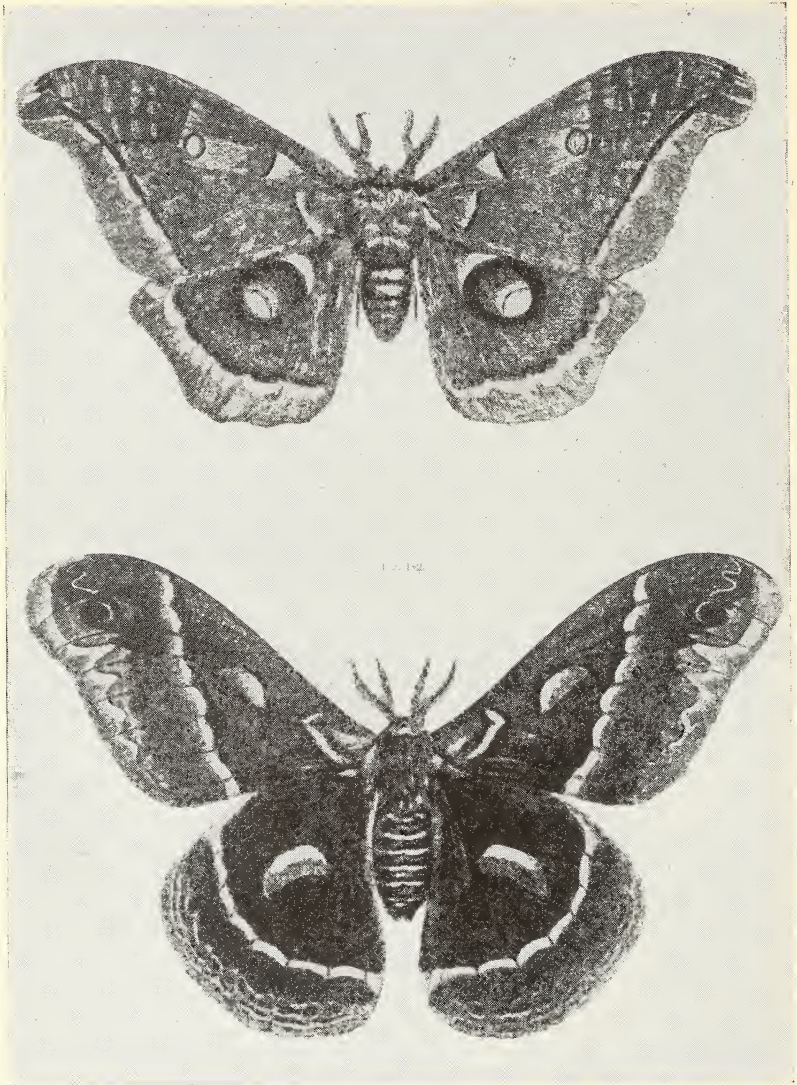
#### *Acknowledgments*

It is a pleasure to acknowledge our indebtedness to Mr. Frank Weitenkamp, Curator of Prints, New York Public Library, for his many helpful suggestions, to Mrs. A. W. Drake, Mr. Sidney L. Smith and Mr. Timothy Cole for their kindness in supplying information relative to Henry Marsh and to Mr. Alexander S. Graham, of the Rutgers University Library, for his help so freely given on this and many other occasions.

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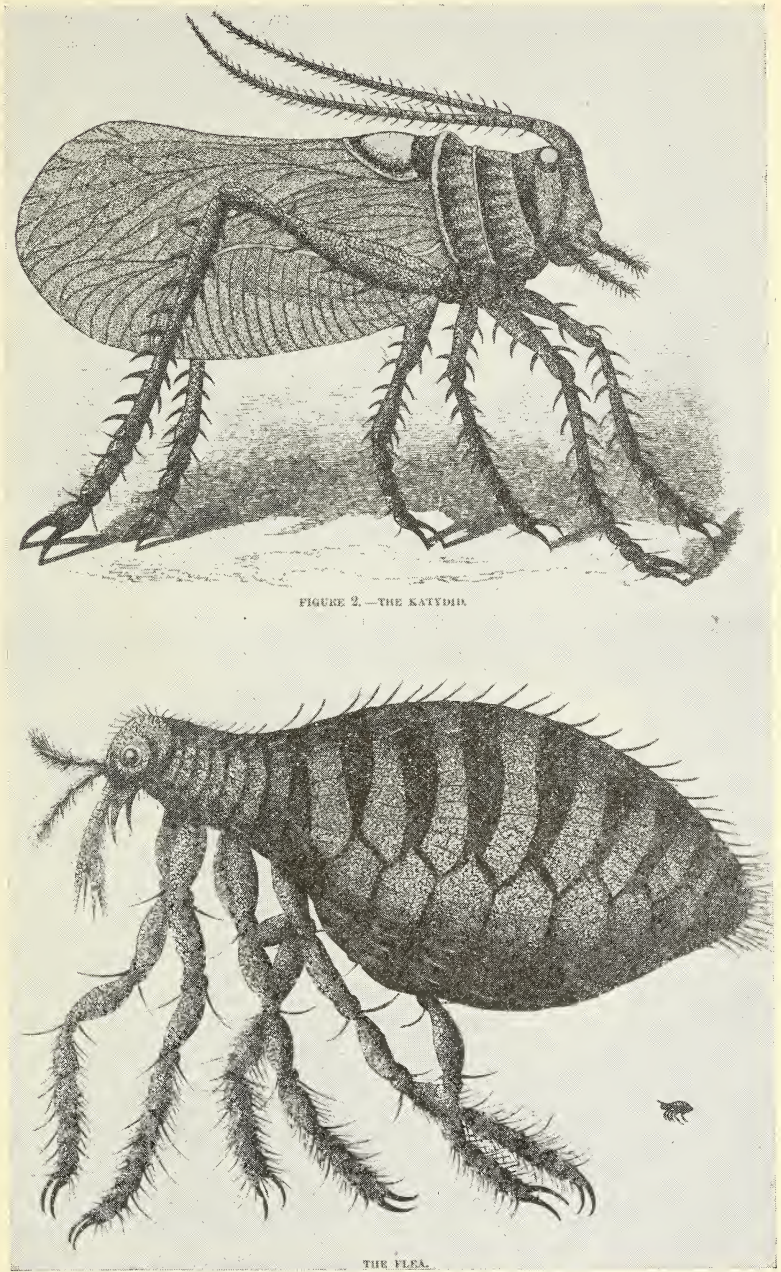
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Reproductions of woodcuts by Henry Marsh, from Harris's "Insects Injurious to Vegetation," 3rd ed., 1862. (Reduced.)





Reproductions of unsigned woodcuts of the Katydid and the Flea, from Harper's New Monthly Magazine, July and August, 1859. (Reduced.)



## SOME HIBERNATION QUARTERS OF THE ORIENTAL FRUIT MOTH<sup>1</sup>

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In the fall of 1927 the writer collected a large number of peach mummies and pits from the college farm orchards for the purpose of studying the overwintering habits of the Oriental fruit moth and some of its parasites. Various bits of orchard débris were collected along with the pits and mummies. Shortly after the overwintering moths had emerged, in the early summer of 1928, the writer gathered all pits, mummies and other objects from which moths had emerged and made a record of the number of overwintering Oriental fruit moth larvæ found on them.

A review of the literature on the subject shows that there is little information on the types of orchard débris chosen by the Oriental fruit moth larvæ for overwintering quarters. It has been assumed, and no doubt correctly, that the majority of the overwintering larvæ go over the winter in and on the mummies on the ground. That any woody material, such as dead weeds, bits of twigs and roots of orchard trees, bits of wood, old asparagus roots, etc., may be used by the larvæ for overwintering quarters, is shown in this paper.

The data presented in Table 1 show the different kinds of material on which larvæ overwintered successfully. About seventy per cent. of all the pupal skins found were located on mature and immature peach mummies. Fifteen overwintering larvæ were found on the mummy pictured on Plate XVI, figure 1. The immature mummies, which apparently were from thinned peaches, were especially favored as overwintering situations. This was also true of old asparagus roots; every mass of these roots examined contained one or more empty pupal skins.

<sup>1</sup> Paper No. — of the Journal Series, New Jersey Agricultural Experiment Station, Department of Entomology.

TABLE 1. NUMBER OF ORIENTAL FRUIT MOTH LARVÆ FOUND OVERWINTERING ON DIFFERENT KINDS OF ORCHARD DEBRIS.

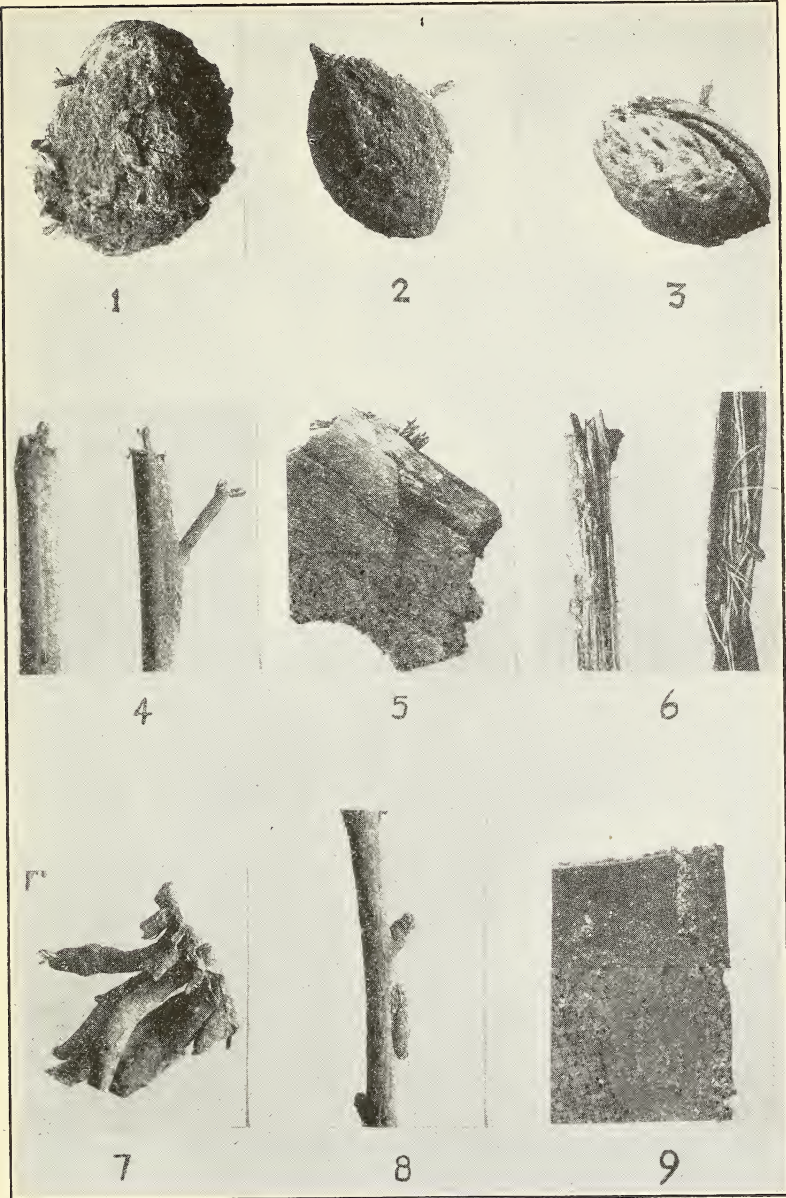
No.	Description of Object	No. of Larvæ	No.	Description of Object	No. of Larvæ
1	Mature mummy .....	98	8	Side of dead twig.....	3
2	Immature mummy .....	101	9	Rubber hose .....	6
3	Clean peach pit .....	18	10	Fragment of wood.....	4
4	End of dead twig.....	10	11	Match box .....	3
5	Bits of rotting wood.....	15	12	Peach tree root.....	2
6	Stalk (of corn?).....	10	13	Curled leaf .....	1
7	Asparagus roots .....	16	14	Peach limb .....	7

Some of the situations in and on which larvæ were cocooned, and from which empty pupal cases may be seen protruding, are shown in Plate XVI, figures 1 to 9, inclusive. Numbers 1 to 9 in Table 1 correspond, respectively, to figures 1 to 9 on Plate XVI. The individual photographs on Plate XVI were made by Mr. R. L. Coffin, of the Japanese Beetle Laboratory.

The data presented here indicate that the larvæ of the Oriental fruit moth will overwinter in any kind of waste material found in and around orchards. Although the majority of the larvæ found were in peach mummies, proportionally, there were no more larvæ in mummies than in some of the other situations noted. Therefore, control of this insect by the destruction of the overwintering larvæ on the ground should include the burning or plowing under in the spring of all mummies, pruned twigs, weeds and other orchard débris.

## PLATE XVI

- FIGURE 1. Mature mummy.
- FIGURE 2. Immature mummy.
- FIGURE 3. Clean peach pit.
- FIGURE 4. End of dead twigs.
- FIGURE 5. Bits of rotten wood.
- FIGURE 6. Stalk (of corn?).
- FIGURE 7. Old asparagus roots.
- FIGURE 8. Side of dead twig.
- FIGURE 9. Section of rubber hose.



ORIENTAL FRUIT MOTH



## CICADAS BELONGING TO THE GENUS DICEROPROCTA WITH DESCRIPTIONS OF NEW SPECIES

BY WM. T. DAVIS  
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When W. L. Distant published his catalogue of the cicadas in 1906, and again in his account of the family Cicadidæ in "Genera Insectorum" in 1912, he listed many of the North American species having the song apparatus completely covered when viewed from above, under the two genera *Cicada* Linnæus, 1758, and *Rihana* Distant, 1904. His type for *Rihana* was *ochracea* Walker of Asia, a species with the front of the head prominent and with long opercula (see "Monograph of Oriental Cicadidæ," p. 96 and Plate XII). His type for *Cicada* was *plebeja* Scopoli of Europe, but as pointed out by Mr. Edward P. Van Duzee in the "Bulletin of the Buffalo Society of Natural Sciences," June, 1912, and in the "Canadian Entomologist" for November, 1914, the genus as restricted by Distant does not include any of the original Linnean species.

*Rihana ochracea* Walker, of China and Formosa, can stand as the type of the genus *Rihana*, but as far as our North American species are concerned, Mr. Van Duzee very properly sought some other name and selected *Tibicen* Latreille, with *plebeja* Scopoli as type. In his "Catalogue of the Hemiptera of America North of Mexico, he placed all of our species under this generic name, as the characters given by Distant for separating *Rihana* from *Cicada* based on the relative length and width of the head, etc., could not be followed. The species *robusta*, *montezuma*, *hilaris* and *dorsata*, for instance, listed on page 40 of Mr. Distant's catalogue, should have been placed in his genus *Rihana* to be near their relatives; *dorsata* with a narrow head should not be far separated from *Tibicen marginalis* in which the head is broader.

Mr. Van Duzee in his catalogue page 489 gives *Diceroprocta* Stål as a subgenus. This was described in "Ofversigt of Kongl. Vetenskaps-Akademiens Forhandlingar," xxvii, p. 714, 1870.

The characters are last dorsal segment of males sinuate behind and produced on both sides into an acute lobe; sixth ventral segment of females sinuangular at middle of apex and on each side very obtusely rounded sinuate. Mexican species, for instance, *C. alacris* Stål.

Distant states in "Biologia Centrali Americana," p. 9, that he had examined Stål's type of *alacris* (1864) and found it to be a synonym of *transversa* Walker (1858) from Mexico. In addition to the characters given above, this insect has the uncus wish-bone shaped instead of simple as in *Tibicen plebeja*, and the first cross vein of the fore wing does not, as a rule, start as far back or near to the base of the wing from radius 3 as it does in *Tibicen*. The tympana are completely covered as in *Tibicen*.

Mr. Distant in the opinion of the writer was correct when he tried to separate many of our North American Cicadas lately placed as a whole under *Tibicen* into two genera, only it could not be done on the characters given by him; relative width of the head, etc.

In addition to *transversa* of Mexico the type of *Diceroprocta*, the following table includes all of the species belonging to the genus so far described from the United States, also *digueti* from Lower California, *bonhotei* from the Bahamas and the new species closely allied to *viripennis* from Vera Cruz, Mexico. A number of other species of *Diceroprocta* are to be found in Mexico and Central America, but these are left for future consideration when more material is available.

On a subsequent page it is noted that Uhler long ago was inclined to use the generic name *Diceroprocta*, and labeled a specimen in his collection "*Cicada* (*Diceroprocta*) *viridifascia* Walker."

In the species of *Diceroprocta* known to the writer the song is continuous like that of some of the species of *Neoconocephalus* among the long-horned grasshoppers for which it may be mistaken, whereas in the *Tibicen* of the eastern United States, and no doubt in the western species as well, the song is of much shorter duration, lasting usually not over a minute.



Diceroprocta Stål.

- A. Opercula triangular; about one half the length of the abdomen.
- B. Fore wings entirely clear, or the first and second cross veins very slightly clouded.
- C. Inland species, expanding about 85 mm. or less. For figures see this Journal, March, 1921, and March, 1925.

Opecula with the outer edges nearly parallel to each other; 8th segment and middle base of tergum pruinose. Collar and costal margin of fore wing usually bright orange in color.

Texas, New Mexico.....**cinctifera** Uhler  
 Opercula with outer edges converging; without central pruinose spot at the base of the tergum.

Hind margin of pronotum or collar yellowish, or straw-colored; eyes reddish and membranes at base of both pair of wings pale; often straw-colored. Pubescence at base of abdomen golden.

Arizona, California, Utah.....**apache** Davis  
 Hind margin of pronotum or collar with anterior portion blackish and posterior portion pale. Eighth segment pruinose, and pubescence at base of abdomen, silvery. Eyes darker than in **apache** (not reddish in dried specimens), and membranes at base of all wings darker gray. Usually smaller than **apache** and with opercula more extended at tips.

Arizona, Mexico.....**semicineta** Davis

- CC. Coast species; expands more than 85 mm. Tergum of male pruinose centrally at base, and at the sides in both sexes.

Lower California, Mexico.....**digueti** Distant

- BB. Fore wings with the first and second, and in some species the remaining cross veins as well, clouded.

Coast species.

Opercula reaching the second abdominal segment and rounded at the tips. Dorsal spine at tip of abdomen in female straight, not bent upward. Expands 100 mm. or less.

Florida and Cuba.....**biconica** Walker  
 Dorsal spine at tip of abdomen in female with an upward bend otherwise closely resembling **biconica**. (See figure.)

Bahama Islands.....**bonhottei** Distant  
 Opercula reaching the fourth abdominal segment and more pointed at the tips. Expands 80 mm. (See figure.)

Mexico.....**transversa** Walker  
 Opercula reaching the fifth segment. Head narrower than in **transversa** and fore wings with the first four of the cross veins clouded. (See figure.)

Texas.....**marevagans** Davis

## Inland species.

All of the cross veins clouded and sometimes the outer marginal areas as well. Expands 63 mm. (See figure.)

Arizona .....(*castanea* Davis) *swalei* Distant

## AA. Opercula short; rounded at the extremities.

B. Fore wings with the first and second cross veins clouded. Basal cell in all of the species clear or nearly so.

Chestnut brown with a prominent front. Tympanal coverings not bulging from sides of the abdomen. Expands 70 mm.

Arizona and Lower California Mexico.....*knightsi* Davis

Resembles the last but is smaller; front not as prominent and has bulging tympanal coverings at sides of abdomen. Expands 52 mm.

Arizona .....*arizona* Davis  
Small, with prominent eyes and rounded front; collar green or yellowish green; all of the veins about the marginal cells clouded in some specimens. Expands 57 mm.

Louisiana, Texas, Mexico.....*delicata* Osborn

An inconspicuous dull colored species and the only small cicada of the genus having the 1st and 2nd cross veins clouded to be found in the south eastern U. S. Expands 65 mm.

Georgia, Florida, Alabama, Mississippi.

(*sordidata* Uhler) *olympusa* Walker

Resembles *olympusa* but is more robust and has a larger head. Can be most readily separated by the absence of the notch on the inner side of the uncus when viewed in profile. A few individuals collected in September have the 1st and 2nd cross veins in fore wings unclouded. Expands 65 mm.

Texas, New Mex., Mexico.....*texana* Davis

BB. Fore wings clear, the first and second cross veins unclouded. (An occasional *texana* may be included.)

C. Opercula short and broadly rounded at the extremity. Yellowish with blackish markings; costal margin of fore wings yellowish to end of radial cell; collar yellowish. Front of head more prominent than in *vitripennis*. Expands 60-70 mm.

Texas, Oklahoma, Arizona, New Mex., Kansas.

*eugraphica* Davis

Wings proportionately narrower than in *eugraphica*; markings greenish in color, collar greenish. Transverse black stripe on head usually reaching from eye to eye. Mesonotal × greenish, not spotted; basal cell of fore wings clear. Expands 70 mm.

Michigan southward; general region of the Mississippi.

*vitripennis* Say

Head much larger than in *vitripennis* and colors usually more

contrasting. Transverse black stripe on head between the eyes not reaching the eyes. Expands 70 mm.

Texas, Louisiana.....*vitripennis* var. *bequaerti* Davis  
Resembles *vitripennis* but the claws of the uncus are short. (See figure.) Mesonotal  $\times$  green; basal area of abdomen between the tympana silvery with a bright white spot each side. Expands 70 mm. (See figure.)

Vera Cruz, Mexico.....*albomaculata* Davis  
Blackish brown in color with the front of the head and eyes very prominent; costal margin of fore wings very dark in color; orange at the extreme base of both pair of wings and basal cell more clear and collar more brown than in *viridifascia*. Expands 75 mm. (See figure.)

Texas .....*bibbyi* Davis  
Chocolate colored with the hind margin of the collar and fore margin of the wings to end of radial cell orange; oblong spot in upper part of basal cell; mesonotal  $\times$  spotted at top tergum blackish. Expands 70 mm.

Along the coast from Virginia to Gulf of Mexico.

(*reperta* Uhler) *viridifascia* Walker

CC. Opercula longer and more lobate.

A pale and greenish colored species; head and pronotum almost entirely green; a broken band of black spots between the eyes; opercula green; under side of abdomen straw colored. Expands about 60 mm.

Oklahoma, Texas, Mexico..(*pallida* Distant) *azteca* Kirkaldy

### 1. *Diceroprocta cinctifera* Uhler.

This species is figured and considered at some length in this JOURNAL for March, 1921, pages 2 and 3. The specimens there mentioned came from New Mexico and southwestern Texas; the northern California record being doubtful. It is again referred to in this JOURNAL for March, 1925, and a table given for the separation of it, *apache* and *semicineta*. On Plate 4, figure 25, Genera Insectorum, 1912, there is a figure of a cicada said to be *cinctifera*, but the fore wing is much too broad in proportion to its length, as will be noted by comparing it with the figures published in this JOURNAL for 1921.

A considerable number of specimens have been examined from Las Cruces and Mesilla both in Dona Ana Co., New Mexico, and from the following counties in Texas: El Paso, Presidio, Pecos, Brewster and Val Verde. The dates of collection have been from May to August, both included.

## 2. *Diceroprocta apache* Davis.

Described and figured in this JOURNAL for March, 1921, pp. 3-5, from Arizona specimens. It is there recorded that some of the specimens from the arid regions of California and Utah "range all the way from a light brown with darker marks, particularly on the head and mesonotum, to very pale almost unicolorous individuals." Reference is also made to figure 13, Plate 28, in Howard's Insect Book, where a female is figured under the name of *Cicada vitripennis*. This individual has since been examined in the United States National Museum collection and it bears a label, San Diego Co., California.

This species has been collected in June, July and August.

## 3. *Diceroprocta semicincta* Davis.

Described and figured in this JOURNAL for March, 1925, from over two hundred specimens collected principally by O. C. Poling during several years in the Boboquivari Mountains, Arizona. Numerous other specimens from Arizona are also mentioned; collected in June and July. It also occurs in Mexico.

## 4. *Diceroprocta digueti* Distant

Described in the "Ann. Mag. Natural History" (7) XVII, p. 156, 1906, from Lower California, where it appears to be, in places, quite common. Three specimens received for examination from Mr. E. P. Van Duzee are labeled Cape San Lucas, Lower Calif., Aug. 4, 1919 (J. Slevin Coll.) Apparently it also occurs on the adjacent mainland, for in the collection of the American Museum of Natural History there are two males and one female labeled "Envir de Guadalajara Estat de Jalisco, 1901 (M. Diguët)." Mexico.

## 5. *Diceroprocta biconica* Walker

Described in the "List of the Specimens of Homopterous Insects in the Collection of the British Museum," Part I, London, 1850, from the island of Cuba, and figured, rather poorly in "Genera Insectorum," Plate 4, Fig. 24, 1912. A specimen from Florida was figured in this JOURNAL for 1918, Plate VIII, Fig.

3. This appears to be a rather plentiful species in Cuba and the Isle of Pines, while from Florida the following specimens have been examined: Big Pine Key, July 1915, male, Davis collection; Key West, female, collection Brooklyn Museum; Key West, female, U. S. Nat. Museum; Key West, female, Acad. Nat. Sciences; Phil.; Long Key, Monroe Co., July 13, 1912, male (Rehn and Hebard), Acad. Nat. Sciences, Philadelphia.

6. *Diceroprocta bonhotei* Distant. Pl. XVII, Fig. 1.

Described in the "Entomologists' Monthly Magazine" (2) Vol. XII, p. 71, 1901, from five specimens from Nassau, Bahama Islands. Mr. C. E. Olsen of the American Museum of Natural History collected thirty-eight specimens on several of the Bahama Islands in June and July, 1924. Mr. George P. Engelhardt has also taken many, and seven males and fourteen females have been examined from Mangrove Cay, Andros Island, Aug. 4, 1904 (Allen, Barbour and Bryant) Museum Comparative Zoology, Mass.

In all of the eight females in the writer's collection the spine at the end of the abdomen has an upward turn instead of extending straight out, as in *biconica*. With the exception of this structural difference *bonhotei* and *biconica* closely resemble each other. Some of the specimens of *biconica* in the writer's collection have the last four of five segments of the abdomen pruinose above, and the area at the base of the abdomen, between the tympanal coverings, is often pruinose. This pruinose spot is present in all of the thirteen males and in some of the female *bonhotei* in the collection, but in this species the pruinosity on the last segment of the abdomen is often reduced to two spots and is not as extensive as in some *biconica*.

The specimen figured is one of the males in the collection of the British Museum, and the photograph was kindly sent to me by Mr. W. E. China.

7. *Diceroprocta transversa* Walker. Pl. XVII, Figs. 2 and 3.

This species was described from Vera Cruz, Mexico, by Francis Walker in "Insecta Saundersiana," 1858, and was later

figured by Mr. Distant, in "Biologia Centrali-Americana," Homoptera, plate 2, figure 1. Through the courtesy of Mr. W. E. China, I am enabled to present figures from the type in the British Museum. These figures closely resembles the one in Biologia. In the collection of Cornell University there are three males labeled Vera Cruz (Crawford), that agree with the original description, with Distant's figure, and with the figure herewith presented. A comparison of these specimens with the type of *marevagans* described in this paper, shows that in *transversa* the front is more prominent; eyes more conspicuous, and the opercula slightly shorter, reaching but to the fourth segment, while in *marevagans* they reach the fifth.

Mr. China states that the dorsal spine at apex of pygofer in the female, is straight. Mr. Distant considered *alacris* Stål a synonym of *transversa* Walker, as we have mentioned.

**8. *Diceroprocta marevagans* new species. Pl. XVII, Figs. 4 and 5.**

Type male, Galveston, Texas, August 22, 1918, (E. C. Wurzlow). Davis collection.

Resembles *D. transversa* Walker, of Mexico.

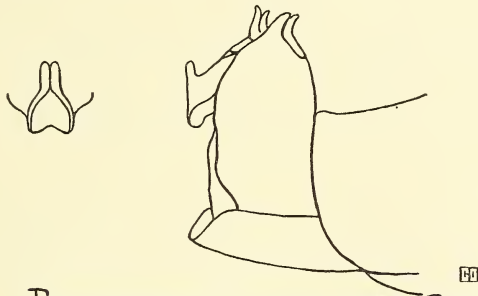
Head across eyes broader than the anterior width of the pronotum, but little produced, and rounded; medium sulcus of the front shallow; transverse rugae shallow, black in the grooves. Many white hairs on the sides of the face. The opercula slightly separated at the base, triangular in shape and reach the fifth segment. The outer sides are not quite parallel to each other, as shown in the illustration. The last ventral segment truncate at the extremity with a slight sinuation in the middle. Uncus wish-bone shaped, as shown in the illustration, and the last segment with the extremity prolonged upward into two upturned horns. Abdomen slightly broader across the middle than at the base.

General color chestnut brown; head black with pale spots at the front above the antennae and one each side posteriorly near the eyes. Pronotum chestnut colored, variegated with black, and the collar pale straw-colored, with a small fuscus spot at each extremity near the base of the fore wings. Mesonotum with four obconical spots extending backward from the front margin, the out pair about twice as long as the inner pair. The elevated  $\times$  pale, with the darker stripe across each of the fore limbs connected with an anchor shaped spot immediately before the  $\times$ . Upper side of the abdomen of an almost uniform dark or chestnut brown slightly paler on the sides of the third and fourth segments. Under side of the body including the opercula pale; almost black about the eyes; abdomen castaneous with a slightly darker stripe centrally. Fore wings with the basal area almost

clear, slightly yellowish at the base and along the front margin; veins yellow except about the marginal areas where they are dark brown. First four cross veins infuscated. Basal membranes of both pair of wings pale gray.

MEASUREMENTS IN MILLIMETERS

	Male Type
Length of body.....	29
Width of head across eyes.....	10
Expanse of fore wings .....	78
Greatest width of fore wing.....	12
Width of operculum at base .....	6
Greatest length of operculum.....	8.5



DICEROPROCTA MAREVAGANS TYPE

Mr. Wurzlow wrote that he heard the type here described singing, and found it on a fence over a clump of *Amaranthus*. He also heard several others in the gardens about the houses.

In addition to the type a male from Padre Island, Texas, August 23, 1915, in the collection of the University of Michigan, has been examined through the courtesy of Prof. F. M. Gaige. This specimen was figured in this JOURNAL, March, 1921, Plate 2, Fig. 1, under the name of *Tibicen transversa* Walker, but as has been shown on a previous page the true *transversa* is a different insect. With further collecting *marevagans* may prove to be a northern race of *transversa*.

9. *Diceroprocta swalei* Distant. Pl. XVIII, Fig. 1.

*Rihana swalei* Distant (1904).

*Tibicen castanea* Davis (1916).

When *castanea* was described and figured in this JOURNAL for March, 1916, it was stated (p. 51) that it resembled *swalei*

described by Distant without locality, but supposed by him to have come from Central America. The figure in *Ann. Mag. Nat. Hist.* (7), XIV, p. 427 (1904) shows a more robust bodied insect with more prominent eyes than the specimens of *castanea* from Arizona. However, Mr. W. E. China, who has kindly compared specimens from Arizona with the type, writes me that he believes them to be the same. It is possible that Distant's type actually came from Arizona, and not Central America, as he supposed.

All of the specimens so far examined by the writer have come from Arizona, where it sometimes occurs in considerable numbers. In June, 1924, Mr. O. C. Poling collected 52 males and 37 females in the Boboquivari Mountains, Pima County, which he found resting on Ocotillo and Mesquite stems. The last ventral segment of the female is broadly notched with a second notch within.

In this paper a figure is given of the suffused variety mentioned in the original description (1916) from Santa Rita Mountains, Arizona. It is in the collection of the Brooklyn Museum.

#### 10. *Diceroprocta knighti* Davis.

Described and figured in this *JOURNAL*, December, 1917, from male specimens taken by Dr. Harry H. Knight in the Santa Catalina Mts., Arizona. In July, 1921, Mr. Edward P. Van Duzee collected eight specimens, including two females, while on a trip along the shore of the Gulf of California. They were taken at San Pedro Bay and San Carlos Bay, Sonora, and were not uncommon. The last ventral segment of the female is singly notched and on each side of the notch the margin of the segment is produced into points.

#### 11. *Diceroprocta arizona* Davis.

Described and figured in this *JOURNAL*, March, 1916, from males collected in June in the Santa Rita Mts., Arizona. Later a female collected by Prof. F. H. Snow at the same place and time was examined, and the notch in the last ventral segment was found to be shallow, broadly open and with its sides slightly



sinuate. This appears to be an uncommon species, unless the collector is fortunate enough to come upon it during a brood year.

**12. *Diceroprocta delicata* Osborn.**

Described in the "Ohio Naturalist," Vol. VI, p. 498, April, 1906, and figured in this JOURNAL, March, 1916, from one of the Louisiana specimens kindly furnished by Prof. Herbert Osborn. A number of individuals have been seen from numerous localities in central and southern Texas. In the U. S. Nat. Museum there are two specimens labeled "Mex." In this species the apical fourth of each fore wing is more smoky than usual.

**13. *Diceroprocta olympusa* Walker.**

*Fidicina olympusa* Walker (1850).

*Cicada milvus* Walker (1858)

*Cicada sordidata* Uhler (1892)

Figured, and the descriptions under the above names reviewed in this JOURNAL for March, 1916, and March, 1923. It is quite common in Florida, especially along the coast; extends northward into Georgia, and westward to Mississippi. In Florida it has been collected from April to October, and a male in the University of Michigan, collected at Gainesville by Prof. T. H. Hubbell, is labeled December 18, 1923. Mr. H. P. Loding and Mr. Thomas S. Van Aller have collected some examples in June and July at Irvington, Alabama, in which the upper surface of the head and thorax is almost black. A remarkable and beautifully colored male is in the collection of the Museum of Comparative Zoology at Cambridge, Mass. It is very dark in color with the anterior half of the collar black, posterior half green; hour-glass shaped mark in center of pronotum black, green each side, upper surface of abdomen black with dorsal row of silvery hairs.

**14. *Diceroprocta texana* Davis.**

Described and figured in this JOURNAL, March, 1916, from Cameron County, Texas, and in the JOURNAL for March, 1921,

recorded from other localities in Texas, chiefly near the Rio Grande. Mr. Raymond H. Beamer, of the Univ. of Kansas, has since sent to me for examination twenty specimens collected in Chaves County, New Mex., July 8, 1927, that are somewhat lighter in color than any seen from Texas.

On July 14, 1928, Mr. F. F. Bibby and Mr. J. F. Cooper collected 85 males and 8 females in Winkler Co., Texas, and reported them numerous on various shrubs and easily collected. They had evidently but recently emerged. On September 11, Mr. Bibby and Mr. Cooper collected 9 additional males at the same locality that are like those collected in July, except that the clouded condition of the first and second cross veins in the front wings no longer prevails as it does in nearly every one of the 93 collected in July, and in all others seen from any other locality in Texas, New Mexico or Mexico. They reported those found in September easily taken by placing a small cyanide bottle over each one as it sat on a bush.

On July 27, 1928, Mr. Bibby and Mr. Cooper collected 8 males and one female in Val Verde Co., Texas, that are more robust and more brightly colored than those found in Winkler County, and they reported that they were shy and much more difficult to capture. The uncus, however, is of the same shape and they may be considered to be *texana*.

In the writer's collection there are two males labeled "Mexico" that also appear to be *texana*, and recently Dr. Alfons Dampf kindly sent for examination a male from Cuernavaca, Mexico, that is evidently of the same species.

#### 15. *Diceroprocta eugraphica* Davis.

Described and figured in this JOURNAL, March, 1916, from New Mexico. It is also known from Kansas, Oklahoma, Texas and Arizona; is usually found in dry situations and is sometimes quite common.

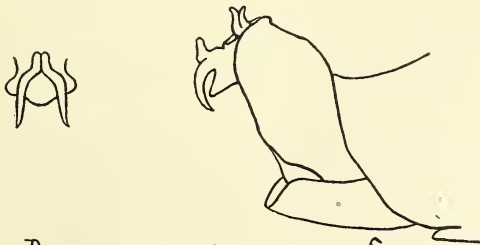
There was probably a brood of this species appearing in Barber County, Kansas, in 1916, for from the 19th to 21st of July in that year Mr. Raymond H. Beamer collected 80 males and 11 females. In 1927 he sent for examination 41 specimens col-

lected during July in Culberson, El Paso, Jeff Davis, Presidio and Pecos counties, Texas, and Chaves and Eddy counties, New Mexico. They were all quite alike except that the specimens from Ft. Stockton, Tex., averaged somewhat larger than those from the other localities. The dates of capture from various localities extend from May to September.

16. *Diceroprocta vitripennis* Say.

*Cicada erratica* Osborn.

This species was described in 1830 and Say states that it was presented to him by Mr. Nuttall "from the Arkansaw." It is figured in this JOURNAL for March, 1916. It appears to be confined to the central part of the United States and specimens have been examined from Michigan, Indiana, Illinois, Nebraska, Kansas, Missouri, Oklahoma, Arkansas, Texas, Louisiana, Mississippi and Alabama. The dates of capture are from June to September. Miss Louise Knobel collected a great many in her Light-Trap at Hope, Arkansas, in 1923, 1924 and 1925, in the latter year 43 females and 18 males were taken in the trap from June 4th to 18th and sent to the writer. The three males and one female from Berrien Co., Michigan, June 24, 1919, were collected by Prof. Theodore H. Hubbell, who found them common on poplars growing among the dunes near the lake. In the southern part of its range *vitripennis* is often found in corn fields and is destructive to cotton. Both Prof. R. W. Harned and R. W. Lobdell have sent me specimens from Mississippi found emerging from land that had been under water, so the young insects are evidently able to live in very wet soil.



DICEROPROCTA VITRIPENNIS SAY

17. *Diceroprocta vitripennis* var. *bequaerti* Davis.

Described and figured in this JOURNAL for December, 1917, under the name of *Tibicen viridifascia* Walker, var. *bequaerti*, but in the JOURNAL for March, 1921, it is suggested that it was more likely a variety of *vitripennis* Say. It may be owing to its broader head and differences in marking, a distinct species. The type and four paratypes came from Richmond, Texas, and other specimens have been collected at Wharton, near the coast in Texas. It also occurs in Louisiana.

In the U. S. National Museum there is a female specimen of *bequaerti* from Columbus, Texas. It bears a label stating that it was figured in the "Insect Book, Pl. 28, Fig. 15."

18. *Diceroprocta albomaculata* new species. Plate XVIII, Figs. 2 and 3.

Type male form Vera Cruz, Mexico. Collection United States National Museum.

Resembles *D. vitripennis* but the claws of the wish-bone shaped uncus are much shorter than in either *vitripennis* the species of the region of the Mississippi, or *D. viridifascia* the coastal species of the north. The basal area in the fore wings is clear as in *vitripennis*; in *viridifascia* the same area contains a dark oblong spot along the front margin. Basal area of abdomen between tympana silvery, with a conspicuous white spot each side.

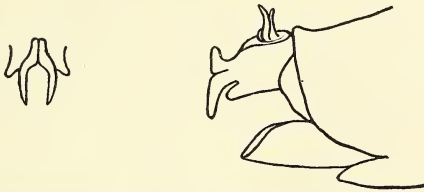
Head broad with the front not as prominent as in *vitripennis* or as broadly rounded as in variety *bequaerti*. Body short and robust as in *viridifascia*. Opercula short, rounded at the extremities, and extending to the first abdominal segment; slightly separated on inner margin. Last ventral segment with the tip rounded and slightly sinuate centrally. Uncus as figured, with the claws short and pale colored, instead of being dark brown or almost black as in *vitripennis*, and when viewed from behind more parallel than in that species.

General color of the head and mesonotum greenish variegated with much black or dark brown, and of the dorsum of the abdomen chocolate brown. Head black, pale above each antenna, and with an oblong greenish spot each side between the front and the eyes, and one each side posteriorly between the ocelli and the eyes. Pronotum greenish with a central oblong dark spot and the grooves blackened; collar green. Mesonotum greenish with four obconical marks, the inner pair short and dark colored; the outer pair longer and much dissected with greenish. Two dark spots each side near the wings; elevated  $\times$  pale with an irregular dark spot centrally between it and the central pair of obconical spots. Abdomen chocolate brown somewhat lighter each side on the tympana, and with the basal area between the tympana silvery with a brighter spot each side. The whole of the upper

surface of the abdomen is beautifully covered with silvery and bronzed pubescence, the silvery predominating on the sides. Beneath pale greenish and pruinose; tip of rostrum brown; tarsi and claws darkened; opercula pale; first abdominal segment brownish; succeeding segments very pale brown, somewhat darkened at the sides. Fore wings clear; costal margin to end of radial cell green, brownish beyond; membranes at base of wings smoky and of the same color as in *vitripennis*.

MEASUREMENTS IN MILLIMETERS

	Male Type
Length of body.....	21
Width of head across eyes.....	10
Expanse of fore wings.....	70
Greatest width of fore wing .....	10
Width of opercula at base.....	5
Greatest length of opercula.....	5



**DICEROPROCTA ALBOMACULATA TYPE**

In addition to the type there is a paratype from the same locality that agrees with it in size, structure and markings.

In "Biologia Centrali-Americana," Homoptera (1881), Plate 2, Fig. 6, there is figured a cicada resembling the present species, but much larger, under the name of *Cicada nigriventris* Walker. Later in his catalogue of Cicadidæ, 1906, p. 36, Mr. Distant refers the figure to "variety *Cicada nigriventris* Distant," which he places under *Rihana vitripennis* Say. *Cicada nigriventris* Walker was described in 1858 and is a distinct species, so the name used by Distant was preoccupied. Possibly he did not intend to designate a new variety of *vitripennis*.

**19. Diceroprocta bibbyi** new species. Pl. XVIII, Figs. 4 and 5.

Type male and allotype female from near Langtry, Val Verde County, Texas, July 27, 1928 (F. F. Bibby). Davis collection.

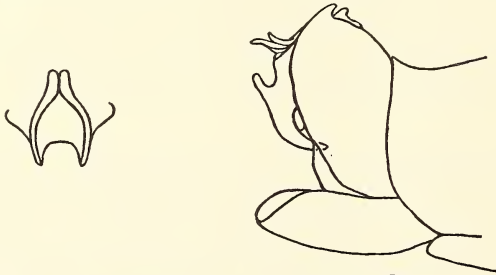
About the size of *D. vitripennis*, but more shining and blackish-brown in color and the front more prominent. Head across eyes broader than the

anterior width of the pronotum and the front more prominent than in most species of the genus. Median sulcus of the front shallow; transverse rugae black; plainly marked and tomentose in the grooves. Many white hairs on the sides of the face. The opercula slightly overlap (or almost touch in some of the paratypes) at the base; about as long as broad, rounded at the extremities which reach the second segment. The last ventral segment is truncated with a sinuation in the middle. Uncus wish-bone shaped as shown in the illustration, and the last segment with the extremity prolonged upward into two short horns. Abdomen in the male nearly as broad across the middle as at the base. Last ventral segment of the allotype with the notch single; the edges of the segment on either side of the notch but slightly sinuate.

General color a chocolate brown, head black with a narrow, oblong, orange spot on the front, a small one over each antenna, one each side between the front and the eyes, and one each side posteriorly between the ocelli and the eyes. Pronotum brown and black with a pale line centrally; collar orange-yellow with the anterior portion irregularly blackened. Mesonotum almost black with the obconical spots reduced to two orange J-like marks; the elevated  $\times$  pale; black centrally (or wholly black in one of the paratypes); hind margin pale and a pale spot each side near the base of the fore wings. Abdomen of a uniform dark brown, the sides silvery with flattened scale-like vestiture; a conspicuous tomentose spot each side on next to the last segment. Under side of the body including the opercula tomentose, the legs striped with brown; the posterior margin of each abdominal segment

## MEASUREMENT IN MILLIMETERS

	Male Type	Female Allotype
Length of body .....	26	25
Width of head across eyes.....	10.5	11
Expanse of fore wings.....	75	77
Greatest width of fore wing.....	11.5	12
Width of operculum at base.....	6	
Greatest length of operculum.....	5	



DICEROPROCTA BIBBYI TYPE

and the sides of the valve pale. Fore wings with the basal area clear, very slightly clouded along the front margin; outer veins black, inner, paler; first and second cross veins not clouded. Orange at the extreme base of both pair of wings; basal membranes pale, those of the hind wings almost white.

In addition to the type and allotype Mr. F. F. Bibby has sent me 13 males and two females, all collected near Langtry, Val Verde Co., Texas, near the end of July, 1928. Mr. Bibby states that it was common on *Covillea tridentata*, *Prosopis chilensis* and other shrubs, and was easily collected.

#### 20. *Diceroprocta viridifascia* Walker.

*Cicada viridifascia* Walker (1850).

*Cicada reperta* Uhler (1892).

Figured in this JOURNAL, March, 1916, Pl. 6, Fig. 1. The synonymy given above was suggested in this JOURNAL for March, 1916, and December, 1917, and in 1920 confirmed by Mr. W. L. Distant, who compared North Carolina specimens with Walker's types in the British Museum.

In the United States National Museum there is a male from Florida (Pergande) P. R. Uhler collection, labeled "*Cicada* (*Diceroprocta*) *viridifascia* Walker," and on another label is the statement that it was determined by Uhler. From this it would appear that Uhler at one time thought that the coast species had been described by Walker. This was probably after 1892, for in the original description of *reperta* in the "Trans. Maryland Acad. Sciences," the name *viridifascia* is not referred to and was probably overlooked. In the "Bulletin, Buffalo Society of Natural Sciences," IX, p. 184, 1909, Mr. E. P. Van Duzee identified *viridifascia* Walker as occurring in Florida, from whence came most of Uhler's specimens.

The species occurs from Virginia along the coast to the Gulf of Mexico, and has been collected from May to September.

#### 21. *Diceroprocta azteca* Kirkaldy.

*Cicada pallida* Distant (1881).

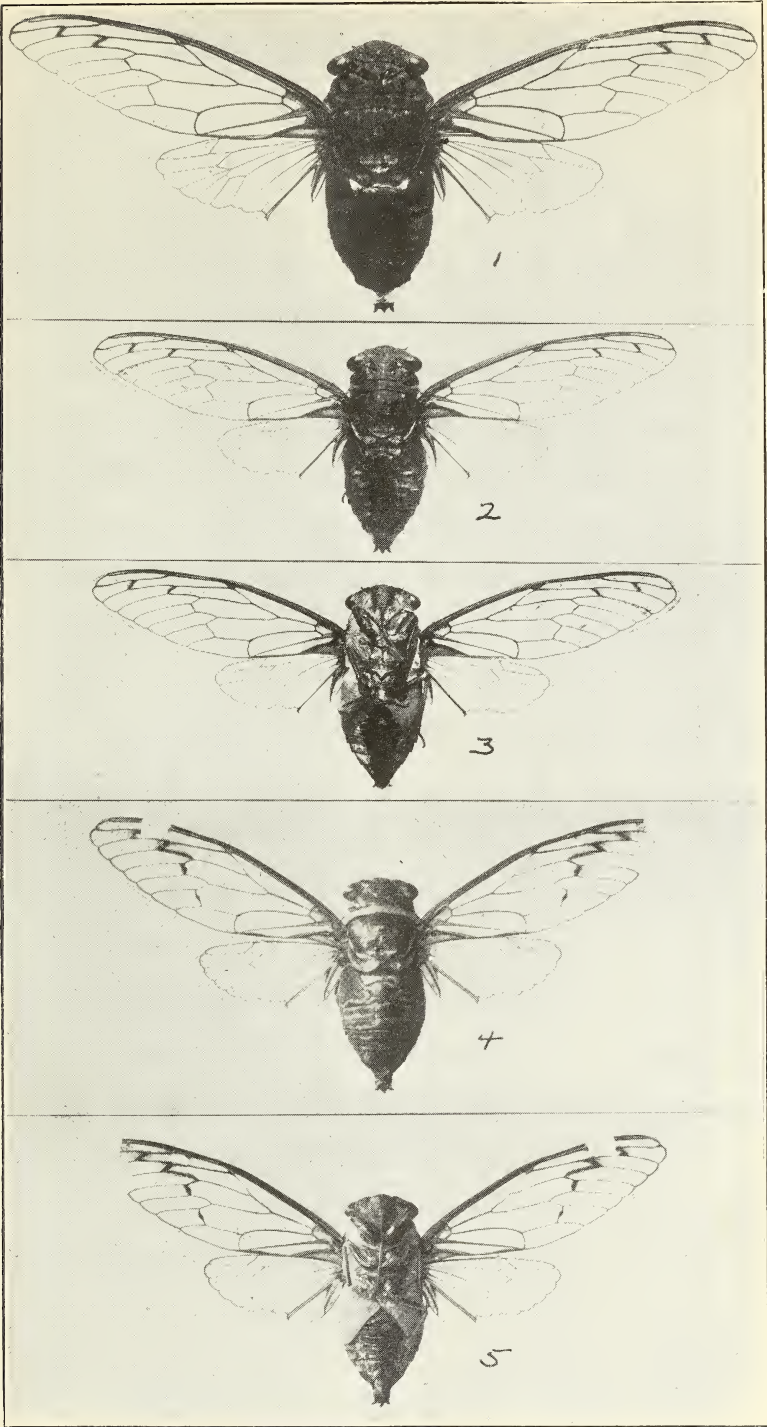
*Cicada pallida* is described and figured in "Biol. Centr.-Amer.," Rhynch. Hom., 1881, and in this JOURNAL for Decem-

ber, 1917. The name given by Distant being preoccupied, Kirkaldy proposed *azteca* in 1909. Specimens from the United States have been compared with the type in the British Museum. At times *azteca* is a common insect in parts of Oklahoma and eastern Texas, and has been collected from June to August.

## PLATE XVII

- Figure 1. *Diceroprocta bonhotei* Distant.  
Figure 2. *Diceroprocta transversa* Walker, from Type in British Museum.  
Figure 3. *Diceroprocta transversa* Walker, under side of Type in British Museum.  
Figure 4. *Diceroprocta marevagans* Davis. Type.  
Figure 5. *Diceroprocta marevagans* Davis. Type, under side.





CICADIDÆ





## PLATE XVIII

- Figure 1. *Diceroprocta swalei* Distant, var. *castanea* Davis.  
Figure 2. *Diceroprocta albomaculata* Davis. Type.  
Figure 3. *Diceroprocta albomaculata* Davis. Type, under side enlarged.  
Figure 4. *Diceroprocta bibbyi* Davis. Type.  
Figure 5. *Diceroprocta bibbyi* Davis. Allotype.



CICADIDÆ



## PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

### MEETING OF MARCH 20, 1928

A regular meeting of the New York Entomological Society was held at 8 P. M., on March 20, 1928, in the American Museum of Natural History; President Henry Bird in the chair with twenty members and twelve visitors present.

Dr. William Moore, American Cyanamid Sales Co., 535 Fifth Avenue, was elected a member.

A letter from an absent member, Harrison M. Tietz, was read.

Mr. Davis exhibited "Fundamenta Entomologiæ" by W. Curtis, 1772.

Mr. Sherman spoke of Dr. Melander's latest work 440 pages with eight plates as a sumptuous entomological publication.

Mr. Davis and Dr. Felt spoke of the severe illness of Dr. John Henry Comstock. The secretary was instructed to send him the sympathy of the Society.

Dr. J. L. Horsfall spoke on "Feeding Punctures of Aphids" explaining the methods of study and the manner in which the aphid reaches the plant cells rich in sugar phloem. The results of his studies will be printed in full.

Mr. Shoemaker exhibited his collection of *Basilarchia* butterflies including *arthemis*, and its form *proserpina*, *astyanax* and its form *albofasciata*, with numerous specimens in which the white band was more or less feebly indicated. The localities in which he had collected were Canadensis in the Pocono Mts., Pennsylvania and the Catskill Mts., New York. Mr. Shoemaker added that in his experience about ten per cent. of the specimens seen were white-banded.

His remarks were discussed by Messrs. Davis and Hall, who had collected *albofasciata* west of Sussex, New Jersey, and Angell, who had seen the white-banded forms at Cook's Falls, New York.

Mr. Frank Johnson exhibited *Ornithoptera* butterflies.

Mr. Mutchler exhibited Chinese beetles collected by Mr. H. H. Johnson.

Mr. Bird spoke of a *Papaipema* found on Chelone.

### MEETING OF APRIL 3, 1928

A regular meeting of the New York Entomological Society was held at 8 P. M., on April 3, 1928, in the American Museum of Natural History; President Henry Bird in the chair with twenty-one members and eight visitors present.

Mr. Davis read communications from Mr. Engelhardt reporting a visit at Tallulah, Louisiana, with Dr. Folsom and Mr. Glick; and from Mr. Barber reporting his visit to the Imperial Valley, California.

Mr. Angell called attention to a recent article in Pan Pacific Entomologist on *Dinapate wrighti*.

The secretary of the Society was presented with a watch inscribed "To Charles W. Leng, from the members of the New York Entomological Society, as a token of their appreciation of his long and faithful service to the Society. April, 1928."

Addresses were made by the President, by Mr. Davis and Mr. Sheridan as a committee, and by individual members of the Society including Mr. Sherman and Dr. Lutz, all of a complimentary character. The secretary, surprised and embarrassed, briefly expressed his thanks.

Mr. Schwarz read a paper "A Winter Trip to Brownsville, Texas" and exhibited the Hymenoptera and Coleoptera collected on the trip; as well as photographs illustrating January conditions. Two nests of the honey wasp *Nectarina lecheguana*, commonly called Mexican stingless bee, were obtained and it was discovered by experiment on Dr. Lutz that it was not stingless, and by chemical examination of the nest that honey had been stored by the wasp, although not present in quantity in January. That the sting, being barbed, remains in the wound was affirmed by Dr. Lutz in the discussion that followed.

In the discussion of the New York State List of Insects which closed the meeting Messrs. Olsen and Bromley offered some taxonomic corrections, which are appended, and several members spoke of its value in studying distribution.

Dr. Lutz pointed out that the maps are purely altitude maps, indicative therefore of distribution only in so far as it is controlled by that factor. He added also that a study in distribution should be based upon the average result of data for numerous species.

Mr. Notman commended the guarded statement regarding distribution contained in the preface to the Coleoptera; and pointed out that certain data brought out were hostile to theoretical faunal zones. As an instance he spoke of *Amerizus oblongulus* Mann, a species found in Alaska, Labrador, and associated in the Adirondack Mts. above 3500 ft. elevation with the genus *Trechus*. This apparently typical boreal beetle was nevertheless found also in a deep canon near Westfield and on the banks of the Racquette River in St. Lawrence County.

Mr. Leng pointed out the value of the adaphagous beetles in studying distribution and careful work therein of Mr. Notman, whose collections for several years previous to the publication of the List had been specially directed towards obtaining data for determining the distribution of such within the state.

Mr. Davis, after citing comparative figures to show the austral character of the Orthoptera, made a humorous protest against attributing stupidity to them because of the lowly phylogenetic position they occupied in the List. He did not dispute that the Cockroach was regarded as one of the lowest of insects but argued that, in the education it had received since its first



appearance in the Carboniferous period, it had acquired an enviable mentality. We should be proud that the male Surinam Cockroach had been found in the Reptile House in Bronx Park and take into consideration in forming our estimate of Orthoptera the vast number of intelligent musicians it contributes to our fauna.

Mr. Bromley called attention to the Asilid list in the New York State List. A new record was found in Mr. Davis' collection, *Asilus lecythus* Walker from Staten Island. The synonymy of *Laphria acutus* with *L. index* was questioned. A comparison of *index* with the type of *acutus* in the British Museum disproved the synonymy.

#### MEETING OF APRIL 17, 1928

A regular meeting of the New York Entomological Society was held at 8 P. M., on April 17, 1928, in the American Museum of Natural History; President Henry Bird in the chair with eighteen members and seven visitors present.

Dr. Lutz spoke of the arrangements for the American Association for the Advancement of Science meeting in December.

Mr. A. L. Stillman, 134 East 6th St., Plainfield, N. J., was elected a member of the Society.

A letter from Mrs. Anna Botsford Comstock, thanking the Society for its sympathy in Dr. Comstock's illness, was read.

Mr. Leng called attention to an error on page 456 New York State List of Insects in the distribution cited for *Saperda shoemakeri* Ds. The locality "Slide Mt., July" is correct. The two Long Island localities which follow are incorrect belonging two lines above to *S. unicolor*.

Mr. M. E. Ryberg spoke, with blackboard illustrations, on "Biochemistry and Olfactory Response," giving the results of investigations carried on at the Boyce Thompson Institute.

Mr. Rivnay, under the title "Morphological and Taxonomic Notes on Parasitic Beetles" discussed the relation of the families Mordellidæ, Meloidæ, and Rhipiphoridæ in Coleoptera with the group treated by Pierce as an order under the name Strepsiptera. Blackboard illustrations, showing the general form of these insects and some of their characters, as antennæ, elytra, genitalia, etc., were used to support the argument that Strepsiptera are truly Coleoptera. Specimens of the beetles discussed were exhibited and it was pointed out that Rhipidius had been included in the catalogue on the basis of one specimen found on Shipboard at Panama.

Mr. Lemmer exhibited bred specimens of *Gonodontis pilosaria* from eggs obtained at Lakehurst, New Jersey, and raised on white birch.

#### MEETING OF MAY 1, 1928

A regular meeting of the New York Entomological Society was held at 8 P. M., on May 1, 1928, in the American Museum of Natural History; President Henry Bird in the chair with seventeen members and fourteen visitors present.

A letter from Dr. Walther Horn in reference to the arrival of about 25 entomologists about August 7 was read.

Dr. Lutz stated that there would be about as many from England and France arrive about August 7 and outlined his tentative plans for their entertainment, terminating in a meeting of the Society about August 10.

On motion the matter was referred to the Executive Committee for report at the next meeting.

Mr. V. I. Saffro spoke on "Some Interesting Phases of the Japanese Beetle Problem," pointing out that, the peak of the appearance of adults being in normal years from July 4 to August 20, the part of the year before and after those dates was comparatively safe. He also showed that the traps used to attract and catch the adults attracted many more beetles to the trap location; and that the spraying of the trees killed only about thirty per cent. of the beetles. Spraying about June 25 so as to coat the foliage was successful in protecting the trees sprayed. He spoke also of the high cost of attacking the grubs in the soil and of the slow process of establishing control by parasites.

His remarks were discussed by Dr. Felt, Mr. Bird and Mr. Leonard.

Mr. Rivnay, supplementing his remarks at the preceding meeting, spoke of the paper by Mrs. Schrader on the fertilizing of female *Stylops*.

Mr. Angell, discussing the Lucanidae of the New State List of Insects, spoke of the taxonomy of *Platycerus depressus* and the distribution of *Nicagus obscurus*. In reference to the latter he mentioned the swarming of the males observed by Mr. Darlington at Plymouth, New Hampshire.

Dr. Curran spoke of the arrangement of certain families of Diptera as failing to reflect recent studies.

Dr. Felt spoke of the showing for the state made in the list of gall midges as highly gratifying.

Dr. Sturtevant spoke of the ants collected by Mr. Davis on Long Island and Staten Island which, compared with the records from other sections, showed how good a collector Mr. Davis was.

Mr. Rivnay said the record, on p. 336, of *Macrosiagon cruentatum* was based on an error in identification as determined by reexamination of the specimen.

The president spoke of the historical value of the List and of the gratitude due to volunteer workers who had produced it.

Mr. Davis speaking of the Orthoptera said that the *Ceutophilus* records were the weak point owing to the difficulty of identification which, however, might disappear from the use made by Hubbell of the plates discovered by Walker.

Mr. Davis also exhibited the moth *Phragmatobia fuliginosa*, rare on Staten Island, but found on April 19, following a high wind. He also spoke of the seventeen-year locust as on the point of emerging.

## ERRATA

Volume XXXV, No. 4, Dec., 1927, page 423, lines 34-39 should read: "The damage done is of two kinds—that resulting directly

from sucking plant juices, and that resulting from the fact that certain species produce or serve as carriers of plant diseases. Two hoppers of the latter class were discussed in more detail; *Empoasca fabæ* which causes hopperburn of potatoes, and *Cicadula 6-notata*, carrier of aster yellows."

Volume XXXV, No. 4, Dec., 1927.

Page 391. For Genus "ETONEUS" read Genus "ETEONEUS."

Page 397. Line 6 from bottom, for "*globulifera*" read "*globuliferum*."

Page 398. Ten lines from top, for "*globulifera*" read "*globuliferum*."

Page 404. Line 14 from top and line 7 from bottom, for "*nasuta*" read "*nasutus*."

Page 406. Line 4, for the first "*obliqua*" read "*cicadooides*."

Page 408. For "Walkeria" read "Euwalkeria."



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