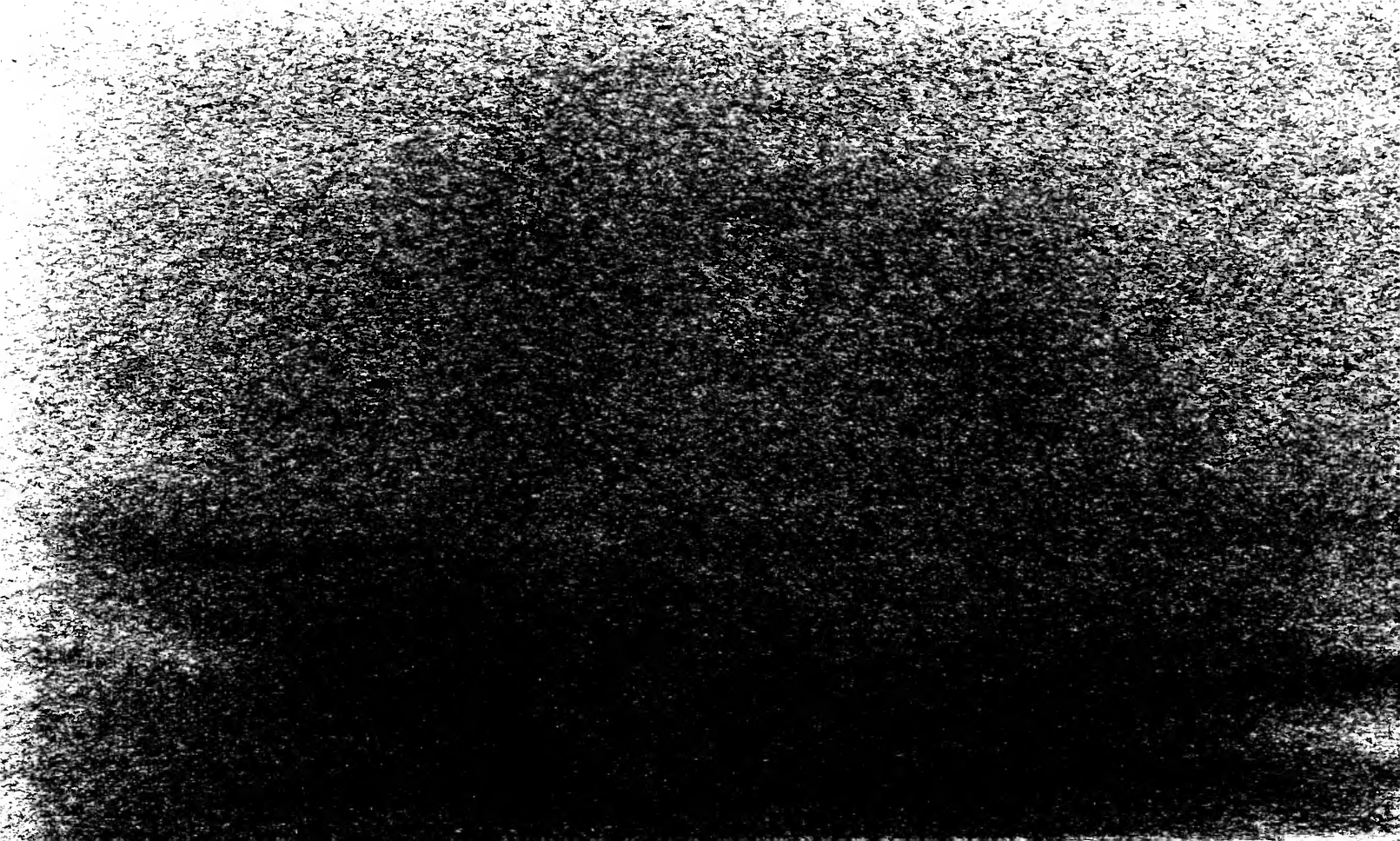

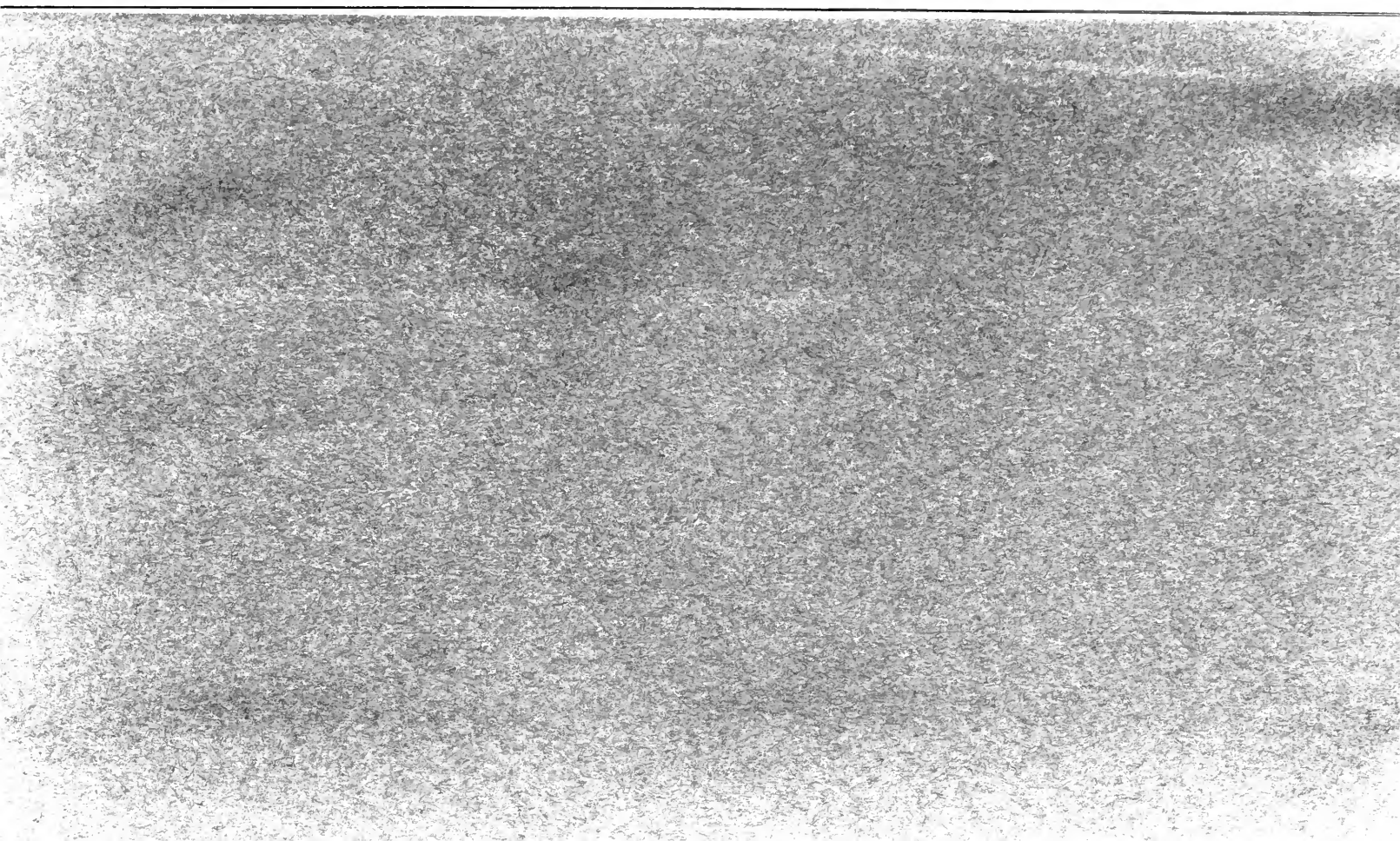

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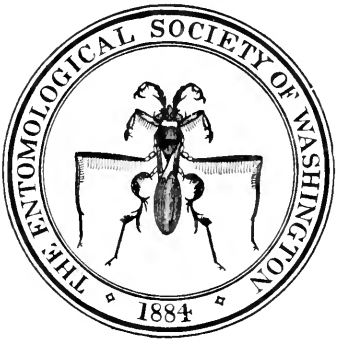

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PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 20 JANUARY, 1918 No. 1

RULES AND SUGGESTIONS GOVERNING PUBLICATION IN "PROCEEDINGS OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON."

RULE 1.—No description of a new genus, or subgenus, will be published unless there is cited as a genotype a species which is established in accordance with current practice of zoological nomenclature.

RULE 2.—In all cases a new genus, or subgenus, must be characterized and if it based on an undescribed species the two must be characterized separately.

RULE 3.—No description of a species, subspecies, variety or form will be published unless it is accompanied by a statement which includes the following information, where known (1) the type-locality; (2) of what the type material consists—with statement of sex, full data on localities, dates, collectors, etc.; and (3) present location of type material.

RULE 4.—No unsigned articles or articles signed by pseudonyms or initials will be published.

RULE 5.—The ordinal position of the group treated in any paper must be clearly given in the title or in parentheses following the title.

SUGGESTION 1.—All illustrations accompanying an article should be mentioned in the text and preferably in places where the object illustrated is discussed.

SUGGESTION 2.—It is desirable in describing new genera and species that their taxonomic relationship be discussed and that distinguishing characters be pointed out.

SUGGESTION 3.—In discussion of type material modern terms indicating its precise nature will be found useful. Examples of these terms are: Type (or holotype), allotype, paratype, cotype, lectotype, neotype, etc.

SUGGESTION 4.—In all cases in the serial treatment of genera and species and where first used in general articles the authority for the species, or genus, should be given and the name of the authority should not be abbreviated.

SUGGESTION 5.—Where the title of any publication referred to is not written in full standard abbreviations should be used.

SUGGESTION 6.—When a species discussed has been determined by some one other than the author it is important that reference be made to the worker making the identification.

THREE HUNDRED AND SIXTH MEETING, OCTOBER 4, 1917.

A REVISION OF THE DIPTEROUS FAMILY CLUSIODIDAE (HETERONEURIDAE).

J. R. MALLOCH.

During the last three years I have collected a large amount of material in this small and interesting family, and finding some new or rare forms and the early stages of one species I consider that a short revision of the whole may be of value to students of Diptera.

I had purposed including the matter in the present paper in a comprehensive treatise of the Cyclorrhapha, but find that such course is not possible because of the limited facilities for publication that are at present available, and in order to limit the size of my subsequent paper I now present this revision.

The family name has recently been changed to comply with the rule of priority, Heteroneura, a preoccupied name, having been supplanted by Clusiodes.

Family **Clusiodidae.**

Family Characters.

Larva.—Muciform; the head rudimentary consisting of 2 small yellowish downwardly directed projections, and without a chitinized internal skeleton; thoracic segments tapered anteriorly; apical abdominal segment slightly rounded; each spiracle on a raised chitinized bifid plate.

Puparium.—Rather slender; rounded at both extremities; metathoracic spiracles not developed; posterior spiracles as in larva.

Imago.—Head broad, eyes widely separated; orbits with 3 pairs of strong bristles; vibrissae well developed; antennae of moderate size, third joint not much elongated, generally little longer than broad; arista pubescent or densely hairy; frons often with a pair of cruciate frontal bristles. Tibiae usually with distinct preapical dorsal bristle. Cross veins of wings closely approximated except in *Clusia*,[9] auxiliary vein complete; first vein falling much short of wing-middle; basal cells complete; sixth vein not extending to margin of wing.

Habits of Larvae.

The larvae live in decaying wood and are very sluggish in habit. Some European species have been recorded as leaping, but I saw no indication of such activity upon the part of the larvae I had

Habits of Imagines.

The imagines are rarely met with, but when they are it is usually upon tree-trunks, particularly on dead or dying specimens. Not uncommonly examples are found on windows in houses. They feed upon nectar, decaying vegetable matter, or sap exuding from trees.

Key to Genera

1. Eyes with short, upright hairs.....*Acartophthalmus*
— Eyes bare..... 2
2. Cross veins of wings not closely approximated, the length of penultimate section of fourth vein about one third that of ultimate *Clusia.*
— Cross veins closely approximated, the length of penultimate section of fourth vein less than one fourth that of ultimate..... 3
3. Postvertical and cruciate bristles absent; ocellar bristles very small.....*Chaetoclusia*
— Postvertical bristles present; ocellar bristles distinct..... 4
4. Cruciate frontal bristles present.....*Clusiodes*
— Cruciate frontal bristles absent.....*Heteromeringia*

Genus **Acartophthalmus** Czerny

This genus has not been recorded from North America. The presence of very short, stiff upright hairs on the eyes sufficiently distinguishes the genus from its allies.

Acartophthalmus nigrinus Zetterstedt

Anthophilina nigrina Zetterstedt, Dipt. Scand., vol. 7, p. 2697, 1848.

This is the only species of the genus. It occurs in continental Europe, and is readily distinguished from its allies by its small size, entirely black color, and waivy eyes.

One specimen from the collection of Professor J. M. Aldrich, taken May 17, 1910, on Mt. Constitution, Washington.

Genus **Clusia** Haliday.

Key to Species.

1. Abdomen without conspicuous black spots on lateral margins of segments.....*occidentalis.*
— Abdomen with conspicuous shining black spots on lateral margins of segments..... 2
2. Wing with 2 brown or blackish bands, one slightly beyond middle and the other at apex; male with bristles of antero- and postero-ventral surfaces of fore femora subequal in length.....*czernyi*

— Wing with only 1 brown band, the aptical one; male with bristles of postero-ventral series on fore femora much stronger than those of antero-ventral..... *lateralis*

Clusia occidentalis n. sp.

Male.—Yellow, distinctly shining. Frons golden yellow, upper half of orbits and ocellar triangle shining, the remainder opaque; bristles black; antennae and palpi pale yellow; face and cheeks whitish. Thorax, abdomen, and legs yellow. Wings slightly grayish, with a brown costal mark extending from apex of first vein round apex of wing to a point posterior to fourth vein; outer cross-vein with a large brown spot, the latter extending into first posterior cell.

Cruciate frontal bristles strong; ocellar bristles extending to base of cruciate pair. Abdomen stouter than in *lateralis* and with stronger bristles. Fore and mid femora with strong black bristles on the posterior ventral surfaces. Last section of fourth vein about two and one-half times as long as preceding section.

Female.—Similar to male.

Length, 5.5 mm.

Type locality, Washington State (Kincaid).

Type—Collection State Natural History Survey of Illinois.

Paratypes and *Allotype*, Portola, Cal., April 13, 1906 (coll. Aldrich).

Clusia czernyi Johnson.

Clusia czernyi Johnson, Psyche, Vol. 20, 1913, p. 100.

Originally described from specimens obtained from the following states: Maine, Vermont, Massachusetts, New Hampshire, Pennsylvania, New York.

Represented in our Laboratory collection by one female from Algonquin, Ill. (Nason), and one male from Alto Pass, Ill., May 3, 1917 (Hart and Malloch).

Clusia lateralis Walker.

Heteromyza ? lateralis Walker, List of Insects in British Museum, Vol. 4, p. 1095. 1869.

Heteroneura spectabilis Loew, Wien Ent. Monatschr., Vol. 4, p. 82. 1860.

Clusia lateralis (Walker) Czerny, Wien Ent. Zeit., Vol. 22, p. 89. 1903.

Originally described from a female specimen from North America. Recorded from the following states by Johnson: Maine, Vermont, Massachusetts, Connecticut, New Jersey, and Pennsylvania; and also from Canada. Loew's specimens came from Washington, D. C.

Represented in our Laboratory collection by one male specimen from Algonquin, Ill. (Nason), and another from Dongola, Ill., May 11, 1916 (Hart).

Genus **Chaetoclusia** Coquillett.

There are two American species of this genus, neither of which I have before me at present. The first vein of the wings is bristly on the apical portion in this genus.

The species may be separated as follows:

Thorax entirely yellow; anterior tibiae and tarsi brown, mid and hind legs yellow; wings yellowish hyaline (New Jersey)....*affinis* Johnson

Thorax with a black stripe on each side of mesonotum and otherwise marked with black; fore legs yellow, basal half of mid and hind tibiae usual brownish; wings with apices and cross veins more or less clouded with brown (Nicaragua).....*bakeri* Coquillett

Genus **Clusiodes** Coquillett.

There are five North American species of this genus, which may be separated by means of the following key.

Key to Species.

1. Thorax largely yellowish on disc; legs entirely yellow; face of male black.....*melanostoma*
— Thorax largely black on disc, always so in front; legs not entirely yellow except in flavipes..... 2
2. Wing with 2 dark marks, a narrow one below apex of first vein, and another, much larger, at apex; legs entirely pale yellow...*flavipes*
— Wing with one dark cloud covering the apex of wing and sometimes continued along costal margin; legs partly black or brown..... 3
3. Infuscation of wings extending from apex of first vein round tip of wing.....*geomyzina*
— Infuscation of wings confined to apical third, falling far short of apex of first vein..... 4
4. Fore tarsi entirely yellow.....*apicalis*
— Fore tarsi in part black..... 5
5. All fore tarsal joints of female and the apical 3 or 4 in male black *pictipes*
— Basal or basal and second fore tarsal joints black, the others conspicuously white .....*albimana*

Clusiodes melanostoma Loew.

Heteroneura melanostoma Loew, Berl. Ent. Zeitschr., 1864, p. 98.

Originally described from specimens obtained in New York State, and subsequently recorded by Johnson from the following

states: Maine, New Hampshire, Vermont, Massachusetts; and also from Montreal, Canada.

There are female species in our Laboratory collection from Algonquin (Nason) and Urbana, Ill. (Malloch). The dates range from May 9 to August 12. Three of the Urbana specimens were taken on the inner side of windows in the basement of the Natural History Building of the University of Illinois, the other on a tree-trunk on the campus.

Clusiodes flavipes Williston.

Heteroneura flavipes Williston, Trans. Ent. Soc. London, 1896, p. 376.

This species, which was originally described from examples obtained on the Island of St. Vincent, West Indies, has been recorded by Johnson as occurring in Florida.

I have seen one specimen of this species from the collection of Professor J. M. Aldrich, taken in the type locality.

Clusiodes geomyzina Fallen.

Heteroneura geomyzina Fallen, Agromyz., 1823, 2, sp. 2.

I have not seen this species. It occurs in Europe and has been recorded by Johnson from Maine.

Clusiodes apicalis Zetterstedt.

Heteroneura geomyzina var. *apicalis* Zetterstedt, Dipt. Scand., Vol. 7, p. 2789. 1848.

This species is rather doubtfully distinct from the foregoing one, but always has the apical third of the wing infuscated, whereas *geomyzinae* has the infuscation extending to the apex of first vein.

In our collection here there is one female example that is referable to *apicalis*.

Locality, Algonquin, Ill., May 20, 1897 (Nason).

There is no previous record of the occurrence of the species in America.

Clusiodes albimana Meigen.

Heteroneura albimana Meigen, Syst. Beschr. Eur. Zweifl. Ins., Vol. 6, p. 128. 1830.

Recorded by Johnson from the following states: Maine, New Hampshire, Vermont, Massachusetts, New Jersey; and also from Quebec, Canada.

Probably occurs in Illinois, but not yet taken here so far as I am aware. I have seen two specimens from Waubamic, Parry Sound, Ont. (coll. Aldrich).

Clusiodes pictipes Zetterstedt.

Heteroneura pictipes Zetterstedt, Dipt. Scand., Vol. 12, p. 4816. 1855.

This species has been recorded from Mount Washington, N. H., but there is some doubt about the correctness of the identification.

Genus **Heteromeringia** Czerny.

There are four species of this genus recorded as occurring in North America, three of which are in the collection here, one of them being represented by larvae, puparia, and imagines.

Key to Species

1. Species almost entirely yellow..... 2
— Species almost entirely black..... 3
2. Bristles on head yellow; thorax without blackish spots on posterior portion of disc..... *flaviseta*
— Bristles on head black; thorax with a large black spot on each side of disc posteriorly..... *latifrons*
3. Fore legs entirely yellow; hind femora and tibiae yellow, annulated with brown..... *annulipes*
— Fore legs with the exception of the basal half of femora black; hind legs yellow, sometimes slightly brownish on bases of tibiae *nitida*

Heteromeringia flaviseta Johnson.

Heteromeringia flaviseta Johnson, Psyche, Vol. 20, 1913, p. 99.

Larva.—Length, 4–6 mm. Milk-white, slightly shining.

Cephalic papillae small but distinct; cephalopharyngeal skeleton not chitinized internally, the only chitinized portions consisting of 2 small, yellowish, almost straight, downwardly directed processes which function as mandibles; anterior respiratory organ 6-lobed; body segments distinct; postsutural locomotor spinules very small, arranged in short transverse series on a moderately broad band on middle of ventral segments and anterior margins of dorsal segments; posterior spiracles much elevated, located on a pair of flat chitinized plates, the outer upper angles of each of which are produced conically upward.

Puparium.—Length, 3–4.5 mm. Brownish red, subopaque.

Cephalic extremity depressed dorsoventrally; anterior respiratory organs slightly protruded; first segment coarsely rugose, dorsum of thoracic segments smooth, remaining segments with rather sharp, coarse, regular transverse rugae; metathoracic respiratory organs undeveloped; apical abdominal segment with a sharp marginal ridge which is most distinct ventrally; apex truncated, the spiracular plates more distinctly elevated than in the larva; anus with a large dark plate which is transversely oblong and covers the greater portion of the last segment.

The specimens from which the foregoing descriptions were drawn, were obtained by the writer from a decayed tree-stump in Crystal Lake Park, Urbana, Ill., June 10, 1916. The imagines emerged on various dates in the last week of June. The species occurs commonly at Lafayette, Ind. (coll. Aldrich).

No parasites were obtained.

The larvae occurred in groups of three or more in the slightly moist wood and were evidently associated with the burrows of coleopterous insects. They are very sluggish in their movements.

Heteromeringia latifrons Loew.

Heteroneura latifrons Loew, Wien Ent. Monatschr., Vol. 4, p. 82. 1860.

Originally described from specimens obtained in the District of Columbia.

Johnson records it from the following states: Massachusetts, New Jersey, Pennsylvania. Our collection here contains examples from Centerville, Urbana, and Mt. Carmel—all in Illinois. The dates of capture are June 1 and 18, July 3 and August 16. One Urbana specimen was taken on the inner side of a window in the basement of the Natural History Building of the University of Illinois. I have seen specimens from Lafayette, Ind. (coll. Aldrich).

This and the preceding species are doubtfully distinct. Williston's species *valida* differs from *latifrons* in having the wings narrower, the inner cross vein before middle of discal cell, and the dorsum of thorax and abdomen dark brown. His other West Indian species of this genus, *lumbalis*, may be a synonym of *latifrons*. I have seen specimens of both these species from the collection of Professor J. M. Aldrich. They were taken in the island of Grenada, W. I.

Heteromeringia annulipes Johnson.

Heteromeringia annulipes Johnson, Psyche, Vol. 20, 1913, p. 99.

Described from one specimen taken at Murfreesboro, Hartford Co., N. C. No other published record.

Heteromeringia nitida Johnson.

Heteromeringia nitida Johnson, Psyche, Vol. 20, 1913, p. 99.

Originally described from three specimens obtained near Long Branch, New Jersey, and not since recorded.

There are two females, obtained in Illinois, in the Laboratory collection, with the following data: Plainview, July 16, 1915, on appletree (Flint), and Algonquin, July 12, 1897 (Nason).

THREE HUNDRED AND SEVENTH MEETING, NOVEMBER 8, 1917.

THE CORRECT NAMES FOR SOME OF OUR COMMON ICHNEUMONID PARASITES.

By R. A. CUSHMAN,

Entomological Assistant, Bureau of Entomology, United States Department of Agriculture.

Among the most important parasites of the codling moth, tussock moth, tent caterpillar and many other insects of economic importance in North America are two ichneumonids that have for many years gone under the names *Pimpla annulipes* Brullé, *Pimpla inquisitor* Say, and *Pimpla inquisitoriella* Dalla Torre. But careful study of specimens and literature leads to the conviction that these names as usually applied are erroneous, and that other names already proposed must be employed.

Brullé described his *Pimpla annulipes* from South America, and one of our most common ichneumonids remained undescribed for many years because of an apparently mistaken idea that it is Brullé's species. In 1880 Provancher described it under the name *Pimpla aequalis*. So far as Brullé's description goes the North American species is very similar to *annulipes*, but the geographical distribution taken together with the color characters make it appear most unlikely that they are the same. The only character given by Brullé which would distinguish the two species is found in the color of the middle tibiae, which in *annulipes*, according to Brullé are always black, at least behind, with a white annulus. In *aequalis* the black, if at all present, is confined to that portion of the tibia basad of the annulus, with a faint trace just beyond the annulus, and frequently the tibia is entirely red, even the annulus being lacking. It is highly improbable that a South American specimen of a species would be darker in any respect than one from North America, and on this ground I ressurrect Provancher's name.

Pimpla conquisitor var. *rufuscula* Davis is simply a large form of *aequalis* with an unusual amount of red on the abdomen.

Davis (Proc. Acad. Nat. Sci. Phil., 1894, p. 190) synonymized *Pimpla marginata* Prov. and *P. ashmeadii* Prov. with *annulipes* Brullé. But Mr. Rohwer, who has seen the types of both of Provancher's species, considers them as synonyms of *tenuicornis* Cress. This last species is very closely allied to *aequalis*, being separable by the following characters:

Front tibiae in female not at all excavated beyond middle; only the hind tibiae annulated; tegulae black; front coxae black to piceous; darker in male..... *tenuicornis* Cress

Front tibiae in female more or less deeply excavated below beyond middle; middle tibiae also usually annulated; tegulae usually whitish, though sometimes brownish apically; front coxae testaceous.....*aequalis* Prov.

The latter species shows variation in all the characters toward the condition existing in *tenuicornis*, and it is very possible that *tenuicornis* is simply an extreme and comparatively rare variation from the more typical form.

Both of these species belong to the genus *Pimplidea* Vier. The synonymy is given below:

Pimplidea tenuicornis (Cresson).

Pimpla tenuicornis Cresson, Proc. Ent. Soc. Phil., IV, 1865, p. 267.
Meniscus marginatus Provancher, Nat. Can., XIV, 1883, p. 15.
Meniscus ashmeadii Provancher, Addit. Faun. Can. Hym., 1888, p. 430.

Pimplidea aequalis (Provancher).

Pimpla annulipes Authors, not Brullé.
Pimpla aequalis Provancher, Nat. Can., XII, 1880, p. 36.
Pimpla conquisitor var. *rujuscula* Davis, Trans. Am. Ent. Soc., XXIV, 1897, p. 368.

Ichneumon inquisitor Say, transferred by later writers to *Pimpla*, was renamed *inquisitoriella* by Dalla Torre because of the preoccupation of the specific name in *Pimpla*. Say also described what he called *Ichneumon inquisitor* var. α. Later Walsh described his *Pimpla coelebs*.

Say's description of *inquisitor* is very brief, and it is impossible to determine exactly what it was. But that it was an *Epiurus* there is apparently no room for doubt. Its general form and structure preclude the placing of it elsewhere. It was probably closely allied to, if not the same as, (*Pimpla*) *Epiurus indagator* (Walsh). But the synonymizing of the two is inadvisable because of the fact that in his description Say stated that his specimen was reared "from a larva (of a *Bruchus?*) which feeds in the seeds of *Clematis*." The exact status of *inquisitor* Say can therefore be determined only by rearing it again from the seeds of *Clematis*. Say's variety α is undoubtedly the same as *coelebs* Walsh, and its description as a variety of *inquisitor* is partly responsible for the great confusion in literature of biological data.

Pimpla coelebs Walsh belongs to the genus *Iseropus*.

In the records of the host relations published in connection with the names *inquisitor* Say and *inquisitoriella* Dalla Torre it is very evident that several species are confused. Those reported as having been reared from such hosts as *Laverna eloiselle*,

Grapholitha olivaceana, and *Coleophora cinerella* may be the true *inquisitor* Say, while these are possibly and that from *Mineola indigenella* is undoubtedly *Epiurus indagator* (Cresson), a species commonly reared from the last mentioned host. The weevil, *Mononychus vulpeculus*, reported by Hamilton (Ent. News, V, 1894, p. 288) as heavily parasitized by *inquisitor*, is a rather unusual but not necessarily impossible host for a parasite normally attacking lepidopterous larvae, and it may be that this again was the true *inquisitor* Say. Glover's record (Rept. Comm. Agr., 1866, p. 41) of *Thyridopteryx ephemeraeformis* as a host of *inquisitor* is obviously due to a misdetermination of the parasite; for he says "a small yellow-banded ichneumon fly," and his figure published in his "Illustrations of North American Entomology," Plate I, figure 5, could only represent *Itoplectis conquisitor* (Say), a very common parasite of *Thyridopteryx*. The *inquisitor* recorded as reared from spider egg-cocoons can be nothing but a species of *Tromatobia*, probably a dark form of *T. rufopectus* (Cress.). Riley's record (Ins. Life, I, p. 161) of *Gnorimoschema gallaesolidaginis* as a host of this species is probably based on a misdetermination of *Epiurus pterophori* (Ashm.). Most of the records of the rearing of *inquisitor* from such hosts as Liparidae and Lasiocampidae should be credited to *Iseropus coelebs* (Walsh). Such records refer to (*Orgyia*) *Hemerocampa leucostigma*, (*Clisiocampa*) *Malacosoma americana*, etc. Coquillett's record (Bur. Ent. Bul. 32, p. 30) of *Clisiocampa constricta* as a host of *inquisitor* at Los Angeles, Calif., apparently forms an exception, as what are undoubtedly the specimens on which this record was based are in the National Museum and belong to an undescribed species of *Iseropus*.

Ashmead's *Pimpla (Itoplectis) orgyiae*, except for its smaller size, is identical with *coelebs*, and additional California material from the same host as the types do not differ even in this respect.

Viereck's *Epiurus brunicfrons* differs from *coelebs* only in the color of the face in the male, and is at most worthy of varietal rank. The other two characters mentioned by Viereck are variable in the large series of *coelebs* examined.

Provancher's *Bassus cylindricus* was declared by Davis (Proc. Acad. Nat. Sci. Phil., 1894, p. 190) to be synonymous with *Pimpla inquisitor* (Say), and examination of the type by Mr. Rohwer showed it to be the male of *coelebs*, not of *annulipes* Brullé as listed by Dalla Torre.

We therefore have the following synonymy:

Epiurus inquisitoriella (Dalla Torre).

Ichneumon inquisitor Say, Contrib. Macl. Lyc. Phil., II, 1828, p. 71.
Type Lost.

?Pimpla, Epiurus, or *Iseropus inquisitor* (Say), Authors, in part.
Pimpla inquisitoriella Dalla Torre, Cat. Hym., III, 1901, p. 435.
?Pimpla, Epiurus, or *Iseropus inquisitoriella* Authors, in part.

Iseropus coelebs (Walsh).

Ichneumon inquisitor var. a Say, Bost. Journ. Nat. Hist., I, 1835, p. 234.
Type. Lost.
Pimpla coelebs Walsh, Trans Acad. Sci. St. Louis, III, 1873, p. 141.
Type. Destroyed. Neotype in U. S. Nat. Mus.
Bassus cylindricus Provancher, Addit. Faun. Ent. Can. Hym., 1889, p. 111.
Pimpla, Epiurus, or *Iseropus inquisitor* (Say), Authors, in part
Pimpla, Epiurus, or *Iseropus inquisitoriella* Authors, in part.
Pimpla (Itopleetis) orgyiae Ashmead, Trans. Am. Ent. Soc., XXIII, 1896, p. 213.
Pimpla (urus) bruneijrons Viereck, Ent. News, XX, 1909, p. 391.

THREE HUNDRED AND NINTH MEETING, JANUARY 3, 1918.

The annual presidential address was given by Prof. Chas. R. Ely, the subject chosen being "Recent Entomological Chemistry and Some Notes Concerning the Food of Insects."

RECENT ENTOMOLOGICAL CHEMISTRY AND SOME NOTES CONCERNING THE FOOD OF INSECTS

BY CHARLES R. ELY

In treating the subject of this paper it is the intention of the writer to consider only such data as have found their way into chemical literature during the past eleven years. The reason for selecting this period of time is that the discussion is based upon the articles or papers listed in Chemical Abstracts, a journal published by the American Chemical Society, which appeared for the first time in 1907. This Journal covers the chemical literature of the world in an exhaustive manner, as may be seen by the fact that the index to the first ten volumes, which is now in the course of publication, will contain about 6000 pages and about 800,000 entries.

In examining the thousands of pages of abstracts listed to see which ones were of interest from an entomological standpoint, in the broadest sense, and after including everything which could be classified as falling under this head, only a few more than 800 titles were found to have been secured. In making up this list,

abstracts concerning substances or compounds known to be found in, or in connection with, insects were not included, unless they had to deal with an investigation having a direct bearing on entomology.

An arbitrary classification of the 800 or more titles above mentioned led to the following result:

	per cent
Honey and beeswax	27.5
Silk	27.3
Insecticides	20.4
Biochemical, Biological and Misc.	15.7
Well known economic products	9.0

It will be seen from this list that entomological contributions to Chemistry have, in recent years at least, been made very largely by the insects themselves.

The greater part of the work referred to concerning Honey and Beeswax was analytical and had to do with the examination of the purity of these substances and with their valuation.

With Silk, as with honey and beeswax, there was but a small portion of direct interest to the entomologist. A large part of the work concerned the properties of silk in relation to dye stuffs and textiles.

In the case of Insecticides, as would perhaps be expected, the greater number of investigations dealt with their analytical examination, manufacture, etc.

The above three groups are not here taken up for detailed discussion, but those interested in any of these subjects will probably find many valuable papers listed in the Index referred to at the beginning of this article. In fact one of the purposes the writer had in mind, in preparing this paper, was to call attention to this useful publication.

Under the well known products of economic importance were included those to which several references were made. These were nutgalls, cantharides, lac and cochineal. As with insecticides already mentioned, references in regard to these products were, for the most part, concerning analytical methods for their examination and commercial valuation.

Under the list entitled Biochemical, Biological and Misc. are included a number of references an examination of which may be not without interest. These included, on the one hand, subjects of peculiar interest to the entomologist, such as the chemical examination of chitin from insects and concerning which it was to be expected that considerable work would have been done in the period covered. On the other hand, one notes unexpected and

curious bits of information such as that concerning the use of beetle larvae for arrow poison[1] or that in regard to the "manurial value of locusts."[2]

At times there are found references which may be regarded as of interest to the chemical investigator in a negative sense, as in the case of a paper which tends to show that insect coloration is, at times, due to physical causes rather than to the properties of definite chemical compounds in the form of pigments.[3]

A few papers were found which were of interest to the collector primarily, such as those dealing with methods for preserving or protecting collections or, in one case, a paper in which it was asserted that in baits for insects frequenting fragrant flowers it is the sugar in the bait which attracts the insects. Experiments in which various essences were used tended to show that fragrant essences, such as that of mint or the like, were without added attractiveness.[4]

The remaining investigations may be classed under the heads of biochemical and biological researches. With these we might mention a few which dealt with vegetable products, such as manna which, as with galls, may owe their formation or deposition to the work of an insect or to an insect poison or stimulant.

Among the biochemical references are some dealing with definite chemical compounds. Such are those giving the chemical composition of substances found in the bee, in its different stages, or of the silk worm. One abstract of interest announced the finding of certain carbohydrate ferments in species of Diptera and Lepidoptera.[5] In other papers but a single compound is mentioned, as for example urea, which is stated to be found in insects generally,[6] the presence of calcium oxalate in crystals in "la Blatte" (Cockroach),[7] and of formaldehyde as a protective poison in the case of ants.[8]

In some instances the investigations, while of interest, have led to less definite results, in a chemical sense, the exact nature of the substances not having been determined. Examples of this class may be found in studies dealing with pigments in beetles and butterflies,[9] and the nature of the poisons of the browntail

[1] Trommsdorff, Arch. Schiffs-u-Tropenhuyg. 13, 617. C. A. 6, 892.
[2] Anon., Bull. Impl. Inst., 14, 290–1 (1916). C. A. 10, 3132.
[3] Mallock, Proc. Roy. Soc. Lond., 85, 598–605. C. A. 6, 571.
[4] Plateau, Bull. Sci. acad. roy. Belg., 1910, 144–6. C. A. 4, 2664.
[5] Strauss, Z. Biol., 52, 95–106. C. A. 3, 1182.
[6] Fosse, Ann. inst. Pasteur 30, 642–76 (1916). C. A. 11, 1432.
[7] Hallez, Compt. rend., 148, 317–18. C. A. 3, 1284.
[8] Tzitovich and Smirnov, Compt. rend. soc. biol., 77, 122–3 (1914). C. A. 11, 666.
[9] Gortner, C. A. 5, 1921; 6, 893; Gebhardt, 7, 3797; Hasebroek, 10, 787.

moth[10] and of the hornet.[11] To a less extent also this is true of two papers dealing with "chrysalis oil" obtained from the pupae of the silkworm.[12]

Under the head of biological chemistry may be found some interesting results of experiments in feeding, some of which will be referred to later. The changes caused in chlorophyll by which a red pigment is produced is noted, in the case of Lepidoptera[13] and, in another instance, it is shown that the so called "grasshopper green" is not chlorophyll, as had formerly been supposed to be the case.[14] One reference deals with the effect of starving in regard to certain physiological compounds in the eggs of a species of bark beetle.[15] With silk worms the effect of feeding glycocoll on the properties of the silk which is produced, is shown[16] and, in another investigation, the influence of lime, in the food, upon the insect and its silk.[17] The latter experiment is a very interesting one and the claim is made by the investigator that silk worms which have had calcium salts added to their food thrive upon this diet better than upon a natural one. It is stated that larger pupae and cocoons are produced and a greater weight of silk.

Two investigators have occupied themselves with the problem of immunity shown by certain insects to the alkaloid poison strychnine.[18]

When several workers are engaged upon the same problem it sometimes happens that their results lead them to make deductions which are widely divergent or even contradictory. A case in point concerns the question of whether the chrysalids of butterflies have the power of obtaining carbon from the carbon dioxide of the surrounding atmosphere. A number of references were found concerning a controversy over this question which extended from 1907 to 1912.[19] One of the authors referred to

[10] Lyzzer, J. Med. Res., 16, 43–64. C. A. 1, 1293.

[11] Bertarelli and Tedeschi, Centr. Bakt. Parisitenk, 1. Abt., 68, 309–17. C. A. 7, 2433.

[12] Lewkowitsch, Nahr. genussm., 12, 659–60. C. A. 1, 786.
Tsujimoto, J. Coll. eng. Imp. Univ. Tokyo, 4, 63–74. C. A. 2, 2024.

[13] Petersen, Naturwiss. Wochschr., July, 1913. C. A. 7, 4019.

[14] Przibram, Ges. Physiol., 153, 385–400. C. A. 7.

[15] Knoche, Verh. Deut. Zool. Ges., 18, 224–30. C. A. 3, 2312.

[16] Pigorini, Arch. farm. sper., 20, 225–57, 1915. C. A. 10, 74.

[17] Hatano, Bull. de l'Assoc. sericole du Japan, March, 1916, 1–4. C. A. 11, 1491.

[18] Juckenack and Grübel, Z. Nahr. Genussm., 19, 571. C. A. 4, 2339.
J. C. de Ruijter de Wildt., Nahr Genussm., 20, 520. C. A. 5, 751.

[19] a. M. von Linden, Bonn. arch. Physiol. (Engelmann). 1907, 162, 208. C. A. 1, 2801.

b. M. von Linden, Arch. anat. physiol., Suppl. Bd. 1910, 153–98. C. A. 6, 2795.

c. E. T. v. Brücke, Arch. Nat. Phys., Waldeyer-Engelmann., Physiol. Abt., 1908, 431–44. C. A. 4, 1190.

d. Buytendijk, Biol. Zentr., 31, 643. C. A. 6.

also claimed that there was evidence showing that four-fifths of the newly formed protein in the chrysalids obtained its nitrogen from the surrounding atmosphere.[20] These claims are most unusual and the present writer is not aware that the original claimant has received the support of other investigators.

An interesting case of a single problem attracting the attention of a number of investigators is shown by the references to papers regarding fire flies and other light producing insects. These papers began to appear, in the literature under discussion at least, in 1911 and have continued to appear up to the present time. The work referred to covers the manner in which light is produced, the nature of the light, and that of the substances concerned in its production.[21]

One of the main purposes in publishing this paper, and in reviewing the work that has been done recently, in the field of entomological chemistry, is to call attention to the fact that this field is not overcrowded and that it affords many attractive opportunities for study and experiment. It is very gratifying to note that one of our most eminent scientists, Jacques Loeb, during the last three years has been engaged in researches which come within the scope of this review. In 1915 there appeared an article by him on the simplest constituents required for growth and the completion of the life cycle in an insect.[22] In 1916 another was published on the salts required for the growth of insects[23] and, in 1917, a third in which he shows, in an investigation regarding the growth of certain flies, that yeast is a necessary food for species of the genus *Drosophila*, and that, while these flies may be kept alive on other foods, yeast is necessary for the production of offspring.[24]

The very broad nature of the problem which Loeb is helping to solve should be here noted. What is required in the food of insects for their growth and reproduction? This is indeed a difficult question and one which may never be completely answered. It would seem however, judging by Loeb's success with the lesser problem, in the case of *Drosophila*, that the necessary food of a particular insect may in some cases be determined.

In the case of the Lepidoptera, with which the writer is more familiar, one finds at his disposal a vast amount of data with regard to the food of a very great number of the species listed. That these lists of foods, supposedly required, are not always satisfactory is a matter of common knowledge.

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[20] M. v. Linden, same as (19) b. above.

[21] Thirteen references may be found in Chemical Abstracts in volumes 5, 6, 7, 8, 9, 10, and 11.

[22] Loeb, Science, 41, 169–70 (1915). C. A. 9, 1944.

[23] Loeb, J. Biol. Chem., 23, 431–34. C. A. 10, 354.

[24] Loeb, J. Biol. Chem., 27, 309–12. C. A. 11, 851.

The writer remembers his disappointment when, upon first becoming interested in entomology, he had the good fortune, as he then regarded it, of having a fine lot of larvae of the common luna moth. Upon having to move to another locality, and not finding the food plant available upon which the colony was being fed, he changed to another food plant which the text books said was also a customary food for this species. The colony flourished and in time a goodly number of cocoons and, finally, of adults was secured. Hoping to obtain a much larger number of specimens, some of the moths were mated and the eggs kept for further experiments, but, much to the surprise and disappointment of the experimenter, none of the eggs hatched. It is of course quite possible that the disastrous results in this case were due to the sudden change in diet, rather than to its unsuitability, and that satisfactory results might have been secured had the second food been used from the beginning.

In an experiment carried out during the past summer with what appeared to be the same species of saw fly, an *Argid*, found upon *Amelanchier* and also on *Crataegus*, a portion of the larvae were in each case transferred to the other food plant. It was found that, in this instance, the larvae in both cases throve on *Crataegus* while unsatisfactory results were obtained on *Amelanchier*. While not conclusive, this experiment is used to illustrate the fact that the food plant, upon which a larva is found to be feeding, may be one which will not enable the insect to undergo its later transformations.

Another series of experiments were carried on several years ago with some larvae of another saw fly, *Croesus latitarsus* Norton, which were believed to feed on two species of birch, *B. lenta* and *B. populifolia*. Larvae were at this time found in great numbers on the latter but none on the former food plant and some attempts were made to rear larvae by transferring them to *B. lenta*. It was found, in all cases, that the larvae if transferred when very young would die, while if they were changed during one of the later stages they could sometimes be brought through satisfactorily, at least so far as securing adults is concerned.

Such instances as those given above are probably familiar but are given to illustrate certain points in regard to the question of what should be considered a "food plant." Starting with a case in which the larva lives for a short time only, whether the egg be deposited on the plant itself, or whether the larva begins to feed upon it in one of its later stages, we may have instances in which the larva feeds upon it throughout all its stages, but dies in the pupal state or, if it produces an adult, is infertile. Finally we may, conceivably, have a case where for several generations the insect may feed upon the same food plant and then

die out. Wherever the line is to be drawn it would appear that there is need that our lists be more carefully kept, than is usually the case, for the purpose of determining for a given species what are the satisfactory or the necessary food conditions.

All of the above has probably been stated by others in a much more satisfactory manner than in the present instance. The writer wishes to emphasize this matter, in connection with the subject of this paper, in order to urge that our entomological records be so kept that those who may in the future be engaged in investigations concerning the food of insects, from the chemical standpoint, may have helpful and, in so far as possible, accurate and reliable data at their disposal.

THREE HUNDRED AND TENTH MEETING, FEBRUARY 7, 1918.

A NOTE ON CHALCIS ABIESAE GIRAULT (HYM. CHALCIDIDAE).

BY S. A. ROHWER,

Specialist in Forest Hymenoptera, Bureau of Entomology, Washington, D. C.

Chalcis ovata abiesae Girault, Descriptiones Stellarum novarum, 1917, p. 19. (This is a privately published leaflet dealing with descriptions of new chalcids.)

The form which Mr. Girault described as variety *abiesae* may perhaps better be treated as a species. Besides the characters given in the description this form differs from the typical eastern form in the closer punctures on the scutum, in having the median lower notch in the carina defining the antennal foveae broader and U-shaped, and in having the supraclypeal carina less strongly arched medianly; these characters hold for a series bearing the same data as the type series and also for a series collected at Palo Alto, California on the foliage of *Quercus agrifolia*, by F. B. Herbert.

DESCRIPTION OF A NEW HYMENOPTEROUS PARASITE (BRACONIDAE).

BY A. B. GAHAN,

Bureau of Entomology, U. S. Department of Agriculture.

The new species of *Microbracon* described below is, according to Mr. C. N. Ainslie, an important parasite of the western grass-stem sawfly, *Cephus cinctus*.

Microbracon cephi, new species.

This species resembles *M. lixi* Ashmead and *M. furtivus* Fyles but may be distinguished by the shorter ovipositor. The male is very similar to *M. rhyssemati* Ashmead but may be separated by the longer antennae and smoother propodeum. The cocoons of *rhyssemati* are dark brown with thicker walls than in this new species which has pale parchment-like cocoons, squarely truncate at each end and placed singly in the burrows of its host.

Female.—Length 4.1 mm. Antennae 38-jointed in the type; frons and face very delicately and faintly shagreened, remainder of head and thorax polished; propodeum faintly sculpture at posterior middle on each side of the incomplete median carina; abdominal tergites all granularly opaque; suturiform articulation deep, crenulate, and scarcely at all angled at the middle but curving forward slightly at the margins of segment; ovipositor exserted not over half the length of abdomen. Color reddish testaceous; antennae, eyes, ocelli, ovipositor sheaths, apex of hind tibiae, their tarsi, and the apical joint of fore and medium tarsi black or blackish; wings subhyaline, the stigma blackish, venation brownish.

Male.—Length 3.5 mm. Antennae 40-jointed in the allotype, and distinctly longer than the body; posterior tibiae and their tarsi only slightly infuscated; otherwise like the female.

Type locality.—Bottineau, North Dakota.

Type.—Cat. No. 21772, United States National Museum.

Host.—Larva of *Cephus cinctus* Norton.

Type and one female paratype reared by Mr. Ainslie from *Cephus cinctus* infesting stems of *Agropyron* and recorded under Webster No. 14788. Allotype and a male paratype bear Webster No. 13734 and were reared by the same collector at Minot, North Dakota from the same host in stems of *Elymus*. Two female paratypes are from the same host in stems of *Bromus* from Rugby, North Dakota, and are recorded under Webster No. 14786. One female paratype was reared by Mr. Norman Criddle at Treesbank, Manitoba, from *Cephus cinctus* in the stems of *Elymus canadensis* and is recorded under Webster No. 14788.

The last mentioned paratype has the head above the mesoscutum for the most part and the propodeum blackish, showing that the species is variable in color.

SOME MUSCOID SYNONYMY, WITH ONE NEW GENUS.

By Charles H. T. Townsend.

The following synonymic notes have been held in manuscript for a year and should be published without further delay.

Xenoppia hypopygialis Towns.—Synonym, *Camptopyga aristata* Ald., Sarc. & Allies, 41–3, genus and species.

Oppiopsis sheldoni Coq.—Synonym, *Harbeckia tessellata* Ald., op. cit., genus and species.

Wohlfahrtia opaca Coq.—I consider this species distinct from the European *meigenii* Schiner, which it represents in western America. It furnishes another example of west American species closely resembling European congeners. Synonym, *Wohlfahrtia meigenii* Ald. (nec Schiner), op. cit.

Wohlfahrtia chittendeni Coq—This is evidently distinct from *vigil* Walker. The holotype has red hypopygium and the other characters do not accord.

Paraphrissopoda lamanensis RD.—Synonym, *Sarcophaga wiedemanni* Ald., op. cit., 193–6.

Paraphrissopoda auribarbata Towns.—Synonym, *Sarcophaga cotyledonea* Ald., op. cit., female only. Aldrich's allotype is identical in every character with the holotype of *auribarbata*. Aldrich's holotype is evidently specifically distinct from the allotype, as it does not agree in various characters. The holotype may be conspecific with *circumcisa* Rdi., or *chrysostoma* Wied. It is evidently not *otiosa* Willist., which, like *auribarbata*, has the first hypopygial segment red.

A male from Mayaguez, Porto Rico, October 31, 1913 (Van Zwaluwenburg), agrees exactly in pollen, pile color and bristle characters with the females from Peru. The species is distinct from *otiosa*, which has the abdomen bluish silvery-white pollinose. Synonym, *Sarcophaga capitata* Ald., op. cit., male only, being the holotype.

Paraphrissopoda otiosa Willist.—I determine a male from Barbados as this species. The cotype specimens, male and female, studied by Aldrich, may not be the same form as the holotype. It seems very doubtful if the females mentioned by Williston under *concinnata* are this species. *Sarcophaga amoena* Ald., op. cit., is very likely this species. *Sarcophaga capitata* Ald., female, allotype, is same as *amoena* allotype.

Paraphrissopoda hillifera Ald.—The three females referred to *spectabilis* Ald., op. cit., are this species. The chaetotaxy of anal segment shows this. They are TD 1246, 1289, etc.

Oxysarcodexia ochripyga Wulp—Synonym, *Sarcophaga australis* Ald., op. cit.

Argoravinia argentea Towns.—Synonym, *Sarcophaga fissa* Ald., op. cit.

Spirobolomyia basalis Walker—It is almost certain that *singularis* Ald. is a synonym of this species. The peculiar color characters given by Walker seem to fix the determination.

Sarcophagula occidua F.—I am unable to identify *Tachina pusilla* Wied., type of *Sarcophilodes* BB., as distinct from *occidua*. Wiedemann's description agrees exactly with material.

Protodexia hunteri Hough—Synonym, *P. synthetica* Towns.

Euphyto subopaca Coq.—Described as *Leucostoma subopaca*, 1897. Made type of *Euphyto* Towns., 1908. Synonym, *Tetropsis modesta* Coq., 1910, genus and species.

Pseudomyothyria ancilla Walker—*Tachina ancilla*, Dipt. Saund., 299, is certainly this genus. *P. indecisa* Towns., described from Illinois, is probably only a subspecies of *ancilla*. *P. perplexa* Towns., measuring 3.5 mm., described from Peru, is nearly as small a species as *ancilla*, which measures 2.5 mm. This is not *Frontina ancilla* Coq., for which see the following.

Frontiniella pararcilla Gen. et sp. nov.

New name for *Frontina ancilla* Coq., 1897, Rev. Tach., 106 (nec Walker, Dipt. Saund., 299). Holotype, No. 21593 U. S. N. M.

Measures 4.5 to 5 mm. in length. Twenty specimens, both sexes, reared by Mr. H. G. Ingerson, Benton Harbor, Michigan, June and July, 1916; transmitted through Mr. W. R. Walton.

Differs from *Frontina* as follows:—Second antennal joint shorter in proportion to third joint. No discal macrochaetae on abdominal segments. Frontalia much narrower. Facialia not ciliate over about one-half way. Arista not so long, thickened on basal half only. Male front narrower. No median marginal macrochaetae on first abdominal segment. No decussate apical scutellar bristles in either sex.

The great disparity in size caused me to doubt Coquillett's determination of this species as *ancilla* Walker. Comparison of specimens of this and the preceding disclosed the fact that Walker's description fits *Pseudomyothyria* closely in structural details, such as length and thickening of arista, apical, crossvein not bent in, fourth vein very obtuse at bend, third antennal joint linear and slender, etc., in all of which it disagrees with the present form, *Frontiniella*.

A NEW GENUS OF LEPIDOPTERA ALLIED TO LEUCOPTERA HUBNER.

By Carl Heinrich,

Specialist in Forest Lepidoptera, U. S. Bureau of Entomology.

Paraleucoptera gen. nov.

Type: *Cemiostoma albella* Chambers.

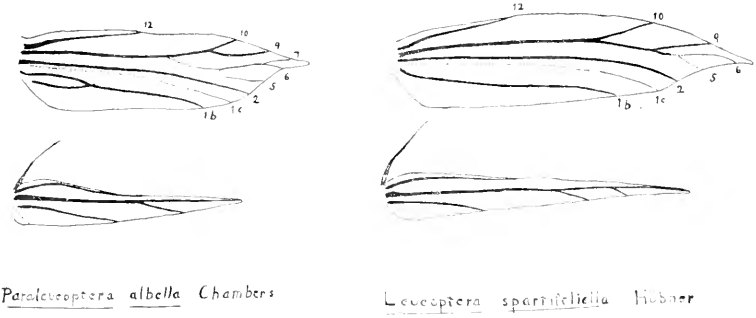
In 1902 (Jn. N. Y. Ent. Soc., Vol. X, pp. 98-99) Busck erected the genus *Proleucoptera* with *smilaciella* Busck as the type. He included in his new genus (*Cemiostoma*) *albella* Chambers calling attention, however, to its more advanced neuration. In the

foregoing paper I had occasion to mention the differences in the maxillulae of the larvae of the two species. These are shown in figures 28 and 29 (Plate IV). There is also quite a striking difference in the relative position of the setae on the ventral side of the epicranium. In *albella SO-3*, *SO-2*, and *O-2* (Plate IV, fig. 34) are well separated and in a line close to the lateral margin while in *smilaciella SO-3* has moved forward until it is on the level of *SO-2* (between *SO-2* and the hypostomal ridge). *O-2* and *A-3* have also moved further forward on the head in *smilaciella*.

In venation the two species agree in having *1-b* of forewings furcate at base, but *smilaciella* has an extra vein (3 of *FW*) not found in *albella*, 11 is present and strong and all veins are separate. In *albella* 6 and 7 are long stalked, the base of 5 is weak, 11 nearly obsolete and the cross vein of the cell between 2 and 7 very weak and obsolete between 7 and 9. While no two species of the old genus *Leucoptera* (*Cemiostoma*) have identical venation, the amount of difference which justified the separation of *Proleucoptera* from the group should also exclude *albella* from *Proleucoptera*. The larval differences offer a very strong argument for their separation. On the other hand if the erection of *Proleucoptera* was valid we cannot associate *albella* with the type of *Leucoptera* (*spartifoliella* Hubn.). The latter has *1b* of the forewings simple at base, 7 is obsolete or nearly so, 5 is absent or very weak, and the cross vein of the cell is lost between 2 and 6 but fairly strong between 6 and 9.

I am therefore proposing *Paraleucoptera* as the name of a new genus for *albella* Chambers. The European *susinella* H-S would also go in this genus.

The complete venation of *albella* and *spartifoliella* is shown in the following figures.



Paraleucoptera albella Chambers

Leucoptera spartifoliella Hübner

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THREE NEW CHALCIDOID EGG-PARASITES.

By A. B. Gahan.

In this paper will be found descriptions of two species of *Mymaridae* and one species of *Trichogrammatidae*.

Family MYMARIDAE.

Tribe Gonatocerini.

Gonatocerus ornatus, new species.

This species should be easily recognized by the pallid lines on the head and thorax. No other species known to the writer is thus ornamented.

Female.—Length .9 mm. Head and thorax smooth and polished, only the face below the antennae weakly sculptured; abdomen apparently smooth (wrinkled somewhat in drying). Antennae not quite as long as the body; scape flattened, slightly swollen beyond the middle and rounded at apex, narrowly spatulate in outline; pedicel very slightly longer than broad at apex; funicle gradually thickening from base to club; joints one and two of the funicle subequal, slightly longer than broad, together about equal in length to the pedicel and approximately one-third as thick as the pedicel at apex; funicle joint three about one and one-half times as long as thick, shorter than joint four which is twice as long as thick; joints five, six, and seven subequal and each distinctly longer than four; joint eight slightly shorter than seven; club solid and a little longer than the three apical joints of funicle combined; face below antennae with a distinct fold extending from the base of each antenna to the clypeus and converging slightly anteriorly; antennal grooves narrow and shallow but distinct and well separated below, converging above at the front ocellus; parapsidal grooves impressed; propodeum apparently smooth; forewing moderately broad with dense evenly distributed cilia, the longest marginal cilia equal to less than one-fourth the greatest breadth of wing; submarginal vein with a single stiff bristle basad of the middle; abdomen rather robust, longer than the head and thorax, the ovipositor sheaths extending very slightly beyond the apex of abdomen. General color shining black; the antennal grooves, a narrow line on vertex from lateral ocellus to eye-

margin, a narrow curved line on occiput connecting the lateral ocelli, a line on each lateral margin of the praescutum following the parapsidal grooves, a broader line on the lateral margins of the scutellum, and a spot on each side of the postscutellum pale yellow or whitish; frequently also an obscure longitudinal pale line on each side of the middle of propodeum; antennae brownish black, the scape at base and the pedicel brownish testaceous; coxae entirely and all femora and the hind tibiae for the most part blackish, the trochanters, apices of all femora, fore and middle tibiae and all tarsi pallid, the middle tibiae more or less stained with fuscous; wings uniformly subhyaline.

Male.—In size and color markings agrees with the female. Antennae slightly longer than the body, the scape short, about twice as long as the pedicel which is barely as long as thick; first funicle joint slightly the shortest of the funicle joints and about one and one-half times the length of pedicel; joints beyond the first funicle joint subequal in length and tapering slightly in width toward the apex; club not differentiated. Otherwise like the female.

Type locality.—Tempe, Arizona.
Type.—Cat. No. 21698 U. S. N. M.
Host.—Eggs of *Stictocephala festina* Say.

Nineteen females and eighteen males, all from the type locality, and reared by V. L. Wildermuth under Webster No. 6190. Eighteen of the females bear, in addition to the Webster number, the label Tempe No. 2739 while one female and all of the males bear Tempe No. 2738. The type and allotype are mounted in balsam on slides for better preservation. All paratypes are on card points. The description was for the most part drawn from the types before being mounted on slides.

Polynema imitatrix, new species.

Very similar to *sibylla* Girault but differs by being smaller in size, the abdomen shorter and more robust, the marginal cilia of the forewing two-thirds as long as the breadth of the wing or a little more than two-thirds as long, the ovipositor not or barely exserted. Differs from *piceipes* Girault by having much longer marginal cilia on the forewing. Distinguished from *maculipes* Ashmead by having fine and moderately dense discal cilia on the forewing.

Female.—Length .95 m. Smooth and polished without apparent sculpture. Antennae about as long as the head, thorax and abdominal petiole combined; first funicle joint very slightly more than half as long as the second; third funicle joint approximately two-thirds as long as the second; the joints beyond the third subequal and about the same length as the first joint but distinctly thicker; club rather robust and nearly as long

as the three last joints of the funicle combined; forewings moderately broad with short moderately dense discal cilia; abdomen a little longer than the head and thorax and rather robust; legs slender. Head, thorax, and abdomen except the petiole polished black; antennal funicle and club black or blackish, the basal joints of funicle often slightly testaceous; scape, pedicel, legs including all coxae, and the basal joint of abdomen pale testaceous; apical joint of all tarsi blackish; the middle and front femora sometimes slightly infuscated; wings hyaline, venation testaceous.

Male.—Length .88 m. Antennae much longer than the whole body, the first funicle joint very slightly shorter than the second; second and third funicle joints nearly equal, the joints beyond the third to apex of antennae subequal and very slightly shorter than the third; other characters as in the female.

Type locality.—Tempe, Arizona.
Type.—Cat. No. 21703, U. S. N. M.
Host.—Eggs of *Stictocephala festina* Say.

Eighteen females bearing Tempe No. 2739 and twelve males bearing Tempe No. 2738, all reared by Mr. V. L. Wildermuth and recorded in the Bureau of Entomology under Webster No. 6190. Type, allotype, thirteen female paratypes, and nine paratype males mounted on slides in balsam. Four female and two male paratypes mounted on card points. The type series was evidently reared along with the types of *Gonatocerus ornatus* Gahan, ante, and from the same material, since the rearing numbers are identical for both series of specimens.

Family TRICHOGRAMMATIDAE.

Abbella (Ittys) perditrix, new species.

Very similar to *Abella (Ittys) ceresarum* (Ashmead) Girault but differs by being smaller in size, paler in color, the forewings distinctly less strongly ciliated discally, the fuscous stain below the stigmal vein entirely absent, the discal ciliation of hind wing more reduced. Differs from *subflava* Girault and allies in having the funicle joints distinctly longer, and a transverse row of discal cilia behind the stigmal vein. Differs from *nympha* Girault in the shorter marginal cilia of the forewing.

Female.—Length .85 mm. Antennae rather long, scape normal, pedicel longer than the whole funicle, approximately twice as long as broad; one distinct ring-joint and what appears to be a second which is distinctly separated from the base of the first funicle joint; first funicle joint longer than broad, the apex somewhat obliquely truncate, its upper margin longer than the lower; second funicle joint not longer than broad, narrower at base than apex; club long, narrowly fusiform, slightly thicker at base, distinctly three-jointed; the joints subequal in length, joints one

and two of the club combined about equal to the combined funicle and pedicel; forewing broad, evenly rounded at apex, the discal cilia sparse and arranged in several distinct rows as follows; a row from the uncus of stigmal vein to the anterior margin of wing near apex and corresponding to the radial vein of some Hymenoptera, the area before this row with only three or four irregularly placed cilia; a very distinct row from the apex of stigmal vein to the apical middle of wing and between this row and the one corresponding to radius lie about five shorter rows of less regularly arranged cilia; behind this median row and extending to the apex of the wing is a moderately broad nearly hairless streak bounded caudad by another distinct row of cilia; the ciliation behind this row sparse and consisting of about three or four more or less poorly defined rows with some irregularly placed cilia between; transverse row of cilia behind the stigmal vein composed of about six hairs; longest marginal cilia of the forewing equal to approximately one-fourth to one-fifth the greatest breadth of wing; discal ciliation of the hind wing very weak and apparently consisting of a very obscure row along the anterior margin, and a somewhat more distinct row medially, otherwise entirely bare; marginal cilia on the posterior margin of the hind wing fully twice as long as the width of wing, those on the front margin hardly half as long as the wing breadth; front tibiae slightly swollen with three obscure tooth-like projections on the anterior margin each bearing a short spine or hair; abdomen longer than head and thorax, pointed at apex; ovipositor barely exposed at apex. Color very pale lemon yellow, the eyes and ocelli reddish when mounted in balsam; mandibles brownish; first joint of funicle and the first and last joints of club blackish; pedicel also slightly fuscous above; apex of ovipositor sheaths black; apical tarsal joints blackish; wings hyaline, the venation pale.

Male.—Length .71 mm. Except for the slightly smaller size and the fact that the abdomen is slightly shorter and not pointed at apex the male agrees with the female.

Type locality.—Tempe, Arizona.

Type.—Cat. No. 21699 U. S. N. M.

Host.—Eggs of *Stictocephala festina* Say.

Described from nine females and twelve males reared by V. L. Wildermuth under Bureau of Entomology WebsterNo. 6190, Tempe No. 2740. Type, allotype, and seven paratypes mounted on slides. Others on card points.

ON THE LEPIDOPTEROUS GENUS OPOSTEGA AND ITS LARVAL AFFINITIES.

By Carl Heinrich,

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It has been the writer's good fortune during the past year to be able to study the larvae of two species[1] of this interesting genus and to ascertain certain facts in regard to the modification of the head capsule and trophi which throw considerable light on its relationship to other bark and leaf-mining Microlepidoptera.

The proper position of the genus *Opostega* in lepidoptera classification has been uncertain. Meyrick (6–7) associates it with *Bucculatrix, Lyonetia, Phyllocnistis, Leucoptera,* etc. in his concept of the family *Lyonetidae* Spuler (8) places it in the subfamily *Oposteginae* under the *Nepticulidae*. Busck (2) likewise connects it with the *Nepticulidae* and our latest list (1) follows him in this; but in all late classifications, *Leucoptera* (*Cemiostoma*) and *Lyonetia* with which *Opostega* has much in common are placed far from *Nepticula*. Both groups have a number of characters in common, the large developed eye caps, maxillary palpi, and the short drooping labial palpi. Both show a corresponding advance in venational development. On the other hand the *Nepticulidae* as well as the *Tischeriidae, Opostegidae, Adelidae, Prodoxidae, Incurvariidae* and *Micropterygidae* all possess certain aculei on the wings which are lacking in the *Leucopterygidae* (*Cemiostomidae*), and it is the retention of this primitive and significant character which has largely determined the placing of *Opostega* with *Nepticula* and away from *Leucoptera*. The venation of *Opostega* is the most advanced in the Lepidoptera. The forewings have no cross veins and only three horizontal veins, and in the hind wings the venation is reduced to six veins, (3 and 4 absent, and the cell open between 2 and 5). If we compare this venation with that of any species of *Nepticula* or with that of *Leucoptera* (*L. spartifoliella* Hbn. for example) we can easily understand how it could be derived from either one. Both in the *Leucopterygidae* and *Nepticulidae* reduction in venation is going on at a rapid rate, but by methods somewhat different. In *Opostega* the result has been achieved and nothing remains to show if it has followed the tendencies exhibited by the one or the other of the two groups or, for that matter, followed a course different from either. And this is significant; for it

[1] An unnamed *Opostega* species from Honolulu, T. H., mining the leaves of "Pela," collected by Mr. Otto H. Swezey (1915), and *O. nonstrigella* Chamb., larva found mining stems of Ribis and moths reared by Mr. J. G. Grossenbacker (Geneva, N. Y., 1910).

must be remembered that these forms, however primitive they may be in group origin, are all highly specialized representatives upon whom biological influences have produced a startling and wide variety of modifications. *What* is lost, or retained, or changed is therefore of considerably less significance than *how* the loss or change came about or how adverse or favorable the biological conditions have been to any character that has been retained. The tendency to lose certain veins rather than others where either could be sacrificed to the same advantage, or the tendency to modify certain parts of the larval head rather than other parts when either modification would produce a form equally suited to conditions is more important than the mere form that results. One is distinctly an inherited character, the other often merely biological.

This brings us to our consideration of the larva of *Opostega* (Plate I) with which we are here chiefly concerned. In general appearance it resembles nothing in the Lepidoptera except in a very superficial way certain sap-feeders of the *Gracilariidae* with which it has in reality nothing in common. The head (figs. 8, 9) is oval, wedge-shaped, widest near the hind margin, flattened to a extreme degree, with two long, thin blades (*Bl*) articulated to the dorsal hind margin at the posterior extremities of the adfrontal ridges (*ADFR*) and extending into the prothorax. The frons (*FR*) is widest at the hind margin, narrowing slightly anteriorly and bearing the two frontal punctures (*Fa*) just back of the anterior margin. The frontal setae are absent as are also the adfrontal areas with their setae. There is nothing to correspond to the bridge (*Ob*, figs. 16, 33) connecting the posterior dorsal extremities of the adfrontal ridges in so many leaf and bark miners, and so conspicuously developed in the sap-feeding *Gracilariidae*. The articulation between frons and epistoma is very decided and the latter part greatly developed, fused with pleurostoma (*EP* + *PLR*) and completely enclosing all but the anterior margin of the labrum. The labrum (*L*, fig. 1) itself is very peculiar. It is thin, weakly chitinized, and capable of little or no movement. There is one median and one lateral, hairless tubercle on the anterior margin on either side of the epipharyngeal shield. Both the epipharyngeal teeth (*ET*) and the epipharyngeal shield (*ES*) are enormously developed and thrust well forward of the limits of the labrum. The shield might easily be mistaken for the labrum itself save that it bears no setae or punctures and has none of the muscle attachments peculiar to that organ. Of the epicranial setae only three remain, two on the dorsal surface (representing most probably *A-1*, and *A-3*) and one on the ventral surface (one of the larger of the sub-ocellar or ocellar groups, either *SO-3* or *O-3*). There are

no traces of either ocellar pigment or lenses. The lateral margin of the epicranium is thickened into a conspicuous, dark, heavy endoskeletal ridge (*LtR*) articulating at the lateral angle of the antennal ring and continuing back to where the dorsal and ventral hind margins unite on the lateral edge; from here it divides apparently into two arms, one curving around the dorsum and forming the dorsal hind margin and finally fusing without appreciable articulation with the adfrontal ridge, the other curving similarly on the venter and fusing (also without articulation) with the long ridge (*Hr*) of the hypostoma. This lateral ridge, the peculiar development of the hypostoma and the modification of certain of the mouth parts are the most striking and significant characters of this unique head. The triangular plates of the hypostoma (*Hp*) which in most Lepidoptera are well back on the ventral surface of the head, are in *Opostega* thrust forward until they lie immediately under the epistoma and pleurostoma.

The endoskeletal ridge of the hypostoma (*Hr*) extends backward from the triangular plates to the ventral hind margin rather than forward from them as in normal generalized forms, almost the entire mid-ventral surface of the capsule being occupied by a thin transparent gula (*GL*). The tentorial bridge (*TR*) of other lepidoptera is in *Opostega* a complete ring set well back in the head. The articulation of the ventral arms of tentorium (*VaT*) are at the extreme posterior limits of the hypostoma[2] and the epicranial fossa (*Fs*), for the mandible, which in all other forms is a socket in hypostoma at the anterior end of the hypostomal ridge is, in *Opostega*, a hole in hypostoma partially or perhaps completely limited by the triangular plate. The condyle of the mandible is thrust into this hole and the mandible thus firmly locked into the head, a specialization, which as far as I know, is not found in the Lepidoptera outside this family. There is also a very unique structure on the mandibles. In place of the two dorsal setae commonly found on most lepidopterous mandibles we have in *Opostega* a long, thick, tapering, membraneous cone (*Cn*, fig. 7) projecting well forward of the mandible. From its structure and position we may assume that it is used as a brush to sweep into the mouth the fine, torn fragments that are not carried in by the mandibular teeth, or that it is used to sweep and clean the dorsal surface of the lower mouth parts. The mandibles themselves are broad and considerably flattened. They approach somewhat the flat mandibles of cer-

[2] In normal forms the attachment of tentorium to hypostoma is to the triangular plates (the inner invaginated area of hypostoma). In *Opostega* the triangular plates are so reduced and so completely restricted to the forward part of the head that the ventral arms of tentorium appear to originate directly from the endoskeletal ridge (*Hr*).

tain *Gracilariidae*, but still distinctly belong to the tissue feeding type of larva.

On account of the crowding forward of the triangular plates of the hypostoma the labial and maxillary parts are greatly reduced in size. The hypopharynx and maxillae project well forward of the labrum, but are so small that they are almost entirely covered by the mandibles, only the galea, lacinia, and palps of the maxillae and the anterior third of the lobes of the maxillulae projecting beyond.[3] The labial palpi are very short. Stipes labialis (*Stl*) is faintly indicated. Cardo (*C*) and stipes maxillaris (*St*) are proportionately large for the reduced size of the mouth parts and clearly indicated; but palpiger is not discernible and mentum (*M*) and submentum (*SM*) are fused. On the lacinia of the maxillae there is a spreading brush (*Br*) of moderately long, hair-like spines. The maxillulae (fig. 2) consist of two fleshy lobes densely spined, attached to the long rod-like arms of the mentum; the upper moves freely, is moderately wide, and extends the entire length of the hypopharynx. Its inner margin is fringed with fine, long hairs. The lower lobe is much shorter and about half covered by the upper one; there are no blades.

To compare such a highly specialized type with any of the more generalized forms is obviously unprofitable. It is necessary to seek among the leaf and bark miners where similar biological factors have influenced larval development, and there to find, if possible, the forms approaching it. If these show tendencies to develop certain parts of the head at the expense of others and if such tendencies persisted in, would result in a head structurally like that of *Opostega* we may consider them as probable relatives. If, on the other hand, we see tendencies of development from the normal in opposite or other directions we can not justly connect the forms in any immediate relationship. By such a test we can at once dismiss such groups as *Brenthia, Bedelia,* the *Gracilariidae*,[4] or the *Bucculatrigidae*. *Nepticula, Ectoedemia,*

[3] In *Opostega nonstrigella* Chamb. (fig. 6), the specimens also show a large well developed spinneret of the broad flattened type, slightly constricted at the tip, projecting well forward. In the species from Hawaii the spinneret is much reduced. This, as well as the differences in the antennae (figs. 3, 5) would indicate that the Hawaiian specimens are either an earlier feeding stage than those of *nonstrigella* which are presumably last instar larvae, or that the two species represent distinct but very closely allied genera.

[4] The *Gracilariidae* represent a distinct line of larval development different from other lepidopterous families and quite opposite in its tendencies to *Opostega* or its allies. In *Gracilariidae* the anterior regions of the head develop at the expense of the posterior, the triangular plates of hypostoma are being continually thrust further and further back and more and more reduced in size, while the maxillary stipes and sub-mentum become longer and longer until in some forms they occupy most of the

Tischeria and the *Leucoptcrigidae* on the other hand resemble *Opostega* in a number of striking peculiarities. The lateral ridge (*LtR*) which is such a prominent character in *Opostega* is also present and quite discernible in two elements in *Nepticula* and *Ectodemia,* as a short endoskeletal arm (*Lrd*) (fig. 16) branching out on the dorsum of the epieranium from the angle of the antennal ring, and a more or less extended ventro-lateral ridge (*Lrv,* figs. 13, 17). A little constriction of the head in the ocellar region and the two branches unite to form the lateral ridge of *Opostega.* The posterior dorsal regions of the epieranium developed into thin, flattened, triangular, blade-like projections in the *Leucoptcrigidae, Tischeriidae,* and *Nepticulidae* are still further narrowed in *Opostega* until they are represented only by the narrow, ribbon-like projections (*Bl*). Most significant of all, however, is the development of the hypostoma in all these forms. The tendency is always toward an enlargement and anterior movement of the triangular plates and a consequent crowding forward and reduction in size of the labial and maxillary parts. In the *Leucoptcrigidae* (fig. 32) this tendency has distorted a normally proportion stipes which has not accommodated itself to the change and forced it to slop over the anterior margin of the epieranium and a large part of the area occupied by the postmentum.[5] In *Tischeria* the labial palps have accommodated themselves better and the maxillary stipes are narrowed, though still rather long. The *Nepticulidae* show a much greater reduction of the labium and maxillae and in *Opostega* we have the most extreme development with the triangular plates of hypostoma well forward and the labium and maxillae crowded under and almost completely covered by the mandibles. Another interesting character is the tendency for the ridges of hypostoma to diverge posteriorly rather than run parallel as they do in the normal feeding Lepidoptera. We see the beginnings of this in *Mnemonica* (Comp. Busck and Böving [3] Plate X, fig. 7) where

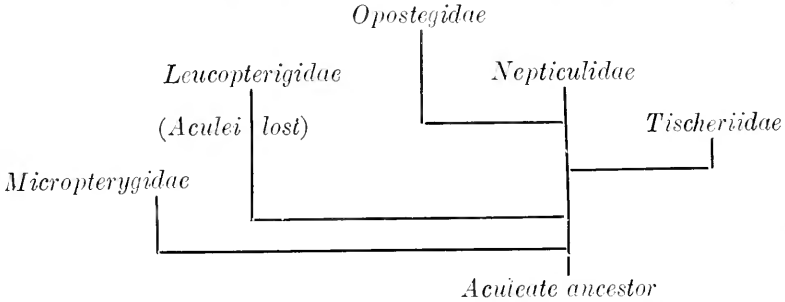
mid-ventral surface of the head. I would like to take this opportunity to correct a former statement of mine (5, pp. 155, 156) that the head of *Phyllocnistis* showed tendencies which pointed to an origin different from that of the *Gracilariidae. Leucanthiza,* which is unquestionably a Gracilariid and very near to *Phyllocnistis* indicates that *Phyllocnistis* is a true Gracilariid. This gives us another defining character for the family for nowhere else, as far as I know, has the sap-feeding habit developed.

[5] Tragardh (9, p. 35) with his usual keeness in such matters notes the exceptional character of the stipes of *Leucoptera* (*Cemiostoma*) and considers that it is their greater development which is responsible for their peculiar form. He notes that an even higher degree of development along the same lines has taken place in *Lithocolletis.* I think the lines of progress are just opposite in these two forms. In *Leucoptera* the stipes is not growing larger. It is being crowded by the hypostoma.

the ridges are slightly bowed. In *Tischeriidae*, *Leucopterigidae* and *Opostegidae* they are straight, divergent, and extend back and fuse with the ventral hind margins of epicranium. In the *Nepticulidae* they are also widely divergent but do not reach the hind margins.

There are several other points of resemblance: the extremely lateral position of setae *La-2* on the labra of *Tischeria* (fig. 21) and *Ectoedemia* (fig. 14); the strikingly similar maxillulae of *Prolcucoptera* (fig. 29) and *Opostega* (fig. 2) with their double pair of elongate, anteriorly, projecting, and well spined lobes;[6] the gradual disappearance of setae from the same epicranial areas and the similar arrangement of those that remain.[7]

Some of these developments might be attributed to purely biological causes but their sum total and the facts that the same tendencies manifest themselves in the production of heads so radically different in superficial structure and design, to meet such various environment, indicate a close relationship and a common ancestor for the group. The following tree shows their probable derivation as it is suggested by the larval characters:



The *Leucopterigidae* probably branched off from the Nepticulid stem earlier than *Tischeria* from which it appears to have diverged, approaching in some ways more nearly to *Opostega* Unfortunately for the perfect symmetry of our scheme it is the only family of the group which has lost the aculai from the wings of the adult. But of this we can only say as we do of so many other structures, that it is lost.

The writer is greatly indebted to Miss Mary Carmody of the Bureau of Entomology for the excellent drawings that accom-

[6] For a comparison of the maxillulae of *Ectoedemia* see DeGryse (4, pp. 175–176). *Nepticula* has the same structures without the large chitinized blades. *Proleucoptera smilaciella* Busck lacks the lower pair of projecting lobes so conspicuous in *P. albella* Chamb.

[7] Compare for example *Tischeria* with *Proleucoptera* (Figs. 24, 25, 33, 34) and *Ectoedemia* with *Opostega* (Figs. 8, 9, 16, 17).

pany this paper and to Dr. Böving for his valuable criticism and suggestions.

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EXPLANATION OF PLATES

ADF, Adfrontal area of frons.
ADFR, Adfrontal ridge.
AT, Antenna.
BL, Blade-like posterior dorsal region of Epicranium.
Br, Brush of hair-like spines on Lacinia of Maxilla.
C, Cardo.
Cu, Spined cone on dorsum of mandible (Opostega).
Cnd, Mandibular condyle.
DrT, Dorsal arm of tentorium.
E, Epicranium.
(*A-1*, *A-2*, *A-3*, *Aa*, *O-1*, *O-2*, *O-3*, *SO-1*, *SO-2*, *SO-3*, *SOa*, *P-1*, *P-2*, *-Pb*, *G-1*, *Ga*, Epicranial setae and punctures.)
EP + PLR, Epistoma and pleurostoma.
ES, Epipharyngeal shield.
ET, Epipharyngeal setae "teeth" of Opostega).
EX, Epipharynx.
F-1, *Fa*, Frontal setae and punctures.
FR, Frons.
Fs, Epicranial fossa for mandible.
G + Lc, Galea and lacinia of maxilla. (Including the Maxillary lobe [MxLb] and Brush [Br.] of Lacinia).
GL, Transparent gula between ridges of hypostoma.
Hr, Endoskeletal ridge of hypostoma.
Hp, Triangular plate of hypostoma.
L, labrum.
LP, Labial palpus.
LtR, Lateral ridge of epicranium.
M, mentum.

MD, mandible.
MX, maxilla.
Mxb, Blades of Maxillulae.
MxL, Maxillulae.
MxLb, Maxillary lobe.
OB, Bridge connecting dorsal hind margins of epicranium.
P-I, *P-II*, *P-III*, Joints 1, 2, 3, of maxillary palpus.
Prg, palpiger.
SM, Submentum.
SP, Spinneret.
St, Stipes maxillaris.
Stl, Stipes labialis.
TR, Tentorial bridge.
VaT, Ventral arm of tentorium.

PLATE 1. HEAD PARTS OF THE OPOSTEGIDAE.

Fig. 1, labrum and anterior dorsal region of head capsule (*Opostega* sp. from Hawaii); fig. 2, maxillae, hypopharynx and maxillulae (do); fig. 3, antenna (do); fig. 4, labium, maxillae, and anterior ventral region of head capsule (do); fig. 5, antenna (*Opostega nonstrigella* Chambers); fig. 6, labium and maxilla (*O. nonstrigella* Chamb.); fig. 7, mandible (*Opostega* sp. from Hawaii); fig. 8, dorsal view of head (do); fig. 9, ventral view of head capsule (do).

PLATE 2. HEAD PARTS OF THE NEPTICULIDAE.

Fig. 10, antenna (*Ectooedemia phleophaga* Busck); fig. 11, mandible (do); fig. 12, labium, maxillae, and anterior ventral region of head capsule (do); fig. 13, half of head capsule, ventral view (*Nepticula nyssaefoliella* Chambers); fig. 14, labrum (*E. phleophaga* Busck); fig. 15, epipharynx (do); fig. 16, dorsal view of head (do); fig. 17, ventral view of head capsule (do).

PLATE 3. HEAD PARTS OF THE TISCHERIIDAE (TISCHERIA QUERCIVORELLA CHAMBERS).

Fig. 18, antenna; fig. 19, mandible; fig. 20, maxillae, hypopharynx and maxillulae; fig. 21, labrum; fig. 22, epipharynx; fig. 23, labium, maxillae, and anterior ventral region of head capsule; fig. 24, dorsal view of head; fig. 25, ventral view of head capsule.

PLATE 4. HEAD PARTS OF THE LEUCOPTERYGIDAE.

Fig. 26, labrum (*Proleucoptera albella* Chambers); fig. 27, epipharynx (do); fig. 28, maxilla, hypopharynx and maxillulae (*Proleucoptera smilaciella* Busck); fig. 29, hypopharynx and maxillulae (*P. albella* Chamb.); fig. 30, antenna (do); fig. 31, mandible (do); fig. 32, labium, maxillae, and anterior ventral region of head capsule (do); fig. 33, dorsal view of head (do); fig. 34, ventral view of head capsule (do).

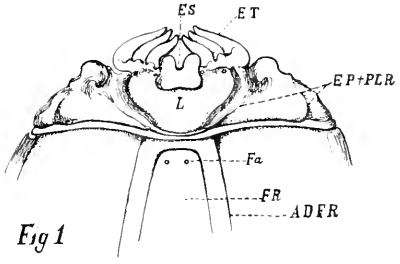
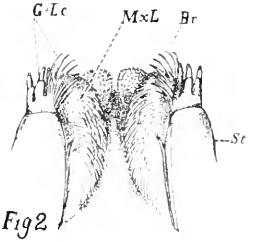


Fig 1



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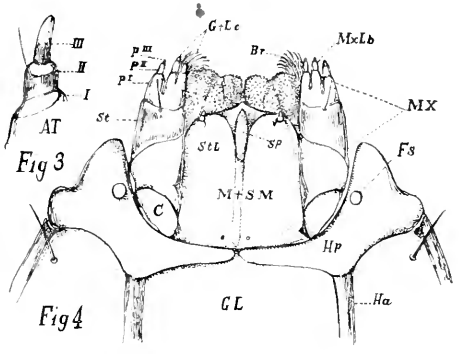


Fig 3

Fig 4

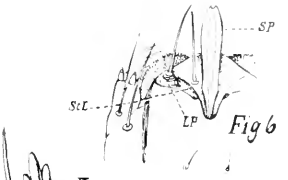
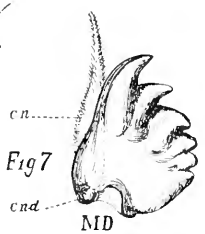


Fig 6

Fig 5



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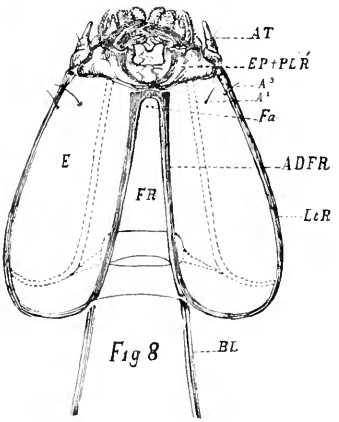

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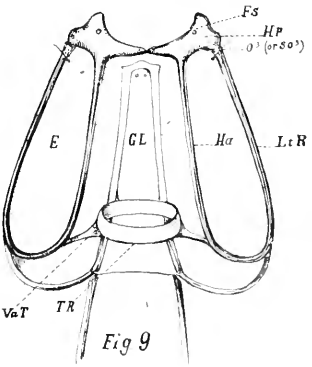

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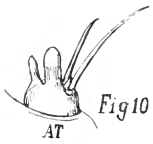

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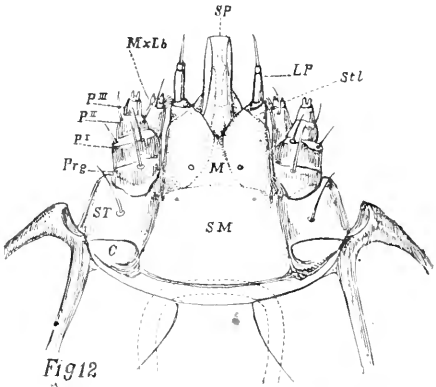

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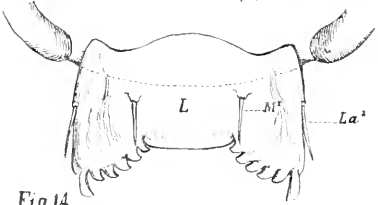

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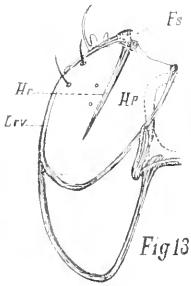

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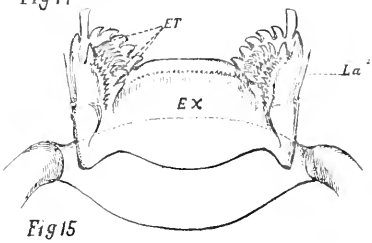

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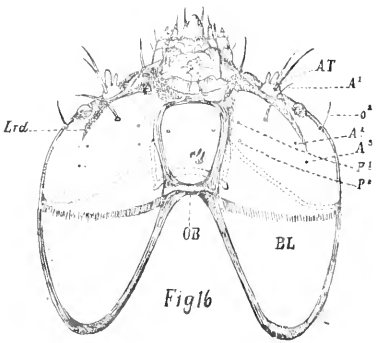

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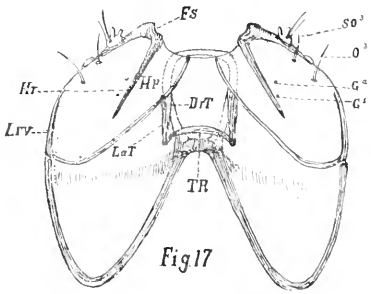

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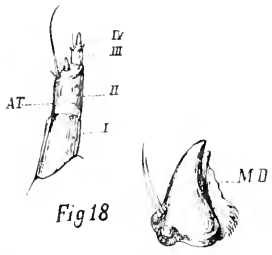

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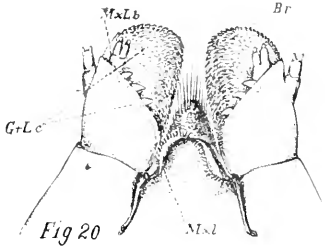

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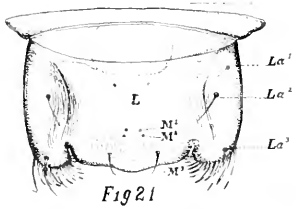

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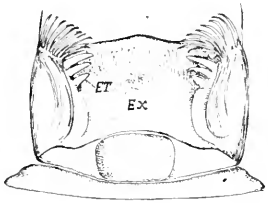

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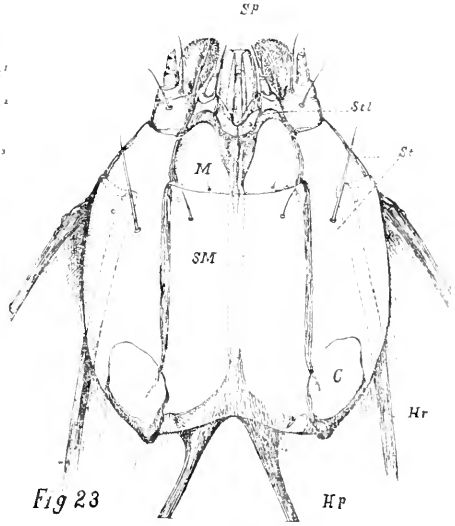

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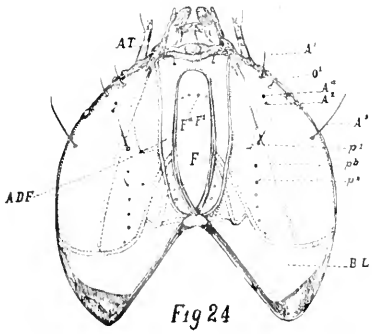

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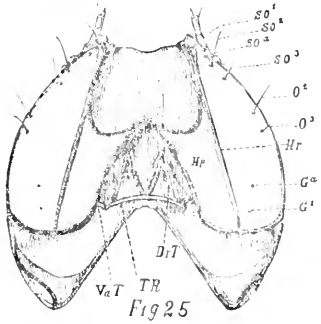

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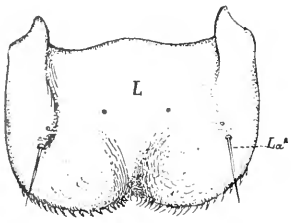

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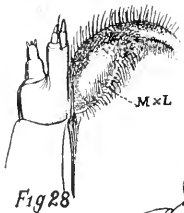

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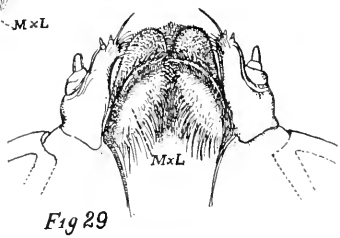

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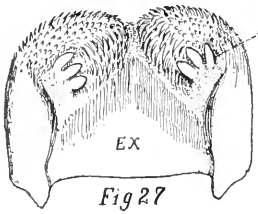

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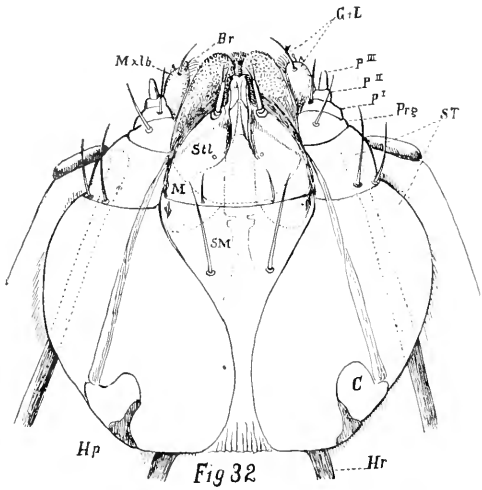

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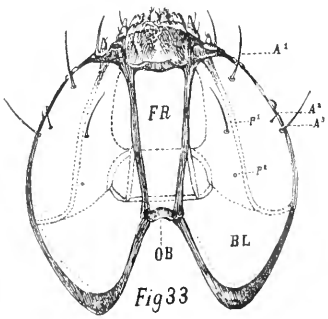

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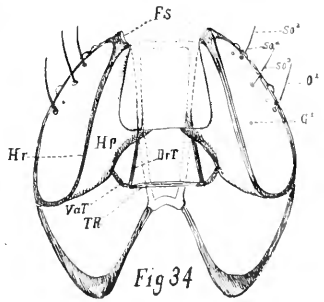

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PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 20 MARCH, 1918 No. 3

THE THORACIC SCLERITES OF IMMATURE PTERYGOTAN INSECTS, WITH NOTES ON THE RELATIONSHIPS INDICATED.

By G. C. Crampton, Ph.D.[1]

Numerous studies of the thoracic sclerites of adult insects in recent years, have resulted in the homologizing of the plates in most of the orders; but the knowledge thus gained has never been applied to immature Pterygotan insects in general, or to the Apterygotan forms. In attempting to determine the homologies of the sclerites in immature insects, it has been found necessary to make a study of the thoracic sclerites in Apterygotan insects, in order to establish, as far as possible, the original condition of the parts in question. The detailed discussion of the thoracic sclerites of the Apterygota, however, can be more profitably taken up in a separate paper, and they have therefore been only very briefly referred to in the following discussion.

Since the homologies proposed in the present paper, were largely determined by a comparison of the sclerites of immature Pterygotan insects with those of the more primitive Apterygotan forms, from an evolutionary point of view, it has been the source of no small gratification that the conclusions arrived at from a phylogenetic study of the parts, are in accord with the results obtained by Dr. Böving and Mr. Craighead, who are investigating the question from an entirely different standpoint—namely from a study of the muscles attached to the parts in question. The study of the musculature is of the utmost value in attempting to establish any obscure homologies, since the muscles frequently remain distinct and practically unchanged in character, after the sclerites to which they are attached have become indistinguishably fused together, or have undergone some rather disconcerting re-combinations, or shifting of position, with reference to the usual landmarks used in identifying them. I am therefore greatly indebted to Dr. Böving and Mr. Craighead for allowing me to look over their drawings of a wide range of forms, and for

[1] Contribution from the Entomological Laboratory of the Massachusetts Agricultural College, Amherst, Mass.

their many invaluable suggestions which have helped to clear up certain of the more obscure phases of the present investigation. I would also use this opportunity of expressing my gratitude to Dr. N. Banks for the loan of Panorpid and Raphidian larvae which have been of great value from the standpoint of a comparative study of the sclerites, and without which the present paper would have been very incomplete. As it is, the lack of material has made it impossible to treat of certain larvae, but enough of the principal types have been discussed, to furnish a basis for a further study of the various modifications met with in the different orders of insects.

Sternal Subdivisions

In the prothorax of the more primitive representatives of the Plecoptera, such as *Capnia* (fig. 14) there occur six sternal sclerites, or *sternites, is, ps, bs, fs, pfs,* and *ss,* and traces of certain of these sternites are found in a number of insects including both adults and larval forms.

The anteriormost sternal plate *is* of figure 14, called the *intersternite,* is situated very close to the labium, and may possibly be a posterior plate of the labial segment, rather than the anteriormost plate of the prothorax—a question which can be best settled by a study of the embryonic development of this region. It is usually small and unimportant, and is retained in but few larvae such as those of the Neuropteroid insects *Corydalis* (fig. 4, *is*) and the Raphididae (fig. 6, *is*), and in certain rather primitively organixed Coleopterous larvae such as *Pyrochroa* (fig. 7, *is*), etc.

The second sternite *ps* of figure 14, called the *presternite,* is usually situated between the lateral cervical plates *lc.* In most cases, the lateral cervicals *lc* remain distinct, as in figures 14, 16, 17, 23, 24, etc., but in the Pyrochroid larva shown in figure 17, they have apparently united with the presternite to form the plate *ps* of figure 7, which is thus composed of plates *ps* and *lc* of figure 14. At any rate, plate *ps* of figure 7 includes a much greater area than plate *ps* of figure 14. Similarly, in the Neuropteroid larvae such as *Corydalis* (fig. 4) and the Raphididae (fig. 6) the *jugular plate, ps,* or narrow transverse band in the neck region contains a much greater area than the plate *ps* of figure 14, and apparently also includes the lateral cervicals (*lc* of fig. 14) extending, as it does, well around into the dorsal region. This narrow transverse jugular plate is characteristic of the Neuropteroid larvae; and although the sclerite *ps* of figure 7 also very probably includes the lateral cervicals, it has not the outline of the jugular plate *ps* of figures 4 and 6, nor does it extend so far around into the dorsal region. In the prothorax of the larva of *Dytiscus* (fig. 3) there occurs a large anterior plate

ps, which is situated behind the anterior margin of the pronotum, instead of extending forward into the neck region as is the case with the plate *ps* of figure 7, and on this account, the two may not be strictly homologous. Merely for the sake of convenience, however, the designation "*presternum*" has been applied to all of the sclerites labeled *ps* (in all figures) which are situated immediately in front of the basisternum *bs*, regardless of whether they are exactly homologous in every instance.

The third sternal subdivision is the *basisternum*, or *basisternite bs* of figure 14. In *Gryllus* the coxo-basisternal muscles extending from the coxa to the basisternum, and in *Periplaneta*, the basisterno-prescutal muscles, extending from the basisternum to the prescutal region, are of some value in determing the identity of the basisternal region. When the basisternal region is not chitinized, it is represented by the region somewhat in front of, and between the coxae, as in figure 3, *bs*. In some larvae, as in the Hydrophilid larva (fig. 5) and that of *Corydalis* (fig. 4) the basisternum *bs* and pleural region are connected by a continuous chitinous region extending in front of the coxae.

In the prothorax of *Capnia* (fig. 14) the lateral portion of the basisternum, *ls*, is still connected with the sternal region, but in the mesothorax of the nymphal Plecopteron *Perla* shown in figure 15, the lateral region of the sternum, called the *laterosternite*, *ls*, has become demarked from the remainder of the sternum, as in the earwig *Arixenia*, shown in figure 13, *ls*. Voss, 1904, terms the region *ls* the "coxosternum," but this designation had already been used by Verhoeff to denote the fusion product of the coxa with the sternum in Apterygotan insects. In *Gryllus*, the laterosternite (*ls* of figs. 13 and 15) of the mesothorax is connected with the episternal region by the laterosterno-episternal muscles, and with the scutum, by the laterosterno-scutal muscles; while in the prothorax, the laterosternite is connected with the cervical plates by the laterosterno-cervical muscles, and with the occipital region, by the laterosterno-occipital muscles; and, when they are retained, these muscles aid in identifying the regions homologous with the laterosternite.

The fourth sternal subdivision, *fs* of figure 14, is called the *furcasternite* or *furcasternum*, because it bears the *furca*, or paired internal apophyses, for muscle attachment. Since the furca is composed of the two invaginations of the body wall forming the apophyses, it is usually hollow, and the position of the apophyses which form it is indicated externally by the *furcal pits*, *f*, of figures 3, 4, 14, etc. When the furca, or the paired apophyses homologous with it, are present, they serve to identify the furcasternal region, although their position in this region is not always precisely the same with regard to the coxae and other usual landmarks.

The furcasternum is connected with the pleural region by a post-coxal bridge (fig. 14, *po*) in many adult insects, and in certain Apterygota (fig. 12, *po*). This postcoxal bridge is retained in but few larvae, such as those of the Pyrochroids (fig. 7, *po*), although in the larva of *Corydalis*, there is found a postcoxal plate (fig. 4, *po*) which is homologous with the postcoxal bridge. This region is not chitinized in the larva of *Dytiscus*, but is represented by a membranous fold behind the coxa (fig. 3, *po*). Behind the postcoxal region, two internal *parapophyses* for muscle attachment, are found. Their position is indicated externally by pits, as in figure 4, *p*, or by small sclerites as in figure 3, *p*.

The arm of the furca, or internal apophyses, may be united with the apodeme, or internal ridge of the pleural region; but when this is not the case, the furcal arm is usually attached to the apodeme of its side of the body, by the furco-apodemal muscles; and the furco-postscutellar muscles extend between it and the postscutellum, as shown by Voss, 1904, in the thorax of *Gryllus*. The furca of the prothorax is attached to that of the mesothorax by the profurco-mesofurcal muscles, and the furca of the mesothorax is similarly attached to that of the metathorax by the mesofurco-metafurcal muscles (the prefixes pro-, meso-, and meta-, being used to indicate whether the structures between which the muscles extend, are in the prothorax, mesothorax, or metathorax respectively). The spina, or unpaired median apophysis, is connected with the furca of its own segment by the spina-furcal muscles in some insects, and the spina of one segment is usually connected with the furca of another segment by the prospino-mesofurcal or by the mesospino-metafurcal and mesospino-profurcal, etc. (the prefixes being used to indicate the segment in which the structure to which the muscles are attached, is located). As shown by Voss, 1904, in *Gryllus*, the trochantero-furcal and the coxo-furcal muscles extend from the trochanter and coxa to the furca, and, with the other muscles mentioned above, serve to identify the furcasternal region when they are retained. The basisternum and furcasternum are frequently united, but are usually separated by a suture. When not otherwise demarked, the furcasternum may be regarded as that region somewhat between and behind the coxae, as in figure 3, *fs*, although in this case, the furcasternal region is indicated by the furcal pits *f*, and is separated from the sternite behind it by a crease, as indicated by the dotted line.

The fifth sternal plate, found in the prothorax of such insects as *Capnia* (fig. 14, *pfs*) is present in but few insects as a distinct plate. It is doubtless united with the region behind it in larval insects.

The sixth sternal plate is the *spinasternite*, or *spinasternum* (fig. 14, *ss*) which, as the name indicates, bears the *spina*, or internal median unpaired apophysis for muscle attachment. The location of the spina is indicated externally by the *spinal pit* (figs. 3, 5, etc., *s*). In many instances in which the spinasternal region is not chitinized, the spina is present, and to it are attached the characteristic muscles. The spino-furcal muscles extend between the spina and the furca of the same segment, and the coxo-spinal muscles extend between the coxa and the spina of the same segment; while the prospino-mesofurcal muscles extend between the prothoracic spina and the mesothoracic furca, and the mesospino-metafurcal muscles connect the mesothoracic spina with the metathoracic furca. Similarly, the mesocoxo-prospinal muscles connect the mesothoracic coxae with the prothoracic spina, and the metacoxo-mesospinal muscles connect the coxae of the metathorax with the spina of the mesothorax. In *Periplaneta*, the interspinal muscles connect the spina of one segment with that of the segment following it. When the muscles are retained, they serve to assist in homologizing the regions in question, even when the latter are not pigmented and strongly chitinized.

The spinasternum (figs. 4, 6, 7, etc.) is usually situated between the subspiracular plates *ip*, or between the subspiracular regions; but, in all probability, the spinasternum belongs to the segment in front of it, while the subspiracular plates belong to the segment behind them, since the spiracle develops in the segment behind it, and later migrates into the intersegmental region, or even into the posterior portion of the segment in front of it, as in the prothorax. On the other hand, it is quite possible that the spinasternum, instead of being the *posteriormost* sternite of the segment in front of it, may be the *anteriormost* sternite of the segment behind it, since the musculature would easily admit of such an interpretation, and in certain cases, such as in the prothoracic sclerites of *Japyx*, there is some reason for considering that the anteriormost prosternal plate may be homologous with the spinasternum. This point, however, can be best determined by an embryological study of the region in question, and for the time being, I would consider the spinasternum as the posterior most sternal subdivision.

Other Terminologies and Interpretations.

In the Diplopod *Julus*, and the Crustacean *Squilla* (which at that time were classed as "insects"), McLeay, 1830, thought that he could detect four sub-segments in each typical segment. Since the prescutal, scutal, scutellar, and postscutellar areas had been noted in the tergum of true insects, McLeay erroneously concluded that these four areas represent the terga of four sub-

segments composing the typical segment; and suggested that at some time there might be found four sterna for these hypothetical sub-segments, proposing for them the designations praesternum, sternum, sternellum, and poststernum (not "poststernellum," which is Comstock's term), although he was unable to detect them himself in any insect, and was therefore unable to either figure or define them, merely supposing that they should occur in some hitherto unstudied insect, on the erroneous supposition that each segment is composed of four subsegments. The subsequent search for the sterna of these nonexistent subsegments, has led to a chaotic confusion in the application of McLeay's undefined terms, since any four consecutive sternal subdivisions of the six shown in figure 14, *is*, *ps*, *bs*, *fs*, *pfs*, or *ss* could be designated by these terms; and if one is to use them at all, it will be necessary to state in each case, that his application of the term used is not that of this or that entomologist, for practically all possible applications of these terms have been made, as will be seen from the following discussion.

Meinert, 1867, was among the first entomologists to apply McLeay's terms to actual sternal subdivisions in insects. Meinert employs the terms presternum, "sternum" and poststernum, to designate three sternal subdivisions in *Japyx*, but, while the plate which he calls the presternum, is the presternum, *ps*, of figure 14, unfortunately, the plate which he terms the "poststernum," is homologous with the anteriormost sternite *is* of figure 14, so that this usage of the term poststernum is hardly admissible. Amans, 1885, on the other hand, applies the term poststernum to any part of the sternum between and behind the coxal cavities, while Petri, 1899, designates the region homologous with the meral region of the coxa as the "poststernum," in the Diptera.

Comstock and Kochi, 1902, erroneously conclude that the typical segment is composed of two subsegments, and propose that the terms "sternum" and sternellum be applied to the ventral plates of these imaginary subsegments. In the only two instances in which they apply the term sternellum to sclerites other than the neck plates—namely in their figures 12 and 13 of the metasternum of *Pteronarcys* and *Stenopelmatus*—the plate designated as the metathoracic "sternellum" is the sternum of the *first abdominal* segment in both cases. In the only other instances in which they employ the term sternellum, the plates so designated are in the neck region, and are the anteriormost sternites of the prothorax. Thus, in their figure 5, of the head of *Corydalis*, the "sternellum" is plate *is* of figure 4 (of the present paper), while in their figure 22 of the head of *Stenopelmatus*, the "sternellum" is plate *ps* of figure 14 (of the present paper), the "sternellum"

being the anteriormost prothoracic sternites in both instances. If we were to accept Comstock and Kochi's interpretation of the "sternellum," this designation would therefore be applied to the first or second prothoracic sternite (i.e., *is* or *ps* of fig. 14) or to the first abdominal sternum.

In their "Elements of Insect Anatomy" (fourth edition, pages 22–24) Comstock and Kellogg, 1902, employ yet another usage of the term sternellum. Thus, the narrow, transverse, anterior, marginal region of the mesosternum, which is a *mesothoracin* sclerite, they designate as the *prothoracic* "sternellum" in *Melacoplus femur-rubrum*. They also refer to the mesosternal and metasternal lobes of this insect as the sternella of the meso- and metathorax. If we accept this usage of the term sternellum, it would therefore refer to the anterior transverse marginal region of the mesosternum and also to the mesosternal or metasternal lobes.

I have been unable to find any other usage of the term sternellum by Comstock, but Voss, 1904, evidently believes that Comstock employed yet another application of the term sternellum, since, in his list of abbreviations on page 756, Voss refers to the hindermost sternite, or spinasternum (i.e., sternite *ss* of fig. 14, which bears the label "*est*" in Voss' list on page 756) as the "epimerales sternit, *sternellum* Comstock." Forbes, 1910, also thinks that the sternite which I have interpreted as the spinasternum in the Lepidoptera larva (fig. 8, *ss*) should be called the "sternellum;" so that if we accept these usages, the term sternellum would be restricted to the spinasternum, or hindermost sternite *ss* of fig. 14.

Hopkins, 1909 (page 24), adopts McLeay's terms praesternum, sternum and sternellum, but the term "poststernellum," which he attributes to McLeay, 1830, was introduced by Comstock, 1902, not by McLeay (who proposed the term *poststernum* instead of poststernellum, for the sternum of the imaginary fourth sub-segment). In *Dendroctonus*, only two of the original sternites are represented by chitinized areas, namely the basisternum and the furcasternum (fig. 14, *bs* and *fs*). These are very closely united, and in them certain ill-defined regions have become marked off by the formation of new lines and ridges and other superficial markings which have no especial phylogenetic significance. In his figures 17 and 18 of the prothorax and mesothorax of *Dendroctonus*, Hopkins designates these purely secondary subdivisions of the basisternum and furcasternum as the presternum, "sternum," sternellum and poststernellum (or areas representing these subdivisions). If Hopkins' interpretation of the terms presternum, "sternum," sternellum, and poststernellum were adopted, they would therefore be applied to the secondary subdivisions of

only *two* of the original sternal plates here recognized, namely the basisternum and furcasternum.

Berlese, 1906–1909, has made an unfortunate attempt to apply the terms prosternite, mesosternite and metasternite (which should be restricted to a sternite of the prothorax, mesothorax or metathorax respectively) to subdivisions of one and the same segment. This application of the prefixes pro, meso, and meta, to sclerites of segments other than the one indicated by the prefix in question, is wholly inadmissible, and if adopted, would lead to endless confusion. Fortunately, however, the regions to which Berlese applies these terms do not represent the true subdivisions, in most instances, and therefore have no bearing upon the interpretation of the subdivisions here discussed. Thus, in his figure 204 of a *Dytiscus* larva, Berlese refers to the anterior sclerite *ps* of fig. 3 (i.e., the presternum) as the acrosternite, and calls the space between it and the basisternum (*bs* of fig. 3) the "prosternite." The basisternum of figure 3, *bs*, he designates as the "mesosternite," while the furcasternum *fs* and the spinasternum *ss* together are termed the "metasternite" by him. In other cases, his applications of these terms is so varied, that it is impossible to determine to which sternites he intends that they should refer in general.

Assuming that the two hypothetical subsegments postulated for each segment by Comstock and Kochi, 1902, actually exist, Berlese adopts Comstock's designations "sternum" and sternellum for the ventral regions of these imaginary subsegments, and states that his acrosternite and "prosternite" together compose the sternum of Comstock's terminology, while his "mesosternite" and "metasternite" together make up the sternellum of Comstock's terminology. Berlese's method of employing the terms "sternum" and sternellum, however, is very different from those employed by his predecessors, and his application of the terms is so varied as to greatly increase, instead of clearing up, the chaotic confusion in the usage of these terms, thus forcefully illustrating the fact that it is quite impossible to designate homologous plates by the same term in every case unless some descriptive terms such as furcasternum for the furca-bearing sternite, spinasternum for the spina-bearing sternite, etc., are used.

On page 171, in describing the condition found in the meso- and metathoracic sternal regions of an adult *Dytiscus*, shown in his figure 167, Berlese states that in this figure the plates labeled "*Is*" (which are really the subspiracular plates and the spinasternum of the *prothorax*—i. e., *ip* and *ss* of fig. 74) represent the "sternum" of the *mesothorax*. On the other hand, the plate which he designates as the "sternellum" of the mesothorax in his figure 167 is the true mesosternum, while the structures which

he interprets as the "sternellum" of the metathorax are simply the much flattened coxae! In the prothorax of his figure 179 of *Calliphora*, Berlese applies the term "sternum" to the prothoracic presternum (*ps* of fig. 14), and designates the prothoracic basisternum (*bs* of fig. 14) as the "sternellum." In the mesothoracic region of his figure 183 of *Sphinx*, he applies the term "sternellum" to the meral region of the coxa! In his figure 185 of *Cicada*, he applies the term "sternellum" to the lower portion of the epimeron in the mesothorax, while in the metathorax, he applies the term "sternellum" to the entire epimeron. In his figure 195 of *Periplaneta*, the plate which he terms the prothoracic "sternellum" is the spinasternum alone (*ss* of fig. 14), while in the mesothoracic region the plate which he terms the "sternellum" is the united furcasternum and spinasternum together (*fs* and *ss* of fig. 14), and in the metathoracic region, the region to which he applies the term "sternellum" is the furcasternum alone (*fs* of fig. 14). On the other hand, in his figure 198 of *Acridium*, the prothoracic "sternellum" is the spinasternum (*ss* of fig. 14) while the mesothoracic "sternellum" is practically the entire mesosternum, the sclerite to which he applies the term "sternum" in this region being the anterior marginal region of the mesosternum (which Comstock and Kellogg, 1902, interpret as the prothoracic "sternellum"). In the metathorax, however, Berlese designates practically the entire metasternum as the "sternum" in his figure 198, while he designates the *first abdominal sternum* as the metathoracic "sternellum" (thus agreeing with the interpretation of the metathoracic "sternellum" by Comstock, 1902, in the Orthoptera). If we therefore accept Berlese's application of the term "sternellum" it would thus be applied to the entire sternum; to the basisternum by itself, or united with the furcasternum; to the furcasternum by itself, or united with the spinasternum; to the spinasternum alone; to the entire coxa, or to the meral region of the coxa (meron); to the entire epimeron, or to its lower portion alone; to the first abdominal sternum, etc., etc. Comstock and Berlese together have thus exhausted all of the possibilities in applying the term "sternellum" to the first, last, and all of the intermediate sternites (as well as to the first abdominal sternum, etc., etc.), and this merely goes to show how impossible it is to successfully employ a terminology which takes no consideration of the landmarks (such as the furca, spina, etc.), but merely implies four consecutive plates, begining the count anywhere and ending it anywhere in the series of six consecutive sternites shown in figure 14!

Snodgrass, 1909, in his excellent paper on the thoracic sclerites of insects, uses the terms presternum, "sternum," and ster-

nellum, for regions which, however, do not correspond to the subdivisions here recognized. Thus, in his figure 32 of the mesosternum of *Byrsotria*, the sclerite which he designates as the "presternum" is the anterior margin of the basisternum (marked off by an impressed line having no especial phylogenetic significance), while the socalled "sternum" is largely the posterior portion of the basisternum, and the plate which he terms the "sternellum" is the spinasternum (in which usage he agrees with Voss, 1904). Snodgrass' other applications of the term presternum are quite different from that given in the above-cited figure, and do not correspond to that adopted in the present paper. Thus, in his figures 94, etc., he includes in the term "presternum," the lateral wings of the basisternal region, here termed the laterosternites (fig. 13, fig. 14, fig. 15, etc., *ls*). This region has nothing whatsoever to do with the presternum, which is an anterior sternite, not a lateral wing of the basisternal region; so that it is difficult to understand why he includes the lateral region *ls* of figures 13, 15, etc., under the designation "presternum." Snodgrass, however, does not apply the term presternum to the same sclerites in every case, for, while he applies the term presternum to the region on either side of the sternum in his figures 10, 11, etc., he applies the term pre-episternum to the same region in his figures 29, 46, etc. In his figure 93 of the neck region of *Spongiphora*, he calls the lateral cervicals the "presternum," while in his figure 98, he applies the term presternum to yet another plate, so that it is impossible to tell exactly to what region he intends to refer in using the designation presternum, since he applies it to so many different sclerites. The term sternellum, however, he uses in but a single instance, and applies it to the spinasternum in this case.

The terms presternum, basisternum, furcasternum and spinasternum applied to the four principal sternites here recognized, have been taken over from a paper written nine years ago (Crampton, 1908) at a time when I was not familiar with a large range of insects, but, since certain fixed landmarks were employed to identify these sternal plates, a further study of a wider series of forms has merely confirmed the conclusions concerning the sternal plates set forth in the original paper; and it is only by taking these landmarks into consideration that one can homologize the plates with any degree of certainty. As was pointed out in the original article, the term "sternum" could not be at the same time time applied to both the entire sternum and also to one of the sternal subdivisions, without creating confusion, and that whatever terminology was accepted, the term basisternum (applied to the basal portion of the sternal region, *bs*, whose

lateral wings forms the laterosternites *ls* of figs. 14, 15, text-fig. 1, etc.) should supplant the designation "sternum" used in the restricted sense. Snodgrass, 1910, however, substitutes the term "eusternum" for the third sternal subdivision, without giving any reason for so doing; but, since he has applied his terms to no actual sclerites in any insect (other than the use of the terms presternum? "sternum" and sternellum cited above) it is impossible to determine to what sclerites his terms should be applied, and the designations presternum, basisternum, furcasternum, and spinasternum remain as the only terms actually applied to the consecutive sternal subdivisions figured or described in any insect, and they are the only terms which can be used without specifying that they are employed in this or that sense, and not as applied by this or that entomologist! Furthermore, since such terms as furcasternum and spinasternum could not possibly be applied to the wrong sternites (since the names imply that the sternite in question bears the furca or spina), it is preferable to employ these purely descriptive terms.

The advisability of using purely descriptive terms is at once apparent, if we consider the possibility that the sternite *ss* of figure 14 (i.e., the spinasternum) may prove to be the *anteriormost* sternite of the segment behind it, instead of being the *posteriormost* sternite of the segment in front of it (as here given)—for the musculature would admit of such interpretation, and the fact that in the mesothorax of *Corydalis* the so-called spinasternum of the prothorax is attached to the front of the mesosternum, instead of being associated with the prothoracic region, points to the possibility of the spinasternum being the anteriormost sternite, as also does the fact that it is located between the subspiracular plates which are portions of the segment behind them instead of the segment in front. If it should thus be the anteriormost sternite of the segment behind it (from an embryological study of the formation of the spinasternum), the designation "poststernum" or "poststernellum" would hardly be appropriate, while the purely descriptive term spinasternum would be equally applicable in either case. It is also evident that it is inadmissible to apply the same set of terms to entirely different sclerites in adults and larvae when it is perfectly possible to homologize the sclerites in all stages. Since Hopkins, 1909, has applied the terms sternellum and poststernellum, etc. to subdivisions of the basisternum and furcasternum alone of the sternites, in adult Coleoptera, these terms should be applied to homologous regions in larval Coleoptera also, if used at all, and therefore cannot be applied to the regions here recognized, which are not subdivisions of the basisternum and furcasternum. This, however,

does not apply to the term presternum, which, unlike the terms sternellum and poststernellum, had practically always been used to designate the plate *ps* (of fig. 14) alone (Meinert, 1867, Comstock and Kochi, 1902, Crampton, 1908, etc.), and its application was therefore fixed by general usage before Hopkins attempted to apply it to the sclerites of the Coleoptera.

If the previous usages of the terms sternellum, poststernellum, etc., were disregarded, the equivalence of the terms here employed, as expressed in the terminology of McLeay, 1830, might be tabulated as follows.

Presternum	Praesternum
Basisternum	"Sternum" (Basisternum or Eusternum)
Furcasternum	Sternellum
Spinasternum	Poststernum or Poststernellum

Pleural Subdivisions.

The entire lateral region of a segment, including both the sclerites and the more membranous region as well, is called the *pleuron*—i.e., the region between the alar area, *al* and the coxa *cx*, in figures 18, 19, 21, etc. In the pleural region of many insects, there occurs a distinct plate called the *pleural plate* or *eupleuron*, *ep* of figures 18, 19, etc. As first pointed out by the writer (Crampton, 1908, page 14) the pleural plate becomes divided into an episternal region, *es*, and an epimeral region, *em*, by an inpocketing, or infolding of the integument, possibly due to the stress of the muscles attached to this region. The internal fold forms the *apodeme* for muscle attachment, while the external lips of the pocket meet to form the *pleural suture*, or dividing line between the episternum, *es*, and the epimeron, *em*.

Berlese, 1909, considers that the epimeron, *em* of figures 18, 19, etc., is a detached portion of the tergal region, while the episternum, *es*, is a portion of the sternal region. It is not clear, however, how he arrived at the conclusion that the episternum and epimeron are not portions of a single plate, for this can be readily seen in both adult and larval insects, and none of the observed facts is in harmony with his view.

Boerner, 1903, at first thought that the episternum and epimeron are detached portions of the sternal region, and Craighead, 1916, came to a similar conclusion from a study of the musculature of larval Coleoptera. Boerner, however, later discarded this view in favor of Heymons' idea of the pleural plate representing a basal portion of the leg.

Miall and Denny, 1886 (page 61), suggested that the pleural plate represents the basal segment of the leg which has "become

adherent to the thorax." The embryological investigations of Heymons support this view, and Boerner adopts it in his later publications.

In the early embryonic stages, there is no clear line of demarcation between the base of the leg and the pleural region, and this may have given rise to the idea that the pleural plate represents the basal portion of the leg. At any rate, a further study of the embryological development of the region in question should be carried out before this point can be definitely decided; and even if it should prove to be the case that the pleural plate represents a detached basal portion of the leg, it is none the less true that the pleural plate occurs as a separate and distinct plate in the lowest Apterygotan insects, and in many of the immature Pterygotan forms, and must therefore have occurred as a distinct plate at a very early stage in the evolution of insects. On this account, I formerly maintained that it probably occurred as a distinct plate from the very beginning, having been formed by the greater deposition of chitin and pigment, due to the stimulus of muscle stress, friction, or other mechanical causes.

Although the plural plate occurs as a separate and distinct plate in many immature insects, this is not the case in most adults, and the question naturally arises as to whether the episternum *es* and the epimeron *em* of a larval insect, such as that shown in figure 18, really represents the episternum and epimeron of the adult. A comparison of the larval and adult stages of the same insect would indicate that the pleural plate of the larva merely increases in size (encroaching more and more on the membranous region of the segment) to form the corresponding regions of the adult, and that a union of plates originally distinct frequently take place by the further chitinization and pigmentation of the membranous region between them. In some cases, new lines and sutures are formed in the adult stages, thereby tending to mask the original condition, but the principal landmarks usually remain but little changed, and the parts can be homologized by referring them to these landmarks in both adult and larval stages. It may be further remarked, that the larvae usually retain the plates in a condition approximating that found in the lower Apterygota, much more closely than the adults do, and, in most cases, the condition found in the larvae must therefore be considered as much nearer the original one, although the more primitive, rather than the more highly specialized larvae, should be considered in this connection.

The pleural plate in some cases is connected with the basisternum, *bs* (figs. 4, 5, 6, 7, etc.) by a continuous chitinous region forming a connecting bridge between the sternal and

pleural region, and extending in front of the coxae. In the prothorax of the Plecopteron *Capnia* (fig. 14) that portion of the connecting bridge which is of strenal origin (i. e., *ls* of fig. 14) is still attached to the basisternum *bs;* but in the mesothorax of a nymph of the Plecopteron *Perla* (fig. 15) it becomes detached to form the distinct sclerite *ls,* as is also the case in the Forficulid *Arixenia* (fig. 13, *ls*). In the adult stages of *Perla,* however, it is still united with the basisternal region.

As shown by Voss, 1904, in the thorax of Gryllus, the apodeme of the pleural plate is connected with the furca of the sternal region by the furco-apodemal muscles. Epimero-subalar and epimero-scutal muscles connect the epimeron with the subalar and scutal regions, while the trochantero-episternal, coxo-episternal and trochantino-episternal muscles connect the trochanter, coxa, and trochantin, with the episternum.

As pointed out in a recent paper (Crampton, 1917 a), in practically all of the thoracic segments of Apterygotan insects (fig. 12), and in the prothoracic region of the most primitive of the Pterygotan insects, such as the Plecopteron *Capnia* (fig. 14), the Embiid *Embia,* the Grylloblattid *Grylloblatta,* the Forficulid *Echinosoma,* the Blattid *Blaberus,* the Phasmid *Simema,* the Mantid *Stagmomantis,* various Isoptera, etc., there intervenes between the true pleural plate *ep* and the coxa *cx* a plate labeled *et* (in figs. 12, 14, etc.), which has been designated as the *eutrochantin,* or true trochantin (figs. 12, 24 and 25, *et*—shaded in all figures). As seen in figure 25, the shaded eutrochantin breaks up into an anterior portion labeled *tn,* which remains distinct to form the plate commonly called the trochantin in higher insects, while the posterior portion unites with the pleural plate above it to form the lower portion of the episternal and epimeral regions. The steps in the process of the fusion of the posterior portion of the eutrochantin with the pleural plate are admirably shown in a series of illustrations of the sclerites of Dermaptera recently published by Pantel, 1917. As shown in plate III of Pantel's extremely important monograph, the posterior portion of the eutrochantin, which is distinct in *Allostethus, Echinosoma,* etc., becomes partially united with the pleural plate in *Labidura,* though still partially demarked by an incomplete "fissure divisante," while in *Anisolabis* and *Calocrania* only the faintest traces of the "fissure divisante" are retained, the fusion being practically complete in the latter insects.

The plate *et* of figs. 24 and 25 may possibly represent a basal portion of the leg (since certain embryologists maintain that the trochantin is a basal segment of the leg) or it may have had an origin similar to that of the pleural plate *ep* mentioned above.

Berlese, 1909, on the other hand, maintains that the trochantin is a lateral portion of the "sternellum;" but there seem to be no adequate grounds for maintaining this view.

The trochantinal plate *tn* of figure 18 is not the exact equivalent of the sclerite designated as *tn* in figures 21 and 15, since the anterior portion of the region *tn* marked off by a dotted line in figure 15 (which is demarked by a well defined suture in some Plecopteron nymphs) corresponds more nearly to the plate *tn* of figure 18. For the sake of convenience, however, the sclerites labeled *tn* in the different figures will be referred to simply as the "trochantin." In the thorax of *Gryllus*, the trochantin is connected with the episternum and with the praesternum by the trochantino-episternal and the trochantino-presental muscles.

The trochantin (or eutrochantin) and the pleural plate (which is divided by an approximately vertical suture in most of the insects studied—figs. 2, 9, 12, 13, 15, 18, 19, etc.) apparently represent the original sclerites of the pleural region, since they are present in many Apterygotan and larval Pterygotan insects. In certain larval forms, however, there occur in the pleural region several other sclerites whose homologies and phylogenetic significance are not always clear. Thus, in the mesopleural region of the Tenthredinid larva shown in figure 17, there occurs a true pleural plate *ep* divided by the typical suture as in the larva of Corydalis (fig. 18, *ep*) and other lower forms. In the Tenthredinid larva, however, in addition to the true pleural plate (fig. 17, *ep*) there occurs a sclerite labeled *pp* which bears no suture, and is situated immediately above the coxa. Similarly, in the Lepidopteron larva shown in figure 20, there occurs a *surcoxal plate* labeled *pp*, which bears no typical suture, and is also situated immediately above the coxa, while in the Panorpid larva shown in figure 23 a non-suture-bearing plate labeled *pp* is found immediately above the narrow band *cx?* (which apparently represents the chitinized portion of the coxa of the Lepidopteron larva, fig. 20, *cx*). The various sclerites labeled *pp* in figures 17, 20, and 23, may not be strictly homologous in every case, but the correspondence is sufficiently close for all practical purposes.

In the mesothorax of the Calosoma larva shown in figure 18, there occurs immediately below the alar area *al* a distinct plate labeled *d?*, which, from its position immediately below the wing region, appears to be homologous with the *subalar plate* of adult insects. Mr. Craighead informs me that the muscles which normally extend between the coxa and the subalar plate (i.e., the coxo-subalar muscles of such insects as *Gryllus*) are not attached to the plate *d?* (of fig. 21), but extend to a point above it, along the

lower margin of the alar area *al*. It is possible for muscles to shift slightly in certain cases, however, as may be seen by comparing the muscles attached to the subalar plate in the mesothorax, with those of the metathorax, in the figures of the musculature of *Gryllus*, by Voss, 1904. At any rate, the location of the plate *d?* of figure 21 corresponds so closely to that of the typical subalar plate of adult insects, that I have provisionally homologized it with the true subalar plate. On the other hand, the plates labeled *d* in figures 17, 20, and 23, may not be strictly homologous with plate *d?* of figure 21, but since my material of these insects is too shrunken and poorly preserved to permit a study of the muscles, this point must await further investigation.

With regard to the true pleural plate *ep* of figures 18 and 21, which is divided by an internal ridge, or apodeme, and an external suture, into two regions *es* and *em*, it would appear that the plate in question comes to occupy a much greater area in the adult than in the larval condition; so that the region *es* of figure 18 corresponds only in a general way to the episternum of the adult, as *es* does to the epimeral region of the imago.

The apodeme of the pleural plate in Gryllus, is connected with the furca by the furca-apodemal muscles. The epimero-subalar and epimero-scutal muscles connect the epimeron with the subalar plate and scutum; and the trochantero-episternal, coxo-episternal, and trochantino-episternal muscles connect the episternum with the trochanter, coxa, and trochantin in Gryllus, as shown by Voss, 1904.

Tergal Subdivisions.

The entire dorsal region of a segment, including the more membranous as well as the more heavily chitinized portions, is termed the *tergum*, or *notum*. When the longitudinal dorsal muscles are developed, they are usually attached to *phragmas*, or transverse shelf-like internal structures of the tergal region, which serve to demark the limits of the metameres. The *alar area 'al'* of figures 18 and 21, in which the wing develops, is tergal in nature, according to Craighead, 1916—a view which is in harmony with the modern conception of the nature of the wings (see Crampton, 1916).

As pointed out by Verhoeff, 1904, and Snodgrass, 1909, two principal plates occur in the tergal region. The anterior one of these two plates (*en* of text-figure and figs. 18, 19, 21, etc.) is usually the only one developed in larval forms, while the posterior plate (*psl* of text-figure), which is the *postscutellum* of adult insects, usually found in the region *psl* of figures 22 and 18, when the muscles of flight have developed: to it are attached the prescuto-postscutellar, scutello-postscutellar, and other longitudinal muscles, as in *Gryllus*.

Snodgrass, 1909, refers to the plate *en* of figures 18, 19, 21, etc., as the "notum," in the restricted sense; but the term notum has always been used as a synonym of tergum, and refers to the entire dorsal region (both membrane and the more heavily chitinized sclerites) of the segment. On this account, the term "scutoscutellum" was applied to the plate in front of the postscutellum (Crampton, 1914, Martin, 1916, etc.) but since this term is somewhat cumbersome, the simple designation *eunotum*, which has been suggested for the plate in question, has been here adopted.

In the young of certain of the more primitive insects, a marginal region extends entirely around the eunotum, as in the pronotal region of the nymph of *Perla* (fig. 24, *per*). In the mesonotum of the Carabid larva shown in figure 21, this marginal region is incomplete, only the anterior portion *prt* having been retained, although this region extends backward for a short distance along the sides of the plate. In the mesonotum of the nymph of *Perla* (fig. 15) the anterior transverse region *prt*, and in the pronotum of the Trichopteron larva shown in figure 19, the posterior transverse region *pot*, are all that remain of the marginal region *per* of figure 24. The anterior transverse marginal region *prt* of figures 15, 18, etc., is apparently homologous with the *preterbite* of adult insects, and the posterior transverse marginal region *pot* of figure 19 is apparently homologous with the *postergite* of adult insects. The anterior region *prt* of figure 15, occurs in many Lepismids and other Apterygotan insects, as well as in the pronotum of many Pterygotan forms, such as the Grylloblattids, Embiids, etc. (see figures by Crampton, 1917 b), and may therefore represent the primitive condition, rather than the remains of a marginal region originally extending completely around the normal plate. The region *prt* (fig. 15, 18, 21, etc.) does not represent the prescutum, but is formed in front of the latter region; similarly, the region *pot* of fig. 19, does not represent the postscutellum, which is formed behind the latter region.

In the mesonotum of the Coleopterous larva shown in figure 22, there occur three regions *psc*, *sc*, and *psl*, which are demarked by wrinklings of the integument. The region *psc* apparently represents the true *prescutum*, while the region *sc* corresponds in a general way to the *scutum* of the adult. Concerning the region *psl*, there is some doubt. That it contains the postscutellar region is quite certain, but the true postscutellum is extremely small in the mesothoracic region of Coleoptera in general, thus suggesting that the region *psl* of figure 22 may possibly contain a portion of the scutellum also.

An examination of the sclerites of Apterygotan insects would indicate that the condition shown in figures 24, 21, and 18, more

nearly represent the original one, while the sclerites of the higher forms, such as those shown in figures 17, 20, and 23, present some variants of the original condition, as might be expected. In figures 20 and 23, the dorsal plates labeled *b* form the *apical tergal plates*, while the plate labeled *c* is the *lateral tergal plate*. In figure 17, the plate labeled *a* is apparently an additional *anterior dorsal tergal plate* of the mesonotum, and the plates labeled *c* appear to be additional *upper* and *lower anterior* and *posterior lateral tergal plates*.

Intersegmental Region.

In figures 18, 21, etc., there occurs an intersegmental region labeled *int*, in which the spiracle *sp* is located. In some instances, a *subspiracular* plate (fig. 21, *ip*) occurs below the spiracle. These plates are not always associated with the spiracle (fig. 12, *ip*), and are apparently homologous with the *interpleurites*, which, in the neck region, form the *lateral cervical plates* (figs. 23, 24, 16, 17, etc., *lc*), while the other intersegmental plates form the dorsal and ventral cervicals, as has been discussed in a recent article (Crampton, 1917 a).

An examination of figures 23, 20, 17, etc., would lead one to believe that the first spiracle (fig. 23, *sp*) is prothoracic, since it is apparently located in the prothoracic region. Embryology, however, shows that the spiracle originates in the anterior portion of the segment behind it, and later appears to migrate to an intersegmental position, or even into the posterior region of the segment in front of it. In such cases, there is frequently an impressed line, or fold, in front of the spiracle, marking it off from the remainder of the segment in front of it, although this is not always the case.

The intersegmental region (figs. 18, 21, etc., *int*) is doubtless a demarked region of the segment behind it, although a portion of it may belong to the segment in front. The spinasternite (figs. 7, 6, 4, etc., *ss*) for example, is located between the intersegmental plates *ip* near the spiracles; but, while the spiracles belong to the segment behind them, the spinasternite has been provisionally regarded as the posteriormost sternal subdivision of the segment in front of it. The spinasternum itself, however, may possibly belong to the segment behind it also, since the musculature would permit of such an interpretation; but, until an embryological study of the region in question has been made, it is impossible to determine this point.

The dorsal intersegmental plates *it* of figure 18 appear to be homologous with the *interterbites* of the adult insect. Their exact significance, however, is not clear, and until an embryological

study of the intersegmental region has been made, it will be impossible to interpret the different intersegmental plates with any degree of certainty or satisfaction.

Relationship Indicated.

As is apparently true of many features which are of no vital importance to the organism (and would not therefore be greatly modified by natural selection—or by use and disuse) the thoracic sclerites furnish many valuable clues as to the relationships of the different groups of insects. In the case of larvae, as is true of the adult forms, it is necessary to examine the most primitive insects, and these are usually too rare to be readily accessible for study. Furthermore, an insect which has preserved certain other features in a comparatively primitive condition will frequently be quite highly specialized in the particular feature one wishes to study; so that it is largely a matter of chance whether one obtains the proper material for his purpose, or not. Some of the conclusions to be drawn from an examination of the larvae available for study, despite the incompleteness of this material, are in harmony with the results obtained from other sources, and may therefore be regarded as of general application.

Among the most interesting of the results here obtained, are the evidences of relationship obtained from a comparison of the sclerites of the nymphal Plecopteron *Perla* with those of the Euplexopteron *Arixenia*. Thus, in comparing the sclerites of the nymphal *Perla* (fig. 15), part for part, with those of *Arixenia* (fig. 13), it is at once apparent that there is a remarkable similarity between the two—a similarity which is all the more striking when one compares the sclerites of *Perla* with those of other insects such as those shown in figures 10, 18, 19, 23, etc., all of which differ markedly from the Plecopteron in question. The relationships indicated by the sclerites are borne out by a comparative study of the head region in various Plecoptera and Euplexoptera, and by a comparison of the segmented cerci of certain Euplexoptera, such as nymphs of *Diplatys* (in which segmented cerci precede the forceps-like structures of the adults) with the segmented cerci of certain Plecoptera, etc. Since the Plecoptera are the more primitive of the two groups of insects, the probabilities are that the Euplexoptera are descended from ancestors not very different from modern Plecoptera.

The sclerites of an Ephemerid nymph (fig. 2) bear a slight resemblance to those of a nymphal Plecopteron (fig. 15), but are more similar to those of a larval Neuropteron (fig. 18). The sclerites of the Ephemerid (fig. 2) differ more from those of a nymphal Odonatan (fig. 11) than one would be led to expect

from the fact that both Ephemerid and Odonatan adults appear to be somewhat related; but the Odonata have apparently followed a strongly aberrant course of development, and their sclerites also differ markedly from those of other insects.

From the study of other structures, I had been led to expect that the sclerites of larval Coleoptera would resemble those of nymphal Euplexoptera and Plecoptera very closely; but the resemblance to the condition found in the Neuroptera is much greater, in the Coleoptera here figured, as can be seen by comparing figure 21 with figure 18. The condition found in some Coleopterous larvae (fig. 5) is rather suggestive of that found in the larva *Corydalis* (fig. 4), while that found in other Coleopterous larvae of (fig. 7) bears a rather strong resemblance to the nature and arrangement of the sclerites in the larva of the Neuropteroid insect *Raphidia* (fig. 6). The insects of the order Coleoptera, however, exhibit such different types of larvae, and the range of modifications met with in the nature and arrangement of their sclerites is so great, that I feel confident that some Coleopterous larvae will be found, in which the sclerites will bear a strong resemblance to those of the nymphal Euplexoptera and Plecoptera; although it must be admitted that thus far the evidence obtained from the study of the sclerites of the larvae would point to a closer relationship between the Coleoptera and the Neuropteroid insects. Indeed, the nature of the narrow transverse *jugular plates* of figures 4 and 6, which is characteristic of many Neuropteroid larvae, is the only absolute feature in the thoracic sclerites which would clearly distinguish the larval Coleoptera from the larval Neuropteroid insects here studied.

The condition of the sclerites of the Homoptera (fig. 1) is quite similar to that of the Neuroptera (fig. 18), as might be expected from the fact that adult Homoptera have retained many features suggestive of their descent from ancestors resembling the Neuroptera. The sclerites of nymphal Homoptera likewise resemble those of larval Coleoptera, in some respects, as might be expected if the Coleoptera are also closely related to the Neuroptera.

It is a rather surprising fact that, so far as the thoracic sclerites are concerned, the larvae of the Trichoptera (fig. 19) resemble the larvae of the Neuroptera (fig. 18) more than the larvae of the Panorpids (fig. 23) do, since such Neuropteroid insects as *Nemoptera* occupy a position somewhat intermediate between the Panorpids and other Neuroptera. Until the larvae of *Nemoptera* and such primitive Panorpids as *Meropc*, *Panorpodes*, etc., are available for study, it is extremely unsatisfactory to attempt to draw any further conclusions concerning the interrelations of the Trichoptera, Panorpids and Neuroptera from the

study of the larval sclerites, since the larvae at present available for study, are too highly specialized for this purpose.

Adult Trichoptera are structurally very similar to the lower Lepidoptera, and one would naturally expect that the sclerites of the larval Trichoptera (fig. 19) would be very similar to those of the larval Lepidoptera (fig. 20), whereas, on the contrary, the sclerites of the Panorpid larva (fig. 23) seem to be much more like those of the Lepidoptera (fig. 20) than the sclerites of certain Trichopterous larvae are; and the same is true in regard to the narrow bands representing the chitinized portions of the coxae *cx* in both Panorpids and Lepidoptera. If one compares the sclerites of a more primitive Lepidopteron larva such as that of *Hepialis*, with the Panorpid here figured, the resemblance is even more pronounced; but the Trichopteron larva shown in figure 19 is possibly not as suitable for such a comparison as others which were not available for study. On the other hand, in comparing the ventral region of the Trichopteron larva shown in figure 9, with the ventral region of the Lepidopteron larva shown in figure 8, there is apparent a marked similarity in the nature of the sclerites, especially with regard to the transverse sclerite *ss*. It is impossible to make a close comparison, however, since I have been unable to borrow a larval *Adela* for study, and figure 8 of this larva, was therefore taken from a figure by Forbes, 1910, who does not distinguish between the chitinous and membranous region in his drawing, thus making it more difficult to compare the two larvae.

The larvae of the Tenthredinids (fig. 17) resemble those of the Panorpids (fig. 23) in having retained the lateral cervical plates *lc*, which I have not found in any Lepidopteron larva. In certain other respects, however, the sclerites of the Tenthredinid larva bear a slight resemblance to those of the Lepidoptera (fig. 20), although neither the Lepidopteron nor the Panorpid larva seem to have retained a plate similar to that labeled *ep* in figure 17, and the coxae of both are quite different from those of the Hymenopteron larva.

Conclusions based upon an examination of one set of structures alone can hardly be regarded as of much value, so that the study of the thoracic sclerites has been made to supplement that of the various other structures of larval and adult forms in attempting to determine the relationships of the different groups of insects. Furthermore, the extreme rarity of the larvae of the more primitive representatives of the different groups, has made it impossible to obtain this very necessary material for comparison, so that the purpose of the present paper is largely that of presenting the principal types of thoracic sclerites met with in the study of the commoner forms, as a basis for the further study of the various modifications met with in the different groups of insects.

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ABBREVIATIONS.

a, Anterior tergal plate.
al, Alar area.
b, Apical tergal plate.
bs, Basisternum or basisternite.
c, Lateral tergal plate or plates.
cx, Coxa, or bands representing coxa.
d, Lateral plate or subalar plate (?).
em, Epimeron.
en, Eunotum.
ep, Eupleuron.
es, Episternum.
et, Eutrochantin.
f, Furcal pits.
fs, Furcasternum or furcasternite.
int, Intersegmental region.
ip, Interpleurites or subspiracular plates.
is, Intersternite, or gular plate.
it, Intertergite.
lc. Lateral cervical plates.
lp, Lateropleurite.
ls, Laterosternite.
mn, Mesonotum.
p, Parapophyses, or parapophysis plate.
per, Perinotum.
pfs, Postfurcasternite.
pn, Pronotum.
po, Postcoxal sclerite or region.
pot, Postergite.
pp, Surcoxal plate.
prt, Pretergite.
ps, Presternum.
psc, Prescutal region.
psl, Postscutellar region.
s, Spinal pit or depression.
sc, Scutal region.
sp, Spiracle.
ss, Spinasternum or spinasternite.
st, Sternum.
tn, Trochantin.

Plate 5.

Fig. 1. Lateral view of prothorax of *Ptyelus* nymph (Homoptera).

Fig. 2. Lateral view of mesothorax of Ephemerid nymph.

Fig. 3. Ventral view of prothorax of *Dytiscus* larva (Coleoptera).

Fig. 4. Ventral view of prothorax of *Corydalis* larva (Neuroptera).

Fig. 5. Ventral view of prothorax of *Hydrophilus* larva (Coleoptera).

Fig. 6. Ventral view of prothorax and mesothorax of *Raphidia* larva (Neuroptera).

Fig. 7. Ventral view of prothorax and mesothorax of *Pyrochroa* larva (Coleoptera).

Fig. 8. Ventral view of prothorax of *Adela* larva (Lepidoptera) based on figure by Forbes, 1910.

Fig. 9. Ventral view of prothorax of Trichopteron larva.

Plate 6.

Fig. 10. Lateral view of mesothorax of *Melanoplus* nymph (Orthoptera).

Fig. 11. Lateral view of mesothorax of Libellulid nymph (Odonata).

Fig. 12. Ventral view of mesothorax of *Eosentomon* (Protura), pleural and sternal sclerites spread out as though in one plane. Based on figure by Prell, 1913.

Fig. 13. Lateral view of mesothorax of *Arixenia* (Euplexoptera).

Fig. 14. Ventral view of prothorax of *Capnia* (Plecoptera), sclerite of pleural and sternal region drawn as though spread out in one plane.

Fig. 15. Lateral view of mesothorax of *Perla* nymph (Plecoptera).

Fig. 16. Ventral view of prothorax and mesothorax of Tenthredinid larva.

Plate 7.

Fig. 17. Lateral view of prothorax and mesothorax of *Pteronidea* larva (Tenthredinid).

Fig. 18. Lateral view of mesothorax of *Corydalis* larva (Neuroptera).

Fig. 19. Lateral view of prothorax and mesothorax of Trichopteron larva.

Fig. 20. Lateral view of prothorax and mesothorax of *Porthetria* larva (Lepidoptera).

Fig. 21. Lateral view of mesothorax of *Calosoma* larva (Coleoptera).

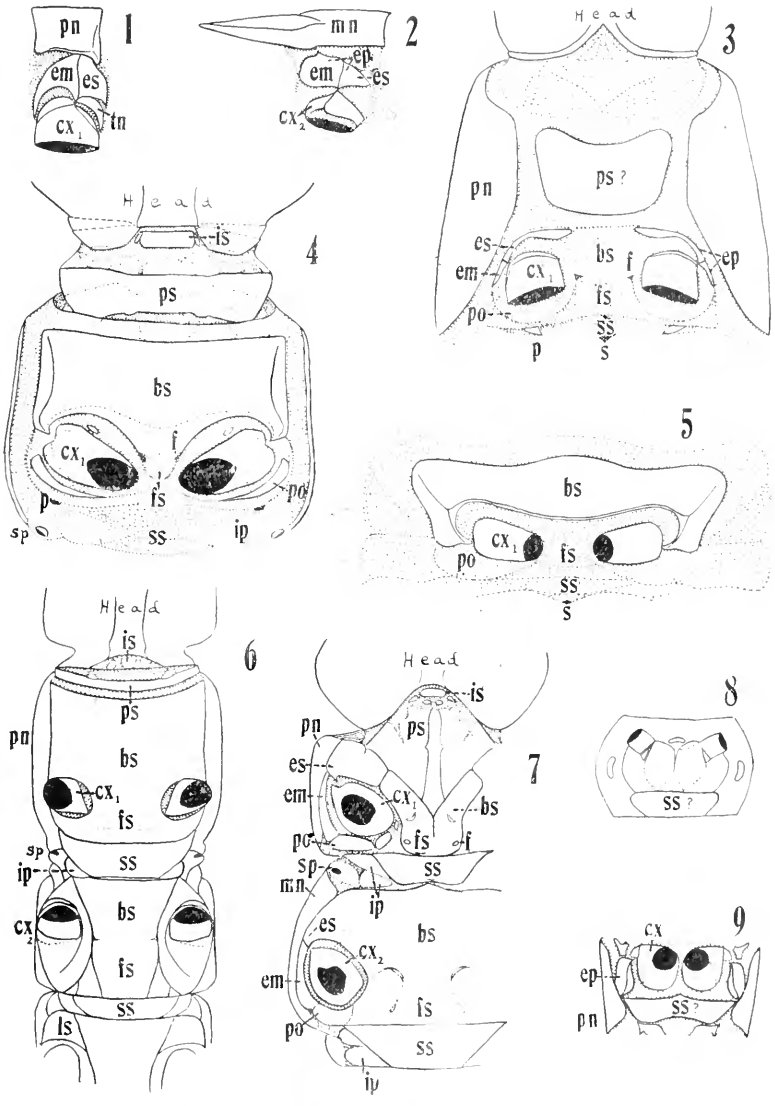
Fig. 22. Lateral view of prothorax and mesothorax of Scarabaeid larva (Coleoptera).

Fig. 23. Lateral view of prothorax and mesothorax of *Panorpa* larva (Mecoptera).

Fig. 24. Lateral view of prothorax of *Perla* nymph (Plecoptera).

Fig. 25. Lateral view of prothorax of *Echinosoma* (Euplexoptera).

In all figures the coxae have been represented as though partially cut off. In all ventral views, the anterior end is directed toward the top of the page; in all lateral views, it is directed toward the right hand margin.



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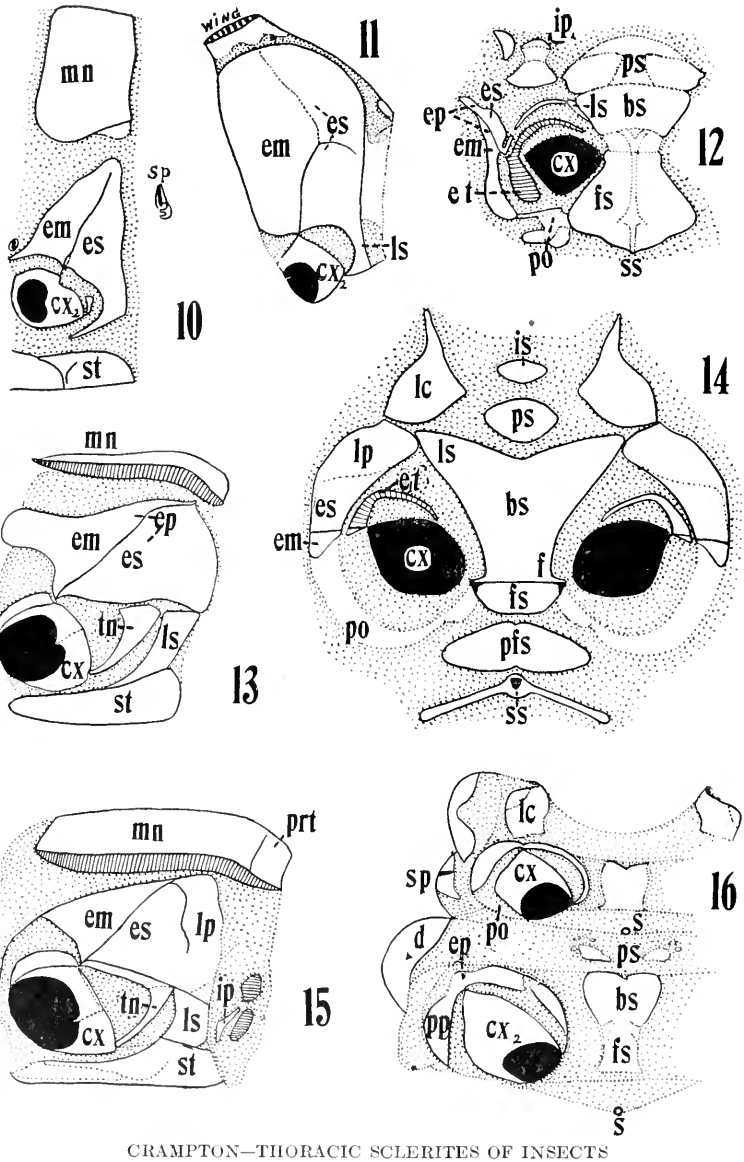

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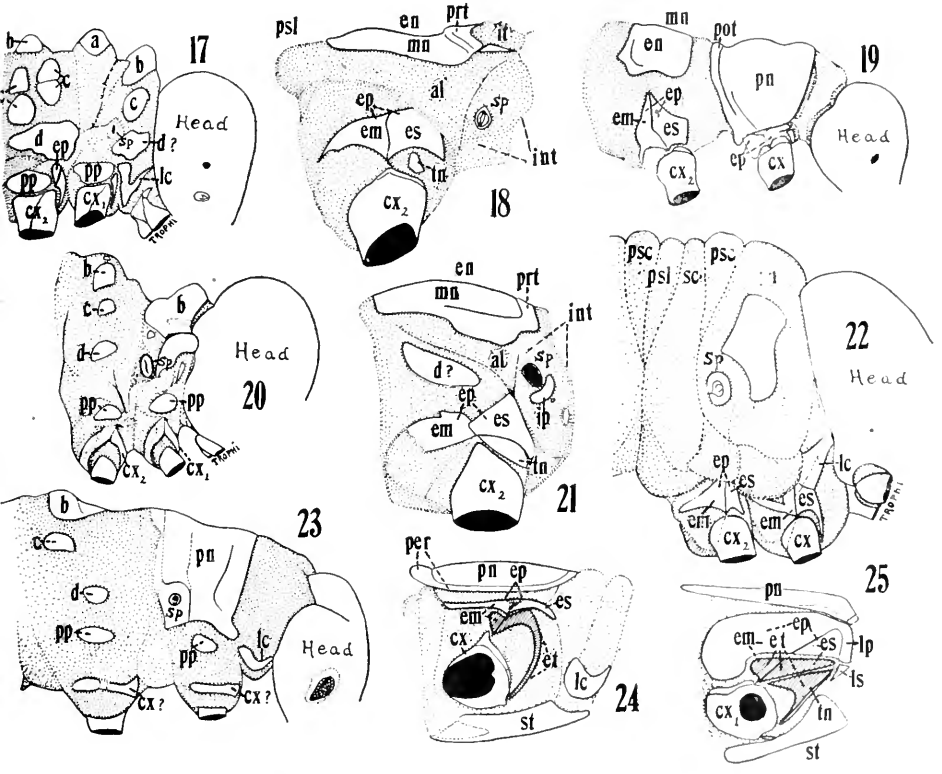

CRAMPTON—THORACIC SCLERITES OF INSECTS

PROPACHYNEURON GIRAULT (HYMENOPTERA, CHALCIDOIDEA).

By A. B. Gahan,

Bureau of Entomology, U. S. Department of Agriculture.

In Psyche, volume XXIV, 1917, p. 102, Mr. A. A. Girault has proposed the new generic name *Propachyneuron* which he state is "based on *Encyrtus siphonophorae* Ashmead of which *Pachys neuron micans* Howard, *P. aphidivorum* Ashmead, and *P. maidaphidis* Ashmead are synonyms."

It is evident from the material in the U. S. National Museum that Ashmead's *Encyrtus siphonophorae* was a composite species, the type series having included two species. The true type is an Encyrtid and was correctly placed by Ashmead (Proc. U. S. Nat. Mus. XXII, 1900, p. 399) in the genus *Aphidencyrtus*. The author of the species, subsequent to the description, apparently discovered that he had included more than one species among the types and removed three of the specimens, one of which he labelled *Pachyneuron siphonophorae* Ashmead but did not describe the species. Mr. Girault evidently intended to base his genus *Propachyneuron* on this manuscript species of Ashmead's, being under the impression that these were the true types of *Encyrtus siphonophorae*.

While Mr. Girault's intention is clear, he has named as type of his genus an apparently valid species entirely different from that which he intended. This raises the complicated nomenclatorial question whether the concept of a genus shall be determined by the species named as type, regardless of the intention of the author, or whether it shall follow the intention of the author. If the former view is adhered to, as the writer believes it should be, then *Propachyneuron* must fall as a synonym of *Aphidencyrtus* Ashmead. If the latter view is accepted then *Propachyneuron* will have as type *Pachyneuron aphidivorum* Ashmead, the oldest synonym of *P. siphonophorae* Girault (not Ashmead.)

In his description of *Propachyneuron* Girault says: "The same as *Pachyneuron* but the antennae bear three ring-joints." This is true only of the female of *aphidivorum*. The male has a distinctly 6-jointed funicle and two ring-joints. The other characters given by Girault for *Propachyneuron* are all duplicated in *Pachyneuron*. It is the opinion of the writer, therefore, that the group, if it may even be called a group, is not deserving of a name. The generic name *Propachyneuron* is, therefore, a synonym, whether of *Aphidencyrtus* or *Pachyneuron* makes little difference.

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THREE HUNDRED AND ELEVENTH MEETING MARCH 7, 1918.

A NEW SPECIES OF AGRILUS FROM FLORIDA (COLEOPTERA; BUPRESTIDAE).[1]

BY W. S. FISHER,

Specialist in Forest Coleoptera.

Agrilus dozieri. n. sp.

Form resembling *bilineatus;* thorax coppery, subopaque, head and elytra black, opaque. Antennae passing the middle of the thorax, piceous, with brassy lustre; serrate from the fourth joint. Front depressed, the occiput more deeply impressed but not as deep as in *vittatocollis,* the median impressed line extending only to the middle front and not reaching the base of the clypeus; lateral sides concave above the base of antennae; surface rather closely strigose and punctuate, clothed with short white pubescence except on the occiput. Prothorax only slightly wider than long, wider at apex than base; sides slightly sinuous; lateral margin sinuate; hind angles with a sharply defined carina in both sexes; disc convex, the median line with an anterior and posterior depression, and with an oblique depression at the sides nearly reaching to the median line; surface rather coarsely strigose, clothed with a median band of sparsely placed yellow pubescence, which is often denuded, and a broad band of similar pubescence adjacent to the lateral margin which extends to the hind angle. Scutellum transversely carinate. Elytra slightly sinuate behind the humeri, broadened behind the middle, nearly concealing the abdomen; apices serrulate, rounded; disc slightly depressed with a very feeble trace of a costa, the sutural edge slightly elevated at apical third, basal foveae moderate; surface densely granulate and opaque. Body beneath black, clothed with short sparsely placed white hairs; prosternal lobe broadly moderately emarginate; the intercoxal process narrow, sides parallel to behind the coxae, then abruptly narrowed to the apex, the surface closely punctate. Abdomen finely punctate, sparsely along the median line, more densely at the sides and on the first two segments; the ventral portion of the segments densely clothed with yellow pubescence; suture between first and second segment not visible at side. Pygidium coarsely punctate, not carinate. Claws dissimilar in the sexes. First joint of hind tarsi as long as the next three joints united.

[1] Contribution from the Branch of Forest Insects, Bureau of Entomology.

Length 6–8 mm.; width 1.5–2 mm.

Male.—Prosternum densely punctured and pubescent. First ventral segment feebly depressed at middle and rugose, not pubescent; second segment simple. Antenna joints all longer than wide. Anterior and middle tibiae distinctly mucronate at the inner apical angle. Claws of anterior and middle tarsi bifid; broadly toothed on posterior tarsi.

Female.—Prosternum less densely punctate, more shining and not pubescent. Ventral segments not impressed at middle. Antennal joints 6 to 11 not longer than wide. Anterior and middle tibiae feebly mucronate at the inner apical angle. Claws rather broadly toothed on all three pairs of tarsi.

Type-locality.—Gainesville, Florida.

Other localities—Enterprise and Archer, Florida.

Type (male), allotype and paratypes.—Cat. No. 21708, U. S. N. M.

Described from four males and two females; type and allotype received from Mr. H. L. Dozier labeled "Agric. Exp. Station, Gainesville, Fla., 3-25-17, H. L. D." and two males labeled "Gainesville, Fla., Coll. H. L. Dozier, 16-78." There were also one female in the Museum Collection labeled "Archer, Fla., 3-28, A. Koebele, Collector" and one male "Enterprise, Fla., 17-6, Coll. Hubbard & Schwarz."

In a letter from Mr. Dozier he states that "This species was collected March 30 to April 5. They were fairly abundant on the foliage of blue beech (*Ostrya* sp.) from March 30 to April 1, 1917 in different parts of the hammocks (hammocks is a term applied in Florida to the dense hardwood forests as distinguished from the open pine lands and cypress swamps.) Some were in copula on these dates, others were flying about in the sunshine from one tree to another. During the two seasons that I was in Florida, I collected this insect only from *Ostrya* foliage and this fact leads me to believe that this species breeds in the wood of this tree." The species is named in honor of my friend Mr. H. L. Dozier who has sent me a number of interesting species from that part of Florida.

In color this species resembles *vittatocollis* and *audax* but is much more slender than either of these two species. It also differs from both species by not having the pygidium carinate and by having the hind angles of the prothorax strongly carinate in both sexes while in *vittatocollis* and *audax* there is no trace of carina..

THREE NEW SPECIES OF DIPTERA.

By Charles T. Greene,

Specialist on Forest Diptera, Bureau of Entomology, Washington, D. C.

While making a study of some miscellaneous Diptera in the collection of the Branch of Forest Insects, the following species, which appear to be new, were found.

CHLOROPIDAE.

Madiza conicola, new species.

Male and female.—Glossy black. Antennae brownish black on outer surface, inner surface of second joint entirely and third joint mostly dark red, upper and apical edge blackish; third joint rounded. Arista brownish black, short pubescent. Arista as long, in the male, and nearly as long in the female, as width of frons at base of antennae. Palpi black. Cheek about half as high as width of third antennal joint, anterior angle produced slightly, lower half of cheek finely bristled, along upper edge of these fine bristles are several much longer bristles; vibrissae present. Frons shiny black. Female, frons at vertex slightly wider than width of eye, and at base of antennae, width equal to that of eye. A narrow area above base of antennae, reaching half way along the frons, opaque blackish. Opaque area much wider in the male and frons narrower. Ocellar triangle, in both sexes, fairly well defined, finely rugose, bare, and with a single bristle on each side. Mesonotum thickly covered with short, blackish hairs; humeral and post alar callosity each have a strong bristle. Two bristles, one stronger than the other, on the mesonotum, near each corner of the scutellum. Scutellum rounded, disk covered like mesonotum. A pair of bristles at apex and a single bristle on each side along the margin. Abdomen shiny black with a small lighter area near the base. Legs brown-black; tip of femur, base and tip of tibiae and all tarsal joints yellow; the infuscation on the middle of the front tibia is variable from a pale grayish to a brown. Wings hyaline, veins yellow; third costal section nearly or about half the length of the second; third and fourth veins parallel. Halteres whitish. Length 1.25 to 1.5 mm.

Type-locality.—Long's Ranch, Oregon, September 3, 1916. Reared November 20, 1916. Other localities are Ashland, Oregon, September 2, 1916; Quincy, California, Sept. 20, 1916. Mr. F. P. Keen, collector.

Larva of this species feed within the cones of *Abies concolor.*

Type.—Female, Allotype male, Cat. No. 21709, U. S. Nat. Mus.

SYRPHIDAE.

Chrysotoxum coloradensis, new species.

This species is near *laterale* and *pubescens*.

Male.—Head—Antennae black, shorter than head. First joint slightly shorter than second, third joint slightly longer than first and second together; bristly hairs on first two joints, black; arista deep yellow, brownish towards apex. Front shiny, brownish-black with numerous long brown hairs and a broad band of short, yellow pubescence along the eyes. Ocellar triangle shiny black, with numerous long dark hairs and a whitish pubescence across the base, front ocellus yellowish-white, basal pair quite reddish. Face pale yellow, finely pubescent and covered with numerous yellowish-brown hairs, shorter than those on the front, a black stripe reaching from antennae to the oral margin, very narrow at the antennae and much broader at the tubercle. (Sometimes this stripe is interrupted by a narrow yellow stripe between the oval margin and the facial tubercle.) Cheek yellow, with a broad, shiny, black stripe reaching from the oral margin to the eye.

Thorax black, dorsum sub-opaque, with a bronze reflection and slightly shiny along the sides; dorsum covered with numerous, yellow hairs, more reddish along the sides. In the middle are two, faint, yellowish stripes extending from half to two thirds the length of the thorax; the lateral edge has a yellow stripe broadly interrupted in back of the transverse suture. Pleura black, posterior half of mesopleura pale yellow, extending up to the base of the wing. Scutellum yellow, brownish in center; bristly hairs on basal half yellow, those on apical half, brown and slightly longer.

Abdomen mostly yellow. The lateral carina black on first, second and third segments, yellowish-brown on fourth and fifth and yellow on apical corner of all the segments except the first. First and second segments black, second with a yellow, arcuate fascia across the middle, broadly interrupted in the middle and dilated towards the outer-edge. (Extreme apical edge of segments sometimes yellow.) Third segment with a narrow black fascia entirely across the base and widening as it meets the carina; a wider black fascia near the middle extending obliquely towards, but not touching, the apical corner (the fasciae on this segment are variable in width); segments four and five have a very narrow black fascia of uneven width along the base, connecting with the carina; fourth segment has a black spot in the center and a longer one towards each apical corner; fifth segment has three black spots in a triangular form. All the black markings on the dorsum and the yellow on the apical part of the last three segments covered with numerous, short, black, bristly hairs. Venter black, three segments visible, basal segment with a narrow yellow fascia along the apical edge, broader on the ends and sometimes interrupted in the middle; middle and apical segments with a yellow fascia along the apical edge, broader at ends and two ovate yellow spots. Black, bristly hairs located

similar to those on the dorsum, with numerous longer hairs, especially down the center. Hypopygium dull yellow, with numerous, black bristly hairs and a brownish, transverse stripe across the middle of the two basal segments. Legs yellow, tarsi reddish; front and middle femora with a brownish infuscation at the base, hind femora brownish on apical half, the tip yellow. Wings faintly cinerous; costal edge lutescent on basals half and brown on apical half.

Length 12 to 13 mm.

Described from 3 males.

Type-locality.—El Paso Co., Colorado, June 7, 1914, A. B. Champlain, collector.

Type.—Male, Cat. No. 21710, U. S. Nat. Mus.

STRATIOMYIDAE.

Myxosargus nigricormis, new species.

Near *Myxosargus fasciatus*, Brauer.

Male and female.—Black, dorsum of thorax deep bronze. Antennae entirely black.

Female.—Head, front deep, shiny, blue-black, with numerous dark hairs with a silvery reflection; tubercle near the middle, weak and variable; face deep, shiny blue-black, covered with numerous, long, dark-brownish hairs with a silvery-white reflection. Thorax shiny black, dorsum microscopically rugose, not so shiny and decidedly bronze colored, with a brownish pubescence having a whitish reflection. Scutellum and spines yellow, with a narrow black area across the base of the scutellum. Abdomen shiny black, pubescence with a silvery reflection, pubescence longer on the sides of the abdomen. Halteres pale green, stem brownish at base. Legs black; front knees yellow, middle knees less yellow; apical third of front tibiae, apical half of four posterior tibiae, three basal joints of the four posterior tarsi, yellow. Wings like *Myxosargus fasciatus*, Brauer.

Male.—Like the female except the dorsum of the thorax is greenish metallic. The pubescence on the front, face, dorsum of thorax and abdomen, longer and black. Scutellum black, spines yellow. Legs entirely black except apical half of middle tibiae and two basal joints of the four posterior tarsi.

Length, Female 6 mm., Male 5.25 mm.

Type-locality.—Chain Bridge, D. C. Described from 22 females and 3 males collected June 10th to July 19, 1912, by the author. Also a female from Plummer's Island, Md., June 27, 1909, collected by Mr. W. L. McAtee.

Type.—Female, Allotype male, Cat. No. 21711, U. S. Nat. Mus.

This species was taken on low grass in a very marshy place.

(THREE HUNDRED AND TWELFTH MEETING, APRIL 4, 1918).

THE CASE OF THE GENERA RHINA AND MAGDALIS.

BY W. DWIGHT PIERCE.

The two genera concerned in this note present a very interesting nomenclatorial case which the writer has attempted to clarify. A number of authors have written on the subject, but it is also necessary to bring up the matter again because of an unfortunate error made by the writer in his paper published in the Proceedings of the United States National Museum, vol. 51, No. 2159, in which an earlier error of Latreille's was followed.

Rhina Latreille (1802) does not belong to the Curculionidae, Magdalininae as there stated, but, as formerly treated, to Cossonidae, Rhininae. The synonymy may be stated as follows:

Family **COSSONIDAE.**

Subfamily **Rhininae.**

Orthognathinae Pierce, 1916, p. 465.

Genus **Rhina** Latreille, 1802.

Rhina Latreille, 1802, His. Nat. Gen. et Part. des Crust. et Ins., vol. 3, pp. 198, 199.
Rhinus Latreille, 1810, Pierce, 1916.
Rhinostomus Rafinesque, 1815.

Type, *barbicornis* (Fabricius) Latreille (1802), designated by Crotch (1870) and accepted by Pierce (1916). This is a synonym of *barbirostris* Fabricius, 1775, Syst. Ent., p. 135.

The original confusion in the genus arose as follows: In 1802 Latreille described Rhina with two described sections. The first contained "*barbicornis* F.," the second "*cerasi* (?) F." There is no *Curculio barbicornis* F., so the first species which is validly described, must be known as *Rhina barbicornis* (F.) Latreille (1802). It is a synonym of *Curculio barbirostris* Fabricius which was probably what Latreille meant. Crotch (1870) and Pierce (1916) fix *barbicornis* (F.) Latreille (1802) as type of Rhina. Latreille (1810) fixes *barbirostris* Fabricius as type of Rhinus.

In 1804 Latreille treated Rhina with two species *barbirostris* Fabricius and *barbicornis* Latreille. The first is the same as *barbicornis* Latreille (1802); the second is preoccupied and is a synonym of *triforcolata* Gyllenhal.

From (*barbicornis* Latreille, 1802) = *barbirostris* Fabricius, we obtain our modern genus Rhina of the Cossonidae.

From (*barbicornis* Latreille, 1804) = *triforcolata* Gyllenhal,

through its synonym *rhina* β Gyllenhal, we obtain the genus Magdalis of the Curculionidae.

Magdalis is fully discussed below.

Family CURCULIONIDAE.

Subfamily Magdalininae.

Rhininae Pierce, 1916, Proc. U. S. N. M., vol. 51, No. 2159, p. 465.

As noted under Rhina the writer was in error in above quoted work.

Genus Magdalis Germar, 1817.

Magdalis Germar, 1817, Mag. der Ent., vol. 2, p. 339; type—(*aterima* Fabricius) = *armigera* Geoffroy, designated by Leach, 1819, and 1824.

Rhinodes Dejean, 1821, Cat. Col., p. 98; type—*cerasi* (Fabricius) Linnaeus, hereby designated.

Thamnophilus Schönherr, 1826, Curc. Disp. Meth., p. 52 (not Vieillot, 1816); type—*violaceus* (auct.) Linnaeus, by original designation.

Magdalinus Schönherr, 1843, Gen. et. Sp. Curc., vol. 7, pt. 2, p. 135, proposed for Thamnophilus; hence with *violaceus* as type.

Rhina Pierce, 1916, Proc. U. S. N. M., vol. 51, No. 2159, p. 465 (not Latreille, 1802); type—*barbicornis* Latreille (1804 not 1802).

Schönherr as first reviser divided the genus into two subgenera Thamnophilus and Panus and the first subgenus into two stirpes Thamnophilus and Edo.

Stephens (1829) subdivided into three genera Magdalis, Rhinodes and Panus. The following subdivision agrees with Stephens.

Now for the first time is it possible to correlate the European and American classification in one system which will render identifications easier.

Table of groups of the genus Magdalis.

(After Daniel 1903.)

1. Antennal club of male abnormal, at least as long as the funicle and finely pubescent; only black species 2
   Antennal club simple, alike in both sexes 3
2. Antennal clubs of male and female different, that of male longer than funicle, that of female normal; one or more of the funicular joints of male antennae finely pubescent as on the club, *Panus* Schönherr
   Antennal clubs alike in both sexes; funicular joints not clothed as club ..... *Rhinodes* Dejean
3. Prothorax in anterior third or fourth laterally without hook, tooth or other prominence 4
   Prothorax in anterior third or fourth laterally toothed, keeled or roughly sculptured 5

4. Scutellum between elytra, not deeply imbedded; elytral interspaces more or less finely sculptured, not punctate; metepisternum not thickly pubescent; femora not or very faintly toothed; small species (2-4 mm.) 6

   Scetellum deeply imbedded or pushed forward; elytral interspaces punctate; femora toothed; claws mutic; upper sides with more or less of a metallic luster ..... *Magdalinus* Schönherr

5. Upper surface hardly or sparsely clothed with decumbent reddish pubescence; thorax laterally in anterior third granulate, keeled, or toothed; claws usually toothed ..... *Magdalis* Germar

   Upper surface covered with ochreous hairs; thorax on anterior third with a granulate hook; claws simple .... *Eumagdalis* Daniel

6. Beak in female curved, longer than head; claws toothed; species black, nonmetallic; elytra with fine, brownish, decumbent rows of hairs on elytra ..... *Panopsis* Daniel

   Beak in both sexes straight; at most as long as head; claws not toothed; black or metallic ..... *Edo* Germar

Subgenus **Magdalis** Germar.

Genus *Magdalis* Germar, 1817, Mag. der Ent., vol. 2, p. 339; type—(*aterrima* Fabricius) = *armigera* Geoffroy.

Genus *Thamnophilus* stirps 1, Schönherr, 1826, Curc. Disp. Meth., p. 52, (preocc.); type—*violaceus* Linnaeus (Germar).

Genus *Magdalis* (Germar) Stephens, 1829, Syst. Cat. Brit. Ins., p. 183; type—*aterrima* Fabricius.

Genus *Magdalinus* Schönherr, 1843, Gen. et. Sp. Curc., vol. 7, pt. 2, p. 135; type—*violaceus* Linnaeus.

Subgenus *Magdalis* Daniel, 1903, Münch. Kol. Zeit., band 1, pp. 239–245 (not Germar, 1817); type—*violaceus* Linnaeus.

Subgenus *Magdalinus* Daniel, 1903, Münch. Kol. Zeit., band 1, pp. 239-245 (not Schönherr, 1843); type—*armigera* (Foureroy) Geoffroy, hereby designated.

Subgenus *Magdalis* (Germar), Heyden, Reitter and Weise, 1906, Cat. Coleop. Europ., p. 694, 695.

The last named authors consider this one subgenus but Daniel treated it as two, *Magdalis* (type *violaceus*), and Magdalinus (type *armigera*), and subdivided Magdalis into two groups with *violacea* Linnaeus and *frontalis* Gyllenhal as types.

The first group is therefore Magdalinus Schönherr (type *violaceus*), synonymy: Thamnophilus Schönherr, Magdalis Daniel group 1.

The second group is unnamed, type *frontalis*.

The third group is Magdalis Germar, (type *aterrima*), synonymy: Magdalinus Daniel.

Preliminary tables of our American species according to the new arrangement are herewith presented, arranging Magdalinus and Magdalis separately, and for the present leaving alone the question as to whether they are groups or subgenera.

Table of the North American Species of the group Magdalinus Schönherr.

(After Fall.)

1. a. Antennae inserted approximately at basal two-fifths of the beak in the male, and at basal one-third in the female (group *lecontei*)..... 2
   b. Antennae inserted at or slightly behind the middle in male, a little more posterior in female, usually at or near the basal two-fifths (group *gentilis*)..... 6
   c. Antennae inserted distinctly beyond the middle in male, and at about the middle in female (group *alutacea*)..... 9
2. Size 3.5–7 mm.; color typically rather brilliant blue or green, *lecontei* Horn 3
   Size smaller, 3 mm.; black throughout or with the elytra faintly bluish..... 4
3. Varieties of *lecontei* Horn.
   a. Color brilliant blue or blue green.....*lecontei* Horn
   b. Prothorax dark purplish-blue, elytra violaceus, varying to entirely brilliant green.....*superba* Fall
   c. Entirely black.....*tenebrosa* Fall
   d. Black, elytra dark blue or bluish black.....*tinctipennis* Fall
4. Prothorax strongly convex, beak longer and more arcuate, elytra faintly bluish, moderately shining; intervals narrow, convex, *convexicollis* Fall
   Prothorax normally convex, beak less strongly arcuate, color black, luster dull, elytral intervals flatter and more rugose, *austera* Fall 5
5. Varieties of *austera* Fall.
   Prothoracic punctures not confluent, color dull black, elytra with faintest suspicion of blue.....*austera* Fall
   Prothoracic punctures more or less longitudinally confluent, elytra with dark blue or greenish luster.....*substriga* Fall
6. Femoral tooth obtuse, rudimentary, antennae of male inverted very slightly behind the middle of the beak, second funicular joint much less than twice as long as wide.....*vitiosa* Fall
   Femoral tooth acute, well developed..... 7
7. Elytral striae lightly or scarcely impressed, the intervals nearly flat..... 8
   Elytral striae rather strongly impressed, the intervals distinctly convex.....*striata* Fall

8. Beak in male fully as long as, and in female distinctly longer than, the prothorax..... *gentilis* LeConte
Beak in male evidently shorter than, and in female subequal in length to, the prothorax; eyes a little less distant; entirely black, surface duller and more rugose..... *proxima* Fall
9. Black, opaque, head rather sparsely punctate; antennae of female inserted at the middle of the beak, funicle more slender. *alutacea* LeConte
Reddish-brown, opaque, head very densely punctured, antennae of female inserted distinctly beyond the middle of the beak, funicle stout..... *imbellis* LeConte

Table of the North American Species of the group Magdalis Germar

Claws toothed at base; thorax serrulate or dentate on sides in front.
1. Mesosternum protuberant; head elongate conical; scape of antennae not attaining the eyes; body red or black..... *barbita* Say
Mesosternum not protuberant; scape of antennae attaining or passing the eyes..... 2
2. Hind angles of prothorax feebly laminiform, disc densely punctured..... 3
Hind angles broadly laminiform, covering the entire base of the elytra, disc sparsely punctured, opaque; body black.... *pandura* Say
3. Elytra feebly striate, intervals convex..... 4
Elytra feebly striate, intervals flat..... *inconspicua* Horn
4. Body and appendages unicolorous..... 5
Body and appendages not unicolorous..... 6
5. Body bronzy black..... *aenescens* LeConte
Body ferruginous..... *armicollis* Say
6. a. Body piceous or nearly black, elytra pale ferruginous, legs black, tarsi piceous..... *pallida* Say
b. Body black, elytra with blue reflection; eyes flat, *subtincta* LeConte
c. Body entirely black but appendages sometimes otherwise colored..... 7
7. Tibiae, tarsi and antennae pale piceo-testaceous..... *olyra* Herbst
Antennae and tarsi piceous..... 8
8. Head broadly conical, eyes moderately convex, scutellum densely clothed with white pubescence..... *gracilis* LeConte
Head elongate conical, eyes flat, scutellum feebly pubescent. *salicis* Horn

Subgenus **Rhinodes** Dejean, 1821.

Genus *Rhinodes* Dejean, 1821, Cat. Col., p. 98; type—*cerasi* Linnaeus.
Genus *Rhina* (Megerle) Dejean, 1821, Cat. Col., p. 98 (not Latreille, 1802), originally quoted in synonymy with Rhinodes; type therefore *cerasi* Linnaeus.

Genus *Anabola* (Megerle) Dejean, 1821, Cat. Col., p. 98, originally quoted in synonymy with Rhinodes; type therefore *cerasi* Linnaeus.

Genus *Porrothus* (Megerle) Dejean, 1821, Cat. Col., p. 98, originally quoted in synonymy with Rhinodes; type therefore *cerasi* Linnaeus.

Subgenus *Panus* Schönherr, 1826, Curc. Disp. Meth., pp. 52, 53, described as subgenus of Thamnophilus; type originally designated—(*rhina* β Gyllenhal) = *trifoveolata* Gyllenhal. *Rhina barbicornis* Latreille (1804 not 1802), is a synonym of the type.

Genus *Panus* (Schönherr) Stephens, 1829, Syst. Cat. Brit. Ins., p. 184; type—*rhina* β Gyllenhal.

Genus *Rhinodes* (Dejean) Stephens, 1829, Syst. Cat. Brit. Ins., p. 183; type—*cerasi* Linnaeus.

Subgenus *Panus* (Schönherr) Daniel, 1903, Münch. Kol. Zeit., band 1, pp. 231–236; type—(*barbicornis* Latreille 1804 not 1802) = *trifoveolata* Gyllenhal.

Subgenus *Panus* (Schönherr) Heyden, Reitter and Weise, 1906, Cat. Coleop. Europ., p. 695; type—*rhina* β Gyllenhal.

Daniel divides the subgenus into two groups, and is followed by Heyden, Reitter and Weise.

The first group is therefore Rhinodes Dejean (type *cerasi*), synonymy: Rhina Dejean; Anabola Dejean; Porrothus Dejean; Rhinodes Stephens; Panus group 1 of Daniel, and Heyden, Reitter and Weise.

The second group is Panus Schönherr, Stephens (type—*rhina* β) synonymy: Panus group 2 of Daniel, and Heyden, Reitter and Weise.

There are no species of the typical group Rhinodes in this county. Of the group Panus we have one species recorded.

Magdalis (Rhinodes, Panus) Trifoveolata Gyllenhal.

Magdalis trifoveolata Gyllenhal, 1827, Insecta Suecica, tome 1, pt. 4, p. 564.

Magdalis barbicornis (Latreille, 1804 not 1802) Fall, Trans. Am. Ent. Soc., vol. 39, p. 33. See discussion under Rhina.

This species is recorded by Fall from New York and Massachusetts.

Subgenus **Edo** Germar, 1819.

Genus *Edo* Germar, 1819, Neu. Ann. Wett. Gesell., vol. 4; type—(*pruni* Linnaeus) = *ruficornis* Linnaeus, designated by Schönherr (1826).

Stirps *Edo* (Germar) Schönherr, 1826, Curc. Disp. Meth., p. 52; stirps 2, in Thamnophilus proper; type designated—*pruni* Linnaeus.

Subgenus *Edo* (Germar) Daniel, 1903, Münch. Kol. Zeit., pp. 237, 238, subgenus in Magdalis; type—*pruni* Linnaeus.

Subgenus *Edo* (Germar) Heyden, Reitter and Weise, 1906, Cat. Coleop. Europ., p. 695; type—*pruni* Linnaeus.

Table of North American Species of Edo.

(After Fall.)

1. Blue, moderately shining, first and second funicular joints subequal, the first not much stouter; length 5.5–8 mm. *cuneiformis* Horn
   Black species 2
2. Elytral intervals wider than the striae, except occasionally in *hispoides* 3
   Elytral intervals narrower than the striae; punctuation coarse; size 4.5–5.5 mm. ..... *perforatus* Horn
3. First and second funicular joints subequal, the first not or scarcely wider than the second; strial punctures of elytra smaller, intervals perfectly flat and nearly three times as wide as punctures at middle of disc; body beneath densely punctate; length 6 mm. *morio* Fall
   First funicular joint much stouter than the second; strial punctures of elytra larger, the intervals flat or slightly convex and from one to two times as wide as punctures at middle of disc; body beneath rather sparsely finely punctate; size 3–4.5 mm. *hispoides* LeConte

Subgenus **Panopsis** Daniel, 1903.

Subgenus *Panopsis* Daniel, 1903, Münch., Kol. Zeit., pp. 237, 239; type—*flavicornis* Gyllenhal, hereby designated.

Subgenus *Panopsis* (Daniel) Heyden, Reitter and Weise, 1906, Cat. Coleop., Europ., p. 695; type—*flavicornis* Gyllenhal.

Subgenus **Eumagdalis** Daniel, 1903.

Subgenus *Eumagdalis*, Daniel, 1903, Münch. Kol. Zeit., pp. 238, 249; type—*grilati* Bedel.

A NEW HOST PLANT OF THE BOLL WEEVIL.

By E. A. McGregor

Bureau of Entomology, Washington, D. C.

The writer spent the month of November, 1917, in Sonora, Mexico, for the purpose of securing data on the possible occurrence of the boll weevil and the pink boll worm in that region. It is of great economic interest to report that *Anthonomus grandis*, or what Doctor Pierce determines as the variety *thurberiae*, was found heavily infesting a wild littoral species of cotton, *Gossypium davidsonii* Kellogg.

Several launch landings were made below Guaymas and, finally, at a point about 20 miles southeast of this city a large clump of this interesting wild cotton was discovered growing

on moist sand dunes almost at the ocean's edge. At the date of the visit the plant, which is a vigorous growing shrub of dense habit, was in an advanced fruiting condition, and the bolls were harboring adult weevils in abundance.

An examination of the material in the National Herbarium has revealed the presence there of eleven sheets of *G. davidsonii*, one from Guaymas, Sonora, and ten from Lower California points as follows: Cape San Lucas; Magdalena Island; San Jose del Cabo; Agua Verde; Cerralvo; Tres Pachitas; Valle Flojo, elev. 200 to 500 feet; Cerro Colorado, elev. 800 feet; Rodriquez, elev. 1400 feet. These distributional data indicate that this new boll weevil host occurs rather thoroughly throughout the southern portion of Lower California at elevations varying from sea level to 1400 feet, and as far northward on the east shore of the Gulf of California as Guaymas. Later, a trip was made southward from San Luis, Mexico, to a point near the head of the Gulf about 15 miles south of La Bolsa, where no sign of this cotton species was found, nor did it occur on the coast opposite Tiburon Island. It will be of great interest to determine just how far northward this new boll weevil host occurs, both in Sonora and in Lower California.

NEW SAWFLIES OF THE SUBFAMILY DIPRIONINAE (HYM.)

By S. A. Rohwer.

Specialist in Forest Hymenoptera, U. S. Bureau of Entomology, Washington, D. C.

For a number of years the author has been working on the sawflies belonging to the subfamily Diprioninae and has practically completed a revision of the species, in which all of the species known to him are characterized and notes on their biology summarized. Because of the size and number of illustrations in this manuscript revision it seems impossible to publish it at present. It, therefore, seems desirable to publish a preliminary paper, outlining the classification used and describing some of the new species.

Subfamily **Diprioninae** Enslin.

The following references refer only to the more recent authors:

Lophyrides Konow, Gen. Insect. Fas. 27, 1905, p. 41.
Lophyrinae Macgillivray, Proc. U. S. Nat. Mus., vol. 29, 1906, p. 629.
Monoctenidae Macgillivray, Proc. U. S. Nat. Mus., vol. 29, 1906, p. 634.
Diprionidae Rohwer, Proc. Ent. Soc. Wash., vol. 13, 1911, p. 220.
Diprioninae Enslin, Deutsch. Ent. Zeitschr., Beiheft, 1912, p. 38.

In a previous paper the writer had considered this group of family rank but after studying the larvae and habits it seems that the group is so closely allied with certain subfamilies in the Tenthredinidae that it should be treated as a subfamily. Moreover, the differences between the Diprionids and the Tenthredinids is not of as much taxonomic value as the differences between the Tenthredinids and Argids or Cimbicids. The writer, therefore, prefers to consider the group as a subfamily of the Tenthredinidae where it can easily be separated from the other groups by the multi-jointed antennae and well defined dorsal plate of the mesoepimeron. The difference between *Diprion* and *Monoctenus* is not, in the author's opinion, great enough to be of subfamily importance. The length of the fusing of the submedius and anal veins varies and in many of the wings of species of *Monoctenus* there is a distinct contraction in the first anal cell. In fact the anal cell in certain individuals of the subfamily differs so much that if this was the only character they would be placed in different subfamilies from their brothers and sisters. A full discussion of the variation of the anal cell and vein has been prepared but for this paper it is sufficient to say that while for most species and specimens it is constant there are some specimens in which the basal abscissa of the anal vein is nearly straight; and there are also specimens in which the interanal is wanting.

If the Erlangen List of Panzer 1801 is treated as a publication validating the new names there proposed the genus *Diprion* Schrank will fall as a synonym of the older name *Pteronus* Panzer (or Jurine?) and the subfamily name should be changed to Pteroninae. For the time being the writer prefers to leave this matter open, but he admits that as far as he can see there is no rule of the Internation Commission which would even suggest that this upsetting, long overlooked, review of an unpublished book cannot be used for the establishment of certain generic names.

The five genera which belong to this subfamily may be distinguished by the following key:

Key to Genera based on Adults.

1. First and second anal cells separated by the fusing of submedius and anal veins; antenna of male uniramose, of female serrated; malar space large; longer calcarium of hind tibiae shorter than basitarsus; claws with an inner tooth..... 2

   First and second anal cells normally separated by the interanal vein, but occasionally this is wanting and the two cells are confluent; antenna of male biramose, of female usually serrate but sometimes shortly biramose..... 3

2. Intercosta wanting; head and thorax metallic; posterior orbits as broad as cephalo-caudad diameter of eye. . . . *Augomonoctenus* Rohwer
Intercosta present; head and thorax not metallic; posterior orbits only about two-thirds the cephalo-caudad diameter of eye, *Monoctenus* Hartig

3. Malar space very narrow, reduced to a line; intercosta wanting; longer calcarium of hind tibiae subequal with basitarsus; antennae biramose in both sexes although the rami are shorter in the female. . . . *Neodiprion* Rohwer
Malar space broad usually nearly as broad as the width of mandible at base; intercosta present; longer calcarium of hind tibiae much shorter than basitarsus; antennae biramose in male, serrate in female. . . . 4

4. Scutellum of the metathorax large, well developed, flat, densely covered with large punctures, its cephalo-caudad length equal or longer than the cephalo-caudad length of the propodeum, *Diprion* Schrank
Scutellum of the metathorax smaller, not so well developed dorsally, more or less vertical, without large punctures and its cephalo-caudad length shorter than the propodeum, *Neodiprion* Rohwer

Augomonoctenus, new genus.

Genotype.—*Augomonoctenus libocedrii* Rohwer.

Belongs to the Tenthredinid subfamily Diprioninae, and is related to the genus *Monoctenus* Hartig from which it is readily separated by the absence of the intercosta, metallic head and thorax, and the much broader posterior orbits. Robust; anterior margin of the clypeus emarginate; malar space distinct; mandibles extremely broad at the base; posterior orbits wider than the cephalo-caudad diameter of the eye; eyes diverging below; antennae, of the female, wanting but undoubtedly serrate; of the male, with single rami from each joint as in *Monoctenus;* head and thorax highly polished, metallic; wings as in *Monoctenus*, except the intercosta is wanting; longer calcarium of the posterioe tibiae much shorter than the basitarsis; tarsal claws with an erect inner tooth; sheath without brush-like plates at the apex; last sternite of the female rounded posteriorly.

Augomonoctenus libocedrii, new species.

Female.—Length 9 mm. Anterior margin of the clypeus subsquarely emarginate; the emargination in outline and size approximately the same as the lobes; supraclypeal area convex, sharply separated from the clypeus by a suture; middle fovea deep, elongate, and extending to the anterior ocellus; antennal furrows complete; postocellar furrow

poorly defined; anterior ocellus in a triangular shaped depression; vertical furrows sharply defined anteriorly; postocellar line distinctly longer than the ocellocular line, but one-half shorter than the ocelloccipital line; prescutum parted by a median longitudinal depression which is especially prominent anteriorly; the suture between the scutellum and the scutum deep, broad, and U-shaped; third abscissa of the radius distinctly greater than the first and second combined; the submedius and anal veins united for a distance as great as the first anal cell. Shining blue black; head and thorax with short white hair; first five abdominal segments rufous; wings subhyaline, venation dark brown.

Male.—Length 5.5 mm. Anterior margin of the clypeus with deep arcuate emargination; head and body characters as described from the female; except that the submedius and the anal veins are not united for such a great distance; hypopygidium rounded apically. Blue black, shining; head and thorax with short gray hair; the legs beyond the femora rufo-ferruginous; abdomen rufous except the apical three tergites and the hypopygidium; wings subhyaline, venation dark brown.

Type-locality.—Siskiyou, Oregon. Described from one male and one female reared from larvae collected feeding in the cones of *Libocedrus decurrens*, and recorded under Bureau of Entomology No. Hopk. U. S. 14206 *a*. Material collected and reared by P. D. Sergent.

Type.—Cat. No. 21706, U. S. Nat. Mus.

Genus **Diprion** Schrank.

The middle European species of the genus *Diprion* have recently been tabulated by Enslin. In this tabulation two new subgenera are established. As restricted in the present paper the genus *Diprion* is confined (except for the recently introduced *D. simile* Hartig) to the Palaearctic region, where it includes all but one of the species of the subfamily.

The subgenera recognized by Enslin may be separated as follows:

Key to the Subgenera of Diprion Schrank.

1. Tarsal claws simple; antennae as in *Diprion* s. s. ..... *Mierodiprion* Enslin
   Tarsal claws with an inner tooth 2
2. Antennae of female distinctly tapering, not serrate above, the third joint longer than the fourth, the fourth with a projection; antennae of male not more than twenty-six-jointed and biramose to apex ..... *Diprion* Schrank
   Antennae of female not tapering, serrate above and below, the third and fourth joints subequal, ring-like and without projections; antennae of male thirty-two-jointed, the apical six joints with only one ramus ..... *Macrodiprion* Enslin

Neodiprion, new genus.

All of the Nearctic species which have heretofore been called *Lophyrus* or *Diprion* can easily be distinguished from the old world species (except *sertifer*, which belongs to *Neodiprion* s. s.) by the shape, size and sculpture of the metascutellum. This character is of considerable importance and the writer makes use of it in erecting the genus *Neodiprion*. The genus *Neodiprion* is the only native Diprinoid group in which the anal cells are separated by a short straight vein and it replaces the names *Lophyrus* and *Diprion* for the native species.

The genus *Neodiprion* contains two well defined and easily recognized groups which are worthy of name and are here treated as subgenera. These may be separated by the following key:

Key to the Subgenera of Neodiprion Rohwer.

1. Large robust species with the tergum banded(females) or spotted (males) with yellow; apical six antennal joints of male uniramose; postocellar line of female much less than ocelloccipital line; calcarium of female robust somewhat clavate apically. *Zadiprion* Rohwer

   Small or medium sized species with tergum unicolorous except for a pale lateral band in some females; antennae of male biramose to apex; postocellar line of female equal to or shorter than the ocelloccipital line; calcarium of female normal. . *Neodiprion* Rohwer

Zadiprion, new subgenus.

Genotype.—Diprion grandis Rohwer.

Superficially this group of large species resembes the species of the genus *Diprion* and in some ways it seems to be intermediate between *Diprion* and *Neodiprion*.

The species of this subgenus are known only from the arid western part of the United States and the northern part of Mexico. The females may be separated by the following key:

Key to the species of Zadiprion

1. Emargination of the last sternite about one-half as deep as wide. (scutellun yellow with large separated punctures; antennae twenty-two-jointed) ..... *townsendi* (Cockerell)

   Emargination of the last sternite not a fourth as deep as wide..... 2

2. Scutellum yellow, except the posterior margin nearly impunctate; basal plates yellow..... *grandis* (Rohwer)

   Scutellum piceous and ferruginous, coarsely and closely punctured; basal plates piceous..... *vallicola* Rohwer

Neodiprion (Zadiprion) vallicola, new species.

Female.—Length 8.5 mm. Labrum sparsely punctured, obtusely pointed, part projecting beyond the clypeus about as long as the clypeus; clypeus punctured like the front, distinctly somewhat angularly emarginate anteriorly; antennal foveae large, joining with the supraclypeal fovea; middle fovea poorly defined, circular in outline and indistinctly connected with the ocellar depression; antennal furrows wanting; postocellar line about one-third shorter than the ocellocular line; postocellar area hardly defined; third joint of maxillary palpi distinctly longer than the fourth; front closely, finely punctured, vertex and orbits with distinct separate punctures; antennae wanting; mesonotum with close, rather small distinct punctures; mesoepimerum coarsely punctured; pectus sparsely and more finely punctured; scutellum coarsely, closely punctured, with a more or less distinct median impression; legs normal for the group; tergum coriaceo-reticulate when magnified thirty-five times; venter granular with a few scattered punctures; emargination of the last ventral segment, broadly arcuate, much wider than deep; pad-like portion of sheath about three times as long as broad. Venation abnormal; third intercubitus wanting; interanal wanting. Dark rufous; orbits, clypeus and supraclypeal area slightly yellowish; anterior part of scutellum, spot on mesoepimerum black; abdomen black and yellow, basal plates piceous, second, third and fourth tergal segments, the remaining tergal and all the ventral segments black at base only, nates rufous, basal part of sheath yellow, apical part rufous. Wings yellowish-hyaline, viterous venation reddish yellow.

Type-locality.—Meadow Valley, Mexico. One female collected by C. H. T. Townsend.

Type.—Cat. No. 21721 U. S. Nat. Mus.

Neodiprion, new subgenus.

Genotype.—Lophyrus lecontei Fitch.

To this restricted part of the genus *Neodiprion*, most of the American species belong. The European *sertifer* is the only species known to occur out of the Nearctic region. The species are all rather similar and often exhibit considerable variation in color, number of antennal joints, and many of the head characters which in other groups are so reliable. The writer has grouped the females by the shape and structure of the sheath and has found this to be a very satisfactory character. In some species the pad-like area is very narrow and the concavity between it and the central part of the sheath is wide, in others the pad-like area is broad and is very close to the central part of the sheath. Other characters which have been found useful are: The emargination of the last sternite in the female; the shape of the antennal joints;

the punctuation of the head and thorax, especially the scutellum; the shape and relative length and width of the postocellar area; the hypopygidium of the male, etc.

There are a number of undescribed species in this genus but the tabulation and description of all of these must be held for a more complete paper. Some of the species, however, are abundant and have attracted the attention of economic entomologists. Descriptions of some of these follow.

Neodiprion (Neodiprion) dyari, new species.

Structurally this is close to *fabricii* (Leach) but it feeds on a different pine in the larval stage, is much darker and has a different habitus and sheath.

Female.—Length 7 mm. Labrum polished, obtusely pointed apically; clypeus nearly truncate, with a narrow depressed margin, punctured like the rest of the front; supraclypeal area flattened; antennal foveae poorly defined, connected with the deeper supraclypeal foveae, lateral foveae wanting or nearly; middle fovea shallow, very poorly defined; ocellar basin wanting or only faintly indicated; postocellar area flattened, well defined, not widened posteriorly, about two and a half times as wide as the cephalocaudad length; postocellar line longer than the ocellocular line; head closely punctured, the punctures more separate on the vertex; antennae twenty-jointed, tapering, pedicellum twice or more than twice as wide as long, third joint longer than the fourth, apical joints about two and a half times as long as broad; mesonotum sparsely punctured, punctures of scutellum somewhat larger; mesepisternum more closely punctured than the scutum; first perapteron, in outline, nearly an equilateral triangle; tergum shining in punctate venter with separate poorly defined punctures; last sternite broadly arcuately emarginate; apical ventral pad-like portion of sheath about five times as long as broad, separate from the middle portion; wings and legs normal. Piceous; spot on mandibles, spot on malar space, clypeus and band on vertex reddish-yellow; pronotum, margins of prescutum, large spot on scutellum, pleurae, middle of venter, ventral aspect of tergum, and legs except the brownish bases of coxae and most of the femora, pallid. Wings iridescent, hyaline, slightly dusky; venation rather dark brown, stigma pale brown.

Paratopotypes show this species to vary as follows: antennae nineteen to twenty-jointed; clypeus with a broad, shining depressed margin; head ferruginous, with a broad piceous frontal band, to piceous (the typical color is the commonest) femora brownish to ferruginous; posterior tibiae sometimes piceous; mesepisternum and scutellum sometimes piceous; abdomen castenous to typical.

Male.—Length 6 mm. Labrum punctured, narrowly rounded apically; clypeus broadly arcuately emarginate, apical part more shining than the basal; foveae and punctuation as in female; postocellar area subconvex,

punctured like the rest of the head; postocellar line longer than the ocellocular line; antennae twenty-two-jointed; hypopygidium broadly rounded. Black; legs below trochanters reddish-yellow, posterior femora partly dusky; wings as in female.

The male varies but little.

Type-locality.—Rosslyn, Virginia. Thirty-seven females and four males from larvae on *Pinus virginiana*, bred by Dr. H. G. Dyar for whom the species is named.

Type.—Cat. No. 21722 U. S. Nat. Mus.

Neodiprion (Neodiprion) scutellatus, new species.

Related to *edwardsii* (Norton) but may be separated by the cephalo-caudad length of the scutellum being greater than the width and by the parted postocellar area.

Female.—Length 7.5 mm. Labrum rather narrowly rounded; clypeus with a narrow median notch, apical part depressed, shining, transverse ridge truncate, basal part somewhat opaque; antennal foveae large confluent with the supraclypeal foveae; no lateral foveae; antennal furrows continuous, broken by the lateral ocelli; middle fovea narrow, well defined, continuous with the broader and shallower ocellar depression; postocellar area well defined about four times as long as the cephalo-caudad length, strongly convex, parted by an impressed line, rather more sparsely punctured than the vertex; postocellar line longer than the ocellocular line; sparsely irregularly punctured, the punctures on the front closer; antennae twenty-jointed; meso-prescutum and -scutum very sparsely, finely punctured; scutellum and mesoepisternum nearly or quite impunctate; cephalo-caudad length of the scutellum greater than its width; tergum shining, polished; nates polished; pad-like part of sheath narrow; much longer than wide, not touching middle part; the saw is partly exserted and shows seven rows of regular teeth on the lower gonapophyses, and the upper gonapophyses serrate apically; appendiculation of the hind lanceolate cell a little longer than the transverse median vein. Reddish-luteous; flagellum, base of mandibles, antennal furrows to ocelli, spot enclosing ocelli, suffuse spots on scutum and prescutum and metathorax black or brownish. Wings hyaline, faintly yellowish; venation very pale brown, stigma yellowish-brown.

Type-locality.—Seattle, Washington. One female collected by Mr. T. Kincaid. Another label bears the name "Fir" on it.

Type.—Cat. No. 21723 U. S. Nat. Mus.

Neodiprion (Neodiprion) mundus, new species.

Closely allied to *scutellatus* and may prove to be only a variety of that species, it differs in the following manner:

mundus.	*scutellatus.*
1. General color piceous black.	1. General color reddish-luteous.
2. Antennae 18-jointed.	2. Antennae 20-jointed.
3. Middle fovea broad shallow, indistinctly connected with the ocellar depression.	3. Middle fovea narrow, connected with the broader ocellar depression.

Type-locality.—Siskiyou County, California. One female.
Type.—Cat. No. 21724 U. S. Nat. Mus.

Neodiprion pinetum (Norton).

Lophyrus le Contii (sic!) Kirkpatrick, Ohio Farmer, Cleveland, vol. 9, No. 47, Nov. 24, 1860, p. 269.
Lophyrus pinetum Norton, Trans. Amer. Ent. Soc., vol. 2, 1869, p. 328.
Lophyrus abbotii of most American Authors not Leach.
Lophyrus pinetorum Dalla Torre, Cat. Hym., vol. 1, 1894, p. 297, an emendation.

The type of *pinetum* (Norton) has been lost or is in such a state of preservation to be of little value. In the collection of the American Entomological Society (Philadelphia) there is a pin with part of the thorax and first abdominal segment which may represent part of the type material. As this fragment is entirely unsatisfactory a female reared from larvae collected on white pine (*Pinus strobus*) at Reading, Pennsylvania, and now in the National Museum has been considered as neotype. This female agrees with Norton's original description.

The description of the larva given by Kirkpatrick agrees in all important points mentioned with the larva of the neotype. This species is the common one which feeds on white pine and has been continuously referred to as *abbotii* Leach. This is due, at least in a large measure, to the erroneous determination originally made by Riley, 9th Ann. Rept. Ins. Missouri, 1877, p. 29, 32, fig. 11, and other references. The specimens reared by Riley are in National Museum and are the same species as the neotype of *pinetum*.

There is considerable variation in this species, even in adults reared from the same larval colony. The female antennae vary from 18 to 20 joints; the middle fovea may be obsolete, or small and well defined; the scutum may lack the brownish spots; the dorsal aspect of the tergum may be uniformly ferruginous or distinctly piceous and slightly paler at the base.

Neodiprion virginiana, new species.

This species is closely allied to *pinetum* (Norton), but may be readily separated by the narrower emargination of the last ster-

nite, by the short rami of the antennae, and in having the third and fourth antennal joints subequal on their dorsal margin.

Female.—Length 8.5 mm. Clypeus strongly convex basally with scattered large punctures, the apical margin broadly depressed and arcuately emarginate; median fovea elongate connecting with the depression in front of the anterior ocellus; head shining, the face in front with rather close, well defined punctures; the vertex and posterior orbits with punctures more widely separated; postocellar area slightly arched, sharply defined on all sides, about twice as wide as the median length; antennae 17-jointed, the median rami shorter than the length of their joints, stout, and broader basally than apically; prescutum and scutum polished with only a few widely scattered, small punctures; scutellum broader than long, obtusely angulate posteriorly and with large well defined punctures which are closer posteriorly; mesepisterum with the punctures slightly smaller than those of the scutellum; tergum shining; without sculpture; nates subopaque with a faint reticulation under high magnification and some poorly defined punctures; sheath, seen from below, rounded apically with the pad-like plates two and one-half times as long as wide and close to the median ridge; apical sternite with a deep narrow emargination (in depth this emargination is fully one-third the total width of the sternite); venation normal; tarsal claws with a tooth near the middle; tarsi of normal length. Rufopiceous; head except a line across the ocelli and extending ventrally to the base of the antennae rufo-ferruginous; angles of the pronotum, ventral aspect of the tergites, sternites medianly, apices of coxae, trochanters, apices of the four anterior femora, all of the tibiae basally ,whitish; sternites, mesopectus, and nates and eight tergite ferruginous; wings faintly smoky, venation dark brown.

Male.—Length 5 mm. Robust; medium fovea obsolete; head more closely punctured than in the female; postocellar area strongly arched; antennae 19—jointed; hypopygidium broadly rounded apically, shining, with only a few widely scattered punctures. Black; sternites, ventral aspect of the tergites ferruginous; legs ferruginous; bases of the coxae black; anterior tibiae and the posterior knees whitish.

Type-locality.—Kanawha Station, West Virginia. Described from three females (one type) and two males (one allotype) reared from larvae collected on *Pinus virginiana* by A. D. Hopkins, and recorded under Bureau of Entomology, No. Hopk. U. S. 10719b.

Type.—Cat. No. 21776, U. S. Nat. Mus.

Neodiprion affinis, new species.

This species is closely allied to *virginiana* Rohwer, but may be separated from it by having the third joint of the antennae distinctly longer than the fourth on the dorsal margin, in having the tergites mostly ferruginous, and by the larger punctures on the scutum.

Female.—Length 7 mm. Clypeus strongly convex basally, without well defined punctures; anterior margin broadly depressed and nearly truncate; middle fovea obsolete; head shining, the face and frons sparsely punctured as is also the vertex; postocellar area completely defined, very slightly arched, twice as wide as the median length; antennae 17-jointed; the median rami shorter than the length of their joints, broad basally and narrowed apically; scutum and prescutum shining, with comparatively large scattered punctures; scutellum wider than long, obtusely angled posteriorly, the surface with large, well defined punctures which are closer posteriorly; mesepisternum with the punctures close but slightly smaller than those of the scutellum; tergites polished; nates shining, but under high magnification finely reticulate and with a few scattered, setigerous punctures; sheath, seen from below rounded apically, the pad-like plates a little more than two and one-half times as long as wide, and fitting close to the median ridge; apical sternite with a deep narrow emargination (in depth this emargination is fully one-third the total width of the sternite); posterior tarsi of normal length; tarsal claws with a small tooth at the middle; hind basitarsis subequal with the following joint. Ferruginous; intercellar area and antennal furrows to ocelli black; scutum and prescutum slightly brownish; scutellum paler; metathorax black; basal tergites somewhat piceous; angles of the pronotum, upper part of mesepisternum, and the sides of the tergites whitish; legs ferruginous, the apices of the four anterior femora, the bases of all the tibiae, all the trochanters whitish; wings hyaline; venation dark brown.

Male.—Length 5.5 mm. Vertex almost as coarsely punctured at the front; antennae 18-jointed; hypopygidium, with distinct punctures, broadly rounded apically. Black; sternites ferruginous; legs below trochanters ferruginous, with tibiae (especially at base) and tarsi somewhat whitish. Wings hyaline; venation pale brown.

Type-locality.—Falls Church, Va. Described from three females (one type) and two males (one allotype) reared from larvae collected on *Pinus virginiana* by J. N. Knull and recorded under Bureau of Entomology number Hopk. U. S. 13648g.

Type.—Cat. No. 21777, U. S. Nat. Mus.

Neodiprion maura, new species.

Related to *pratti* (Dyer) but the scutellum is angulate posteriorly and the middle fovea is not large and prominent.

Female.—Length 5.5 mm. Clypeus convex poorly punctured, the anterior margin depressed and arcuately emarginate; head shining, with distinct rather close well defined punctures; middle fovea obsolete; postocellar area not arched, four times as wide as long, vertical furrows poorly defined; antennae 19-jointed, slightly longer than the width of the head, the third joint slightly longer than the fourth, the rami triangular in outline, about half as long as the width of the rest of the joint; prescutum with

small, widely separated puncture; punctures of the scutum closer and somewhat larger; scutellum wider than long, angulate posteriorly, with large well defined punctures which are closer posteriorly; mesepisternum with punctures similar in size but closer than those on the scutum; tergum highly polished dorsally but laterally with some poorly defined punctures; nates shining, with some scattered punctures; sheath seen from below with its apical width less than the distance from the base of pad-like brush to apex of sheath, the pad-like area elongate and well separated from the median ridge; inner tooth of claw erect and well removed from the base; tarsi of normal length, the hind basitarsis distinctly longer than its apical width. Black; apex of clypeus, labrum, palpi, angles of pronotum and upper part of mesepisternum dirty white; legs black, apices of coxae, and femora, bases of tibiae and all of the tarsi whitish; wings hyaline, iridescent, venation dark brown.

The female varies as follows: Antennae 17–19-jointed; middle fovae faintly indicated; vertex slightly piceous; ventral aspect of tergites sometimes whitish; sheath beneath more or less ferruginous.

Male.—Length 4.5 mm. Depressed margin of the clypeus narrower than antennae 22-jointed; sternites, including hypopygidium, with distinct in female and only slightly emarginate; head and thorax about as in female; punctures; hypopygidium obtusely rounded apically. Black; labrum, four anterior femora beneath apically, tibiae and tarsi whitish.

In the male the legs may be pale beyond the coxae.

Type-locality.—Boulder Junction, Wisconsin. Described from three females (one type) and two males (one allotype) reared from larvae collected on Jack pine (*Pinus banksiana*) by S. A. Rohwer, and recorded under note number Hopk. U. S. 10188.

Type.—Cat. No. 21774, U. S. Nat.Mus.

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THREE HUNDRED AND THIRTEENTH MEETING, MAY 2, 1918

MEDICAL ENTOMOLOGY A VITAL FACTOR IN THE PROSECUTION OF THE WAR.

BY W. DWIGHT PIERCE.

The Biological Complex.

The farther one progresses in the study of biology the more he becomes impressed with the absolute interdependence of all forms of organic life. It is impossible to conduct a study of man or any species of animal without soon reaching some phase of the question which demands attention to some other species, until finally a complete biological study has led one far afield. For instance, the investigator, working upon a given disease, finds that the disease is caused by some organism. He proceeds to study the organism and soon finds that it must have a phase of its life outside the host as well as in the host. In his further investigation of the life cycle of the parasite he often finds that there is another host concerned. Thus, before he has gone very far in his investigation he has three widely separate species of life intimately joined together in a biological complex. It is interesting to note that the intermediate or primary hosts of parasites are often found among the invertebrates, especially the insects.

In tracing farther the study of such a parasite the investigator is led to inquire into the life history of the insect and may find that this insect attacks other vertebrate hosts. The question then is to determine whether the parasite of the insect is also found in the newly discovered vertebrate host, and it may often be learned that some wild animal is the reservoir of a disease of man or domestic animals, and thus the complex becomes greater and greater the farther one investigates. It is therefore obvious that a perfect sanitation and prevention of disease necessitates a complete knowledge of all forms of life and their interrelationships.

Division of Labor

Necessarily no one man or group of men can hope to become familiar with the entire subject. The field is tremendous and requires many types of specialists cooperating closely in order that a single disease complex be thoroughly understood.

When we consider that the different diseases, the different insects, and the different animals are inextricably interrelated we see the great necessity of concerted action among all sciences engaged in the study or prevention of disease. The physician finds that he must principally devote his attention to the diagnosis and treatment of the diseases brought to his attention, but is often able to carry his studies farther. The protozoologist, the bacteriologist, and the helminthologist, must follow out the complete life cycle of the organisms which they have studied through all hosts, invertebrate and vertebrate. The entomologist must study the life history and control of the insect, the relationships of the insect to the host and the relationships of the parasites in the insect to the diseases of the host. The sanitarian must understand all those things worked out by the entomologist, protozoologist, bacteriologist, helminthologist, and physician and be able to devise ways and means of accomplishing the recommendations of these specialists. There can be no hard and fast line delineating the energies of any one group of investigators. Each group of specialists must necessarily review a part of the subjects which appears to belong to another group of specialists in order that they may thoroughly understand their own work.

The Phases of Medical Entomology.

We have to deal in this discussion with the entomological viewpoint in medicine and sanitation. The entomologist may divide his activities into three distinct groups—the biological and ecological, the medical and veterinary, and the sanitary. Under the biological and ecological phases of medical entomology we place the studies of the life history of insects which may in some way be related to the transmission or causation of disease.

The medico-veterinary phase of the question involves the study of the insects in direct relationship to the vertebrate hosts, and necessarily must include studies of the transmission of disease by insects for it is obvious that only one trained in the study of insects can adequately perform experiments in disease transmission. The very first necessity in such experiments is the ability to rear the insects and to keep them alive during the period of experimentation. It is fortunate when the person who does this experimentation is not only a trained entomologist but also is trained in the subjects of medicine, protozoology and bacteriology. In fact, we

may assume that such requirements are almost necessary to successful investigation of disease-transmitting insects. There are other phases of the subject, however, which do not require such intimate knowledge of microorganisms. These are the study of the ectoparasites of man and animals, and also of those insects which from some cause or other become endo-parasites.

Sanitary entomology is really the putting into effect of a knowledge of the life history of the insects which cause and carry disease. Entomological sanitation involves many features of engineering but is by no means an exclusively engineering problem.

Thus it will be seen that medical entomology is a necessary part in the great chain of subjects relating to the health of man and animals. It is a link, which, if absent, prevents a correct interpretation of protective medicine. We are all aware of the part health has in winning this war. It is obvious therefore that medical entomology must have a vital part in the great conflict. I shall attempt in a cursory manner to show some of the phases of entomology's part.

THE BIOLOGICAL PHASE OF THE SUBJECT.

We have not been in the habit of looking on medical subjects often enough from the purely biological side of the question. Not many generations ago the medical profession would have denied any biological problems outside the subject of the disease itself. Now we know that for every disease there is a cause, and usually this cause is directly or indirectly an organism.

Types of Relationships.

The science has now progressed far enough so that we are beginning to recognize certain types of interrelationships between the disease organism and its host. Possibly we may make a tentative grouping as follows:

Type 1. The simple relationship existing purely between a given vertebrate species and a given organism, with the transmission voluntary or involuntary, but direct from individual to individual. Simple insect parasitism may be classed here, as for instance bots, lice, mites, confined to single hosts.

Type 2. Such a simple relationship but with the possibility of a third species carrying the organism on its body, or in its body, without altering it or enabling it to multiply or continue its development. Insects have been convicted in numerous cases of such a mechanical transmission of disease, as for instance the transmission of *Trypanosoma hippicum,* the cause of murrina of mules in Panama from infected lesion to uninfected injury by the housefly, *Musca domestica;* and also the transmission of anthrax by the

bites of the stable fly (*Stomoxys calcitrans*), horse flies (*Tabanus striatus* and other species), the horn fly (*Haematobia irritans*) and mosquitoes (*Psorophora sayi* and *Aedes sylvestris*) several of which insects have just been proven carriers by Harry Morris. Many bacteria pass uninjured and unaltered through the intestines of insects.

Type 3. The relationship between vertebrate host and organism still simple, but the organism able to multiply and even increase its virulence by passage through the intestine of an insect, but not necessarily having an intermediate host. Cao has shown that many pathogenic bacteria are taken up by flesh and feces breeding insects and are able to multiply in the insect and acquire greater virulence, as for example, the bacilli of fowl cholera, and of anthrax in the cockroach.

Type 4. An interesting type of relationship is that of normally saprophytic, nonpathogenic organisms, which after a passage through certain insects acquire an intense pathogenicity, and if by chance they should become inoculated in a vertebrate by contact of the insect with an injury, would cause serious disease symptoms. Possibly this is one of the manners in which new bacterial diseases originate. Cao has conducted many experiments with cockroaches, may beetle larvae and fly larvae, in which he has obtained such results as these. Among the organisms thus becoming virulent were *Bacillus fluorescens liquefaciens* and *non-liquefaciens, Bacillus subtilis, Sarcina aurantiaca* and *Sarcina lutea.*

Type 5. The relationship three-sided, that is with two distinct hosts in each of which the parasite must pass part of its life cycle, as for example the organisms of malaria, sleeping sickness, Texas fever, etc.

Type 6. The relationship multiple, in which there is a normal wild animal reservoir of the organism, an insect vector, and one or more other animal hosts, as Rocky Mountain spotted fever, many trypanosome diseases, and possibly the majority of protozoan diseases.

Type 7. An accidental relationship in which an apparently normal insect organism is inoculated and becomes pathogenic to a vertebrate. Experimental inoculations with Herpetomonas and Leptomonas from insects have produced diseases in animals. Some authors believe that possibly if not probably the Leishmania and Trypanosome diseases originated in this manner.

The complications of these types of relationships are many—in fact almost every case is different, and very few are perfectly simple as described above.

In the three and multiple sided relationships, wherein an insect often serves as the intermediate host, are found some of the most interesting biological phases of the subject.

Quite a number of the disease complexes associated in this group contain an unknown factor. The vertebrate hosts are known and the insects known, but the organism or disease principle is unknown. Here belong the filterable viruses of Rocky Mountain spotted fever, typhus fever, papatasi fever, dengue, yellow fever, etc. Various claims have been made for discoveries of the causative factors in these diseases but none have so far been generally accepted.

Types of Transmission.

Among the organisms which are known to pass through insect hosts we find many types of transmission.

1. There are those organisms which pass a certain phase of their life cycle in the insect and are reinoculated into other hosts by means of the insect's proboscis, as the malaria and plague parasites.

2. Others carry out their life cycle in the invertebrate, passing into its egg and are transmitted by the bite of the second generation, as the organism of Texas cattle fever, *Babesia bovis* (*Piroplasma bigeminum*) in the cattle tick, *Boophilus annulatus*.

3. Another group finish their development in the malpighian tubules and are voided with malpighian secretions from the anus while the invertebrate host is feeding, and by means of coxal or other secretions are washed into the wound. Such is the method of transmission of *Spirochaudinnia duttoni* (*Spirochaeta*), the cause of West African relapsing fever, which is transmitted to man by the tick *Ornithodoros megnini*.

4. Still another mode of transmission is that in which the organism passes through the insect and is voided in its excrement and is then scratched into the host, as just proven possible in the case of trench fever carried by lice to men, and also proven the method of entrance of *Spiroschaudinnia berbera*, the cause of North African relapsing fever, another louse borne disease of man. In both of these cases the crushing of the louse over an abrasion will give rise to the disease. At this point it is interesting to note that Futaki found *Spiroschaudinnia exanthematotyphi*, which he believes to be the cause of typhus fever, in lice. Various authors have called attention to certain similarities between typhus fever and trench fever.

5. Another interesting mode of transmission is found in *Haemogregarina muris*, cause of mouse anemia, which passes part of its life cycle in the mite, *Laelaps echidninus*. The mite is finally eaten by the mouse and thus the parasite enters the vertebrate host.

6. In all of the cases quoted above the parasite passed from vertebrate to invertebrate through the sucking of blood by the latter. There are also many disease organisms which leave the vertebrate in its feces, and are taken up by an insect feeding on

such feces; in the insect they continue development, and finally the insect is eaten by a mammal and development continues to its natural conclusion. This is the life cycle of many parasitic worms, as for example the rat tapeworm, *Hymenolepis diminuta*, often secondary in the meal moth and other grain insects, and sometimes primary in man who eats insect infected grain which has been polluted by rodents.

These are merely some of the types of transmission, of which there are also many modifications. I am dwelling on these different biological relationships because I want first to impress upon you the vital necessity of a knowledge of every phase of the life cycle of each unit in a disease complex—that is—the vertebrate hosts, the disease organisms, and the invertebrate vectors and hosts.

Necessity of Knowing Insect Life History.

An excellent example of the necessity of knowing the life history of the invertebrate vectors is found in the ticks, many of which are disease carriers. Nuttall has described at least six types of life cycle among the ticks.

Representing the first type is *Argas persicus*, the carrier of several spirochaete diseases of fowls, which attaches to a host in the larval stage, engorges and drops to molt, then reattaches, but drops twice to molt in the nymphal stage and as an adult drops to oviposit after the engorgement, then reattaches and engorges again and again. It is obvious that this tick can transmit disease organisms to several different hosts during the course of its development.

A second type is represented by *Ornithodorus moubata*, the carrier of several spirochaete relapsing fevers of man. It does not attack a host during its larval stage, but has five different nymphal hosts, one for each stage, and many adult hosts. The individual tick therefore has unlimited possibilities of disease transmission. One single infected tick carried in the personal effects of a traveler might start outbreaks of the fever in many localities.

The third type may be represented by *Dermacentor andersoni* or *venustus* the carrier of Rocky Mountain spotted fever, which has one larval host, one nymphal host and one adult host.

The fourth type may be represented by *Rhipicephalus evertsi* the carrier of *Nuttallia equi* of horses, which attacks only two hosts, one during the larval and nymphal periods and one in the adult stage.

The fifth type is represented by *Boophilus annulatus* the carrier of *Babesia bovis*, cause of Texas fever, which has but one host during its entire development. It is obvious that only an hereditary organism can be transmitted by a tick with such a life history

As an example of the necessity of understanding the life history of the tick I may cite the case of *Haemogregarina canis*, cause of canine anemia, which is carried by the dog tick *Rhipicephalus sanguineus* having the third type of life cycle. For sometime investigators were unable to understand how the parasite reached another host, as parasites taken up by the adult did not complete their cycle of sporogony in the tick. Finally Christophers discovered that only those parasites taken up by the nymph completed their development in the adult tick. Between the nymphal and adult stages this tick drops to the ground and attacks a new host. We have then an easy explanation of the transmission from one host to another.

It is just as important to know the life history and breeding places of mosquitoes. Dr. Carter has very recently called attention to the necessity of accurately determining the extent to which *Anopheles punctipennis* carries malaria, as the measures necessary for the control of this species would add millions of dollars to the cost of malaria control in this country.

During the past two years it has been my privilege to spend most of my time searching the literature of the world for references to the relations of insects to disease. In making this study I have noted a number of outstanding features.

Bacteria and Insects

A brief tabulation made at the beginning of the work had led to the conclusion that there was very little published on the bacteria carried by insects as compared to the protozoa. I have since been surprised to find how much has been done on this subject, following the work of Cao, the Italian investigator. In fact there has not been enough attention given to the results of Cao's research. He found that larvae of the house fly and flesh flies feeding in diseased carrion take up whatever bacteria are present, at all stages of their development, that many of these bacteria multiply and *Bacillus anthracis* even slowly forms spores in the insect, that many of them are carried in the insect body through all its phases of development and persist for days in the adult after its maturity, contaminate its excrement daily, and are found on its eggs when deposited. Thus a single fly larva breeding in diseased excrement and reaching maturity may give rise to cultures of the disease germs wherever it as a fly alights, contaminating the breeding grounds of other flies and finally giving rise to a multitude of disease-germ carriers which may bring about a sudden unexplainable outbreak of a disease thought to be latent. Cao found that cockroaches could likewise take up disease germs and furthermore that often these bacteria acquired greater virulence by passage through the roach. A long series of papers by subsequent

workers have added corroborative evidence to Cao's findings, although certain of the pathogenic bacteria have been found by Ledingham, Bacot, Tebbutt, and others to pass with difficulty through insects in the presence of large colonies of normal fly bacteria.

Climate and Life

One very interesting phase of the whole subject is the emphasis placed by author after author on temperature conditions affecting the organism, or the insect, or its host. And yet the majority of these investigators while stumbling on important biological laws show a lack of understanding of certain fundamental principles. Seldom, if ever, is there any mention of humidity, which bears as strong a relationship to life as does temperature. In fact the numerous records of failure to keep insects alive during the expermental work cause a suspicion that the humidity factor in the breeding cages was overlooked. The bacteriologists recognize high and low fatal temperatures, high and low sluggish periods, and a temperature of most favorable growth, which we know as the optimum temperature. Among the protozoologists these zones of temperature are not worked out so clearly. Nowhere have I seen a recognition of the fatal, sluggish and optimum zones of humidity. I am convinced that in many cases certain confusion which has arisen among various workers will be cleared up by a correlation of the humidity and temperature environment in which they worked. Apparent discrepancies will disappear entirely with this correlation.

Possibility of Error

Many errors have crept into the literature through the efforts of a zealous investigator to go beyond the bounds of his training. Entomologists have been guilty of trying to conduct transmission experiments without understanding the organism they were transmitting, or possibly without knowing the normal insect parasites. Parasitologists have frequently made mistakes in their work through misunderstanding the insects they were dealing with. The subject is large, demanding tremendous patience and care, and there are many possibilities of misunderstanding results.

We will now pass to the medical and veterinary side of the question.

THE MEDICAL PHASE OF THE SUBJECT

My introduction has been long because on the biological work is built the whole fabric of medical entomology. As I am looking

at medical entomology with regard to its part in the war I shall divide this portion of my discussion under five postulates.

Insects are Important Disease Carriers

At first thought we all recognize the fact that insects do carry some diseases, and that they are the only known carriers of a few diseases like malaria, and yellow fever. But most of us would possibly be unwilling to commit ourselves very deeply as to how many diseases insects do carry. As a matter of fact I am afraid that even where we recognize that insects may have a rôle, the tendency is to largely discredit it and minimize their importance. Now if you will take a list of all the communicable diseases and check off all those which are exclusively insect transmitted, and those in which insect transmission has been shown possible, you will be surprised at the small size of the remainder of the list.

Furthermore the rôle of the insect is not confined to the transmission of diseases. They are themselves the cause of many ailments, some very serious.

Let us just take a hurried glance at the list of proven insect borne diseases. The following diseases of man can only be carried by insects: malaria in all its types, yellow fever, dengue, the relapsing fevers of Africa, America, Europe and Asia, typhus fever, Rocky Mountain spotted fever, sleeping sicknesses, Chagas disease, papatasi fever.

The following diseases of animals can only be carried by insects: avian malaria, pigeon anemia, canine anemia, Texas fever, red water, East Coast fever, various animal spirochaete diseases, nagana, zousfana, and many trypanosome diseases, many animal tape worms and nematodes.

The following diseases of man are principally, if not entirely carried by insects: trench fever, plague, tropical sore, Kala azar, verruga, uta, and all other leishmaniases, and filariasis.

The following diseases of animals are principally, if not entirely carried by insects: murrina, anthrax, canine Kala azar, and filariasis.

The following human diseases are readily and possibly often carried by insects: typhoid fever, dysentery, diarrhoea, anthrax, tuberculosis, leprosy, hookworm, tapeworms, cholera, and tetanus.

The following human diseases are frequently suspected of being insect transmitted: pellagra, beriberi, poleomyelitis, and infective jaundice.

The following diseases are the direct result of insect attack: dermal, gastrointestinal and other myiases, tick paralysis, Tsutsugamushi disease, scabies, dermatoses, poisoning by bites.

Although these lists are large every one of them could be enlarged from the manuscripts now on hand.

Insects are largely involved in the transmission of army diseases

One has but to read the literature of the present war to see that the insect borne diseases are among the most important. In fact I believe we may place foremost of all the diseases which have ravaged the European armies the three lice borne diseases, typhus, trench fever and relapsing fever. Next to the louse the medical literature of this war contains more references to flies than any other insects, and the principal flies are of course *Musca domestica*, *Calliphora vomitoria*, *Lucilia caesar*, *Sarcophaga carnaria* and other flesh flies, and the diseases they are responsible for spreading are typhoid fever, dysentery and diarrhoea, and Siberian sore (anthrax). Malignant jaundice in the trenches is suspected but not proven of insect transmission. A great deal of the septicaemia following wounds is caused or aggravated by insect visits before the injury is dressed, and while the injured man is lying on the battle field. Malaria is of course a serious army problem, especially in our southern states.

Insects are largely involved in outbreaks of war time epidemics

Of the great epidemics which have swept the world since the beginning of the war probably the greatest have been the outbreaks of typhus which wiped out a large part of the Serbian nation, decimated Roumania, took terrific toll of Russian prisoners in Germany, and swept through the Austrian armies. When we think that merely the controlling of the body louse stopped these epidemics we begin to realize what a menace these little creatures, so long endured, are to human life. And now trench feve has spread out of the trenches and is serious behind the lines. Outbreaks of plague, a flea-borne disease are reported from many countries. As famine advances in the wake of war, the weakened populace become more and more subject to such epidemics. We are all familiar with the history of our Spanish American war when thousands of our boys died of typhoid fever and other fly-borne diseases, and how in Cuba the reconcentrado camps were swept with yellow fever and malaria. Wherever disease breaks out, if caused by insects, the nation must be on its guard.

Insects spread diseases of army animals

The great animal scourge of this war is the mange of horses caused by the scab mite. This has become so serious that entire veterinary hospital units are set aside for its cure. Great progress is bein made in the handling of the disease. In the various zones of army activities there are many insect and tick borne diseases

of army animals. Horse bots are reported as especially bad as the horses cannot receive the treatment under battle conditions which would ordinarily be given them.

Insects threaten food producing animals

In time of war when meat is of so much value it becomes more than even necessary to prevent insect ravages upon meat producing animals. The cattle tick, which has done so much to hold down southern agriculture by making cattle raising almost prohibitive, must be fought this year with greater vigor. It is more necessary than ever to teach the people how to control screw worms, horn flies, ticks, mites, lice, blow flies, horse flies, bots and warbles. The field of the veterinary entomologist is looming big.

THE SANITARY PHASE OF THE QUESTION

The final phase of our subject is the preventive. If we would save the lives of the nation, and especially of our fighting men from the ravages of disease we must take preventive measures. Of course it is taken for granted that general sanitation against all diseases is greater than the sanitation against any particular group of diseases. Nevertheless the measures taken against insects by an army camp embrace a great part of the sanitary measures pursued.

Army sanitation is largely entomological sanitation

Outside of the water purification and the bactericidal fumigation of buildings few of the larger undertakings of the sanitarian can be excluded from entomological sanitation, although perhaps in some cases the sanitarian may have aimed his measures at something else. For instance all control of waste disposal around a camp is aimed primarily or secondarily at prevention of insect breeding and subsequent contamination of food and person. The drainage operations have as their basic purpose the prevention of breeding by water or moisture loving disease carriers. A large part of the sanitarian's task is often the fumigation of the buildings and the cleansing of the men from infestations of lice and mites.

On the battle field the bodies must be removed to prevent insect multiplication and spread of disease. In other words proper army sanitation must necessarily be arranged with a thorough understanding of the entomological problems involved.

Disease prevention is often reduced to insect destruction

The prevention of disease in the camps is often reduced to insect destruction, depending of course upon what diseases are to be guarded against. With two other leading sanitary principles,

that is isolation of disease suspects, and pure water and milk supplies, insect destruction shares the foreground of army sanitation. Prevent house fly breeding and eliminate water or milk contamination and an outbreak of typhoid fever or other intestinal complaints is practically impossible. Prevent louse breeding and there can be no outbreak of typhus, trench fever or relapsing fever. Prevent mosquito breeding and there will be no malaria, yellow fever, and dengue and little filariasis. Prevent flea breeding and there will be no outbreak of plague or flea borne tapeworms. prevent tick breeding and save the animals from many of their principal ailments. Drain the moist places to control horseflies, gnats and midges and you have guarded against a long series of other diseases.

Some of the most important sanitary measures in the armies

When an army camp is laid out, of course the first concern of the sanitarian is the water supply. His next concern is the disposal of waste, for this must be provided for from the very first day. He then has time to look into the questions of drainage and suppression of breeding places of the noxious pests. The question of waste disposal is sometimes a serious one. It must take into consideration garbage, manure, human excreta, carcasses, and solid waste. In general waste disposal may be divided into two divisions—the prevention of insect breeding and incineration or complete destruction. It is often desirable to save the manure and so different methods of manure disposal have been studied out. The general opinion is in favor of the tightly packed manure stack with straight sides, treated regularly with powdered borax, and with the edges on the ground oiled and the debris swept up and burned. For garbage and human excreta incineration is usually practised. There are many types of incineration from the primitive oiling and burning to the scientifically prepared incineration ovens. Solid waste is burned or crushed to prevent its holding water and then used to fill low places. Carcasses should be covered with a film of creosote oil to prevent fly breeding and then buried or burned. An excellent and exhaustive paper on the prevention of nuisances arising from flies and putrefaction of carcasses on the battle field has recently been contributed by Foreman and Graham-Smith.

The drainage problems for each camp are different. There must first be surveys to determine the danger points of mosquito infestation, and measures taken to prevent this. It may require filling low places, or ditching to accomplish a thorough draining. It may require merely a straightening of the existing drainage and the removal of debris and plant growth from the stream bed and sides. Where ditching is necessary it is sometimes a good plan to construct a double system of ditches, using one at a time,

except in case of high water, and cleaning the other in the meantime. It must be borne in mind that some of the disease carriers breed in moist places, where there is no standing water. Along the Mediterranean literal papatasi fever is carried by the midge (*Phlebotomus papatasi*) which breeds in damp places and attacks primarily lizards and other cold blooded animals.

The greatest entomological sanitary measures arising from this war however are those aimed at louse control. Among these may be mentioned the great vacuum tubes used in Germany for the fumigation of cars returning from Russia, and the bath trains used by the different armies for the cleansing of the bodies and clothing of the men. While the men are going from one bath to another and being shaved and hair cut the clothes are being treated for the control of the lice. The entire proceeding is timed so that thousands of men can be cleansed in an orderly manner in a day. The clothes cleaning establishments are on three general principles and probably a fourth should soon be added. Dry heating huts or cars may be used with the assurance that in thirty minutes at 60°C. the lice are killed. Other places used steam sterilization with subsequent drying. The third method is the washing in insecticides, principal of which are the petroleum and cresol preparations. A few favorable tests have been made of vacuum fumigation and there is no reason why portable vacuum tanks for fumigation and sterilization should not be more generally used. This method is rapid and certain and has the least waste, as the gas can be recovered for using again. One of the latest contributions of the war has been a new method of fumigating horses for mange by the use of sulphur anhydrid, devised by M. M. Lepinay, Vigel and Chollet, in which the horse is placed in a stall with the head out and protected from the gas by a close fitting collar.

Great advances in prophylactic measures against insects have been made in the last two years and entomological sanitation is coming to be one of the important professions of the day, although at present it has but few practitioners.

SOME PROBLEMS STILL TO BE WORKED OUT

There are many important problems in medical entomology awaiting solution, a few of which may be briefly mentioned.

A practical portable field equipment for vacuum fumigation and disinfection is desirable.

We should learn as soon as possible what bacteria can be readily carried by flies, cockroaches, ants, and lice in this country to check the work of European investigators.

Fly larvae breeding in the presence of infected excrement can take up bacteria, which may multiply in their bodies. We must

learn how long the adult fly can retain these bacteria and through how many generations it can carry them to clean uninfected food, assuming that the bacteria are deposited on this food by the fly in oviposition and taken up by the larvae later. Probably such a study would throw considerable light on the epidemiology of certain diseases.

One question I have long wanted solved is whether *Stomoxys calcitrans* can take up the meningococcus from sputum or excreta as adult or larvae, and whether it can in any way transmit this by its bite or its excreta. In the summer of 1912 there was a severe outbreak of equine cerebrospinal meningitis from Texas and Louisiana to Kansas and eastward to New Jersey. Practically contemporary with this epidemic there was an unusual outbreak of *Stomoxys calcitrans*, causing the death of many horses. This outbreak subsided in the fall, but coincident with its subsidence was the beginning of a great wave of human cerebrospinal meningitis which swept from Texas northward and eastward. What connection has Stomoxys to meningitis? It has been claimed that it can carry poleomyelitis, a similar disease. The matter should be looked into thoroughly.

It would be an excellent idea if the bacteriologists of all the army camps would make bacterial studies of the flies caught around the barracks and hospitals, using the technique for examination of the intestinal bacteria worked out by Ledingham, and Bacot, and other writers. This should be done especially in case of the outbreak of certain bacterial diseases in the army.

Finally, I wish to call attention to a remark made by Mr. Goodwin at the December meeting in Pittsburg when he stated that the urates secreted by insects breeding in grain cause symptoms of disease in dogs fed on the grain cooked into cakes. Mr. Goodwin's experiments are not detailed sufficiently, to indicate whether he was dealing with a nutritional disease or an actual poisoning by insect secretions. It will not do to leave the matter untouched now that he has opened it up. We must know positively the effect of insect pollution of grain upon the human system as well as upon animals. There is a bare possibility that such studies will throw new light on certain nutritional diseases which are at present unexplained, such as beriberi, avian polyneuritis, pellagra, etc. As far as I can find those investigators who have studied these diseases from the standpoint of injured food products have looked for fungous diseases following the insect attack and have not attempted to find the effect of the fecal or other secretions of the insects themselves, upon the system. Whether there is anything in it or not, the studies must now be made. In fact we have plenty of evidence that many diseases originate with the introduction into the body cutaneously or orally, of infected insect feces.

AN EYELESS DRONE HONEYBEE.

By Jas. A. Nelson.

The abnormal drone honeybee (*Apis mellifica* L) forming the subject of this paper was received in June, 1914, from Mr. Allen Latham of Norwichtown, Connecticut. Mr. Latham stated in the letter accompanying the specimen that this drone was the only one of the kind that he had ever seen. In a recent letter he also states that no other abnormal drones have since been observed by him.

The general aspect of this drone is most peculiar. It is normal in size, and the thorax, abdomen, wings, legs, etc., are of the normal drone type, the abnormality being confined solely to the head, which lacks the huge compound eyes characteristic of the drone, and is correspondingly reduced in size (fig. 1). The surface of the head is almost completely clothed with long hairs. Those on the lateral surfaces, including genae, are long, silky, and light grey in color (figs. 1 and 2). These correspond to a similar hairy covering found on the posterior surface of the head of a normal drone. The anterior face of the head is also clothed with grey hairs, but these are of a darker shade, two tufts of long hairs being especially conspicuous, each of which is situated laterad and ventrad of the antennal socket (fig. 2). The vertex of the head is covered with shorter hairs, like those of the front above the antennae. The clypeus and labrum are clothed but sparsely with relatively short hairs, while in the normal drone these parts are invested with a dense felt-like coat.

The prevailing color of the chitin of the head is a dark brown approaching black, with the exception of the clypeus and certain other restricted areas which are of a lighter shade. Two of these lighter areas are reniform in outline and situated one on each side of the occipital foramen, and occupy a considerable portion of the sides of the head (fig. 1). These areas are readily identified with similar areas in the normal drone, but in the latter they are situated on the posterior surface of the head and can only be seen by removing the latter from the thorax. Two other and smaller light areas are found on each side at the base of the mandibles.

The clypeus and labrum stand out in sharp contrast to the remainder of the head by reason of their almost entire lack of pigment (fig. 2). In the normal drone the chitin of these parts is lighter than that of the remainder of the front, but not nearly so light as in the abnormal specimen.

The ocelli, as shown in figures 1 and 2 are situated on the vertex of the head, as in worker and queen bees. The median ocellus is oval in outline, instead of circular, as in the normal drone, its larger diameter being transverse, and measures about 0.414 mm.,

while in a normal specimen the median eye has a diameter of about 0.353 mm. The lateral ocelli are circular and of approximately normal size.

The antennae (fig. 1 are of normal size, consisting of 13 segments and in every respect conform to the normal type. The mouth parts show no notable deviation from the normal, although they seem unusually conspicuous. This feature is however due to the relatively small size of the head.

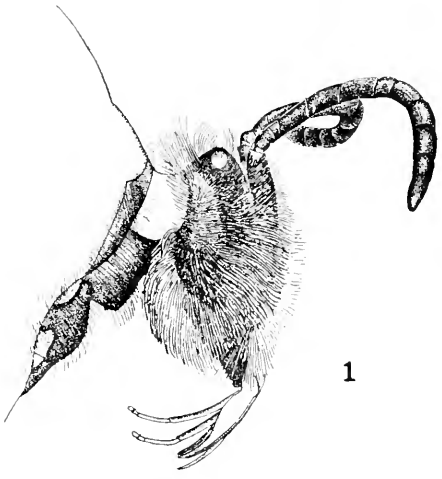
Examination of a series of transverse sections of the head fails to reveal the slightest vestige of the compound eyes. On comparing these sections with a similar series of the head of a normal drone it is evident that the central portion of the brain is of approximately normal size. Figures 3 and 4 represent two sections through the brain of the abnormal drone, the section shown by figure 4 being anterior to that shown by figure 5. The mushroom bodies (*MB*) are apparently of normal size and form, although in the abnormal drone the two calices of each side lie more nearly in the same transverse plane than in the normal drone, being in this respect more like those of the worker bee. The most important and striking feature of the brain of the abnormal drone is the almost complete absence of the optic lobes. In the abnormal drone the parts wanting are those termed by Hickson the "periopticon" and "epiopticon." The "opticon," including the inner fibrillar mass, is present, but in a reduced condition, as seen in figures 3 and 4, *IFM*. Moreover the inner fibrillar mass of the left side (right in the figures) is situated further cephalad than that on the right side. Over both of these the neurilemma extends in an unbroken layer.

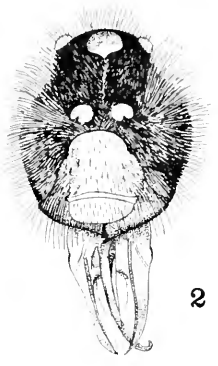
In regard to the cause of the loss of the eyes and the accompanying parts of the optic lobes there is little to be said. The completeness of their absence argues against mechanical injury, moreover this is also rendered improbable by the protected environment of the developmental stages. It is necessary to conclude therefore that the abnormality is referable to a deficiency in the germ of the determining factors for the parts lost, whatever this deficiency may be.

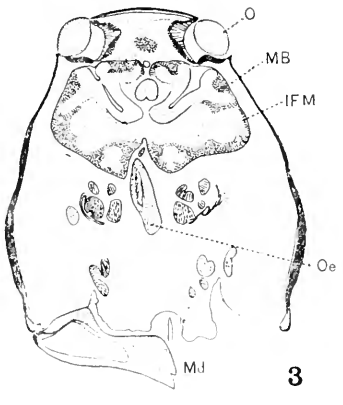
Normally eyeless insects, such as the termites, are of course sufficiently well known. In this connection may be mentioned the cave-inhabiting carabid beetle *Anopthalmus*, in which, according to Packard[1] the optic lobes as well as the eyes are completely wanting. Cheshire[2] describes and figures an eyeless drone quite similar to the one described above but differing from it in that the ocelli are also wanting and the vertex of the head is concave in-

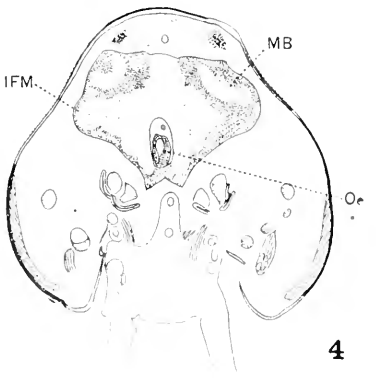
[1] Packard, A. S. A Text-Book of Entomology. New York, 1909, p. 241.

[2] Cheshire, Frank R. Beekeeping, Scientific and Practical. Vol. 1. London, 1886, p. 117.









Explanation of Plate

Fig. 1. Head of abnormal drone, side view. × 11.

Fig. 2. Head of abnormal drone, face view. × 12.

Fig. 3. Transverse section through head of abnormal drone passing through the lateral ocelli, *O*. *IFM*, inner fibrillar mass; *MB*, mushroom body; *Md*, mandible; *OE*, oesophagus. × 21.

Fig. 4. Transverse section through head of abnormal drone, slightly caudad of that shown in figure 3. Lettering same as above. × 21.

stead of convex. No investigation of the internal structure of the head was made. It is of interest to note that drones of this sort are said to have appeared in some numbers in a hive together with other drones having eyes of the normal size and form, but deficient in pigment. This condition is apparently paralleled by that found in the fruit fly, *Drosophila*, in which individuals having the eyes either entirely or partially lacking appeared and were bred in considerable numbers.[3] This character, "eyeless," proved to be inherited according to Mendelian principles. Hoge[4] found that flies having the eyeless character either lacked eye pigment and ommatidia or had one or both eyes reduced in size, and that such flies were also less viable than the wild stock. It is sufficiently obvious that this character would not be likely to gain much headway in the honeybee owing to the fact that deficiency in vision in the drone would doubtless hinder mating, if not altogether prevent it.

THE GENUS PLINTHISUS LATR. [LYGAEIDAE-HEMIPTERA] IN THE UNITED STATES.

By H. G. Barber,

Roselle Park, N. J.

This genus can be differentiated from all of the other United States genera of the Tribe Rhyparochromini of the Lygaeidae by the third ventral suture of the abdomen being straight laterally and reaching the margins on each side. Other reliable characters are as follows: the head narrower than the pronotum anteriorly which is cut out or concave in front, to receive the head which is commonly sunk to the eyes (P. compactus Uhl. is an exception to this); lateral edge of the pronotum more or less strongly keeled, the anterior lobe, except in front, impunctate; scutellum large, commonly somewhat equilateral or broader than long; clavus not deflected to the corium but flat; membrane commonly abbreviated or absent; first segment of antennae well extended beyond apex femora much swollen and most commonly armed with two or more teeth; fore tibia of male more or less curved and expanded apically; shining, color ferrugineus, castaneus or ochraceous.

Lethierry and Severin list 29 species of Plinthisus as occurring in the Palaearctic Region. *P. compactus* Uhler 1904, from New

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[3] Morgan, T. H., Sturtevant, A. H., Muller, H. J., Bridges, C. B. The Mechanism of Mendelian Heredity. p. 14. New York. 1915.

[4] Hoge, Mildred A. Another gene in the fourth chromosome of Drosophila. Amer. Nat. XLIX, 577, pp. 47–49.

Mexico, was the first species of the genus to be described from the United States, though Uhler placed it in *Rhyparochromus* and Van Duzee has transferred it to *Aphanus*. I now add three other species from the United States from material in the U. S. National Museum.

A. Claval suture present. Membrane never wholly absent. Larger species, for the most part dark castaneus and pilose.

B. Pronotum wider than long; anterior lobe not elevated; anterior angles behind eyes rounded. Head not sunk to the eyes. Scutellum finely punctuate. (P. Americanus Van D) *compactus Uhler.*

BB. Pronotum subquadrate; anterior lobe swollen; anterior angles forming a distinct angle. Head sunk to the eyes. Scutellum almost impunctate, *indentatus* n. sp.

AA. Claval suture absent; clavus connate with corium. Membrane absent. Smaller species, for the most part, pale castaneus or ochraceous. Anterior angles of pronotum rounded.

C. Lateral margins of pronotum paralles sided. Apical margin of the corium lightly concave. Abdomen with three or four long setae posteriorly on each side. Pale castaneus and ochraceous *longisetosus* n. sp.

CC. Pronotum widened anteriorly. Apical margin of corium straight. Abdomen with a few shorter setae posteriorly ochraceous *pallidus* n. sp.

Plinthisus compactus Uhl.

Rhyparochromus compactus Uhler, Proc. U. S. Nat. Mus. XXVII, 354, 1904. *Aphanus compactus* Uhler, Van Duzee, Check List of Hemiptera, 23, 1916; Catalogue, 195, 1917.

Plinthisus americanus Van Duzee, Trans. Amer. Entomol. Soc. XXXVI, 75, 1910.

I have examined the female specimen which Uhler described in the U. S. N. M., collected by H. G. Barber at Las Vegas Hot Springs, N. M., labeled Co-type No. 6849 and carefully compared it with a female specimen of Van Duzee's *americanus* from Tyngsboro, Mass., presented to me by Prof. H. M. Parshley. These are identical but the rather inexact color description by Uhler misled Mr. Van Duzee and other Hemipterists. The Las Vegas specimen fits the description of *americanus*, being dark shining castaneus on the head, anterior lobe of the pronotum, scutellum, central disk of corium and beneath, the remaining parts are paler, as described by Van Duzee; the last two segments of the antennae piceous.

Plinthisus indentatus n. sp. (Ms. name of Uhler.)

Shining, sparsely pilose. Head, anterior lobe of pronotum and prosternum castaneus; scutellum, posterior disk of corium, meso and meta

sternum, venter and last two segments of the antennae darker castaneus; posterior lobe of the pronotum, hemielytra anteriorly and laterally, first two segments of the antennae, rostrum and legs ochraceous.

Head, a little wider than long, impunctate, sunk to the eyes, in the arcuate anterior margin of the pronotum. Antennae pilose, the basal segment exceeding the tylus by nearly one-half of its length, second segment not quite twice as long as first and one-third longer than third, the latter a little shorter than fourth. First segment of rostrum shorter than second which is considerably longer than third. Pronotum almost quadrate; anterior margin gently arcuate, punctate within; the anterior angle on each side being obtuse and extended to just beyond posterior margins of the eyes; lateral edge strongly keeled, lightly sinuate between the two lobes; the anterior impunctate lobe a little wider, swollen and twice as long as the coarsely punctate, depressed posterior lobe; posterior margin broadly arcuated. Scutellum about equilateral, impunctate but finely rugulose. Clavus wide, not deflected to the corium, with about three irregular series of punctures. Corium sparsely punctate. Membrane very short and oblique, reaching about to middle of fifth abdominal segment. Anterior femora much swollen, armed with a single stout tooth and two preapical teeth. Anterior tibia of male strongly curved and expanded apically. Several long setose hairs posteriorly on the abdomen.

Length, ♂ 3–3.5 mm.

Described from brachypt. ♂ Assiniboine, Montana, August 2, 1892. (Type U. S. N. M.) and brachypt. ♂ Bear Pw. Mt., Montana August 26. (Paratype U. S. N. M.).

This is about the color, size and general appearance of the preceding species but the head is sunk to the eyes, the pronotum is relatively longer, the anterior lobe being more swollen and the scuttellum impunctate.

I have adopted the Ms. name found attached to the type specimen from the collection of P. R. Uhler.

Plinthisus longisetosus n. sp.

Subshining; sparsely pilose on head and antennae. Head, disk of anterior lobe of pronotum pale castaneus; scutellum, dorsal part of abdomen except connexivum, antennae except at base, darker castaneus. Basal segment and basal part of second segment of antennae, rostrum, anterior margin and posterior lobe of the pronotum, hemielytra, connexivum, legs and ventral parts, ochraceous.

Head triangular, a little wider than long, impunctate, sparsely pilose in front, sunk to the eyes in the lightly arcuated anterior margin of the pronotum. Antennae pilose; basal segment about one-half the length of the second, third one-fourth shorter than the second, fourth segment missing. Pronotum transverse, parallel sided, scarcely sinuate between the two lobes; lateral edge narrowly carinate; impunctate anterior lobe not ele-

vated, nearly four times as long as the very short, sparsely punctate posterior lobe; anterior angles rounded and extended to hind margins of eyes; posterior margin lightly and broadly arcuated. Scutellum a little wider than long, obsoletely punctate. Claval suture obsolete, clavus connate with the corium. Hemielytra very finely punctate, abbreviated, membrane wanting; posterior margin sinuate; lightly oblique, outer apical angle reaching to third abdominal suture. Connexivum elevated, pale. Sides of abdomen posteriorly furnished with three or four long slender setae, nearly as long as one-half the diameter of abdomen. Very much swollen anterior femora appear to be unarmed, the fore legs in the single specimen being folded in such a way as to obscure the under side of the femorae.

Length of ♀, 2 mm.

Described from a single brachypterous ♂, Santa Cruz Mts., Calif., A. Koebele collector. (Type U. S. N. M.). This is a smaller and paler species than the two preceding, with a very short corium and lacking the membrane. The long setae on the sides of the abdomen posteriorly are very striking.

Plinthisus pallidus n. sp. (Ms. name of Uhler.)

Shining, ochraceous, with fine, pale appressed hairs. Head impunctate, a little wider than long, sunk to the eyes, in the rather strongly concave anterior margin of the pronotum. Antennae finely pilose with the last three segments castaneus; basal segment a little exceeding apex of head, second segment twice as long, third a little shorter than second, fourth subequal to third. Pronotum transverse, faintly punctate in front; lateral margins gradually widening anteriorly, then for a short distance abruptly convexed to the rounded angles back of eyes; lateral edge very narrowly keeled, not sinuate between the lobes; anterior lobe not elevated, about four times as long as the posterior lobe; posterior margin gently arcuated. Scutellum wider than long, finely punctate. Clavus not differentiated, entirely connate with the corium. Hemielytra finely and closely punctate; abbreviated; membrane absent; apical margin, not sinuate, lightly oblique, outer apical angle reaching third abdominal suture. Dorsal part of abdomen a little darker, finely punctate; connexivum elevated; a few long setae posteriorly. Inerassate fore femora apparently unarmed.

Length ♂ 1.5 mm.

Described from two ♂'s, Los Angeles, Calif., from the collection of P. R. Uhler, one of which is labeled with the Ms. name. *Plinthisus pallidus* Uhl. (Type U. S. N. M.).

This is the smallest and palest member of the genus thus far known from the United States. It is most closely related to *P. longisetosus* but the pronotum is widened in front and the apical margin of the corium is straight. The posterior setae are not so evident.

A CONVENIENT METHOD OF HANDLING LARGE NUMBERS OF INDIVIDUALS IN LIFE—HISTORY STUDIES OF INSECTS.

By R. A. Cushman.

Life-history studies of insects where it is desired to base the results on large numbers of individuals in order to arrive at the normal average are frequently onerous and require much more time than is available for the average worker. Moreover, many gregarious insects do not act normally when caged singly.

The writer has found the method of handling and keeping notes outlined below very satisfactory both in point of time required and in the large number of individuals that can be studied with a minimum of effort. This method has undoubtedly been employed by others, but it is outlined here for the benefit of those to whom it may not have occurred. It is not applicable to all sorts of insects; in fact, it is very likely limited in application to externally feeding insects.

The method of handling consists, in brief, in starting with an ovipositing female or a large number of eggs or larvae in one cage, and, as changes to be recorded take place, in transferring those individuals that have passed through the change to another cage, leaving the unchanged ones in the original cage. The number of cages to be handled gradually increases, but never reaches the number that would be necessary in starting with a similar number of individuals isolated. Moreover, cages are not installed only to be discontinued upon the death or loss of a single individual, but deaths and losses are automatically eliminated by failing to appear in subsequent cages and notes and do not interfere with the continuity of the records.

Each original cage is given a number or letter, and each subsequent cage is represented by a decimal, the first lot of individuals changing being given the decimal 1, the second lot 2, and so on. Thus the stage or instar of the insects in any cage is indicated by the number of decimals.

The notes are kept on cross-lined cards divided into quarter-inch squares, and are arranged so that one square in each direction represents a change of stage or instar.

Perhaps the citing of a definite example of the use of the system will explain it better than a general discussion. The writer has investigated the life-history of the current-worm (*Pteronidea ribesii* Scopoli), using this system. The study of each generation was begun with individual females each given a Roman numeral. Each female was caged on a single currant leaf and the cage moved each day to a new leaf as long as oviposition continued. Thus were obtained data on the daily and total oviposition of the

8—350

Female No. I.

Pteronidea ribesii Scopoli – 2nd generation. Subject.

Date, 1917 Locality, North East, Pa.

Notes made by R. A. Cushman

6/21 – One female emerged 6/20, mated, caged on currant bush. Died 6/26.

6/22 – 35 eggs (Lot I.1)
6/28 – 14 hatched (Lot I.11)
7/1 – 14 1st molt (Lot I.111)
7/3 – 13 2nd molt (Lot I.1111)
7/5 – 1 3rd molt (Lot I.11111)
7/8 – 1 4th molt (Lot I.111111)
7/13 – 1 prepupa from 5th molt (I.111111)
7/25 – 1 adult ♀.
7/6 – 9 3rd molt (Lot I.11112)
7/8 – 7 4th molt (Lot I.111121)
7/13 – 6 prepupae from 5th instar (I.1111211)
7/26 – 2 adult ♀
7/27 – 1 adult ♀
7/14 – 1 prepupa from 5th instar (I.1111212)
7/26 – 1 adult ♀.
7/10 – 1 4th molt (Lot I.111122)
7/14 – 1 prepupa from 5th instar (I.1111221)
7/10 – 1 prepupa from 4th instar (I.111123)
7/7 – 2 3rd molt (Lot I.11113)
7/11 – 2 prepupae from 4th instar (I.111131)
7/4 – 1 2nd molt (Lot I.1112)
7/7 – 1 3rd molt (Lot I.11121)
7/13 – 1 prepupa from 4th instar (I.111211)
6/29 – 11 hatched (Lot I.12)
7/2 – 7 1st molt (Lot I.121)
7/5 – 5 2nd molt (Lot I.1211)
7/7 – 4 3rd molt (Lot I.12111)
7/14 – 4 prepupae from 4th instar (I.121111)
7/8 – 1 3rd molt (Lot I.12112)

individuals. Each day's eggs were given their proper decimal number. Thus, if the female was No. I, the eggs would be Lots I.1, I.2, etc. The first larvae hatching in each lot were removed and placed in a phial and given the decimal 1, those hatching the next day 2, etc., until all were hatched. Thus, Lot I.11 consisted of the first larvae to hatch from the first day's eggs of female No. I. The larvae molting during each day were moved to a fresh phial and given the next decimal. Thus, Lot I.111 comprised the earliest second instar larvae from eggs of female No. I, and so on. The phials were kept in numerical order in a nearly vertical position in small trough-like racks holding twenty or more phials.

The following is a copy of a page from the writers notebook on the life-history of the current-worm, and shows the method of keeping the notes.

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THREE HUNDRED AND FOURTEENTH MEETING, JUNE 6, 1918.

NOTES ON GADFLIES IN THE FLORIDA EVERGLADES.

BY C. A. MOSIER,
Warden, Royal Palm State Park, Dade County, Fla.

AND

T. E. SNYDER,
Bureau of Entomology.

Two figures are slowly moving along a path in a dense hammock in the Lower Everglades of Florida, stopping now and then, tensely listening. It is 4 a.m.[1] and the stars are still shining, especially the bright morning star, but dawn is tinting the east, the faint light outlining the jungle growth overtopped by majestic feathery palms. Suddenly a barred owl, disappointed in a lonely vigil for frogs, begins a dismal hooting; as we approach it flies from a live oak limb.

Finally a faint buzzing is heard, which gradually increases to a dull roar; thousands of large flies can be seen above the tree tops steadily hovering or suddenly darting to and fro. This is the early morning flight of the large gadfly—*Tabanus americanus* Forster. After a short period the loud buzzing gradually diminishes in volume, and only a few low-hovering flies remain. At the end of about fifteen minutes the flight is entirely over for the day.

This peculiar flight is what we had come out to observe and note. In the early morning light a more hasty return to camp is made. A large bull alligator near his wallow in a slough in the Everglades is loudly roaring—enormously swelling up his throat. Birds are beginning to call or sing and now that the excitement is over we can hear and feel other singers—mosquitoes (*Aedes*), deerflies (*Chrysops*) and the yellow fly of the Dismal Swamp (*Diachlorus ferrugatus* Fab.).

Soon there will be a glorious sun rise and we shall have entered upon another day at Paradise Key. Before the heat of the sun has become intense, one can start across the saw-grass prairies to

[1] Central time (not daylight saving time.)

explore dense tangled hammocks with sub-tropical vegetation, or pine barrens with palmetto and rough limestone outcroppings. After such strenuous days one can calmly enjoy the sight of the sun going down in a blaze of red far across the Everglade prairie.

At dusk frogs begin to serenade, in varied pitch; "chuck will widows" are incessantly calling and the radiant moonlight invites one to stroll in the cool of the evening. A faint, but persistent humming outside of the mosquito netting restrains our enthusiasm. Without is the realm of a mosquito (*Aedes niger* Giles) which is as bloodthirsty at night as in the daytime. The pale greenish-yellow nocturnal *Tabanus flavus* Macq.[2] is also on the wing, alert for any unwary live stock.

Such are the opportunities offered for biological study in the Lower Everglades, especially Paradise Key, with its lofty royal palm trees. On many similar mornings, days and nights the senior author, C. A. Mosier, has observed and recorded the flight, feeding habits and activities of *Tabanus americanus* and other *Tabanidae*. Last year there was evidence for the belief that the early morning flight or swarm was a mating flight.[3] This year's observations cast some doubt on this conclusion, although it has not been definitely disproven. It may be possible that the swarm consists of males only as Knab has noted in the case of mosquitoes.[4] Due to the height at which the adults fly, very few have been caught, less than half a dozen,—hovering low. These have all been males. The habit that the flies have when hovering of darting towards each other and clinging may be mating. Many more observations are necessary. The senior author has evidence to believe that often while hovering the adults reverse and fly upside down, changing to normal when ready to dart away. He has also found that the males feed in large numbers on the blossoms of the saw palmetto—protected by the shade of the large leaves. The junior author has found Tabanid larvae in water and mud under the saw grass in the Everglades. The following notes were mostly made by the senior author.

On March 1, 1918, the first this year's adult was heard buzzing, but the insect was not seen; from March 3 to 8 the adults frequently appeared.

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[2] Knab, F. "What is *Tabanus mexicanus?*" Insecutor Inscitiae Menstruos, vol. iv, nos. 7–9, 1916, pp. 95–100. (*T. mexicanus* not present in the U. S.).

[3] Snyder, T. E. and Mosier, C. A. "A Peculiar Habit of a Horsefly (*Tabanus americanus*) in the Florida Everglades." Proc. Ent. Soc. Wash., Vol. xix, pp. 141–145.

[4] Knab, F. "The Swarming of *Culex pipiens*" Psyche, Oct. 1906, pp. 123–133.

—— "The Swarming of *Anopheles punctipennis* Say." Psyche., Feb., 1907.

The first early morning flight occurred on March 9, this swarm was more noticeable in the jungle than in open spaces. The water on the prairies was low and it was very dry, the temperature ranging from 80° to 86°F. for the last twenty days. The flies were not in evidence on the Everglades. There was very little stock within a distance of 9 miles and the flies were not bothering horses and mules but a few were following automobiles on the road.

From March 10 to 16 the flight was noted to occur daily lasting from fifteen to nineteen minutes; the brighter the dawn, the longer and more pronounced was the flight. The flies were increasing in numbers, the flight being much more pronounced than on March 9.

On March 10 was out before the flight began; the weather was foggy and cool, hence the swarm was late. After the first fly began hovering the flight increased very rapidly until the height was reached, was steady for about seven minutes, than gradually diminished. Numerous flies were noted making a "zipping" noise as if just expanding their wings for the first flight in the grass and ferns.

There was a light rain during the night and very cool, 58°F. at dawn, on March 11. The flight was late and lasted only twelve minutes; it was not as strong as on the 9th and 10th, due to cool and wet conditions.

On the 17th and 18th the flight continued to grow stronger but had not yet been as loud as in the height of the season of 1917. *Tabanus atratus* Fabr. made its first appearance. Deerflies (*Chrysops*) were in evidence but not numerous.

There was a good rain during the night and the morning of the 19th was clear and bright. The flight lasted thirteen minutes and ceased more abruptly than on cloudy or foggy mornings. During the day adults were common along trails in the hammock and were quite persistent in following one and circling around.

March 20. There had been a heavy rain during the night and it continued to drizzle in the morning. The flies did not swarm. There was a heavy downpour in the afternoon.

There was a very strong flight on the 21st. The flies continued to increase in numbers. Very few were biting human beings this season; they were observed on trees and the undersides of leaves during the day. Adults were also observed feeding on the flowers of sweet bay (*Tamala pubescens*) and inkwood (*Exothea paniculata*). Horses and mules had to be protected with burlap. The flies were collecting in the tops of automobiles to the extent of making it uncomfortable for the occupants.

From March 22 to 24 the flight was normal; the flies were daily increasing in numbers; swarms were following autos, lighting inside the tops and were a great nuisance. The flies were more aggressive in the woods. When screen doors were left open, great numbers

soon collected on the inside. On the 24th there was a heavy fog and the flight started later but was more pronounced.

There was a strong flight on March 25. More flies were present on live stock, which had streams of blood on noses and lower part of legs. All stock was protected with bagging and sprays of vile smelling oils which had but little effect and had to be applied frequently.

On March 26 the temperature was so cool until sunrise that there was no flight. All during the day, however, the flies were very annoying to people as well as stock.

This morning, March 27, there was a very strong flight lasting 21 minutes in all. Temperature 54°F. at sunrise; it rained lightly in the afternoon.

March 28–29 normal flights occurred. The weather was dry and warm and there was evidence of new freshly emerged adults arriving, with undamaged wings.

On the mornings of March 30 and 31 I (Mosier) made the interesting discovery that many of the flies were inverted, i.e., upside down, when hovering during flight.

The flights of April 1 and 2 have convinced me that many, if not all, the flies were upside down when hovering. The swarm was on the decline; there were not so many flies. *Tabanus trijunctus* Walker had appeared.

On the 3rd there was a strong flight. Observations were made near the Lodge or about $\frac{1}{8}$ mile farther west than on the 1st and 2nd (near the rock pit and eastward to entrance). The swarm lasted nineteen minutes. I again observed flies inverted. There was a difference in tone when inverted and normal.

From the 4th and 5th the flight was very strong. I walked to about half mile east of the hammock and the sound was very pronounced at that distance, although no flight occurred outside of the edge of the hammock.

April 6 the flight was normal; adults of *T. americanus* diminishing in numbers but *trijunctus* on the increase.

On the 7th there was a strong, early flight, lasting twenty-one minutes. The weather was cloudy and cool. As the days lengthened the flight began correspondingly early by watch but comparatively the same by dawn.

The weather was warm and foggy in the mornings of April 8 and 9 but there were strong and long flights, that on the 9th lasting twenty-one minutes. I observed two flies to strike each other in mid air, both coming to the ground.

On April 10 the weather was cooler and the flight was lighter. I observed that *T. trijunctus* was not as active in the early morning hours as *T. americanus*. During the day many adults of *T. americanus* were observed feeding on the bloom of swamp bay (*T. pubescens*), also on the bloom of saw palmetto.

There was a very light flight on April 11th due to exceptionally cool weather. During the day saw more *T. americanus* adults feeding on *Ilex casine* bloom, also on wild tamarind (*Lysiloma bahamense*) and on naked stopper (*Anamomis dicrana*) which is just coming into bloom.

There was another light flight on the morning of the 12th.

On the 13th the sound of swarming was louder than on the three previous mornings but not normal.

April 14 the flight was much stronger, the weather was bright and warm. I positively observed some flies inverted.

On April 14 the junior author visited Paradise Key and noted that during the day *T. trijunctus* was very common and annoying, collecting in large numbers in auto tops and on the veranda screens. *T. americanus* was not so common. *T. lineola* Fabr. was also present.

The weather was bright and warm on the morning of April 15. The flight was increasing in strength and duration. I (Mosier) made a careful canvas of palmetto bloom and found as many as 11 flies on one stalk, having two bloom spikes, 10 *T. americanus* and 1 *T. trijunctus*. Feeding did not begin immediately after the flight but later on during the day till dusk.

April 16th was warm and cloudy threatening rain. There was a strong flight which lasted 18 minutes. I saw several pairs of flies strike in mid air, but none came within collecting distance. 568 *T. trijunctus* were caught by opening the screen doors of the lodge, among which were only 2 males; 8 *T. americus*—2 being males; and 6 *T. lineola*, 1 being a male! I observed the males feeding on palmetto bloom, also several resting on shrubs and tree trunks near palmetto flowers. These darted out when others came near, so that I could not determine whether the new arrivals were females or not.

The weather was warmer on April 17, the temperature being 68°F. at Dawn. The flight was much stronger than last week; fewer flies were around the screens. I visited Timms Hammock in the Redlands district—9 miles N.W. of Homestead, Fla.—and observed some adults of *T. americanus* but no *T. trijunctus* or *T. lineola* Fabr. There are not as many gadflies in this hammock as at Paradise Key (Royal Palm Hammock). Timms Hammock is on higher ground in pine lands and the glades nearest to this hammock are very dry and rocky, there being no saw grass sloughs near and but little leaf mould on the ground which is very dry. Rock sinks 12 feet deep show no water, whereas the water level at Paradise Key is not more than 4 feet below the surface and the jungle is very dense. Dr. Small has illustrations of this dense hammock growth in a recent article[5] on Florida ferns.

[5] Small, J. K. "Ferns of Tropical Florida." The Amer. Mus. Jour., Vol. XVIII, No. 2, February 1918.

April 18. The flight was stronger than usual, of as long a duration as any during the season. The weather was warm 66°F. at the beginning of the flight. There were not as many adults of *T. americanus* around the screens as usual.

On April 19 the junior author again visited the senior author at Paradise Key and made the following observations. A very heavy cold rain lasted all morning. Beautiful bright green-eyed males of the large *T. americanus* were found to be common feeding on the blossoms of saw palmetto in the late afternoon. We collected several dozen males and a few females before the mosquitoes drove us indoors. Males of *T. trijunctus* with eyes of a soft lavender color, and the purple-banded-eyed females were also collected on this bloom, as were a few males of *T. lineola*. The leaves of the palmetto shading the bloom were cut away by the senior author to expose the bloom to sunlight and thus possibly attract more flies. The senior author was able to detect a difference in tone in the buzzing which the males and females make when they are flying; the same comparison as between the worker and drone honey bee.

April 20 the writers made observations on a flight at 4.33 a.m.[6] but it was very light. (Later, 5.25) with the sun rising above the tree tops the first adults of *T. trijunctus* were observed flying. At 6 a.m. no adults of *T. americanus* were as yet feeding on the palmetto bloom. They remained in the hammock after the early morning flight until the sun was well up.

In the early morning the doors to the screened veranda were opened and a count made of the gadfly adults which came in between 6.40 a.m. and 7.20. Needless to say all were killed: *T. americanus* 1 male; *T. trijunctus* 222 females, no males; *T. lineola* 5 females.

Between 2.30 and 3.30 p.m. several dozen *T. americanus* males were caught feeding on saw palmetto blossoms, with ripe pollen; also about a dozen males of *T. trijunctus*. At 5 p.m. the males of *T. americanus* were not as common as early in the afternoon, and but few were flying. Males of *T. trijunctus* were also collected.

On April 21 at 4.20 a.m. the flight of *T. americanus* began. The stars were visible and the red light of dawn was tinting the eastern sky. The flight was strong, the loud buzzing lasted fifteen minutes but a few adults were flying at the end of seventeen minutes. The flies hovered high among the tree tops at first, then when it became lighter, lower. One male was caught hovering. The senior author was able to see the legs of the flies sticking up in the air when they hovered reversed, with abdomen pointed upward.

[6] Central time.

At 6.45 a.m. males were found to be common feeding on the blossoms of saw palmetto. Several hours were spent in the morning by the junior author digging in the moist rich dark humus in a lower bottomland in the hammock to find Tabanid larvae or exuviae. No trace was found. Water was present at a depth of about 3 inches under the soil and there was a dense jungle growth of royal palm and other hammock trees and ferns. Mosquitoes were very abundant. At 10.30 a.m., however, 3 living Tabanid larvae were found in black muck under saw grass growing in water at the edge of a slough. This was at the beginning of the Everglade prairie east of Royal Palm Hammock, or west of the slough near the hammock. Water was then present over some of the prairie, due to recent heavy rains, especially that of April 19.

At 5 p.m. males and a few females of *T. americanus* were collected on saw palmetto bloom, the males were feeding, and were still present at 5.30 p.m.; they remained till nearly dusk.

On the morning of April 22 there was a heavy dew, but a strong flight of *T. americanus* occurred between 4.24 and 4.40 a.m. The adults flew with the abdomens pointed upwards, at the beginning of the flight hovering high and later low. 1 male was caught. Is this a flight of males only?

Large wasps (*Stictia carolina* Fabr.)[7] locally called the "horse guard," "horsefly killer or chaser,"[8] etc., persistently hovered about live stock which are troubled by gadflies. Usually only 1 or 2 were present, however. When the gadflies hear this wasp approaching they scatter in all directions. It digs in the sand, buries the stung gadflies in a nest then lays its eggs on them. The resulting larvae feed on these flies.

On April 23 the senior author continued his notes, solus. There was a heavy flight of *T. americanus* in the early morning. Later, on the palmetto bloom, 13 males of *T. americanus* and 7 males of *T. trijunctis* were caught. There were but few females of *T. americanus* on the blossoms, but females of *T. trijunctus* were abundant.

April 24. There was a heavy flight of *T. americanus* at the usual hour. At 4 to 5 p.m. I visited the palmetto blooms where there were plenty of females of *T. trijunctus* and caught 4 males also 4 males of *T. americanus*. The flowers seemed to be fading so I cut away many more leaf stems from fresh flowers. I noticed more of both species on fresh flowers. I believe the flies want shade or shelter.

I left the screen to the veranda open from 4 to 5 p.m. and caught 114 females of *T. trijunctus* and 1 male of *T. americanus*, 6 females of *T. lineola* and 7 males.

[7] Determined by Rohwer.

[8] Parker. Proc. U. S. Nat'l. Mus., Vol. 52, p. 132, 1917.

On April 27 there was a strong flight at the usual hour "dawn." The weather was clear and much warmer; the flight was correspondingly heavier; duration fourteen minutes.

I found an unusual number of males on palmetto leaves and flowers, also on shrubbery and trees south of the house. The males were so plentiful that it ceased to be sport to search and collect them. To date have not captured any females during the morning flight. Am sure there are only males in Tabanid flight.

In the afternoon there was a heavy rain and hence no observations were made.

April 28. Weather threatened rain, cloudy and cool. The flight was light, lasting only eight minutes. There was rain during the day and there were very few *T. trijunctus* in evidence; quite a few *T. americanus* males were on trees throughout the jungle.

On April 28 the junior author collected a large series of *Tabanus psammophilus* Osten Sacken along the Ocean on sand, at Miami Beach. Both males and female were collected. They were colored like the sand and flew like *Cicindela*, and were difficult to catch. Females were full of eggs.

On April 29 there was a heavy morning flight. I saw many male *T. americanus*, also a few females in the jungle. *T. trijunctus* were very scarce. More adults of T. *lineola* were present than in the last week, also more *Chrysops*. sp.

April 30 there was a flight of short duration but strong; I noticed males of *T. americanus* feeding in palmetto as soon as the dew was off the plants; they were quite abundant.

In the afternoon I noticed males of *T. americanus* seek the shade, very few were feeding in the strong sunshine; they also sought fresh blooms. I counted 10 males of *T. americanus* on one stalk, with 2 blooms—all in the shade. I caught 11 *T. americanus* males, 2 females; 2 males *T. trijunctus*. There were a few *T. trijunctus* around the veranda screen. No. *T. flavus* adults have been seen since April 19; but few *T. lineola* were present.

From 12 m. to 4 p.m. I canvassed the palmetto bloom where I had cut the fans from blooms. I caught 41 males of *T. americanus* and 23 males of *T. trijunctus*; 8 *T. americanus* females and 424 *T. trijunctus* on the screen, all being females; 31 adults of *T. lincola* were also caught.

The females of *T. trijunctus* were predominant both on the screen and on flowers. I do not think I caught more than 50 per cent of the males seen.

As soon as the leaves were cut from the flowers *T. americanus* males sought new feeding grounds, either for shade or security. The exposure did not have the same effect on either sex of *T. rijunctus*. *T. lineola* was also feeding on palmetto flowers.

May 1. The morning flight was strong but of short duration. All were high in the air and I could not catch any on the wing but I observed 3 light on trees, all proved to be males!

On May 2 there was a light rain at dawn and it was very cool: the flight was strong, during a light drizzling rain and lasted twelve minutes.

I observed many males on the trees throughout the jungle, a very few females. The veranda screen was open five hours and I caught 114 females of *T. trijunctus*, 4 females of *T. americanus*, and 18 *T. lineola*, 1 *Chrysops* sp.

There were light showers all day. The male *T. americanus* was here in far greater numbers than that of *T. trijunctus*, some were quite small and some seemed over large.

The junior author spent May 2 at Hobe Sound (Jupiter Island) and Stuart, Florida, leaving Miami at 5.30 a.m. The gadflies (*T. trijunctus*) became common at Fort Lauderdale; they were a pest at West Palm Beach (there had been very few at Miami). On Juptier Island *T. trijunctus* was by far the commonest gadfly. *T. americanus* and *flavus* were also present.

Residents at Hobe Sound state that gadflies were about and annoying from the first of May till June 10.

Gadflies were abundant wherever the saw palmetto was in bloom. One could find them most abundant by following the blooming of palmetto from southward to the north.

On May 3 it was very cool and cloudy at dawn and there was a very light flight of *T. americanus* at Paradise Key.

It was cool all day and there was very little activity among the gadflies. I saw plenty of males in the jungle but they were not active. A very few were feeding. I saw a few on cabbage palm bloom, which was just then opening.

May 4. The temperature was 58°F. at dawn and damp. The flight lasted thirteen minutes and but few flies on the wing were strong enough to make a distinct hum. They kept high in the air and did not hover as much as on warm mornings. They kept darting high in the air and none were low enough to capture.

The night hawk and "chuck will widow" both caught flies on the wing. The birds kept flying up and down the roadway and I distinctly observed them to pick flies out of the air on the wing.

May 5. Temperature 56°F. No flight; very few *T. trijunctus* around screens all day. I saw a dragon fly catch *T. trijunctus* on the wing and come to ground to devour it, also saw another dragon fly catch *T. trijunctus* from the screen. Very few *T. americanus* were visible all day. Heavy winds were blowing and it was fairly cool in the afternoon. No males were on palmetto flowers in the open.

May 6. No flight. Weather continued cool with high winds No males of *T. trijunctus* or *americanus* observed all day. *T. americanus* seemed more susceptible to cold weather than *T. tri-*

junctus. Very few *T. trijunctus* females were present today and few *T. lineola* and *Chrysops*.

I saw 1 *T. flavus* about sundown at the screen.

May 7. *T. americanus* made a strong but short flight. The males seemed more numerous than females. I saw a small wasp or bee worrying a male *T. americanus* around a palmetto bloom but evidently it was not large enough to capture him.

A large spider with yellow web tangles many *T. americanus* and *T. trijunctus* in its web and devours them promptly.

T. trijunctus were gradually getting scarcer. I think there were fewer now than of *T. americanus*. This was most unusual. They are usually just coming on as *T. americanus* disappears. No egg masses discovered so far although I searched Sagittaria leaves diligently.

May 10. No further flights of *T. americanus*. The veranda screen was open for five hours on May 8 and I netted 66 females of *T. lineola*, 21 females of *T. trijunctus* and 2 females of *T. americanus*. Very few *T. americanus* males in evidence.

I saw an interesting flight of male *Tanabus lineola* Fabr. at dusk. About 200 or more specimens were hovering much the same as *T. americanus* except all were from 5 feet to 8 feet from the ground on the rock road east of Royal Palm Hammock. They broke out spontaneously like a swarm of bees, the flight lasting about eight minutes or until dark. I succeeded in knocking down 5 specimens. All were males.

May 11. All *T. americanus* observed on the tree trunks today were males. There was a preponderance of males to females. Just now in *T. trijunctus* the females predominate.

On May 8, a few females of *T. americanus* were collected at Paradise Key.

May 13, females of *T. lineola* were observed. At dusk females of *T. flavus* were very common at the north side of the house, but were restless and wary.

On May 16, a female of a brown tabanid *T. turbidus* Wied. made its first appearance in 1918, at Paradise Key.

Females of *T. americanus* were collected on May 25, which is a late record for 1918.

On May 30, numerous females of *T. flavus* were caught. The color of these beautiful greenish yellow Tabanids can be preserved by treating them with formalin for forty-eight hours.

On June 2 another species of *Tabanid* made its appearance, i.e., *T. melanocerus* Wied.; it has different habits from *T. trijunctus;* it is very shy. It appears only when the latter species has about disappeared.

On June 9 the water was very low in the Everglade prairies, the weather was exceedingly warm and the hammock (Paradise Key)

very dry. *T. americanus* are very rare; only single individuals were seen daily. *T. trijunctus* are rare, but *T. melanocerus* common. *T. lineola* was more numerous than in late April. The brown *Tabanid* (*T. turbidus*) was rare.

T. flavus was quite numerous at dawn and dusk around the house; none have ever been observed in the hammock or low shrubbery along the roadway, nor on blossoms.

I have observed a small *Tabanid* of about the same size as *T. lineola*, but of a lighter color and with entirely green eyes, with one dark line transversely across the eyes. Very few individuals were observed and it was very shy.

SUMMARY.

The flight at dawn of the large gadfly (*T. americanus*) at Paradise Key in the Lower Everglades in enormous numbers has been observed for two years. In 1917 it was thought that both males and female were in flight. This year's observations indicate that most of the flies "swarming" are males. Possibly females are ttracted by the noise and dart in to mate. F. Knab states that this occurs among mosquitoes. The habit that the flies have when hovering of darting towards each other and clinging may be mating. Due to the height at which the adults fly this has not yet been confirmed; only half a dozen adults have been so far caught hovering low and they were all males.

It is believed that the flies when hovering reverse and hover upside down with abdomen pointed upwards and legs sticking up. In 1918 the swarm was first observed on March 9 and ended May 10.

Males of several species of *Tabanus* congregate in large numbers during the day time and feed on the blossoms of the saw palmetto (*Serenoa serrulata*) where the bloom is shaded.

Tabanus lineola was found "swarming" at dusk on May 10.

The beautiful greenish yellow night flying *T. flavus* are common.

A few Tabanid larvae were found in the water and muck under sawgrass near Paradise Key.

Twelve species of *Tanabus* have been collected at Paradise Key. While extremely annoying, they are beautiful insects. The large eyes of male *T. americanus* are a brilliant light green. Those of males of *T. trijunctus* are lavender and those of the females purple banded.

The yellow fly of the Dismal Swamp (*Diachlorus ferrugatus*) also occurs at Paradise Key, as well as several species of deerflies (*Chrysops*).

The following is a list of Tabanidae collected at Paradise Key, Fla., with the dates of their occurrence. These flies were determined by C. T. Greene.

Tabanus americanus Forster
May 12, 1916. Mosier and Snyder.
March 25–29, 1917. Mosier and Snyder.
March 30—June 30, 1917. Mosier.
March 4, 15, 1918. Females. Mosier.
April 14, 16, 19 and 20. Males and females. Mosier and Snyder.
to May 25, Mosier
Tabanus turbidus Wied. May 16, 1918 Mosier.
Tabanus trijunctus Walker.
May 12, 1916. Mosier and Snyder.
Apr. 23 to June 30, 1917. Mosier.
April 1, 1918. Females. Mosier.
April 14, 15 and 20 Males and females. Mosier and Snyder.
to May 11, Mosier.
Tabanus melanocerus Wied.
March 29, 1917. Mosier and Snyder.
June 2, 1918; Mosier.
Tabanus———1918 Mosier.
Tabanus atratus Fabr.
March 17, 1918. Mosier.
Tabanus lineola Fabr.
March 10, 1918. Females. Mosier.
April 14 to 20. Males and females. Mosier and Snyder.
to May 13 Mosier.
Tabanus quinquevittatus Wied.
March 29, 1917. Mosier and Snyder.
Tabanus flavus Macq.
March 15, 1918. Mosier.
April 1 and 4. Mosier.
April 19, 1918. Mosier and Snyder.
to May 30 Mosier.
Tabanus pumilus Macquart.
April 4, 1918. Mosier.
Diachlorus ferrugatus Fabr.
April, 1918. Mosier and Snyder.
Chrysops plangens Wied.
March 29, 1917. Mosier and Snyder.
April 19, 1918. Mosier and Snyder.
Chrysops flavidus Wied.
March 28, 1917. Mosier and Snyder.
April 23, 1918, Mosier and Snyder.

THE GENUS CNEMEDON EGGER IN NORTH AMERICA (DIPTERA SYRPHIDAE.)

J. R. MALLOCH,
Urbana, Ill.

The genus *Cnemedon* was erected by Egger for the reception of two European species and subsequently two others were added. The only distinguishing characters cited are the spurred hind trochanters, and the presence of a very noticeable constriction between posterior margin of apical abdominal segment and hypopygium in the males. The females have not been satisfactorily differentiated. There is one described North American species of the genus, but owing to the doubtful status of *Cnemedon* it has been retained in *Pipiza* in which Loew originally described it. An examination of a series of 9 males of this species and 2 of another, described herewith leads me to conclude that it is possible to separate the genus *Cnemedon* from *Pipiza* by the fact that the latter has a number of hairs on the inner side of hind coxae while the former has not.

I have no females of either species of *Cnemedon* so cannot say whether the character will hold in that sex but believe that it will, judging from other genera.

The two species occurring in North America may be separated as follows:

Hind trochanter with a boot-shaped spur; disc of apical ventral abdominal segment flat, frontal and facial hairs almost entirely black; upper portion of frontal triangle opaque ..... *calcarata* Loew

Hind trochanter with a thumb-like spur; disc of apical ventral abdominal segment with 2 small protuberances, a sharp one in center at base and a rounded one in center near apex; frontal hairs largely, facial hairs entirely white; frontal triangle entirely glossy ..... *trochanterata* sp. n.

Cnemedon trochanteratus sp. n.

Male.—Black shining. Under half of third antennal joint, arista, extreme apices of femora, bases of tibiae, and the tarsi reddish yellow. Wings clear. Knobs of halteres yellow. Hairs pale, only a few of those on frons black.

Eyes long-haired, closely contiguous for a length about equal to ocellar triangle; arista slightly longer than third antennal joint, the latter 1.5 as long as wide. Mid tibia with a less conspicuous ridge on anterior side than in *calcerata*, and the spur on anterior side of mid coxa much smaller than in that species.

Length, 6.5 mm.

Type:—In collection of State-Natural History Survey of Illinois.

Type locality.—St. Joseph, Ill., May 3 and 10, 1914 (J. R. Malloch).

I have before me specimens of *calcarata* from Dubois, May 24, 1917, on flowers of *Crataeus;* Olney, April 23, 1915; Augerville, near Urbana, June 6, 1915; St. Joseph, May 3, 1914, May 11, 1913; and Urbana, August 28, 1917 (C. A. Hart, J. R. Malloch). Algonquin, July 24 and September 19 (W. Nason). These records are all for Illinois. The species occurs in the Eastern States.

A NEW MOSQUITO (AEDES WHITMOREI) FROM COLOMBIA

By Lawrence H. Dunn,

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Aedes Whitmorei, new species.

During 1916 the Rockefeller Foundation International Health Board sent a commission of six experts sanitarians to South America for the purpose of studying the yellow fever conditions existing at that time. This commission consisted of Major General William C. Gorgas, Dr. Juan Guiteras, Dr. Henry R. Carter, Major T. C. Lyster, Major Eugene R. Whitmore and Mr. William D. Wrightson.

While the party was in Colombia, Major Whitmore collected specimens of mosquitoes prevalent at several places that were visited and made as complete a mosquito survey as time and conditions permitted. As specimens were taken on board ocean going steamers, on river boats, in low lying coast, and in villages located on the upper plateaus at higher altitudes, an interesting collection was obtained. The writer was recently afforded an opportunity to examine the specimens collected on this trip and found one species to be new and previously undescribed. This species is named in honor of the collector, Major E. R. Whitmore.

Female.—Proboscis unusually long, slender, uniform throughout, labellae cone-shaped, clothed with dark scales having bronzy reflections, a patch of pale colored ones on the under surface, a few small light colored hairs scattered over the upper surface. Palpi stout, about one seventh as long as the proboscis, covered with bronzy-black scales, apices broadly silver-white, several small spines extending laterally from basal joints. Clypeus medium in size, roundly triangular, convex above, dark brown, nude. Eyes dark metallic brown. Antennae dark brown, second joint shorter than the following ones and swollen subapically, other joints nearly equal; whorls composed of from 4 to 6 long dark brown hairs. Tori dark brown,

the apical surface covered with flat silvery-white scales. Occiput clothed with black and white scales, a median dorsal white stripe extending from the nape to the antennae, lower down on each lateral surface a wide white stripe also extends from the nape to the eye margin, all three of the sewhite stripes being connected by a stripe of white scales, along the ocular margin, black areas between these white stripes, the lower cheeks covered with wide white scales; several coarse light-brown bristles along the ocular margin project forward, slender upright forked scales on the nape.

Prothoracic lobes well separated, ornamented with a central stripe of white scales; other parts of lobes black scaled. Mesonotum clothed with black scales and ornamented with four longitudinal lines of narrow, curved yellowish-white scales, the two median lines extending unbroken from the anterior edge to the scutellum, the *two outer ones* extending anteriorly from the scutellum and terminating in conspicuous round spots of broad snow-white scales on each side of the disk, a thin border of these yellowish-white scales also present around the anterior margin of the mesothorax; a large white spot near the base of each wing root. Pleurae and coxae dark-brown with a number of patches of white scales, these patches varying in size. Scutellum with a patch of yellowish-white scales on each lobe; coarse long bristles also present on each lobe, the center one having four. Postnotum large, prominent, and nude.

Abdomen long, slender, slowly tapering, subtruncate at tip; vestiture of brownish-black scales with a blue iridescence in some reflections; basal segmental patches of silvery-white scales, widely triangular patches of these white scales are also present on the lateroventral surfaces of each segment, those on the posterior segments rough and outstanding; the apical end of the eighth segment fringed with scales and hairs projecting posteriorly.

Wings somewhat narrow, transparent; length of second marginal cell equal to its petiole, second posterior cell somewhat shorter than its petiole; all veins clothed with long, narrow, dark-brown scales, the vestiture being heaviest on the costal, auxiliary, and first veins. Marginal fringe long, narrow, dark-brown. Halteres with yellowish stems and brown knobs with a small patch of white scales on each knob.

Legs rather long with femora stout and tibia and tarsi slender. Femora pale whitish beneath on basal half, dark brown above, with conspicuous round spot of white scales on the outer side beyond the middle, and white spot on apical end. Tibiae dark brown. Tarsi dark-brown and white, the first three joints on the front and mid tarsi having narrow basal rings of white; wide yellowish-white basal bands on hind tarsi. Claws simple.

Cotypes.—Twelve females, Army Medical School, Washington, D. C.

These twelve females used as cotypes and one male—this latter being too badly damaged for descriptive purposes, were taken

near the emerald mines at Muzo, Colombia. Four of the females were captured in a hut occupied by mine guards. This habitation was palm thatched with side walls of reeds and bamboo. It was open at one side and was in reality but little more than a shed. Whether or not the capture of these females in a place of this kind may be regarded as signifying that this species enters habitations to attack man is open to question. The other nine individuals were bred from larvae taken from a small heavily shaded pool of clear but apparently stagnant water. As soon as these larvae were collected they were placed in tubes and packed on mule back and were carried in this way until the adults emerged, being examined twice daily, morning and evening. That the larvae lived to pupate and emerge as adults under the continual shaking to which they were subjected by being carried on mule back during mountain travel indicates that this species is very adaptable and capable of living under the most strenuous conditions.

THE IDENTITY OF APHIS CIRCEZANDIS FITCH,

By A. C. Baker

On June 11, 1852, Fitch collected five specimens of a species of Aphis from *Gallium circaezans* in "dugway woods" Salem. These he listed in his cabinet under the name *Aphis circezandis* and the numbers 1319–'23. He made descriptive notes at the time, which are now in the writer's hands.

In his 13th Report (1870), page 501, he described this species under his cabinet name from these same notes. He gives the species the name, however, "should further researches show it to be undescribed." Although not entirely indisputable the standing of such a name has been ruled upon by the International Commission. (Opinion 49.) It is evident then that we must consider this name. So far as the writer is able to learn no recognition of the species has been made since the original description was published.

In the National Museum collections four of Fitch's specimens are preserved. These are 1319, 1320, 1321 and 1322. Specimen 1323 is lost. Apparently from Fitch's notes the specimen was apterous and the writer has searched the Fitch collection very carefully for it. The other four specimens are alate forms in somewhat fragmentary condition, but sufficiently intact to discern the important characters. The following description has been drawn up from these specimens.

Alate viviparous female.—Antennae with the following measurements. III 0.288 mm.; IV 0.176 mm.; V 0.208 mm.; VI (0.112 + 0.288 mm.). These

segments all distinctly imbricated and segment III armed with a row of 6 to 8 circular sensoria. Cornicles cylindrical, very distinctly imbricated and 0.176 mm. long. Forewing with the second branching of the media much nearer to the margin than to the first branching. Fitch's specimen of "variety c" has abnormal wing venation. Cauda 0.112 mm. somewhat constricted in the middle. Hind tarsus 0.09 mm. It is impossible to determine the length of the beak from the type specimens on account of their broken condition.

The name appears to be a synonym of *gossypii* Glover. Although some variation from typical *gossypii* is seen, the type specimens seem to fall within the range of variation shown by that species.

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THREE HUNDRED AND FIFTEENTH MEETING OCTOBER 2, 1918.

NOTES ON THE COCOON SPINNING HABITS OF TWO SPECIES OF BRACONIDS (HYM.).

BY R. A. CUSHMAN,

Bureau of Entomology.

The cocoon spinning habits of insects have been for a long time of greatest interest to me, especially of those that construct their cocoons under apparently difficult conditions, such as *Apanteles congregatus* Say, the cocoons of which stand on end on the surface of the parasitized caterpillar, and *Meteorus hyphantriae* Riley, which suspends its cocoon at the end of a long strand of silk. It was with great pleasure, therefore, that I watched both of the above named species spin their cocoons during the past summer.

Apanteles congregatus Say.

On June 20th I secured a larva of the catalpa sphinx (*Ceratomia catalpae* Boisd.), which bore on its back a single cocoon of *Apanteles*. Other parasite larvae very shortly began to emerge from the host. Placing the caterpillar under my binocular microscope I watched the entire operation from emergence to the completion of the cocoon to the point where it becomes too opaque to see through.

In emerging from the host the parasite larva first clears away with its mandibles the muscle tissue from a small area under the integrement, moving its head about until the inner surface is entirely clean. Then by repeated back and forth motion of the head with the mandibles projecting it gradually wears a rupture in the skin, through which it slowly issues by a peristaltic-like motion. At this time the larva can be seen to swallow large bubbles of air. When from a fourth to a third of its body is free the skin of the parasite ruptures just back of the head, the hole rapidly enlarging to permit the body of the larva to pass through. That portion of the exuvium that covers the face

remains attached until about two-thirds of the body is free of the host. Owing to the tension thus caused the body of the larva is constricted at the point where the edge of the retreating exuvium encircles it, and the head is bent downward until the head shield breaks free. As this occurs the inner lining of the mouth can be seen to come away as the last fine strand of the exuvium. By this time all but the apical three or four body segments have been withdrawn from within the host. From this position the parasite immediately begins the construction of its cocoon. The first process is the formation of a small mat of looped silk on the skin of the host ventrad of the parasite and reaching about half way around the emergence hole. With this mat as a foundation the larva constructs the ventral half and apical portion of the loosely woven outer layer of its cocoon. This is made somewhat after the manner of a loose-meshed lace, the ends of the loops being attached more or less regularly to the top of the loops of the preceding row. This layer of the cocoon grows rapidly up the ventral side of the larva, is narrowed off toward the top, and about the apical third of the dorsal part constructed while the larva still has its apical portion within the body of the host. When this much is completed the larva withdraws its head into the cocoon, completes its emergence from the host and from its exuvium at the same time, turns completely around somersault-fashion, and continues the construction of the outer layer of the cocoon from the point where it left off, finishing at the base. This done it begins the spinning of the more closely woven cocoon proper. It seems to employ two principal motions in this operation, sometimes moving the head back and forth in a longitudinal direction and sometimes describing a figure 8 transversely.

The completed cocoon is pure white. It becomes detached from the host rather easily, being attached only by one-half of the loosely woven outer layer to the mat first constructed. The cephalic portion of the exuvium protrudes through the emergence hole in the skin of the host into the cocoon, and can sometimes be extracted from the host by gently pulling on the cocoon.

Meteorus hyphantriae Riley.

The cocoon of this species is a beautiful piece of insect architecture and engineering. Swinging at the end of a crinkled strand of silk of surprising strength and from a half inch to several inches in length it escapes many of the dangers encountered by the cocoons of less sagacious and ingenious insects. The cocoon itself is clear amber in color, of nearly homogeneous shellac-like texture, but with some strands running through it, and

with a coarse outer network of strands. At the upper end of the cocoon the suspending strand forms a coil of several turns. This little coil is the clever feature of the cocoon and holds the secret of its construction.

At one time during the past summer I had a number of colonies of the fall webworm (*Hyphantria cunea* Drury) that had been exposed to the attack of *Meteorus hyphantriae*, and from which I had already secured a few cocoons. I examined a large number of these caterpillars in the hope of finding a parasite larva in the act of emergence and finally found one that had a slight swelling on one side near the caudal end. Examination of this showed that the swelling was caused by the pressure of the parasite larva that was about to issue from within the body of the caterpillar. It had cleared away all the soft tissue at that point, and its face could be distinctly seen through the integument of the host. In this condition it remained for two hours or more, during which time I placed the caterpillar in a phial and carried it home with me. It was nearly dark when the parasite finally issued. Before entirely emerging from its host the larva reached over with its head and fastened the end of its thread to the cotton plug of the phial. It then released its hold on the host and swung down at the end of the strand, hanging head up. It now curled up the body and twisted the silk about its caudal end, grasping it in the deep constriction between the last two segments and then straightened out, thus lengthening the strand. It repeated this operation several times until the thread was about an inch long. Taking a new hold on the strand it proceeded to wind it several times about its caudal end, thus forming the coil referred to. With the support thus formed and hanging head downward it began the construction of the outer loose-meshed layer of the cocoon by alternately straightening out its body, thus pulling out the silk, and curling up to fasten the end to the loops already formed. After making a few courses of these loops it released its hold on the coil about the last segment and thereafter held to the meshes by the short, finger-like cauda. At the beginning, when most of its body was not yet enclosed, it worked from the outside, fastening the ends of the loops on the outside of those above; but as the work progressed to a point where the body was mostly enclosed it worked entirely from the inside. When finished this meshed outer layer still had a hole at the lower end corresponding in size to the emergence hole of the adult. The outer structure completed, the larva proceeded to the building of the inner layer.

At this point darkness prevented further observations, but a few days later another larva was caught just after it had started its cocoon, and the construction of the inner layer was watched.

I had been much interested to learn how the larva makes this shellac-like, transparent layer with its few strands, and had supposed that it was composed of two kinds of secretion, a framework of silk over which was laid a quick-drying liquid. But observation of the process disclosed the fact that the silk is spun in a thread, but the thread is very soft and largely semiliquid so that it spreads out and coalesces with the adjacent threads, while still maintaining somewhat in the center its strand-like appearance.

When first secreted the silk is colorless, gradually assuming the amber tint.

For a long time after the beginning of the inner layer the tip was left open, but it was gradually closed and made thick by short strokes of the head back and forth across it. In this way the little cap that the adult pushes off in emerging was differentiated from the main body of the cocoon.

After the parasite has issued from its host the latter drops, still living, to the ground, where it writhes aimlessly about until death overtakes it, in many cases, twenty-four hours or more later.

A SYNOPSIS OF THE SPECIES BELONGING TO THE CHALCIDOID GENUS RILEYA ASHMEAD (HYM.)

By A. B. Gahan,

Bureau of Entomology, U. S. Department of Agriculture.

The genus *Rileya* Ashmead (Ent. Amer. IV, 1888, p. 42 and Bull. 3, Kans. State Agri. Coll., 1888, App. p. 3.) which has as a synonym *Ashmeadia* Howard (Can. Ent. XXI, 1889, p. 59) is, so far as known, confined in its distribution to North and South America and the West Indies. All of the described species as well as four new species are included in the key given below. A number of the species are placed in the key from the original descriptions, the types not being accessible for comparison. Short descriptive notes on the species, types of which are in the United States National Museum, are included.

All of the species for which there are rearing records are apparently parasitic in the galls of dipterous insects.

The genus is characterized by having thirteen-jointed antennae, the funicle five-jointed, the club three-jointed; antennae of the male similar to that of the female (except in the species *abnormicornis*); head strongly transverse; posterior margin of cheeks sharply carinate; pronotum as broad as the mesonotum and approximately the same length, rounded in front; meso-

scutum with delicate but complete parapsidal grooves; scutellum carinately margined at apex; thorax above rugulose or shagreened, never umbilicately punctate; propodeum short, narrowed at apex into a short neck, and usually with a more or less distinct transverse carina a little before the middle; marginal vein slender and approximately half as long as the submarginal; front coxae with a more or less distinct fovea beneath a little before the middle; first joint of all tarsi short, rarely longer than the second joint; abdomen subsessile in the female, petiolate in the male, rather robust, more or less conic-ovate, as long or a little longer than the head and thorax, the ovipositor barely exposed at tip.

Key to Species of Rileya

Females

1. Yellowish or testaceous species, sometimes more or less brownish above..... 2
   Black species, in only the species *orbitalis* conspicuously marked with yellowish.....8
2. Stigmal vein ending in a large rounded knob.....*megastigma* Ashmead
   Stigmal vein ending in a small knob, normal..... 3
3. General color yellowish-white; praescutum, parapsides discally, median stripe on scutellum, propodeum, pleural sutures, border of hind coxae, petiole, and a broad stripe above and below on abdomen, brownish; pronotum entirely yellowish; face with a median brownish stripe.....*collaris* Howard.
   General color not yellowish-white, or if so, the pronotum is not entirely yellowish and the face is without a median brownish stripe..... 4
4. Third tergite (not counting the petiole) much the largest one; abdomen with but two small disc-like tergites at base..... 5
   Fourth visible tergite the largest; abdomen with three small tergites basally..... 6
5. Head, viewed from in front, forming a nearly equilateral triangle; malar space, in profile, nearly straight, as long as the eye and without a carina separating cheeks from face; head, thorax, and abdomen above dark brown; face orbits, cheeks, three longitudinal spots above and sides of pronotum, spot on inner margin of parapsides, spot on axillae, lateral margins and apex of scutellum, large spot on sides of third tergite, and legs, yellowish-white.....*pulchra* Ashmead
   Head, viewed from in front, broader than long; malar space, in profile, convexly rounded, shorter than the eye, with a distinct carina separating cheeks from face; color uniformly dark reddish testaceous.....*heterogaster* n. sp.

6. Third tergite extending nearly to the middle of abdomen; propodeum without a distinct transverse carina.....*mellea* Ashmead
Third tergite much smaller, not extending nearly to the middle of abdomen; propodeum with a distinct straight, transverse carina..... 7
7. Abdomen strongly compressed from the sides; apical exposure of the third tergite distinctly longer than the second
compressiventris n. sp.
Abdomen not strongly compressed from the sides; apical exposure of the third tergite equal to the second or no longer..*hegeli* Girault
8. Third tergite much the largest, occupying most of the abdomen.... 9
Fourth tergite much the largest.....10
9. Face and orbits yellow or brownish yellow; pronotum and abdomen brownish.....*orbitalis* Ashmead
Head entirely black; pronotum and abdomen black
insularis Ashmead
10. Frons without distinct antennal depression
gallicola Kieffer & Jörgensen
Frons with a distinct antennal depression..... 11
11. Antennae, except the two proximal joints, white; mesonotum anteriorly transversely striated.....*albicornis* Kieffer & Jörgensen
Antennae not white, either brownish testaceous or blackish; mesonotum coriaceous or shagreened, without striae..... 12
12. Tegulae black; scape and flagellum for the most part dark brown or blackish, the former usually testaceous beneath; lateral margins of the dorsal portion of pronotum rounded, not margined.....*tegularis* n. sp.
Tegulae not black; scape and flagellum fusco-testaceous..... 13
13. Lateral margins of the dorsal aspect of pronotum distinctly angulated and more or less distinctly margined above..... 14
Lateral margins of dorsal aspect of pronotum not distinctly angulated or margined, but more or less rounded...*cecidomyiae* Ashmead
14. Ocellocular line very distinctly shorter than the postocellar line, only slightly more than half as long; striations of the face not extending upward along the inner margin of the eye much beyond the lower edge of antennal depression; abdomen scarcely acuminate at apex; first antennal ring-joint transverse
similaris n. sp.
Ocellocular and postocellar line practically equal; some of the striations of face extending upward along the inner eye-margin beyond the lower edge of antennal depression; abdomen distinctly acuminate at apex; first antennal ring-joint as long as broad.....*americana* Girault

Males

1. Yellowish species sometimes more or less marked with brownish or blackish above 2
   Black species 5
2. Third visible tergite (not counting the petiole) much the largest and extending far beyond the middle of abdomen 3
   Fourth visible tergite (not counting the petiole) the largest, the third never extending much beyond the middle of abdomen 4
3. Head, viewed from in front, forming a nearly equilateral triangle; malar space, in profile, nearly straight, as long as the eye and without a carina separating face from cheeks; head, thorax, and abdomen above dark brown; face, orbits, cheeks, three spots above and sides of pronotum, spot on inner margin of parapsides, scutellum laterally and at apex, line on each lateral margin of propodeum, more or less of pleurae, and all legs, yellowish white, hind tibia not black at apex ..... *pulchra* Ashmead.
   Head not forming an equilateral triangle, malar space, in profile, convex, shorter than the eye and with a distinct carinate line separating the face from cheeks; color uniformly reddish testaceous, the apex of hind tibia narrowly banded with black
   heterogaster n. sp.
4. Abdominal petiole fully twice as long as thick; third tergite very short, the fourth constituting distinctly more than half the length of abdomen; hind tibiae mostly blackish
   compressiventris n. sp.
   Abdominal petiole scarcely longer than thick; apex of third tergite at or very near the middle of abdomen; fourth tergite constituting not more than one-third the abdominal length and hardly more than twice as long as the exposed part of the third; hind tibiae entirely reddish testaceous ..... *mellea* Ashmead
5. Second visible tergite (not counting the petiole) occupying more than half the length of abdomen; tegulae black; scape and flagellum blackish ..... *piercei* Crawford
   Second visible tergite (not counting the petiole) small, either the third or fourth tergite the largest 6
6. Third visible tergite much the largest tergite, extending far beyond the middle of abdomen; the fourth tergite not much longer than the first; fifth about two-thirds as long as the fourth
   insularis Ashmead
   Third visible tergite not longer than the fourth and not extending much beyond the middle of abdomen 7
7. Third visible tergite very short, scarcely longer than the second and not extending beyond the basal one-third of the abdomen; fourth tergite comprising about two-thirds of the length of abdomen and fully twice as long as the three first combined; legs including all coxae pale testaceous ..... *pallidipes* Ashmead

Third visible tergite not very short, distinctly much longer than the second and reaching to the middle of abdomen or nearly; fourth tergite not longer than the three basal ones combined; coxae, at least, black..... 8

8. Funicle joints very distinctly pedicellate.....*abnormicornis* Ashmead
Funicle joints not at all pedicellate..... 9

9. Tegulae black; scape and flagellum dark; lateral margins of the pronotum not sharply angulated or margined.....*tegularis* n. sp.
Tegulae not black, either pale or ferruginous; scape and flagellum more or less pale.....10

10. Lateral margins of the pronotum margined or sharply angulated; abdominal petiole strongly sculptured.....*similaris* n. sp.
Lateral margins of pronotum rounded or at least not angulated or margined; abdominal petiole more weakly sculptured
cecidomyiae Ashmead

Rileya megastigma Ashmead.

Ashmeadia megastigma Ashmead, Journ. Linn. Soc. Lond. Zool. XXV, 1894, p. 145.

Rileya megalostigma Schulz, Spolia Hymen., 1906, p. 148 (emendation).

Female.—Resembles *heterogaster* but may be easily recognized by the fact that the stigmal knob is greatly enlarged, the diameter of the knob being equal to the length of the stigmal vein basad of the knob. Head, viewed from in front, subtriangular; malar space, in profile, not strongly convex, shorter than the eye and without a carinate line between the cheeks and face; antennal depression not margined; second tergite barely visible as a very narrow, easily over-looked, margin around the first; third about half as long as the first; fourth large; fifth and sixth subequal and each about as long as the third; ovipositor tip exposed; propodeum with a delicate but distinct, nearly straight transverse carina.

Male unknown.

Three females in the U. S. N. M. Collected on the island of St. Vincent, West Indies.

Riley collaris, Howard.

Ashmedia collaris Howard, Journ. Linn. Soc. Lond. Zool. XXVI, 1896, p. 136.

Placed in the key from the original description. Type, a female, in the British Museum, London. Collected on the island of Grenada, West Indies.

Rileya pulchra Ashmead.

Ashmeadia pulchra Ashmead, Journ. Linn. Soc. Lond. XXV, 1894, p. 145.

Female.—Antennae short, the funicle joints all distinctly broader than long; ocelli very small, the postocellar line a little less than twice the ocellocular line; vertex rather flat; antennal depression immargined; antennae inserted apparently a little below the lower extremity of eyes; face below eyes weakly striated; propodeum with a distinct transverse carina which is sharply angulated at the middle, the area before this carina mostly granular with one or two striae medially on each side of middle; area behind the carina longitudinally striated; first tergite about as broad as long; second about two-thirds as long as first; third large; those beyond the third not longer than the first and second combined; tip of ovipostor exserted. For additional characters see key.

Male.—The abdominal petiole is as broad as long and distinctly sculptured above; first and second tergites small, the margin of the first very indistinct in the specimen at hand; fourth tergite about equal to the first and second combined; following tergites mostly concealed from above.

Two females and a male in the U. S. N. M. collection from the type series. Collected on the island of St. Vincent, West Indies.

Rileya heterogaster new species.

Resembles *mellea* in general appearance but may be distinguished at once from that, as well as most of the other species, by the segmentation of the abdomen.

Female.—Length 2.5 mm. Head, viewed from above, three times as broad as long; antennae inserted almost on a line with the lower extremity of eyes; funicle joints all broader than long, the first slightly the longest; distance from antennal depression to apex of clypeus subequal to the distance from antennal depression to the eye margin; antennal depression not margined and rather shallow; face below eyes distinctly striated and separated from cheeks by a distinct carina which runs along the posterior eye margin nearly to the top of eye; malar space fully twice as long as the width of mandible but less than the length of eye; thorax above a little more strongly sculptured and the axillae slightly more broadly separated at base than in *mellea*, the anterior margin of scutellum broader than anterior margin of axillae; propodeum with a strong, straight transverse carina before the middle, the surface before this carina with longitudinal crenulae, behind the carina rather distinctly striato-rugulose; abdomen a little longer than the head and thorax, subsessile, pointed ovate; first tergite (not counting the very short petiole) small, smooth, and subcircular in outline; exposed margin of second equal to about one-third of the length of the first; third comprising fully two-thirds the length of abdomen; fourth not longer than the second and about half as long as the fifth.

the latter about equal to the sixth; ovipositor barely showing at tip. Pale reddish testaceous, the antennal funicle slightly brownish, legs somewhat paler than the thorax; ovipositor sheaths and tarsal claws black.

Male.—Length 1.9 mm. Agrees with the female except that the funicle joints are all subquadrate, the abdomen is petiolate, the petiole broader than long and rugose above, the fourth tergite (excluding the petiole) is nearly three times as long as the short second, the third the largest; those beyond the fourth very short and mostly concealed from above; hind tibiae at apex narrowly banded with black.

Type locality.—Brownsville, Texas.
Type.—Cat. No. 21830 U. S. N. M.
Host.—*Asphondylia* sp.

Type, allotype, and six paratypes reared by E. G. Smyth from galls formed in the leaf-axils of what Mr. Smyth calls the "Mimosa tree" (possibly *Leucaena pulverulenta* or *Mimosa lindheimeri*) and recorded in the Bureau of Entomology under Webster No. 6467, Experiments Nos. 3 and 4.

Rileya mellea Ashmead.

Rileya mellea Ashmead, Trans. Amer. Ent. Soc. XXI, 1894, p. 321.
Ashmeadia mellea (Ashmead) Dalla Torre, Cat. Hymen. V., 1898, p. 351.

Female.—Head, viewed from above about two and one-half times as broad as long; postocellar line slightly longer than the oecellocular line; vertex somewhat flattened; antennae inserted well above the lower extremity of eyes; face below eyes rather weakly striated; cheeks and face not separated by a distinct carina; malar space scarcely longer than the width of mandible; pronotum and mesoscutum with fine shallow rugulose sculpture, somewhat weaker than in most of the other species; propodeum more or less divided into areas by delicate carinae or striae, the transverse carina very delicate and irregular, often nearly effaced medially, longitudinal striae delicate and widely separated few in number, the median one usually the strongest, first tergite about as broad as long, exposed part of second approximately one-fourth as long as the first; third nearly three times as long as the second, its apex a little in front of the middle of the abdomen; fourth approximately equal to the first three combined; following tergite; very short.

Male.—The male is like the female except that the abdominal petiole is as long as broad, the first tergite beyond the petiole is broader than long, the apex of the third tergite is a little beyond the middle of abdomen and the fourth is not as long as the first three combined.

Type, allotype, and eight paratypes in the U. S. N. M., Cat. No. 2173. Labelled—"Gall on Skunk Bush." Indian River, Florida. The identity of host plant and gall maker are both unknown.

Rileya compressiventris, new species.

This species resembles *mellea* Ashmead in general appearance but may be easily distinguished from that as well as all other species by the more strongly compressed abdomen of the female and the longer petiole of the abdomen in the male.

Female.—Length 2.25 mm. Funicle joints subequal and very slightly broader than long, the first joint slightly the longest, head viewed from above, not more than two and one-half times as broad as long, the vertex rather flat and a little more strongly sculptured than in *mellea*; antennae inserted slightly above the lower extremity of eyes; face below eyes with fine close striae which converge at clypeus; malar space a little longer than base of mandible but not twice as long; without a distinct carina along the malar groove and behind the eye; ocellocular line about three-fourths the postocellar line; dorsum of pronotum shorter than the mesoscutum; mesoscutum and scutellum rather strongly scaly-punctate; propodeum with a distinct straight transverse carina, the surface in front of this carina as well as behind longitudinally striate, the median stria a little stronger than the others; stigmal vein about half the length of postmarginal and a little more than one-third the length of marginal; abdomen about equal in length to the head and thorax, strongly compressed from the sides, its dorsal width much less than its dorso-ventral height, the dorsum strongly arched antero-posteriorly; tergites, except the three basal ones, finely sculptured; first tergite (not counting the very short petiole) longer than broad, elliptical in outline; exposed apex of second a little less than half the length of first and about equal to half the exposed length of third, the latter reaching to about the basal one-third of abdomen; fourth tergite covering most of the remainder of abdomen; fifth about equal to the second; following tergites very short; tip only of the ovipositor exposed. Color pale reddish testaceous, the head except vertex pale yellow, antennal flagellum brownish, apex of ovipositor sheaths and tarsal claws black.

Male.—Length 2 mm. Agrees with the female except that the funicle joints are subquadrate, the abdominal petiole is slender, a little more than twice as long as thick, and finely sculptured; the abdomen is not strongly compressed, its tergites differently proportioned and the posterior tibiae are dark brown or blackish except at base; the first tergite (excluding the petiole) is nearly circular in outline, the second very narrowly exposed, third twice as long as the second, the three basal tergites together covering about one-fourth of the abdomen; fourth tergite covering the greater part of abdomen; fifth about as long as the first; following tergites practically concealed from above.

Type locality.—Brownsville, Texas.

Type.—Cat. No. 21831 U. S. N. M.

Type, allotype, and a large number of paratypes reared by E. G. Smyth from galls of *Asphondylia* sp. on what Mr. Smyth calls "Mimosa tree" (possibly *Leucaena pulverulenta* or *Mimosa lindheimeri*) and recorded under Webster No. 6467, Exp. No. 1.

The types of *Ceratoneura pretiosa* Gahan (Proc. U. S. N. M., vol. 48, 1914, p. 165) were reared from the same lot of material as were the types of this species. The Webster number given in the closing paragraph of the original description of *C. pretiosa* should have been No. 6467 instead of 6480.

Rileya hegeli, Girault.

Rileya hegeli Girault, Can. Ent. XLVIII, 1916, p. 340.

In this species, known only from the unique female type, the head is three times as broad as long as viewed from above; the malar space longer than width of mandible at base; cheeks not separated from face by a carina; the first tergite (excluding the very short petiole) is small and nearly circular in outline, the exposed margin of second and third subequal and together about two-thirds as long as the first; the first, second, and third together constitute about one-fourth the length of abdomen; fourth tergite fully twice as long as the three first combined, following tergites combined about equal to the first; propodeum with a distinct transverse carina.

Type—Cat. No. 20324 U. S. N. M., collected at Biscayne Bay, Florida.

Rileya piercei Crawford.

Rileya piercei Crawford, Proc. Ent. Wash. XVI, 1914, p. 29.

Known only from the unique male type. The species is easily distinguished from all others by the fact that the second visible tergite is much the largest. Head nearly three times as broad as long, antennae inserted above the lower extremity of eyes; funicle joints all broader than long; malar space, about twice as long as the width of mandible; the carina separating cheeks and face not very distinct; postocellar line fully twice as long as the ocellocular line; propodeum with a strong straight transverse carina, the surface before this carina rugulose and more or less crenulate, behind the carina longitudinally striate; abdominal petiole broader than long, rugosely sculptured; first tergite more than one-fourth but less than one-third as long as the abdomen, second a little less than twice as long as the first; third approximately two-thirds as long as the first; following tergites concealed from above.

Type—Cat. No. 16701 U. S. N. M., collected on *Thurberia thespesioides*, Fish Creek, Arizona.

Rileya insularis Ashmead.

Ashmedia insularis Ashmead, Journ. Linn. Soc. Lond. Zool. XXV, 1894, p. 143 & 144.

As represented by the male allotype in the U. S. N. M. this species is easily distinguished from the other black species by reason of having the third tergite (not counting the petiole) much the largest and extending far beyond the middle of abdomen, the fourth not longer than the first and only a little longer than the fifth; second tergite very short. The antennal depression is margined, face striated below the eyes, malar space shorter than the eye, carina on cheek and behind the eye not strongly developed; postocellar almost twice the ocellocular line; propodeum with a distinct transverse carina which is angulated at the middle, the area behind this carina longitudinally striated.

The female is placed in the key from the original description.

Type female in the British Museum, London; allotype male in the U. S. N. M., Cat No. 2418. Collected on the Island of St. Vincent, West Indies.

A male specimen of this species in the U. S. N. M. collected at Chapada, Brazil, is labelled in Ashmead's handwriting "*Rileya orbitalis* Ashmead" and bears the type label "♀ Type No. 8080 U. S. N. M." This cannot be the type of *orbitalis* which was described according to Ashmead from a female from Santarem, Brazil and should be in the collection of the Carnegie Museum, at Pittsburgh. The specimen does not agree with the color description of *orbitalis*.

Rileya pallidipes Ashmead.

Ashmeadia pallidipes Ashmead, Journ. Linn. Soc. Lond. Zool. XXV, 1894, p. 144.

Male.—Funicle joints subquadrate; face below eyes striate, the striae not extending above the base of antennae; antennal depression not margined; malar space not nearly twice as long as the width of mandible, much shorter than the height of eye; face not separated from cheek by a distinct carina; ocellus separated from the eye-margin by about the diameter of an ocellus; dorsum of pronotum not margined laterally; propodeum with a distinct transverse carina, the area before this carina striated, behind the carina without distinct striations; abdominal petiole about one and one-half times as long as broad and nearly smooth; first tergite about as broad as long; second and third short and subequal, together distinctly shorter than the first; fourth large, extending nearly to the apex of abdomen; fifth about as long as the first; following tergites concealed from above; stigmal vein short, less than half the length of postmarginal.

One specimen in the U. S. N. M., apparently the unique male type. Collected on the island of St. Vincent.

Rileya abnormicornis Ashmead.

Ashmeadia abnormicornis Ashmead, Journ. Linn. Soc. Lond. Zool. XXV, 1894, p. 145.

Male.—Differs from all other species in the antennae, the first four funicle joints each strongly narrowed at apex into a cylindrical neck which is nearly as long as the more or less spherical basal portion of the segment, the fifth funicle joint without a neck and rather closely joined to the club; otherwise appears to be a nearly typical *Rileya*. The head is fully three times as broad as long, the postocellar line twice the length of the ocelloocular, face below eyes strongly striated; antennal depression margined; carina on cheeks and behind the eye moderately distinct; propodeum with a distinct transverse carina which is angulated at the middle; abdominal petiole very short; first tergite rather large; second small; third reaching to the middle of abdomen, about twice as long as the second; fourth the largest tergite; fifth about equal in length to the exposed part of third; following concealed from above.

Female.—Unknown.

One male specimen in the U. S. N. M., apparently the unique type, collected on the island of St. Vincent, West Indies.

Rileya orbitalis Ashmead.

Rileya orbitalis Ashmead, Mem. Carnegie Mus I, 1904, p. 467.

Placed in key from the original description. Type, a female, in the collection of the Carnegie Museum, Pittsburgh, Pa. Type locality Santarem, Brazil.

Rileya gallicola Kieffer and Jörgensen.

Rileya gallicola Kieffer and Jörgensen, Centralb. Bakt. Paras. Insekt., Bd. 27, 1910, p. 437.

Placed in the key from the original description. Location of type unknown. Type locality, neighborhood of Mendoza, province of Mendoza, Argentina, South America.

Rileya albicornis Kieffer and Jörgensen.

Rileya albicornis Kieffer and Jörgensen, Centralb. Bakt. Paras. Insekt., Bd. 27, 1910, p. 367.

Placed in key from original description. Described from female, location of type unknown. Type locality, Province of Mendoza, Argentina, S. A.

Rileya tegularis, new species.

Female.—Length 2.2 mm. Head, viewed from above, fully three times as broad as long; middle of face finely sculptured, subopaque; sides of face with fine, close striae, which converge at clypeus, none of the striae extending upward much beyond the base of antennae; antennal groove margined at sides, open above and weakly sculptured within; rest of head finely rugulosely sculptured, opaque; a delicate but distinct carina separates the cheeks from the face and extends upward along the posterior eye margin, from which it is narrowly separated, to near the top of the eye where it joins the eye-margin; postocellar line about twice the ocellocular line; antennal scape not quite reaching the anterior ocellus, slightly thicker at base than apex; pedicel hardly one and one-half times as long as thick; first ring-joint narrower than the other two and approximately half as long as broad; second and third ring-joints strongly transverse; first funicle joint subquadrate, the following funicle joints slightly broader than long; thorax above sculptured like the occiput; dorsal aspect of pronotum as broad as and a little longer than the mesoscutum, rounded in front, its anterior margin with a very delicate marginal carina laterally but absent medially, the angle between the dorsal and lateral aspects of the pronotum rounded or at least not sharp and not margined; propodeum rugulose with a strong transverse carina which is sharply angulated at the middle, the apex of angle sometimes touching the anterior margin of propodeum; marginal vein about one-half the submarginal and about twice the postmarginal, the stigmal distinctly shorter than the postmarginal, abdomen about equal in length to the head and thorax, robust; first tergite (excluding the very short petiole) smooth, a little broader than long, and semicircular in outline; exposed portion of the second also smooth and not quite half as long as the first; third finely sculptured, its exposed margin about one and one-half times that of the second; fourth occupying most of the dorsum of abdomen and distinctly, finely sculptured; fifth tergite not longer than the second; and also sculptured; sixth about twice as long as the fifth and similarly sculptured; following tergites very short; tip of ovipositor barely visible from above. Black; antennal flagellum brownish, scape brownish black; spot on mandibles, apices of all femora, base and apex of median and hind tibiae, front tibiae almost entirely, all tarsi with the exception of claws, and the venation pale testaceous; median and hind tibiae broadly dark brownish medially; wings hyaline.

Male.—Length 2 mm. Agrees with description of female except as follows; antennal pedicel hardly longer than broad; marginal vein a little less than half the submarginal; abdomen petiolate, the petiole broader than long and distinctly sculptured; first tergite (not counting the petiole) nearly twice as broad as long down the middle, faintly sculptured; second less than half the length of first, distinctly sculptured; third reaching to the middle of abdomen and distinctly sculptured; about equal to the first

and second combined; fourth subequal in length to the third and similarly sculptured; fifth approximately one-half as long as the fourth and sculptured; following tergites mostly concealed from above. Color as in the female but with the tibiae less brownish medially and the middle and front femora barely stained with blackish at base.

Type locality.—Tempe, Arizona.
Type.—Cat. No. 21832 U. S. N. M.
Host.—*Asphondylia* sp.

Type, allotype and a large series of paratypes reared by V. L. Wildermuth from stem galls on *Pluchea borealis* and recorded under Tempe No. 2742. Also a large series from the same locality reared by Wildermuth from galls on *Suaeda* sp. under Tempe No. 2741.

The length of this species varies from 2 to 2.5 mm. and the color of the legs is also variable to some extent.

Rileya cecidomyiae Ashmead.

Rileya cecidomyiae Ashmead, Bul. 3, Kansas State Agri. College, 1888, p. 3, Appendix.

Female.—As represented by the female allotype, the head, as viewed from above is more than three times as broad as long, the postocellar line distinctly longer than the ocellocular line; face below the eyes distinctly striate with some of the striae extending upward along the eye-margin above the base of antennae; antennal depression distinctly margined; cheeks separated from face by a distinct carina which extends along the posterior eye-margin and narrowly separated from it nearly to the top of the eye; malar space equal to about twice the width of mandible, shorter than the eye; pronotum as long and as wide as the mesoscutum; propodeum with a distinct transverse carina which is curved forward but not sharply angulated medially, the area before this carina rugulose with some rather indefinite striae, the area behind the carina distinctly striated; first tergite nearly circular; exposed margin of second approximately one-third the length of first; third about twice the length of second; the three basal tergites together constituting about one-third the length of abdomen; fourth tergite large; fifth about equal to the third; following tergites short; ovipositor tip exposed.

Male.—Abdominal petiole about as long as broad, weakly sculptured above; first tergite beyond the petiole broader than long; second very narrow; third fully as long as the first and second combined and extending to the middle of abdomen; fourth somewhat longer than the third; fifth shorter than the first; following very short, practically concealed from above.

This species is represented in the National Museum by the allotype female and three paratypes of which one is a male; all from Jacksonville, Florida. The type is a male and is believed to be in the collection of the Kansas State Agricultural College at Manhattan, Kansas. This type has not been examined.

Rileya similaris, new species.

Female.—Length 2.25 mm. Differs from the description of *tegularis* as follows; the middle of face is slightly more shining, not quite as strongly sculptured; striations at sides of face slightly coarser; margination of antennal depression a little stronger; postocellar line a little less than twice the ocellocular line; pronotum with dorsal lateral margins sharply angulated and more or less distinctly carinately margined; scutellum with a rather distinct transverse ridge at, or a little behind, the apical one-third; propodeum rugose, with a transverse carina which is sharply angulated at the middle, the apex of angulation touching the basal margin of propodeum, the area before the transverse carina and lying between the median line and the spiracle with two more or less irregular longitudinal carinae, the area behind the transverse carina coarsely striated; postmarginal vein two-thirds the length of marginal and nearly twice as long as stigmal; three basal tergites (not counting the very short petiole) small; exposed margin of second tergite not more than one-third as long as the first; third fully twice as long as the second, its apex at about the basal one-third of abdomen; fourth large; tergites beyond the fourth together about equal in length to the first; tip of ovipositor exposed. Tegulae and scape pale reddish-testaceous; flagellum fuseo-testaceous; otherwise the color is like *tegularis* except that the trochanters are pale testaceous like the knees and tarsi and the tibiae are not conspicuously brownish medially.

Male.—Length 2.2 mm. Postocellar line twice as long as the ocellocular line; abdominal petiole broader than long and rugose above; first tergite (not counting the petiole) broader than long; second about one-third as long as the first; third about equal in length to the first and second combined and extending to the middle of abdomen; fourth equal to the second and third combined; fifth about equal to the first; following tergites concealed from above. Agrees with the female in other characters.

Type locality.—Brownsville, Texas.
Type.—Cat. No. 21833 U. S. N. M.
Host.—*Asphondylia* sp.

Type, allotype, and a large number of paratypes reared July 3–15, 1912, by E. G. Smyth from galls on the "Mimosa tree" (possibly *Leucaena pulverulenta* or *Mimosa lindheimeri*) and recorded in the Bureau of Entomology under Webster No. 6467, Exp. Nos. 1 and 2.

Rileya americana Girault.

Rileya americana Girault, Can. Ent. XLVIII, 1916, p. 339.

Female.—Slightly larger than any of the other known North American species and may be separated from any of the other species by the short postocellar line. The malar space is more than twice as long as the width of mandible; face below eyes coarsely striated, some of the striae extending upward along the inner eye-margin far above the base of antennae; carina separating cheeks from face strong and extending along the posterior eye-margin to the top of eye; propodeum with a strong transverse carina which is angulated at the middle, the area in front of this carina and between the median line and spiracle with two carinae which converge and meet at the anterior margin of propodeum; area behind the transverse carina coarsely striated; first tergite a little broader than long; second not quite half as long as the first and about half as long as the third; fourth longer than the first three combined; fifth, sixth, and seventh subequal to each other and each about as long as the first; abdomen acuminate at apex and considerably longer than the head and thorax; ovipositor exposed at tip.

Type and two paratype females in the U. S. N. M., Cat. No. 20323. The types of this species according to the Bureau of Entomology records under No. 5140° were reared Sept. 7, 1891, from a Cecidomyid gall on *Helenium autumnale* sent in by Mr. H. G. Barlow from Cadet, Missouri.

A NOTE ON THE ECONOMIC IMPORTANCE OF SAMIA CECROPIA (LEP.)

By C. N. Ainslie.

Very few of our working entomologists have escaped the infliction of having brought to them from time to time, among other rare things, finger worn specimens of Cecropia moths, believed by the enraptured finder to be something entirely new and valuable. Nearly all of our collectors are aware that this huge moth is fairly common in most localities of the northern states, and they also know that its habit of hiding among the tree tops during the day is most effective in protecting it from observation and capture.

Insect Life, Vol. I, p. 155, records an instance of the appearance of this species, *Samia cecropia*, in unusual and destructive numbers in Custer County, Nebraska, in 1888, but such cases seem to be uncommon. In a heavily timbered locality the larvae of the Cecropia may exist in large numbers and not be noticed unless

they happen to concentrate on a single tree or group of trees. Where trees are not numerous nor large there is less chance for concealment.

Last July, 1917, while investigating grasshopper conditions in western North Dakota, the writer visited one farm where a limited windbreak of small box elder trees had been planted not far from the house. The owner complained of the big worms he had picked from these trees, "by the pailful" he said, in order to scald them to death with boiling water. In the winter he had gathered and destroyed cocoons in large numbers. A short search disclosed several Cecropia moths hiding among the leaf clusters. Eggs were easily found on the leaves near by while numerous empty cocoons on the twigs witnessed to the past history of the insect in the grove. These trees had been more or less injured for several years past according to the farmer's story.

A few weeks later, in September, 1917, in the city of Dickinson, North Dakota, a place of less than 4000 inhabitants, I was informed that for two or three years the citizens had been waging war on this same moth. Some one or more of the Women's Clubs had awakened to the danger that threatened the trees of the city by reason of the attacks of great numbers of the Cecropia larvae and had come to the rescue by offering, at the outset, a cent each for the cocoons that were brought in.

The sharp-eyed boy mobilized at once and two years ago thousands of cocoons were gathered and destroyed. The discovery was made however by the committee of destruction that many of these cocoons contained only dead inmates, the worms having died after spinning the case, before pupation. Quite a percentage of the larvae were also victims of parasites and it was clearly poor policy to kill the enemies of these pests. Consequently last year it became the unpleasant duty of the members of the committee to snip off the end of each cocoon to ascertain the condition of the interior and so to eliminate the dead ones from the payroll. This greatly increased the labor of the undertaking but it saved money.

The financial burden of the battle became finally so onerous that the market price for cocoons sagged to half a cent apiece, but even at this small figure the boys made good money and the treasurer paid out nearly one hundred dollars during the winter of 1916–1917. A little computation gives one the remarkable figure of nearly 20,000 cocoons destroyed in a single year in spite of previous campaigns that were apparently drastic in their thoroughness.

The fight is still on in Dickinson and the small boys, and small girls as well, were in October, 1917, already beginning to collect and store their prizes for redemption when the usual offer for cocoons was again made public.

If the extermination of an injurious insect were ever possible, one would suppose the conditions in Dickinson are most favorable. The individuals of the pest are large, their range is limited by the scanty numbers of food trees in that region, while the annual campaign is profitable enough for those who participate to insure a careful scrutiny of every shrub in that entire district. The suggestion might be made that a substantial bounty paid for each female moth when she first appears might result in materially lessening the possibility of numerous larvae later, but one must remember that the moths are not as easily found as the cocoons.

A NOTE ON THE MUSCULAR COAT OF THE VENTRICULUS OF THE HONEY BEE (APIS MELLIFICA).

By G. F. White,

Bureau of Entomology.

While studying the pathology of Nosema-disease a fact of some anatomical interest in connection with the muscular coat of the ventriculus (stomach) of the adult honey bee was observed. Nosema-disease is an infectious disease among adult honey bees (*Apis mellifica*) caused by a protozoan parasite, *Nosema apis*. Entomologists generally are familiar with pebrine, an infectious disease among silkworms (*Bombyx mori*) caused by a protozoan parasite (*Nosema bombycis*) of the same genus.

In pebrine all of the organs of the insect, whether it be the larva, the pupa, or the imago, are invaded by the parasite. An examination of the tissues show that the hypodermis, tracheal epithelium and muscle fibers are usually very heavily invaded while the fat cells, the epithelium of the stomach and the cells of the reproductive system are also invaded although to a somewhat less extent as a rule. In Nosema-disease on the other hand only the adult bees are susceptible to infection and only the ventriculus and the Malpighian tubules are invaded by the parasite. The epithelium (fig. 1) of the stomach of the infected bee invariably contains the parasite while rarely are the cells of the Malpighian tubules invaded. This distribution of the germ in the Nosema-infected bees encouraged a somewhat careful study of the histology of the stomach.

The epithelium of the organ was found to be as it is generally described. Variations due to the age of the bee and the functional activity of the cells at the time the tissues are fixed are observed. *Nosema apis* gains entrance to the bee by way of the

alimentary tract. Having reached the stomach it grows, invades the epithelium and then multiplies rapidly and to an enormous extent. Never, however, has the germ been found beyond the basement membrane.

Outside the basement membrane (fig. 1, *bm*) is the muscular coat (*m*) comprised of three layers—the external of longitudinal, the middle of circular, and the inner of longitudinal fibers. Each muscular layer consists of a single layer of branched fibers. These fibers are separated from each other and therefore do not form a compact layer. The branching fibers form a network of anastomoses within each layer. Communications by branches exist between the outer and middle layers and between the in-

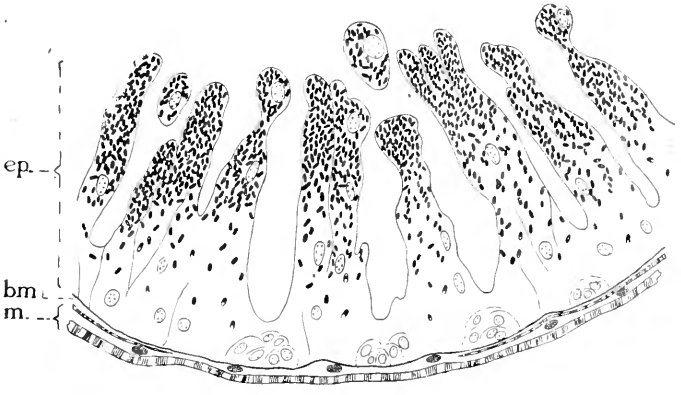

Fig. 1.—A longitudinal section of the ventriculus of the adult honey bee illustrating the three layers of the muscular coat (*m*). The spores of *Nosema apis* are shown in the epithelium.

ner and middle ones. Whether any such direct communication exists between the outer and inner layers has not been established. The diameter of the fibers of the outer and middle layer are about equal and their number per unit of area is approximately the same. The diameter of the fibers of the inner layer on the other hand is much less than of the other two while the number of fibers is much greater. The middle and inner layers follow the course and extent of the basement membrane while the fibers of the outer one bridge across the circular constrictions of the organ. Apparently the fibers of all three muscular layers are striated. While many of the preparations have not shown this character it is yet to be demonstrated whether the absence of striations are not due to the technique of fixation or staining.

Good results have been obtained by mercuric chloride fixatives and iron-hematoxylin stain.

The fact to which attention is specially called in the present communication is that the muscular coat of the ventriculus of the honey bee is comprised of three layers instead of two, the inner layer having been overlooked in the past. The writer is indebted to Prof. W. A. Riley who has examined preparations submitted to him and verified this observation. Naturally it will be of interest to learn whether this third layer is present also in the musculature of the ventriculus of other insects.

TWO NEW SPECIES OF THE BLATTID GENUS ARENIVAGA (ORTH.).

By A. N. Caudell,

Bureau of Entomology, United States Department of Agriculture, Washington, D. C.

While making a critical study of the concealed genital organs of the males of the material of the genus *Arenivaga* in the collection of the National Museum I detected five specimens from Arizona which possess characters proving them to be very surely distinct from *apacha*, the species with which they have been hitherto confused. This species is described below as *Arenivaga genitalis* n. sp. The studies which brought about the detection of this interesting form were undertaken for the purpose of determining the identity of some specimens belonging to this genus taken in Florida. The habitat of these Florida specimens lead me to expect they would prove to be undescribed and an examination of their structure proved this to be the case. They are therefore herein characterized as a new species under the specific name *floridensis*.

The concealed genital organs of the species of *Arenivaga* are easily brought into view by laying a fresh or relaxed specimen back downward on a piece of cork and with a sharp scalpel separating the subgenital plate for most its width from the preceding segment and laying it over to one side, holding it there till dry by a pin stuck into the cork. The sinistral plate bearing the genital hook should be partially raised and held back by a pin until dry.

Arenivaga genitalis n. sp.

Male.—Closely allied to and hitherto confused with *apacha* Sauss., from which species however it is easily distinguishable by the structure of the concealed genital organs. The subgenital plate is here, as in allied

forms, asymetrical, the right half being somewhat more prolonged than the left. Beneath this right half lies the dextral concealed genital plates, of which there are two, one above the other, while on the opposite side lies the sinistral plate with its slender genital hook. The inferior dextral plate is remarkably different in this new species from that of its near relative *apacha*. In *apacha* this plate is armed with a single sharp chitinized tooth as described by Hebard[1] but not very well represented in his figure. In the present species there is a similar chitinized spine and basad of this spine there is a completely chitinized projection as long as the spine and about as thick but with the apical part noticeably swollen and the tip rounded; just beneath this projection is an elevated ridge with a small tooth at the base of the projection, this ridge with the small tooth is not readily seen except on close and careful examination. In *apacha*, instead of a projection and elevated toothed ridge there is an unarmed, moderately chitinized and scarcely elevated ridge; the superior dextral plate of these two species differ almost as much as the inferior ones above described. In *apacha* this superior plate is broadly and roundly excavate on the inner edge, and at the base of this emargination are two elongate sharp completely chitinized teeth situated one above the other, the upper one directed backwards and seen only in completely dissected specimens, and the lower one directed diagonally downwards and generally clearly visible when the subgenital plate is laid aside. In *genitalis* this superior plate is shaped about as in *apacha* but at the base of the inner emargination is an apically rounded subclavate projection, vertically flattened, fully chitinized and with a triangular tooth on the inner surface, seen only upon careful examination; above this projection is a rounded chitinized shoulder, corresponding to the second acute spine in *apacha*. This upper dextral plate in both sexes extends backwards over the ventral plate and in the deeply concealed portions of the genitalia there are various chitinized ridges which are visible only when the organs are removed and dissected out, and in *apacha* there is a sharp, slender spine on one of these deep-lying chitinized portions that is apparently wanting in the new species now under discussion. The sinistral plate and genital hook are very similar in both species, as are also the cerci and supraanal and subgenital plates.

The interocular space of all specimens examined is subequal in width with the interocellar space, sometimes a very little greater, in this respect agreeing with *apacha*. The coloration is uniform in all specimens seen, being rather intensive in degree, the discal shield-shaped spot on the pronotal disk being very distinct and well defined. The size is generally somewhat smaller than in *apacha*, only one of the five specimens before me being as large as the smallest individual of *apacha* in the National Museum.

Female.—Unknown, or if specimens of this sex are in the collection they are apparently inseparable from allied forms.

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[1] Mem. Amer. Entom. Soc., No. 2, p. 237, pl. ix, fig. 14 (1917).

Measurements.—Male (type): length, pronotum, 3.6 mm.; tegmina, 13 mm.; width, pronotum, 5 mm.; tegmina, 5 mm.

Paratypes a, b and c are practically the same size as the type but paratype d is somewhat larger, measuring as follows: length, pronotum, 3.8 mm.; elytra, 14.5 mm.; width, pronotum, 6 mm.; elytra, 6 mm.

Type. Phoenix, Arizona, v-17, R. E. Kunze, coll.; paratype a, same locality and collector, date iv-15; paratype b, same, date, viii-5; paratype c, Higley, Arizona, June 18, 1917, E. G. Holt, collector, at light; paratype d, Catal. Spgs., Arizona, 7-4.

All material in Coll. U. S. Nat. Museum. Catalogue No. 21879. U. S. N. M.

Arenivaga floridensis n. sp.

Male.—In color the species is similar to an intensively colored *apacha*, nearly as blackish as the variety *infuscata* of that species, but the genital structure is more like that of *erratica*. The sinistral concealed plate and the genital hook are about as in *erratica* but the inferior dextral plate is more regular in shape than in that species, though agreeing with it in being unarmed; the superior dextral plate is shaped as in *erratica* and allies but instead of being armed at the base of the inner excavation with a sharp spine as in *erratica* and *apacha* it is there furnished with an elevated rounded ridge which, from an apical view, looks like a rounded subclavate projection, similar to that of *genitalis* described above, but from a lateral view appears to be the terminus of an elongate elevated ridge; the exact nature of this character and the structure further in behind it cannot be made out without complete dissection, which does not seem advisable with the unique male specimen. The interocular space is barely narrower than the interocellar space. The general color, as stated above, is very dark; the shield-shaped maculation on the pronotal disk is distinct and well defined, separated from the anterior and lateral edges of the disk by a wide yellowish margin and from the posterior edge by a narrow, partly infuscated margin. The general shape is decidedly less elongate than in any other member of the genus.

Female.—Shaped about as in *apacha* as figured by Hebard,[2] but the broadest part is more nearly the middle of the insect. Color almost black, the limbs and lower surface partially lighter; pronotum with the disk bordered somewhat broadly on the anterior and lateral margins with reddish yellow and in the allotype the meso- and metanotum are similarly margined laterally; the segments of the abdomen are marked laterally with a black spot as in *erratica* and in the allotype there are also some lighter lateral areas wholly or partially surrounding these black lateral spots.

[2] Mem. Amer. Ent. Soc., No. 2, pl. ix, fig. 16 (1917).

Measurements.—Length, pronotum, ♂ 4.25 mm.; ♀ 5 mm.; tegmina, ♂ 15 mm.; width, pronotum, ♂ 6.5 mm., ♀ 8 mm.; metanotum, ♀ 11 mm.; elytra, ♂ 6 mm.

Type, male, Dunedin, Florida, 4-10, 1915. W. S. Blatchley, collector: allotype, female, Auburndale, Florida, no date, N. R. Wood, collector; paratype a, female, same data as allotype.

Type and allotype in collection of U. S. National Museum; paratype in collection of W. S. Blatchley.

Catalogue No. 21880 U. S. N. M.

There is some evidence indicating specific value for the varieties of *Arenivaga bolliana* and *apacha* erected some years ago by the writer under the names *nigricans* and *infuscata*. In addition to the more intensive coloration *nigricans* is noticeably different from *bolliana*, as represented by material in the National Museum, it being decidedly less elongate in general dorsal outline. In *infuscata* the character, in addition to the blackish coloration, pointing to at least incipient specific distinctness, is the spine of the inferior dextral plate of the concealed genitalia of the male, which is scarcely more than one half as long as usual in *apacha*.

THE NORTH AMERICAN SPECIES OF THE SAWFLY GENUS LAURENTIA (HYM.)

By S. A. Rohwer,

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Until recently, when Enslin* treats it as a subgenus of *Rhogogaster*, Costa's genus *Laurentia* has been considered a synonym of *Tenthredopsis*. No North American species has ever been assigned to Costa's genus, but three of the species occurring in the western states described as *Tenthredo* by Cresson in 1880, belong there. Recently I had the opportunity to study the types of three species described by MacGillivray and assigned to two new genera, namely, *Astochus fletcheri*, *A. aldrichi*, and *Kincaidia ruficorna*. Dr. MacGillivray described these three species from as many specimens, and as these specimens show distinct differences it is not surprising that he considered them as distinct. The series of specimens in the collection of the National Museum, however, show that the venational characters chosen by Dr. MacGillivray to separate the genera *Astochus* and *Kincaidia* are subject to either or both individualistic or asymmetrical variation. The differences between *Astochus* and *Kincaidia*, as pointed out in the original descriptions, is in the presence or absence of the intercosta, recurrentella and intercubitella. Since these charac-

* Enslin, Deutsch. Ent. Zeit. Biheft, 1912, p. 91.

ters are variable and do not always assume the same combinations they cannot be considered of generic importance and as no other characters are known, the following synonymy is necessary:

Genus **Laurentia** A. Costa.

Laurentia, A. Costa, Rendic Accad. Sci. Fis. Napoli, vol. 4 (2), 1890, p. 193.
Syn. *Astochus*, MacGillivray, Can. Ent., vol. 46, 1914, p. 108.
Syn. *Kincaidia* MacGillivray, Can. Ent., vol. 46, 1914, p. 137.

The North American species belonging to this genus may be distinguished by the following key:

1. Entire insect mostly rufoferruginous.....*diluta* (Cresson).
— Head and thorax mostly black..... 2
2. Mesepisternum black.....*rubens* (Cresson).
— Mesepisternum with yellow spot..... 3
3. Scutellum black.....*edwardsii* var. *ruficorna* (MacGillivray).
— Scutellum yellow or partly so.*edwardsii* var. *edwardsii* (Cresson).

Laurentia edwardsii var. **edwardsii** (Cresson)

Tenthredo edwardsii Cresson, Trans. Amer. Ent. Soc., vol. 8, 1880, p. 24.

The nine specimens of this species in the Museum Collection came from the following localities: Sierra Nevadas Nevada County, California; Nevada; Easton, Washington; "Washington State;" and one from Kalso, British Columbia. Of these nine specimens, five have the intercosta present and on this character would be placed in *Astochus*. On the venation of the hind wings one of these five specimens belongs to *Kincaidia*, one to *Astochus*, while the other three have the intercubitella wanting in one wing but present in the other, with the recurrentellae present in both wings. Four of the specimens have the intercosta wanting and would be placed in *Kincaidia*. On the venation of the hind wings, two of these four specimens would belong to *Kincaidia*, one to *Astochus*, while the other has the intercubitella wanting in both wings with the recurrentella present in both. The series also varies considerably in color markings; no two specimens are marked exactly the same. The amount of yellow on the scutellum while somewhat variable, (Cresson says, "Scutellum more or less yellow") may be of varietal importance, and we can recognize, as a variety, the form to which Dr. MacGillivray has given the name *ruficorna*. The variation in color does not follow the variation in wing-venation. Only five of the specimens listed above belong to this variety. These five specimens come from Nevada; Sierra Nevadas, Nevada Co., Calif.

Laurentia edwardsii var. **ruficorna** (MacGillivray)

Tenthredopsis ruficorna MacGillivray, Can. Ent., vol. 25, 1893, p. 242.
Kincaidia ruficorna MacGillivray, Can. Ent vol. 46, 1914, p. 137.
Astochus fletcheri MacGillivray, Can. Ent., vol. 46, 1914, p. 108.

The color markings of the four specimens of this variety vary so that it seems necessary to propose the above synonymy. These four specimens come from "Washington State;" Easton, Washington; Kalso, British Columbia.

Laurentia diluta (Cresson)

Tenthredo diluta Cresson, Trans. Amer. Ent. Soc., vol. 8, 1880, p. 24.

This species is represented in the National Collection by only one specimen from Santa Cruza Mountains, California.

Laurentia rubens (Cresson)

Tenthredo rubens Cresson, Amer. Ent. Soc., vol. 8, 1880, p. 24.

Eight males and one female of this species from Nevada; Placer Co., Siskiyou Co., Santa Cruza Mountain, California; and Kalso, British Columbia, are in the National Collection. They show considerable variation in the amount of yellow on the clypeus and some of the specimens show some yellow on the scutellum. It is possible that some of these may be the males of *edwardsii*, but in the absence of proof it seems advisable to retain the name for the time being. This is also supported by the fact that there is one female in the lot. This female has the abdomen (beyond the propodeum) all rufous and except for the black mesepisternum might be considered as *ruficorna*. Furthermore, the species described as *aldrichi* by MacGillivray may be the female of some of the males in this series.

Laurentia aldrichi (MacGillivray)

Astochus aldrichi MacGillivray, Can. Ent., vol. 46, 1914, p. 137.

Except for the shape of the postocellar area and size there are no characters, in the original description, to distinguish this from *edwardsii* var. *rubcorna*. The female considered as *rubens* is about the right size for *aldrichi* but the mesepisternum is black and the postocellar area is without a median furrow. See also remarks under *Laurentia rubens*.

THREE HUNDRED AND SIXTEENTH MEETING, NOVEMBER 6, 1918

A NOTE ON THE HABIT OF PEGOMYIA AFFINIS STEIN AND OTHER ANTHOMYID GENERA.

BY CHARLES T. GREENE.

At Lyme, Conn., May 13, 1918, the writer was collecting in a field where there were numerous burrows of the common ground hog, Marmota. Numerous specimens of *Pegomyia affinis* Stein, a common fly of the family Anthomyidae, were found flying around the openings of these burrows. On investigation I found pupae in the loose earth which was thrown out around the burrow opening. A few days later the adults of this fly emerged. There were no traces of excrement or any decaying material in this loose earth that I could see.

The U. S. National Museum collection contains several specimens of this species labeled, "In dung in the den of Marmota," collected by Mr. H. S. Barber at Plummers Island, Md., June 15, 1911.

The larvae of Pegomyia are generally known to be leaf miners. The larvae of the family Anthomyidae are rather variable in their habits and it might be of interest to mention the habits of some of the other genera which are as follows: *Hydrotaea* in cow-dung and human excrement; *Ophyra* in human excrement, cow-dung and human graves; *Fannia* in human excrement, dead fresh-water shells, fruit and vegetables just beginning to decay; *Hyetodesia* in cow-dung; *Mydaea* was reared from nestlings of Spermophila sp. and nestlings of the nightingale; *Limnophora* in human excrement; *Anthomyia* in roots of cabbage and radish; *Hylemyia* in human excrement and in swelling on the wing of Picus striatus; *Hammomyia* is parasitic on bees; *Phorbia* is a root miner in cabbage, radish, cauliflower, turnip, winter cress, hedge mustard, celery, onion, beans, potatoes, corn, raspberry, young wheat plants, stems of Lupinus albus and human excrement; *Fucellia* in seaweeds and other refuse.

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NOTES ON, AND DESCRIPTIONS OF SAWFLIES BELONGING TO THE TENTHREDINID TRIBE HEMICHROINI (HYM.)

By S. A. Rohwer,

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The following paper is based on the collections of the U. S. National Museum, but it contains also some notes on the types of species in other collections. In presenting these descriptions of new species it has been considered advisable to give generic and specific keys; and to add a list of the species known from the Nearctic region. The writer wishes to express his indebtedness to Miss Margaret M. Fagan, for assistance in preparing the list of the species, and compiling references.

TRIBE HEMICHROINI ROHWER.

Hemichroini Rohwer, Proc. Ent. Soc. Wash., vol. 13, 1911, p. 225; Rohwer, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 238.

Hoplocampinae Rohwer, Proc. Ent. Soc. Wash. vol. 13, 1911, p. 220, 225; MacGillivray, Proc. U. S. Nat. Mus., vol. 29, 1906, MacGillivray, Bull. 22, Conn. Geol. Nat. Hist. Survey, 1917, p. 105.

Cladiinae MacGillivray, Proc. U. S. Nat. Mus., vol. 29, 1906, p. 635 (part); Bull. 22, Conn. Geol. Nat. Hist. Survey, 1917, p. 108 (part).

Hoplocampini Enslin, Deutsch, Ent. Zeitschr., 1914, Beiheft, p. 244 (part).

Hoplocampides Konow, Gen. Ins., fasc. 29, 1905, p. 71 (part).

Nematini Enslin, Deutsch. Ent. Zeitschr., 1915, Beiheft, p. 311 (part).

Nematides Konow, Gen. Ins., fasc. 29, 1905, p. 44 (part).

Other authors have placed undue stress on the value of the interradius and thus placed the genera here grouped together in the tribe Hemichroini in different subfamilies. According to the writer's opinion the presence or absence of the interradius, in all those groups in which the prepectus is present, can only be used as a generic character. MacGillivray has laid considerable stress on the formation of the two anal cells, and while this character is of great importance and is used by the writer to separate the tribe Hemichroini from the tribe Nematini, it is not of the

same value as the position of the basal vein. The position of the basal vein separates the subfamily Nematinae from the subfamily Cladiinae; and by using this character, the two subfamilies can not only be easily distinguished in the adult, but the species, which in the larvae are closely related, can be grouped together.

In the author's judgment, the genus *Hoplocampa* is not closely allied to the genera *Calirora*, *Phyllotoma*, and *Heptamelus* with which it is grouped by Enslin and Konow. These genera are readily separated from *Hoplocampa* in the adult by the absence of a prepectus. The habits and characters of the larvae are also quite different.

NEARTIC GENERA OF THE TRIBE HEMICHROINI.

This synopsis, while prepared especially for neartic forms, includes all the genera of the tribe Hemichroini known to occur in the world with the possible exception of the genus *Hoplocampoides* Enslin, which is known only from description and cannot well be included in the following synopsis.

1. Malar space wanting or nearly so; second recurrent received by the third cubital cell or interstitial with the second intercubitus.. 2
   Malar space large; head and thorax shining; second recurrent usually received by the second cubital cell..... 3
2. Tarsal claws cleft; head and thorax coarsely punctured; third and fourth antennal joints subequal; eyes subreniform; interradius wanting.....*Craterocercus* Rohwer
   Tarsal claws with an erect inner tooth near the middle; head and thorax shining, not coarsely punctured; third antennal joint longer than fourth; eyes elongate, oval; interradius wanting *Caulocampus* Rohwer
3. Second recurrent received by the third cubital....*Hoplocampa* Hartig
   Second recurrent received in the second cubital..... 4
4. Interradius present.....*Hemichora* Stephens
   Interradius wanting.....*Platycampus* Schiødte

Genus **Craterocercus** Rohwer

Craterocercus Rohwer, Proc. U. S. Nat. Mus., vol. 41, 1911, p. 385.

As far as known this genus is confined to the Neartic region. The following synopsis will aid in the identification of the species.

1. Females..... 2
   Males..... 7
2. Clypeus largely or entirely pale; abdomen with a pale band basally.. 3
   Clypeus black; abdomen black or without a well defined pale band basally..... 5

3. Middle fovea very shallow, nearly circular in outline; basal plates black ..... *phytophagicus* (Dyar)
   Middle fovea deep, rectangular in outline; basal plates pale 4
4. Supraclypeal area broad, gently convex; ocellar basin broader than long, the lower wall rounded; stigma truncate
   albidovariatus (Norton)
   Supraclypeal area narrow, strongly ridged; ocellar basin longer than broad, the lower wall rather sharply defined; stigma oblique
   floridanus Rohwer
5. Head and scutellum smooth, shining; antennae rather slender reaching beyond the apex of the scutellum; small species
   californicus Rohwer
   Head and scutellum opaque, with distinct sculpture; antennae stout, not reaching beyond the apex of the scutellum 6
6. Middle fovea elongate breaking through the frontal crest; prescutum black; tergum black ..... *fraternalis* (Norton)
   Middle fovea shorter, not breaking through the frontal crest; prescutum rufous; tergum suffused with ferruginous basally
   quercivorus Rohwer
7. Abdomen with a pale band dorsally 8
   Abdomen black 9
8. Postocellar furrow straight; no oblique impression behind the lateral ocelli; postocellar area gently convex, four times as wide as long ..... *floridanus* Rohwer
   Postocellar furrow angulate medianly; an oblique impression behind each lateral ocellus; postocellar area convex parted by a median impression, three times as wide as long
   albidovariatus (Norton)
9. Middle fovea breaking through the frontal crest; postocellar area convex, with a median impression, about three times as wide as long ..... *fraternalis* (Norton)
   Middle fovea not breaking through the frontal crest; postocellar area flat, without a median impression, about four times as wide as long ..... *quercivorus* Rohwer

Craterocercus fraternalis (Norton)

Hemichroa fraternalis Norton Trans. Amer. Ent. Soc., vol. 4, 1872, p. 811.
Craterocercus fraternalis Rohwer, Proc. U. S. Nat. Mus., vol. 41, 1911, p. 385.

Type.—Probably in collection Academy Natural Science, Philadelphia. Specimen subsequently determined by Cresson in Coll. U. S. Nat. Mus.

Distribution.—Texas.

As far as known the species as here restricted occurs only in Texas. The species which has been previously confused with

this one is here described as a new species (see *quercivorus*). The female of this species characterized in the above key was collected in Texas by Belfrage and is in the Museum Collection.

Craterocercus quercivorus, new species.

"*F*" Dyar, Can. Ent., vol. 27, 1895, p. 339.

Hemichroa fraternalis Norton: Dyar, Journ. N. Y. Ent. Soc., vol. 6, 1898, p. 124; MacGillivray, Conn. Geol. and Nat. Hist. Survey, Bull. 22, 1917, p. 106.

MacGillivray treats this as a species of *Hemichroa*, but it belongs more properly to the genus *Craterocercus* as the separation of the genera *Craterocercus* and *Hemichroa* given by MacGillivray (Bull. 22, Conn. Geol. Nat. Hist. Survey, 1917, p. 105), is based on a character subject to individual variation. In some specimens of this species the characters treated as generic, by MacGillivray, vary in the same specimen.

Besides in the characters mentioned in the above table, this species differs from *fraternalis* by the rufous mark on the upper part of the mesepisternum. It has been previously confused with *fraternalis* Norton as the above references will show.

Female.—Length 8 mm. Clypeus shining, deeply subangulately emarginate, the lobes narrow and triangular in outline; supraclypeal area narrow, strongly convex, almost keel-like; middle fovea oval, not breaking through the frontal crest; frontal foveae large, confluent with the antennal foveae; ocellar basin wider than eye, well defined, trapezoidal in outline, open above; an oblique impression behind each lateral ocellus; postocellar area flat, well defined, slightly more than three times as wide as long; third and fourth antennal joints subequal; stigma three and one-half times as long as its greatest width, gradually tapering from the base to the apex; sheath broad, straight above, obtusely rounded at the apex, tapering to a broad base. Black; pronotum, trochanters and knees white; prescutum, mesepisternum dorsally and legs except where mentioned, rufo-ferruginous; abdomen piceous with the tergum, basally, and all of the sternum suffused with ferruginous; wings hyaline, iridescent, venation dark brown, costa and stigma ferruginous.

Male.—Length 5 mm.; length of antennae 4.25 mm. Structural characters given in the above description apply well to this sex. Black; pronotum and tegulae white; legs below the trochanters except the infuscated bases of the femora yellowish white; wings hyaline, venation dark brown, costa and stigma pale brown.

Type-Locality.—Bronx Park, New York City, New York. Described from one female and four males (one allotype) reared from larvae collected on *Quercus alba*, May 22, 1897, by H. G. Dyar,

and recorded under his No. F. A. Two female paratypes reared from larvae collected on *Quercus alba* at Pelham Bay Park, New York, May 18, 1897, by Dr. H. C. Dyar. The larvae referred to as "F" by Dr. Dyar in the Can. Ent., 1895, were not reared; they were collected June 4, 1895, at Franklin Park, New York.

Type.—Cat. No. 21702, U. S. Nat. Mus.

(**Craterocercus**) **Priophorus infuscatus** MacGillivray.

Craterocercus infuscatus MacGillivray, Bull. 22, Conn. Geol. Nat. Hist. Survey, 1917, p. 106.

I can find no other reference for this species, and here it is only tabulated in connection with other species; and no locality or sex is given. Examination of the type female, in October 1918 convinced me that the species belongs to the subfamily Cladiinae and to the genus *Priophorus*.

Genus **Caulocampus** Rohwer.

The type species of this genus is treated by MacGillivray as a species of the genus *Priophorus*. According to the writer's opinion, *acericaulis* does not even belong in the same subfamily as does *Priophorus*. The characters of both the adult and the larva point out subfamily differences between *Caulocampus* and *Priophorus*. Only one species is known.

Caulocampus acericaulis (MacGillivray).

Priophorus acericaulis MacGillivray, Can. Ent. vol. 38, 1906, p. 306.
Caulicampus acericaulis Rohwer, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 240.

Paratype.—Cat. No. 14594, U. S. Nat. Mus.
Distribution.—New Haven, Connecticut.

Genus **Hopoclampa** Hartig.

This genus is divisible into two subgenera as follows:

Malar space as great or greater than the width of the mandible at base; eyes short, scarcely twice as long as wide; ocelli in a low triangle ..... *MacGillivrayella* Ashmead

Malar space comparatively narrow, never as great as the width of the mandible at the base; eyes elongate, nearly three times as long as wide; ocelli in a curved line ..... *Hoplocampa* Hartig

Subgenus **MacGillivrayella** Ashmead.

Macgillivraya Ashmead, Can. Ent. vol. 30, 1898, p. 257.
Macgillivrayella Ashmead: Smith, Cat. Ins. N. J., 1899, p. 606; Rohwer, Can. Ent., vol. 42, 1910, p. 242, 244.

Species of this subgenus are confined to the Nearctic region.

Macgillivrayella lacteipennis Rohwer.

Macgillivrayella lacteipennis Rohwer, Can. Ent., vol. 42, 1910, p. 244.

Type.—Cat. No. 12843, U. S. Nat. Mus.
Distribution.—Massachusetts.

Macgillivrayella oregonensis (Ashmead).

Macgillivraya oregonensis Ashmead, Can. Ent., vol. 30, 1898, p. 257.
Macgillivrayella oregonensis Ashmead: Smith, Cat., Ins. N. J., 1899, p. 606; Rohwer, Can. Ent., vol. 42, 1910, p. 243.

Type.—Cat. No. 12841, U. S. Nat. Mus.
Distribution.—Mt. Hood, Oregon.

Macgillivrayella pallida Rohwer.

Macgillivrayella pallida Rohwer, Bur. Ent. Techn. Ser. 20, pt. 4, 1911, p. 141.

Type.—Cat. No. 13469, U. S. Nat. Mus.
Distribution.—Michigan.

Macgillivrayella xanthura Rohwer.

Macgillivrayella xanthura Rohwer, Can. Ent., vol. 42, 1910, p. 244.

Type.—Cat. No. 12842, U. S. Nat. Mus.
Distribution.—Montana.

Subgenus **Hoplocampa** Hartig.

Hoplocampa Hartig, Fam. Blattw. Holzwestp., 1837, p. 276.

The Nearctic species of this subgenus were treated in considerable detail in a paper in the Techn. Ser., Bur. Ent., 20 pt. 4, 1911. The following Nearctic species have been wrongly referred to this genus: *atriceps* Kirby (= *Stronglogaster uncus* Norton); *canadensis* Provancher (= *Macrophya*). Following is a list of the North American species:

Hoplocampa alpestris Rohwer.

Hoplocampa alpestris Rohwer, Bur. Ent. Techn. Ser. 20, pt. 4, 1911, p. 142.

Type.—Cat. No. 13474, U. S. Nat. Mus.
Distribution.—Veta Pass, Colorado.

Hoplocampa bioculata Rohwer.

Hoplocampa bioculata Rohwer, Can. Ent., vol. 40, 1908, p. 179; Konow, Gen. Ins., fasc. 29, 1905, p. 75; Rohwer, Bur. Ent. Techn. Ser. 20, pt. 4, 1911, p. 146.

Type and one *paratype*.—Cat. No. 13470, U. S. Nat. Mus. Paratype in collection Colorado Agricultural College.
Distribution.—Colorado, Oregon and Washington. For detail localities see literature, all of these localities are in the transition life zone.

Hoplocampa cookei (Clarke).

Dolerus cookei Clarke, Can. Ent., vol. 38, 1906, p. 351.
Hoplocampa californica Rohwer, U. S. D. A. Techn. Ser. 20, pt. 4, 1911, p. 143.
Hoplocampa cookei Rohwer, Ent. News, vol. 23, 1912, p. 472; Foster, Bur. Ent. Bull. 116, pt. 3, 1913; Essig, Mo. Bull. Sta. Comm. Hort. Calif., 1914, p. 31.

Type.—Type of *Dolerus cookei* Clarke destroyed in San Francisco fire. Type of *H. californica* Rohwer, Cat. No. 13471, U. S. Nat. Mus.
Distribution.—California and Oregon.

Hoplocampa flavicornis (Provancher).

Selandria flavicornis Provancher, Natural. Can. vol. 10, 1878, p. 100.

Type.—Public Museum Quebec, bearing yellow label 60 and name label "Selandria halcion Harris" on the other side of which is written "Selandria flavicornis Prov."
Provancher considered this the male of *halycon* but from notes on the type I am more inclined to believe that it may be the male of *xantha* Rohwer. It is, however, impossible to be sure because of the difference in the sexes and it is advisable to consider the two as separate until more evidence is available. The following notes on Provancher's type may be useful.

Stigma broader near base tapering to an acute apex; interradius leaving stigma near apex and joining the third cubital about the length of the third intercubitus from the apex; third cubital cell longer on the radius than the first and second; hypopygidium rather broadly truncate with angles rounded; clypens arcuately emarginate, lobes broadly rounded; middle fovea rather large walls sloping rectangular in outline; ocellar basin poorly

indicated, except opposite the anterior ocellus, hexagonal in outline, open above.

This species is a true *Hoplocampa*.

Hoplocampa halcyon (Harris) Norton.

Hoplocampa halcyon Harris: Norton, Proc. Bost. Soc. Nat. Hist., vol. 8, 1961, p. 222.

Hoplocampa halcyon Dalla Torre, Cat. Hym., I, 1894, p. 189. Konow, Gen. Ins., fasc., 29, 1905, p. 75. Rohwer, U. S. D. A. Techn. Ser. 20, pt. 4, 1911, p. 145.

Type.—Academy Natural Science, Philadelphia.

Distribution.—New York, New Jersey, Maine, Massachusetts, Maryland, District of Columbia, Virginia and Eastern Canada. For detailed localities see literature.

Host.—*Amelanchier canadensis*. Wm. Middleton has secured the egg and larva of this species at East Falls Church, Va. Its habits are similar to those of *H. cookei*.

Hoplocampa koebelei Rohwer

Hoplocampa koebelei Rohwer, U. S. D. A. Techn. Ser. 20, pt. 4, 1911, p. 142, pl. 23, f. 6; pl. 24, f. 3.

Type.—Cat. No. 13472, U. S. Nat. Mus.

Distribution.—Oregon.

Hoplocampa marlatti Rohwer.

Hoplocampa marlatti Rohwer, U. S. D. A. Techn. Ser. 20, pt. 4, 1911, p. 143, pl. 24, f. 7.

Type.—Cat. No. 13477, U. S. Nat. Mus.

Distribution.—Riley County, Kansas; Baldwin, Kansas.

Hoplocampa montanacola Rohwer.

Hoplocampa montanacola Rohwer, U. S. D. Techn. Ser. 20, pt. 4, 1911, p. 145, pl. 23, f. 4; pl. 25, f. 3; pl. 24, f. 6; pl. 26, f. 3.

Type.—Cat. No. 13476. U. S. Nat. Mus.

Distribution.—Montana.

Hoplocampa nevadensis Rohwer.

Hoplocampa nevadensis Rohwer, U. S. D. A. Techn. Ser. 20, pt. 4, 1911, p. 143, pl. 23, f. 10; pl. 24, f. 4; pl. 25, f. 4.

Type.—Cat. No. 13475, U. S. Nat. Mus.

Distribution.—Nevada.

Hoplocampa occidentalis Rohwer.

Hoplocampa occidentalis Rohwer, U. S. D. A. Techn. Ser. 20, pt. 4, 1911, p. 144, pl. 24, f. 8; pl. 25, f. 5.

Type.—Cat. No. 13479, U. S. Nat. Mus.
Distribution.—Colorado; Oregon; Placer Co., California.

Hoplocampa orbitalis Rohwer.

Hoplocampa orbitalis Rohwer, U. S. D. A. Techn. Ser. 20, pt. 4, 1911, p. 141, pl. 23, f. 3; pl. 24, f. 10.

Type.—Cat. No. 13472, U. S. Nat. Mus.
Distribution.—Montana.

Hoplocampa pallipes MacGillivray.

Hoplocampa pallipes MacGillivray, Can. Ent., vol. 25, 1893, p. 239. Konow Gen. Ins., fasc. 29, 1905, p. 75.

Type.—Cornell University.
Distribution.—Skokomish River, Washington.

Hopolocampa xantha Rohwer.

Hoplocampa xantha Rohwer, U. S. D. A. Techn. Ser. 20, pt. 4, 1911, p. 144, pl. 23, f. 9; pl. 24, f. 1.

Type.—Cat. No. 13478, U. S. Nat. Mus.
Distribution.—Ottawa, Canada.

Genus **Hemichroa** Stephens.

This genus is divisible into two groups which have been given generic names. They may be separated as follows:

Tarsal claws simple ..... *Marlattia* Ashmead
Tarsal claws cleft ..... *Hemichroa* Stephens

Subgenus **Marlattia** Ashmead.

Marlattia Ashmead, Can. Ent., vol. 30, 1898, p. 287.
Marlattia Rohwer, Bur. Ent. Techn. Ser., 20, part, 2, 1911, p. 108.

This subgenus includes only the type which was described as *Hemichroa laricis* by Marlatt. The species *erythrothorax* which was originally described in this subgenus belongs to the genus *Dineuridea* Rohwer.

Marlattia laricis (Marlatt).

Hemichroa laricis Marlatt, Can. Ent., vol. 28, 1896, p. 257; Dyar, Jn. N. Y. Ent. Soc., vol. 5, 1897, p. 28.

Type.—Cat. No. 3480 U. S. Nat. Mus.

Distribution.—Known only from the unique female type which was reared from larvae collected on larch at Jefferson, New Hampshire.

Subgenus **Hemichroa** Stephens.

Hemichroa Stephens, Illustr. Britt. Ent., Mandib., vol. 7, 1835, p. 55, no. 18.

Enages Gistel, Naturg. d. Thierreichs, 1848, p. IX.
Leptocercus Thomson, Hym. Scand., vol. 1, 1871, p. 76.
Leptocerca Hartig, Fam. Blattw., Holzwestp., 1837, p. 228.

Key to the Nearactic Species of the Subgenus.

1. Females 2
   Males 4
2. Nervulus in the middle of the discoidal cell; third cubital cell but little longer than its apical width; "spot at apex of the posterior femora black" ..... *pallida* (Ashmead)
   Nervulus distinctly beyond the middle of the discoidal cell; third cubital much longer than its apical width; posterior femora black 3
3. Middle fovea small, deep, circular, with shallow lateral impressions which extend above the antennal foveae; clypeus with a rather narrow, deep, arcuate emargination, the lobes broadly rounded apically; second recurrent much before the second intercubitus ..... *americana* (Provancher)
   Middle fovea broad, shallow, without lateral impression; clypeus with a deep, subangulate emargination, lobes triangular in outline; second recurrent close to the second intercubitus *dyari* Rohwer
4. Middle fovea broad, shallow; apex of the hind tibiae and all of their tarsi black ..... *dyari* Rohwer
   Middle fovea narrow, elongate, deep; tibiae and tarsi uniformly pale ..... *pallida* (Ashmead)

Hemichroa americana (Provancher).

Dineura americana Provancher, Nat. Canad., vol. 13, 1882, p. 292.
Hemichroa americana Konow, Gen., Ins., fasc. 29, 1905, p. 49.

Type.—One female bearing yellow label 639 Public Museum Quebec.

Notes taken from type and a study of a homotype from New England. The larvae described by Dyar under this name belong to a different species which is described below (see *dyari*, new species).

Hemichroa dyari, new species.

Hemichroa americana (Provancher); Dyar, Can. Ent., vol. 25, 1893, p. 244; Can. Ent., vol. 27, 1895, p. 340; MacGillivray, Bull. 22, Conn. Geol. and Nat. Hist. Survey, 1917, p. 106 (at least, in part).

This species has been referred to in literature under the name *americana* Provancher, but may be easily separated from that species by the characters given in the above table.

Female.—Length 5.5 mm.; length of antennae 4 mm. Clypeus deeply subangulately emarginate, the lobes triangular in outline; supraclypeal area strongly convex; middle fovea large, shallow, more or less circular in outline; frontal foveae deep, elongate; ocellar basin sharply defined; nearly triangular in outline; antennal furrows interrupted above the frontal foveae; postocellar area strongly convex, well defined, but little wider than long; third antennal joint slightly longer than the fourth; stigma about three times as broad as long, regularly rounded below; nervulus received by the discoidal cell distinctly beyond the middle; sheath straight above, truncate apically, tapering to a broad base. Rufo-ferruginous; antennae, apical margin of the clypeus, most of the mesosternum, the metathorax dorsally, the four posterior femora, the apices of all the tibiae and all the tarsi black; wings brownish, venation pale brown.

Male.—Length 5 mm.; length of the antennae 4 mm. Agrees with the structural characters given for the female. Black; legs beyond the trochanters except the apices of the posterior tibiae and all the posterior tarsi, ferruginous; wings brownish, venation pale brown.

Type-Locality.—Woods Hole, Massachusetts. Described from three females and three males reared from larvae collected on *Alnus*, July 8, 1893, by H. G. Dyar, for whom the species is named.

Type.—Cat. No. 21701, U. S. Nat. Mus.

Hemichroa pallida (Ashmead).

Dineura pallida Ashmead, Bull. 1, Colo. Biol. Assoc., 1890, p. 15.

Type.—Cat. No. 9874, U. S. Nat. Mus.

The type of this species is very badly broken, only antennae and wings remaining. The above key points out the characters which should separate this from the other females.

The males here referred to *pallida* show the usual antigeny. The color of the legs is paler than in the male of *dyari*, and this is also true in the female.

Male.—Length 5 mm.; length of the antennae nearly 5 mm. Clypeus deeply, subangulately emarginate, the lobes broad and triangular in outline; supraclypeal area sharply convex; middle fovea deep, elongate; frontal

foveae elongate, narrower below; ocellar basin pentagonal in outline, but the lower wall nearly obsolete; antennal furrows interrupted above the frontal foveae; postocellar area sharply defined, uniformly convex, but little wider than long; third and fourth antennal joints subequal; stigma about three times as long as its greatest width, regularly rounded below; nervulus received in the middle of the discoidal cell. Black; palpi and tegulae, whitish; legs below the coxae pale ferruginous; sides of the tergites 3, 4, and 5, and most of the sternites with ferruginous spots; wings subhyaline, venation dark brown.

The above description is taken from a number of males collected at Boulder, Colorado, May 22, 1907, by S. A. Rohwer, in the foliage of *Alnus tenuifolia*, *Populus angustifolia*, and *Salix luteosericea*.

Genus **Platycampus** Schiødte.

This genus is divided into two subgenera on the dentation of the claws.

Tarsal claws simple.....*Anoplonyx* Marlatt
Tarsal claws with an inner tooth.....*Platycampus* Schiødte

Subgenus **Platycampus** Schiødte.

Platycampus Schiødte, Mag. Zool., vol. 19, 1839, p. 20 (footnote).
Camponiscus Newman, Ent., vol. 4, 1869, p. 215.
Erasminus Gistel, Naturg. d. Thierreichs 1848, p. IX.
Leptopus Hartig, Fam. Blatt. Holzwesp., 1837, p. 104, (non Latreille, 1809).

Four species of the genus *Platycampus* are known to occur in the Nearctic region:

Platycampus albostigmus (Rohwer).

Camponiscus albostigmus Rohwer, Journ. N. Y. Ent. Soc, vol. 16, 1908, p. 105.

Type.—University of Nebraska.
Distribution.—Ute Creek, Costilla County, Colorado.

Platycampus americanus (Marlatt).

Camponiscus americanus Marlatt, Can. Ent., vol. 28, 1896, p. 251; Dyar, Journ. N. Y. Ent. Soc., vol. 5, 1897, p. 24.

Type.—Cat. No. 3471, U. S. Nat. Mus.
Distribution—Jefferson, New Hampshire. Type material reared from larvae collected on poplar by H. G. Dyar.

Platycampus juniperi Rohwer.

Platycampus juniperi Rohwer, Proc. U. S. Nat. Mus., vol. 41, 1901 p. 386.

Type.—Cat. No. 13994, U. S. Nat. Mus.
Distribution.—Los Vegas, Hot Springs, New Mexico. Larvae on Juniper.

Platycampus smithi (Rohwer).

Camponiscus smithi Rohwer, Journ., N. Y. Ent. Soc., vol. 16, 1908, p. 105.

Type.—University of Nebraska.
Distribution.—Ute Creek, Costilla County, Colorado.

Subgenus **Anoplonyx** Marlatt.

Anoplonyx Marlatt, Bur. Ent., Techn. Ser., 3, 1896, p. 18.
Only one species of this genus is known to occur in the Nearctic region.

Anoplonyx canadensis Harrington.

Anoplonyx canadensis Harrington, Can. Ent., vol. 34, 1902, p. 94.

Type.—Harrington Collection.
Distribution.—Ottawa, Canada.

CHRYSOBOTHRIS TRANQUEBARICA GMEL. VERSUS IMPRESSA FABR. (COLEOPTERA; BUPRESTIDAE)

By W. S. Fisher,

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There has been more or less confusion in the use of the names *impressa* Fabr. and *tranquebarica* Gmel. for a species of *Chrysobothris* found in the southern part of Florida. This species has been rarely collected in the United States until a few years ago, when it was found attacking the so called Australian Pine (*Casuarina equisetifolia* Forster) which has been planted extensively, for ornamental and shade purposes in some parts of that state, and has become quite an enemy of that tree in the section where it is planted by the realty companies. As this insect will figure considerably in the economic literature in the future, the following notes are given in regard to the origin of the names used and may clear away some of the confusion, especially to those who do not have access to the literature.

In 1775 Fabricius (Syst. Ent., p. 220) described the species *Buprestis impressa* from "Indiis" and in 1787 (Mant. Ins., Tom. I, p. 182) under the same name described a species from "Tranquebariae." Gmelin (1788, Syst. Nat., Tom. I, Pars. IV, p. 1932) proposed a new name *tranquebarica* for the species described in 1787 by Fabricius. Two years later, Olivier (1790, Enc. Method., Tom. V, p. 232) proposed a new name *excavata* for the same species and this name was used by Fabricius in all his later works. Fabricius and Olivier, either did not see the work by Gmelin, or would not use his name, as the name *tranquebarica* was not used by either of these writers in their works. Mannerheim in 1837 (Bull. Soc. Imp. Nat. Moscou, vol. X, No. 8, p. 75) described *Chrysobothris fraterna* from Porto Rico and (l. c. p. 74) *C. rugosa* from an unknown locality. The following year, 1838, Castlenau & Gory (Mon.B upr., vol. 2, Gen. *Chrysobothris*, p. 46, plt. 8, fig. 62) describe *denticulata* from Guadeloupe and give an excellent figure of the species, which is the species found in Florida, but (l.c. addenta p. 7) place it as a synonym of *fraterna* Mann. Gory in 1841 (Mon. Bupr. Suppl. vol. 4, p. 178, plt. XXX, fig. 173) describes *denticollis*. Horn in his Monograph of the *Chrysobothris* inhabiting the United States (1886, Trans. Amer. Ent. Soc., vol. XIII, p. 109, 121) reports this species for the first time from the United States under the name *impressa* Fabr. and in a footnote gives the following: "The name *impressa* has been used, although it was preoccupied by Fabricius himself. Later Gmelin changed the name to *tranquebarica*, and two years after Olivier proposed the name *excavata*. In accordance with the strictest rules the name proposed by Gmelin should be adopted, although it conveys an erroneous idea of habitat. Inasmuch as the first *impressa* proposed by Fabricius is now placed in *Halecia*, it might be as well to allow the *Chrysobothris* to retain the name proposed for it. It is better at times, to violate the law of priority than perpetuate an annoyance." Kerremans (1904, Gen. Ins., Fasc. 12, p. 186) places the *impressa* described by Fabricius in 1775 in the genus *Halecia*, retaining the *impressa* described by Fabricius in 1787 in the genus *Chrysobothris*, placing *tranquebarica* Gmel., *excavata* Oliv., *rugosa* Mann., *denticulata* Cast. & Gory, and *denticollis* Gory as synonyms of that species, but as this *impressa* is a homonym, and according to the present nomenclatural ruling, cannot be used again, we must use the name *tranquebarica* proposed by Gmelin for the species found in Florida and the West Indies.

Olivier in 1790 (Ent. II, Gen. 32, p. 44, plt. 5, fig. 42) figured what he supposed was the *impressa* described by Fabricius in 1775, giving the habitat as South America, and Herbst (1801, Coleopt. T. 9, p. 233, plt. 150, fig. 4) figures the same species,

while in 1838, Castlenau & Gory (Mon. Bupr., vol. 2, Gen. *Colobogaster*, p. 9, plt. 2, fig. 7) figure the same species, saying it is not the species described by Fabricius in 1775, as *impressa*, but his *Buprestis sex-punctata* described (1801, Syst. Eleuth. Tom. II, p. 206) from South America. This is also followed by Waterhouse (1887, Biol. Centr.-Amer. vol. 3, pt. 1, p. 35) and Kerremans (1903, Gen. Ins., Fasc. 12, p. 184).

There seems to be considerable confusion in the habitat given for these species, as Fabricius described his *impressa* (1775) from "Indiis," which is not India, but may refer to either the East or West Indies. Gmelin (1788) credits it to South America and India, while Fabricius in his later works gives India for the same specimen that he described from "Indiis," but Castlenau & Gory, Kerremans, and Gemminger & Harold, give South America as the locality. The *impressa* described in 1787 by Fabricius and changed to *tranquebarica* by Gmelin, was described from a specimen from Tranquebar, a seaport of British India, and it is just probable, that this specimen was labeled incorrectly, for in those days collections were made in different parts of the country and often all labeled from the same locality. The citations made by Fabricius, Olivier and Gmelin are all from the same specimen. *Chrysobothris fraterna* Mann., and *denticulata* Cast. & Gory which are considered as synonyms of *tranquebarica* were described from the West Indies.

From the above notes it seems that the range of distribution of *Chrysobothris tranquebarica* Gmel. is confined to the West Indies and extreme southern part of Florida. *Chrysobothris impressa* Fabr. (now in the genus *Halecia*) to South America, while *Chrysobothris sex-punctata* Fabr., is found in Central and South America.

The bibliography and synonymy should stand as follows:

Chrysobothris impressa Fabr.

Buprestis impressa, 1775, Fab. Syst. Ent., p. 220, no. 19. Indiis.

Buprestis impressa, 1781, Fabr. Spec. Ins., p. 277, no. 27. Indiis.

Buprestis impressa, 1787, Fabr. Mant. Ins., Tom. I, p. 179, no. 19. Indiis.

Buprestis impressa, 1788, Gmelin, Syst. Nat., Tom. I, Pars. IV, p. 1931, no. 63. India and South America.

Buprestis impressa, 1792, Fabr. Ent. Syst., Tom. I, Pars. II, p. 200, no. 58. India.

Buprestis impressa, 1801, Fabr. Syst. Eleuth., Tom. II, p. 198, no. 70. India.

Buprestis impressa, 1817, Schönherr, Syn. Ins., Band I, Pars. 3, p 235, no. 114. India.

Colobogaster impressa, 1838, Cast. & Gory, Mon. Bupr., Vol. 2, Gen. Colobogaster, p. 14, plt. 3, fig. 14, addenda p. 6. Surinam.

Colobogaster impressa, 1869, Gem. & Har., Cat. Col., Tom. V, p. 1422. (Part). Surinam.

Halecia impressa, 1902, Kerremans, Gen. Ins., Fasc. 12, p. 70. Brazil.

Chrysobothris tranquebarica mel.

Buprestis impressa, 1787, Fabr. Mant. Ins., Tom. I, p. 182, no. 61. Tranquebar.

Buprestis tranquebarica, 1788, Gmel. Syst. Nat. Tom. I, Pars. IV, p. 1932, no. 74. Tranquebar.

Buprestis excavata, 1790, Oliv. Enc. Method., Tom. V, p. 232, no. 95. Tranquebar.

Buprestis excavata, 1792, Fabr. Ent. Syst., Tom. I, Pars. II, p. 206, no. 84. Tranquebar.

Buprestis excavata, 1801, Fabr. Syst. Eleuth., Tom. II. p. 205, no. 105. Tranquebar.

Chrysobothris fraterna, 1837, Mann. Bull. Soc. Imp. Nat. Moscou, X, No. 8, p. 75. Porto Rico.

Chrysobothris rugosa, 1837, Mann. Bull. Soc. Imp. Nat. Moscou, X, No. 8, p. 74. Locality Unknown.

Chrysobothris denticulata, 1838, Cast, Gory, Mon. Bupr., vol. 2, Gen. Chrysobothris, p. 46, plt. 8, fig. 62. Guadeloupe.

Chrysobothris denticollis, 1841, Gory, Mon. Bupr. Suppl., vol. 4, p. 178, plt. 30, fig. 173.

Chrysobothris impressa, 1867, Chev. Ann. Soc. Ent. France, 4 ser. Tom. 7, p. 586. Guadeloupe and Santo Domingo.

Colobogaster impressa, 1869, Gem. Har., Cat. Col., Tom. V, p. 1422. (Part.) Antilles and Guadeloupe.

Chrysobothris impressa, 1886, Horn, Trans. Amer. Ent. Soc., vol. 13, pp. 109–110, 121, plt. VI, figs. 198–202. Key West, Florida.

Chrysobothris impressa, 1903, Kerremans, Gen. Ins., Fasc. 12, p. 186. Antilles.

Chrysobothris sex-punctata Fabr.

Buprestis sex-punctata, 1801, Fabr. Syst. Eleuth., Tom. II. p. 206, no. 111. South America.

Buprestis impressa, 1790, Oliv. Ent., II, Gen. 32, p. 41, no. 56, plt. 5, fig. 42. South America.

Buprestis impressa, 1790, Oliv. Ent. Method, Tom. V, p. 226, no. 67. South Amer'ca.

Buprestis impressa, 1801, Herbst, Coleopt., Th. 9, p. 233, no. 153, plt. 150, fig. 4. America.

Buprestis splendens, 1801, Voet, Cat. Col., vol. I, p. 96, plt. 51, fig. 24.
Buprestis sex-punctata, 1817, Schönherr, Syn. Ins., Band. I, Pars. 3, p. 255, no. 216. South America.
Colobogaster sex-punctata, 1838, Cast. & Gory, Mon. Bupr., vol. 2, Gen. Colobogaster, p. 9, plt. 2, fig. 7. Cayenne.
Chrysobothris sex-punctata, 1887, Waterhouse, Biol. Centr. Amer., vol. 3, pt. 1, p. 35. South America, Nicaragua.
Chrysobothris sex-punctata, 1903, Kerremans, Gen. Ins., Fasc. 12, p. 184. Brazil.

SOME HALICTINE BEES IN THE UNITED STATES NATIONAL MUSEUM (HYM.)

By T. D. A. Cockerell.

The present paper completes my study of the entire collection of bees borrowed from the National Museum a few years ago. The collection proves to contain 205 new species and varieties but many of these, though in type, have not yet been published.

Halictus bentoni sp. n.

Female.—Length about 8–8.5 mm., anterior wing about 6.5 mm.; black, with the hind margins of the abdominal segments hyaline; pubescence dull white, forming broad entire bands at bases of second and following abdominal segments, but no bands on apical margins; clypeus rather produced, polished, with sparse distinct punctures; mandibles reddened apically; antennae dark, the flagellum very faintly brownish beneath; mesothorax densely and very distinctly punctured, shining between the punctures; area of metathorax hardly defined, appearing rugulose under a lens; posterior truncation with sharp but not prominent lateral margins, and no dentiform angles above; legs black, tarsi reddened at apex; tegulae rufotestaceus; wings hyaline; stigma (which is large) and nervures clear yellowish-ferruginous; abdomen moderately shining, but very finely and closely punctured all over. Microscopical characters: front very densely punctured; area of metathorax cancellate; hind spur with broad obtuse semicircular laminae.

Kotal Malul, Southern Persia, Feb. 1906 (*Frank Benton*), U. S. Nat. Museum. This may be compared with *H. albipes*, but it is more robust, with a longer head, and closely punctured first abdominal segment. Two specimens were obtained.

Halictus persicus sp. n.

Female.—Length about 5.5 mm., anteror wing nearly 5 mm.; black, with the hind margins of the abdominal segments testaceous; pubescence dull

white, scanty; no apical hair-bands on abdomen, but bases of second and following segments with white bands of tomentum, broad laterally, failing in middle; flagellum ferruginous beneath; clypeus not produced, shining and irregularly punctured; front closely punctured, but shining between the punctures; mesothorax polished, distinctly but not very densely punctured, the posterior half distinctly green; scutellum punctured, with two smooth polished spaces; area of metathorax large, rather distinctly defined, irregularly plicate; posterior truncation not sharply defined; tegulae clear testaceous; wings very clear, nervures and stigma pale amber; legs black, with the knees, tibiae at apex and tarsi ferruginous, the anterior basitarsi dark, and the hind basitarsi with a dark cloud apically; abdomen broad, shining, very finely punctured; extreme apex reddish. Microscopical characters: front densely punctured, but the spaces between the punctures polished; mesothorax polished, without any sculpture between the punctures; area of metathorax with strongly wrinkled rugae, hind spur with three strong spines. The green tint on the mesothorax may be hardly appreciable.

Kotal Malul, S. Persia, Feb. 1906, three (*F. Benton*). U. S. National Museum.

The following key separates the above species from those described by Pérez from the Persian Gulf:

Metallic species with large head, related to *H. cephalicus* Morawitz; length 6 mm. (Mascate) ..... *omanicus* Pérez

Head ordinary 1

1. Dark green, with bronzy tints on head and thorax; length 7 mm. (Bahrein) ..... *arabs* Pérez

   General color black, with little or no green 2

2. Larger, without green tints ..... *bentoni* Ckll

   Smaller, with greenish tints on mesothorax ..... *persicus* Ckll

Halictus capitosus Smith

Tlahualilo, Durango, Mexico, at peach flowers, March 9, 1904 (*A. W. Morrill*).

Halictus morrilli sp. n.

Female.—Length about 8.5 mm., anterior wing 7.7 mm.; black, the abdomen with broad bands of white tomentum at bases of second and following segments. Very closely resembles *H. forbesii* Rob., to which it runs in Crawford's (1907) table, but the head is smaller, with the face narrower; the wings are not at all yellowish; the second submarginal cell is very broad, receiving the first recurrent nervure some distance before its end; the scutellum is shorter, with the disc highly polished; and the hind spur has numerous small broad rounded laminae, appearing nodulose or obtusely serrate. From *H. desertus* Smith it is known by the shining meso-

thorax, with a punctureless area on each side of middle posteriorly; the clypeus and supraclypeal area are also highly polished, with very few punctures. From *H. supereretus* Ckll. it differs by the shining thorax, white bands on abdomen, clearer wings and other characters. The tegulae are piceous; area of metathorax granular, not sharply bounded behind; posterior truncation with long, pale hair, not sharply margined; hair of head and thorax white; abdomen subglaucous, extremely finely punctured, hind margins of segments not pallid; stigma rather dull ferruginous.

Tlahualilo, Durango, Mexico, at peach blossoms March 9, 1904 (*A. W. Morrill*). U. S. Nat. Museum.

Halictus respersiformis sp. n.

Female.—Length about 6 mm., anterior wing 5 mm.; robust, black, with black legs, antennae and tegulae, but hind margins of second and following abdominal segments broadly dark brown; pubescence dull white, the bases of second and third abdominal segments with large elongate patches of white tomentum on each side, the base of fourth with white hair right across, but thin in middle; head suboval, face narrow; front extremely densely and minutely punctured; mesothorax shining, but finely and closely punctured all over, on the disc posteriorly the punctures separated by more than the diameter of one; area of metathorax minutely reticulated, with delicate oblique plicae at sides, the posterior middle V-shaped, not crossed by a sharp keel; posterior truncation heart-shaped, sharply defined, with long hair not hiding the surface; tegulae reddish-black; wings strongly dusky, stigma and nervures dark brown, second submarginal cell rather broad, receiving first recurrent nervure well before end; hind spur with three long teeth, all far from base; abdomen shining, with thin pale hair, first segment very minutely punctured, principally at sides, toward the base very finely transversely lineolate.

Tlahualilo, Durango, Mexico, at peach blossoms, March 9, 1904 (*A. W. Morrill*) U. S. Nat. Museum. In Crawford's table (1907) this runs to *H. macoupinensis* Rob. and *H. divergens* Lovell, but it is larger and more robust than these, with dark tegulae. In the Mexican fauna it resembles *H. respersus* Vachal, but is distinguished by the reticulate area of metathorax and dusky wings.

Halictus cordovensis sp. n.

Male.—Length about 6 mm., anterior wing 4.7 mm.; black, the abdomen shining, reddish black; pubescence scanty, white, rather abundant on face, but not hiding surface; head round seen from in front, face broad, clypeus not produced; no pale face-marks; mandibles chestnut-red apically; antennae long, black; clypeus closely punctured; front granular under a lens, but the microscope shows rather coarse punctures, so dense as to give a cancellated effect; mesothorax coarsely and very densely punctured, a

little shining area posteriorly; scutellum polished, punctured round the sides, but scarcely at all along the middle; area of metathorax shining, with irregular coarse branching rugae; sides of metathorax coarsely cancellate; tegulae piceous, not punctured; wings dusky; stigma and nervures dark brown; second submarginal cell marrow, third long, its outer nervure (which is strong) with a double curve; legs very dark brown; abdomen without hair-bands or patches, the depressed hind margins of segments with scanty pale hair; apical plate very broadly rounded, with pallid margin; venter ferruginous, with a dusky cloud about the middle. The joints of the flagellum are hardly at all gibbous, and have a feebly sculptured surface, without any sharply pitted or honey-comb-like structure.

Cordova, Mexico, October (*L. O. Howard*) U. S. Nat. Museum. Nearest to *H. pectoralis* Smith, to the vicinity of which it runs in Crawford's (1907) table. It is larger, and has the mesothorax more coarsely and densely punctured. It also differs conspicuously by the long third submarginal cell. It has rather the aspect of a *Sphecodes*, owing to the coarse sculpture and shape of the head; but the antennae are those of *Halictus*, and the face is not densely covered with white hair.

Halictus deceptor Ellis.

Cacao, Trece Aguas, Alta Vera Paz, Guatemala, June 1907 (*G. P. Goll*).

Rhopalictus patagonicus sp.n.

Female.—Length nearly 7 mm., anterior wing 5.7 mm.; head, thorax, legs and antennae black, the flagellum very obscurely brownish beneath, the small joints of tarsi reddish; abdomen shining ferruginous, impunctate and without hair-bands, first segment marked with black on each side toward base, venter mainly black, with base and apex broadly red; pubescence very scanty, pale fuscous on outer side of hind tibiae; face broad, the eyes strongly emarginate, clypeus and supraclypeal area distinctly greenish, clypeus high, microscopically tesselated, very sparsely punctured; front minutely rugulose; mesothorax shining, without distinct punctures, the surface microscopically tesselated; area of metathorax long, shining, without plicae; posterior truncation shining, not sharply bounded; tegulae piceous; wings faintly dusky, stigma and nervures dark brown; second submarginal cell rather broad, receiving first recurrent nervure very near its end; third submarginal cell broad, broader on marginal than second; hind spur with numerous short, slender spines; ventral abdominal segments fringed with long erect hair.

Chubut, Patagonia, from W. F. H. Rosenberg; U. S. Nat. Museum. I had at first placed this as an aberrant *Halictus*, but it is clearly congeneric with *Rhopalictus corinogaster* (Spinola)

from Chile. The metathorax is much narrower dorsally, but has the same general appearance, and the shape of the third submarginal cell is the same. The strongly emarginate eyes exclude it from true *Halictus*. The next species, also a *Rhopalictus*, is still more like *Halictus*.

Rhophalictus chloronotus sp. n.

Female.—Length nearly 8 mm., anterior wing 6.5 mm.; robust formed as in *Halictus*, but the eyes distinctly emarginate, and the large broad area of metathorax, which is well bounded behind, without plicae; hair of head and thorax dull white, rather abundant; abdomen with triangular hair-patches at bases of segments 2 to 4 laterally; the apex, which is slightly reddened, especially beneath, densely hairy. Head broad, black, nowhere distinctly metallic; clypeus and supraclypeal area somewhat shining, but not polished, not distinctly punctured; antennae dark; front dull and appearing granular, the surface microscopically roughened; mesothorax dark green, dullish (microscopically tessellate) without evident punctures; scutellum more shining, faintly greenish, not punctured; other parts of thorax black; posterior truncation shining, the sharp margin only going half-way up each side; tegulae dark reddish; wings very faintly dusky, stigma and nervures reddish; second submarginal cell much higher than broad, receiving first recurrent nervure before its end; third submarginal cell broad, shaped as in *R. corinogaster*; legs very dark brown, with pale hair; abdomen broad, black, the first segment brownish, hind margins of second to fourth pallid brownish, venter with pale erect hair.

Chile (*E. C. Reed*). U. S. Nat. Museum. A penciled label gives the exact locality which looks like "Chacogut." I cannot now be positive, but I believe this is the species with "mesothorax faintly greenish" (Trans. Amer. Ent. Soc. XXXI, p. 356) which I saw in the British Museum, labeled with a manuscript name by Spinola. It appears to be close to *Halictus chloromelas* Alfken but is larger, without the violet-blue tints on head and thorax.

Halictus perzonatus sp. n.

Female.—Length about 8 mm., anterior wing 6.2, robust, black, the abdomen dorsally dark greenish, the hind margins of the segments dark brown; eyes rather strongly but not abruptly emarginate; clypeus produced, convex, polished and shining, with sparse strong punctures; supraclypeal area also shining; front dull; flagellum obscurely reddish beneath; appearing granular under a lens, but the microscope shows dense minute but very distinct punctures, the surface between tessellate; scutellum very finely punctured, distinctly shining; area of metathorax with extremely dense and delicate plicae, connected by cross-lines, so that the surface is subreticulate, and seems finely roughened under a low-power lens; posterior

truncation shining, distinctly bordered; upper margin of prothorax and tubercules densely clothed with very pale ochreous felt; tegulae piceous, with a pallid margin anteriorly and a large red spot posteriorly; wings dusky, stigma and nervures dark brown; second submarginal cell very broad, receiving first recurrent nervure some distance from end; third submarginal cell hardly larger than second; legs dark reddish-brown, with pale hair, fusceous on outer side of hind tibiae; hind spur with two broad laminae, the first long, the second short and truncate; abdomen broad, dullish, very minutely and densely punctured (except base of first segment which is shining); pale ochreous bands of dense tomentum (appressed plumose hairs) as follows: short narrow lateral apical ones on first segment, narrow lateral apical and basal ones on second, broad complete apical and basal bands on third and fourth, leaving a median dark band (the surface of segment showing) of about equal width between; apical segment with thin, hoary pubescence, not hiding the surface; venter shining black.

Carcarana, Argentina (*L. Bruner* 74) U. S. National Museum. Resembles *Halictus puelchanus* Holmberg, but distinct by the greenish abdomen with ochreous bands.

FURTHER NOTES ON TABANIDAE IN THE FLORIDA EVERGLADES (DIPT.)

By C. A. Mosier,

Warden, Royal Palm State Park, Dade County, Florida,

and T. E. Snyder,

Bureau of Entomology.

In previous articles[1] on gadflies in the Everglades the writers have recorded the habit, developed by species of *Tabanus*, of congregating on the bloom and feeding on the nectar of the saw palmetto (*Seronoa serrulata*), especially where this bloom is shaded by the large fan leaves. After the early morning swarm of *T. americanus*, males are found on palmetto bloom as early as 6.45 A.M., which, however, is some time after sunrise. Males of several species of *Tabanus* feed on the bloom—*T. americanus*, *T. trijunctus* and *T. lineola*—and may be found there from early morning until nearly dusk. A few females also feed on the bloom.

In order to capture a large number of the usually rare males, the leaves were cut from about the flowers of saw palmettos at Paradise Key (Royal Palm Hammock) in April. The males of

[1] Proc. Ent. Soc. Wash., vol. 18, no. 4, Dec., 1916, (June, 1917); vol. 19, no. 4, April, 1917 (Sept., 1918); vol. 20, no. 6, June 1918 (Oct., 1918).

T. americanus at once sought new feeding grounds either for shade or security. The exposure of the blooms did not have the same effect on either sex of *T. trijunctus*.

There is a considerable difference in the date of the blooming of the saw palmetto in the southern and northern parts of Florida but in any given locality the plant remains in blossom over a long period. Therefore, it would seem that in their control, advantage might be taken of the habit of these species of Tabanidae of congregating on the bloom and of feeding on the nectar of saw palmetto and other plants. The Russian entomologist I. A. Porchinski in 1908 recommended spraying the surface of ponds, where Tabanids drink, with kerosene oil in order to clog the air passages of the flies or to prevent them from rising from the surface. It has occurred to the junior author that it might be practicable to spray with an arsenical solution to poison the adults the bloom of plants, the nectar of which Tabanids drink. Of course, in regions where honey bees are abundant, there would be the danger of poisoning the bees. The blossoms should be sprayed before sunrise.

Artificial drainage of the Everglades may be the solution of the gadfly problem, but until this is done, these annoying and dangerous insects will continue to be detrimental to the welfare of live stock.

The senior author has made additional captures of Tabanidae at Paradise Key. A black species—*Tabanus lugubris* Macq., *T. rufus* Palisot de Beauvais and *T. costalis* Wied. are new records for this locality.

On June 11 one female of *Tabanus americanus* was caught; two more were captured on June 13. By the middle of June adults of *Tabanus lineola* were diminishing in numbers on the screens of the Lodge building but were plentiful on the prairies. Of *Tabanus flavus*, only a few adults were nightly observed.

During July, adults of the black gadfly (*Tabanus lugubris*) were observed occasionally but this species was not plentiful. *Tabanus melanocerus* was diminishing in numbers. Females of the large reddish brown *Tabanus rufus* were collected on July 28.

During August, adults of *Tabanus costalis*—a small species similar to *T. lineola*—were collected.

Adults of the "yellow fly of the Dismal Swamp" (*Diachlorus ferrugatus*) were captured during June and August).

An effort was made by the senior author to preserve the beautiful natural pigment of the eyes of the living flies. Specimens of several species of *Tabanus* caught in June were put in a 10 per cent formalin, 10 per cent grain alcohol solution. As long as the flies remained in the solution there was no change noted, but as soon as they were removed and drying took place the colors changed.

The following list gives new records of species of gadflies collected at Paradise Key by Mosier. C. T. Greene determined the flies.

Paradise Key (*Royal Palm Hammock*).

Tabanus americanus Forster. Females. June 11, 13 and 18, 1918.
Tabanus rufus Palisot de Beauvais. Females. July 28, 1918.
Tabanus turbidus Wied. Females. June 18, July 27, August 5, 6, 8, and 13, 1918.
Tabanus lugubris Macq. Females. August 5 and 18, 1918.
Tabanus atratus Fab. Males. October 2, 1918.
Tabanus melanocerus Wied. Females. June 18 and August 5, 1918.
Tabanus lineola Fab. June 18 (male) and August 5 and 6, 1918 (females).
Tabanus costalis Wied. Females. June 4, 9 and 18; August 1, 6, and 13, 1918.
Tabanus flavus Macq. Females. June 18, 1918.
Diachlorus ferrugatus Fab. Females. June 9 and August 6, 1918.
Chrysops plangens Wied. Females. April 24, 1918.
Chrysops flavidus Wied. Females. April 24, 1918.

Occasional males of several species of *Tabanus* were flying as late as December 15, 1918.

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PROCEEDINGS OF THE
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VOL. 20 DECEMBER, 1918 No. 9

ALLEN BOWIE DUCKETT.

By C. H. Popenoe, James A. Hyslop and H. L. Sanford.

Allen Bowie Duckett was born at Bladensburg, Maryland, March 9, 1891. His preparatory schooling was received at the Bladensburg public schools, from which he entered the preparatory department of the Maryland Agricultural College.

His interest in natural science early led him into the study of insects, to which he devoted much time during his junior and senior years at college. In the summer of 1911 he secured an appointment with the Bureau of Entomolgy as student assistant, under Dr. F. H. Chittenden, returning in the fall to college to complete his course in entomology. He graduated from Maryland Agricultural College in 1912, receiving the degree of Bachelor of Science in biology.

In June, 1912, he was appointed scientific assistant with the Bureau of Entomology, under Dr. Chittenden, which position he retained until the year 1917. During this time he was occupied with the investigation of the pests of truck crops in Maryland and Virginia, and was later assigned to work on the life histories and control measures of stored product insects, a task which secured his deep interest, resulting in his transfer to the office of Stored Product Insect Investigations on its creation in 1917. There, under Dr. E. A. Back he was appointed assistant entomologist and assigned to the study of the insects affecting army supplies at the port of New York. On this project he labored unceasingly until his seizure by pneumonia, which claimed him on October 8, 1918, hardly a month after his marriage to Miss Margaret Hildreth, the daughter of Mrs. Margaret B. Hildreth of Washington, D. C.

He was a member of the Washington Entomological Society since 1912, and was also affiliated with the Entomological Society of America, and with the American Association for the Advancement of Science. In the field of systematic entomology his interests were devoted to the Jassidae in the Hemiptera and to the Halticini in the Coleoptera. A contribution on the latter group, prepared as a thesis for advanced work, is now in the

hands of the Maryland Agricultural Experiment Station for publication.

Mr. Duckett was a conscientious and unceasing worker, careful and thorough in his investigations, although owing to the nature of his work he had received but little recognition through publication. His untimely death removes from the field of economic entomology one of its most promising younger workers.

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THE GENUS EPHIALTES FIRST PROPOSED BY SCHRANK. (HYM.).

By R. A. Cushman and S. A. Rohwer,

Bureau of Entomology, Washington, D. C.

The generic name *Ephialtes* was first proposed in 1802 by Schrank (Fauna Boica, vol. 2, pt. 3, p. 316) with *Ichneumon compunctor* mentioned as an example and the only included species. On an earlier page (p. 269) of the same work Schrank listed *Ichneumon compunctor*, stating that he knew two forms that belonged there, one with the body $6\frac{1}{2}$ lines and ovipositor $7\frac{1}{2}$ lines long and the other 13 lines long with the ovipositor $1\frac{1}{2}$ lines, but otherwise alike. At this place he refers to an earlier work by himself (Enum. Ins. Aust. 1781, p. 357), where he cites *Ichneumon compunctor* Linnaeus, Faun. Suec. No. 1609 (evidently a more detailed characterization of the species originally described in Systema Naturae, tenth edition, page 564). It is evident, then, that he meant the Linnaean species when he used the name *compunctor* and this species must be the genotype. *Ichneumon compunctor* Linnaeus has not been definitely recognized by subsequent authors, for references quoted under that name by such authors as Schrank, Fabricus, and even Linnaeus himself refer to such figures as those of Degeer (Mem. l'Hist. Ins., vol. 2, pt. 2, figs. 6–8), which is a *Pimpla* in the sense of authors (= *Pimplidea* Viereck) and very similar if not identical with *Pimpla instigator* Fabricus; Schaffers (Icone. Ins., vol. 2, pt. 1, Pl. 110, fig. 3), which is obviously *manifestator* Linnaeus

or something close to that species; Müller (Linn. Vollst. Natursyst., 1775, Pl. 26, fig. 5), a poor figure of impossible determination but obviously, from the great length of its ovipositor, not the *compunctor* of Linnaeus; and Schaffers (Icone. Ins., pl. 49, fig. 4) which is evidently a Cryptine with the ovipositor longer than the body. Moreover, Dalla Torre has synonymized *compunctor* with such widely different insects as *Ephialtes manifestator* Linnaeus, *Pimpla instigator* Fabricus and *Mesostenus gladiator* Scopoli.

Rowland E. Turner has kindly examined the Linnean collection in London and reports: "*Ichneumon compunctor* is represented by two specimens but although they apparently formed part of the original Linnean collection the name has not been attached by Linné himself but by Smith, with a note 'named from description.' Both specimens are *Pimpla instigator*, but there can be no certainty or even presumption that either is the type."

Obviously the species described by Linnaeus as *compunctor* cannot be his *manifestator* for both of these species are described in the same work, and the very short ovipositor of *compunctor* cannot be reconciled with the very long one of *manifestator*. Moreover, in subsequent references to *compunctor*, Linnaeus says that it is commonly parasitic within the pupae of *Papilio*, a habit entirely foreign to *manifestator* or any of its close relatives, while the species of *Pimplidea* are habitually parasitic within the pupae of Lepidoptera.

In view of the absence of a definite type specimen, and since it is certain that Linnaeus had, according to our present knowledge, a composite and vague idea of his species *compunctor* it will be necessary to base all determination of this species on the original description in the tenth edition, which is as follows: "Body immaculate black, abdomen subpetiolate oblong, legs rufous, ovipositor shorter than antennae."

The most helpful characters in the original description are the shape of the abdomen and the length of the ovipositor, but to thoroughly understand these characters it is necessary to examine the characterizations of well recognized species described at the same time. The various species now placed in *Ambyteles* or in the Cryptinae are all said to have the abdomen petiolate which eliminates from consideration members of these subfamilies. The species belonging to the Ophioninae and allies are said to have the abdomen arcuate or sickle-shaped so they are readily eliminated. Species now placed in the Ichneumoninae (Pimplinae) are said to have the abdomen sessile and cylindrical, or, as in *strobiellae*, ovate, so it is not at all unlikely that Linnaeus would describe the species now known as *instigator*, in which the abdomen is somewhat more attenuate basally than is that of *strobillellae*, as having an oblong subpetiolate abdomen. Further-

more, this species agrees with all the other characters of the original description and with the parasitic habits mentioned in Fauna Suecica. This fact, together with the evidence in the Linnean collection, makes it certain that the species now known as *instigator* was previously described by Linnaeus as *compunctor*.

The synonymy is therefore:

Ephialtes compunctor (Linnaeus).

Ichneumon compunctor Linnaeus, Nat. Syst. 10 Ed. 1758, p. 564, n. 31; Fauna Suec. 2 Ed., 1761, p. 403, n. 1609.

Ephialtes compunctor Schrank, Fauna Boica, vol. 2, pt. 3, 1802, p. 316.

Ichneumon instigator Fabricus, Ent. Syst., vol. 2, 1793, p. 164, no. 126.

Pimpla instigator Gravenhorst, Nov. acta acad. nat. Curios, vol. 9, 1818, p. 291; Morley, Brit. Ichneumons 1908, vol. 3, p. 92.

The species which has heretofore gone under the name *instigator* is a typical member of the genus *Pimplidea* Viereck (= *Pimpla* Authors), and the following generic synonymy is necessary.

Ephialtes Schrank 1802 (not Gravenhorst 1829).
Syn. *Pimplidea* Viereck, 1914.

The Gravenhorstian genus *Ephialtes* (1829) is synonymous and isogenotypic with *Ichneumon* Linnaeus (1758) (See Viereck, Bul. 83, U. S. Nat. Mus., 1914), and must not be confused with *Ephialtes* Schrank which is much older.

DISTRICT OF COLUMBIA DIPTERA: TABANIDAE.[1]

By W. L. McAtee and W. R. Walton.

On account of the biting proclivities of most members of the family, the Tabanidae, or horse-flies, are among the few groups of insects that are recognized by the general public. Wherever the biting species occur they are serious pests of wild mammals, domestic stock, and sometimes even of man. African Tabanidae transmit destructive diseases among mankind, but fortunately so far as known American species have assumed no such rôle.

Although the group is recognized by observers not versed in entomology, its richness in species usually is entirely unsuspected. Ordinary estimates place the number of deer flies at one, and of horse flies at two or three kinds. The facts are quite the

[1] For an account of the Syrphidae, see Proc. Biol. Soc. Wash. 29, 1916, pp. 173–203.

contrary, however, as the group is differentiated into a remarkably large number of species. The larvae of most of them live in water or wet soil, and the adults are found in greatest abundance in well-watered situations. In collecting them advantage is taken of certain characteristic habits. The collector himself attracts the blood-thirsty females of most species of deer flies (*Chrysops*) and of a few kinds of horse flies (*Tabanus*), and as they circle about his head they fall easy victims to the net. Deer flies at times are attracted to flowers, the males frequently, as is the case also with the species of *Pangonia;* hence, looking over flowers must not be omitted by the collector of species of this family. Their favorite flowers in this region so far as known, are chinquapin, *Ceanothus*, and dogbane.

Inspecting horses and cattle is naturally the most important method of finding horse-flies and it is good also for certain deer flies. Sometimes, numerous species are caught in a short time about farm stock. Horse-flies like to sun themselves on fences and poles; and often sit on roads, particularly about puddles. A few species are only obtained, and a number of others, may be caught, by sweeping vegetation about wet places. Most of the horse flies are active and alert and are strong fliers, so that their capture is by no means easy. In fact collecting them appeals to one as rather a sporting proposition with the odds generally in favor of the flies. On a hot summer day one frequently is reminded of his impotence by hearing the characteristic buzz of a horse-fly, which usually darts by so swiftly it is not seen, turns and goes off as rapidly as it came.

The returns for collecting Tabanidae are remarkable considering the large size of most of the species. It was surprising indeed to get a brand new genus in so well collected a vicinity as that of the District of Columbia. Some of the species are either rare, local, or very hard to obtain, as the paucity of records for them shows. Knowledge of these forms can be increased and probably numerous species can be added to our list by assiduous and intelligent collecting. We trust that publication of the list and especially of the keys will stimulate collectors to improve our knowledge of the Washington Tabanidae.

The total number of species in the list is 54. The standard of comparison of local lists, in the Eastern United States, is the New Jersey list of Professor C. W. Johnson.[2] It contains 74 species of Tabanidae. New Jersey has an unusual variety of environments suitable to horse flies, having the maritime, pine-barren, ordinary lowland and upland swamps, bogs, and watercourses, and so

[2] "The Insects of New Jersey," Ann. Rep., N. J. State Mus. 1909–1910, pp. 738–742.

uniform a region as that of the District of Columbia probably never will produce an equal number of Tabanid species. A tabulated comparison of the two faunas follows:

GENUS	NUMBER OF SPECIES NEW JERSEY	NUMBER OF SPECIES DISTRICT OF COLUMBIA
Goniops	1	1
Pangonia	2	2
Chrysops	33	19
Neochrysops	0	1
Haematopota	1	0
Meryeomyia	0	1
Tabanus	38*	30
Totals	75*	54

* One name *exul*, is a synonym.

Haematopota punctulata, and an additional species of *Tabanus* namely *fuscopunctatus* have been taken at Chesapeake Beach, Md., and two additional species of *Chrysops* (*indus* and *mitis*) have been collected at Potomac Run, Va. All of these very possibly may yet be taken within the limits of the District fauna.

Special effort has been made by a number of local entomologists to collect the fauna of Plummers Island, Md., and vicinity. So far 21 species of Tabanidae have been taken on this 12-acre island, and 17 additional species in nearby parts of the Potomac River Valley. When the occurrence of species on Plummers Island is not stated in the text, it is indicated by the initials P. I. in parenthesis following the account of the species, and in the same way V. P. I. meaning vicinity of Plummers Island is added when necessary.

Key to Genera.

A. Hind tibiae with 2 short but definite spines at tip.
  B. Third joint of antenna with 8 divisions faintly indicated.
    C. Wings distinctly divided into anterior colored and posterior hyaline portions; female pale sericeous, abdomen broad and obtuse.....*Goniops*
    CC. Wings uniformly hyaline or smoky; body color darker, abdomen longer and more pointed.....*Pangonia*
  BB. Third joint of antenna with 5 divisions.

D. Abdomen inflated, much wider than thorax; eye-marking consisting of 4 coalescent, more or less diamond-shaped spots.....*Neochrysops*
W. R. Walton, new genus.
DD. Abdomen not inflated; eye-marking different.....*Chrysops*
AA. Hind tibiae without definite apical spines.
E. Ocelli distinct.....*Merycomyia*
EE. Ocelli absent.....*Tabanus*

Goniops Aldrich.

G. chrysocoma Osten Sacken.—All of the specimens thus far taken have been collected on Plummers Island, Md., or within a mile and a fraction of that locality. The females are rather easily found, when the collector once becomes acquainted with the peculiar rattling noise they make when disturbed at their egg-laying or brooding on the underside of leaves. The dates for Plummer's Island are from June 18 to July 21. Males, which are harder to get, were collected June 28, 1908, E. A. Schwarz and July 14, 1907, A. K. Fisher. Along Dead Run, Va., a nearby locality, the species has been taken June 23, Nathan Banks; June 30, 1916; July 11, 1915, R. C. Shannon, and July, 1911, a male, Wm. Palmer. A female in the National Collection was bred from a larva collected near Cabin John Bridge, Md., April 13, 1899. For an illustrated account of the life-history of this species see Proc. Ent. Soc. Wash. 13, 1911, pp. 21–29.

Pangonia Latreille.

Key to the Species.

A. General color yellowish; antennae light reddish or yellow.....*pigra*
AA. General color brownish; antennae dark.....*rasa*

P. pigra Osten Sacken.—Beltsville, Md., in copula on chinquapin flowers, June 18, 1916, Walton; June 25, 1915, R. C. Shannon; July 4, 1912, McAtee; Falls Church, Va., on *Ceanothus* flowers, June 23; Glencarlyn, Va., on *Ceanothus*, June 28, Nathan Banks; Dalecarlia Reservoir, D. C., June 14, 1914, R. C. Shannon.

P. rasa Loew.—Lakeland, Md., caught by young *Phymata* on flowers of *Eupatorium purpureum*, August 14, 1910. F. Knab.

Neochrysops new genus, W. R. Walton. (Fig. 1.)

Hind tibiae bearing spurs; head very much as in *Chrysops* but antennae more slender as in fig. 1; first joint subequal with the third which is but faintly swollen at base and bears five annuli; second segment slender and two-thirds length of first. Eyes in life marked as in fig. 2. Ocelli present, closely approximated; wings evenly infuscated throughout; anterior branch

of third vein bearing a stump at its bend extending into second marginal cell as in fig. 3; abdomen globose, much wider than thorax. Figs. 4 and 5.

Neochrysops globosus, new species, W. R. Walton. Female: Face and front golden yellow, callosities shining pitchy black, a dark stain surrounds the ocelli; palpi yellow, proboscis black. Antennae; first joint yellow, second dark brown, third black, fading into brown at extreme base. Dorsum of thorax bearing three black subshining stripes on a golden yellow ground; the median black stripe extends half way across the scutellum

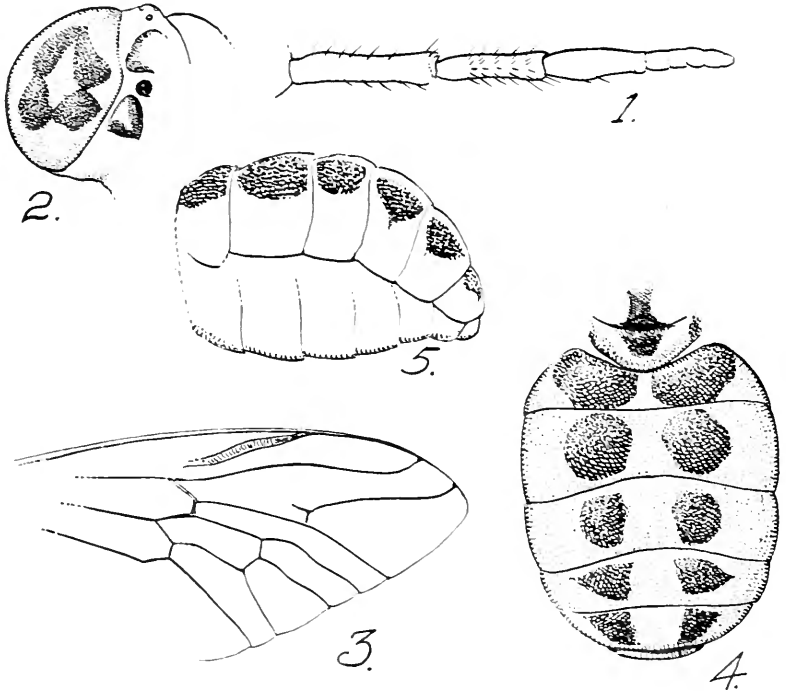

Fig. I.—Structural details of *Neochrysops globosus* Walton, new genus and species.

which is also golden yellow. Abdomen fulvous, first to fifth segments inclusive each marked with a pair of black dots which decrease gradually in size toward tip of abdomen; venter immaculate fulvous. Legs in large part yellow, trochanters, tips of tibiae and tarsi black. Length 8 mm.

Described from a single female specimen deposited in the United States National Museum. This handsome species was collected by Mr. R. M. Fouts of the United States Bureau of Entomology at Cabin John Bridge, Maryland, July 20, 1916.

Some hesitancy is felt in proposing a new genus for the reception of this form because of its evidently strong affinities with *Chrysops*, but it differs so markedly in habitus from any species of *Chrysops* known to the author, that it seems inadvisable to include it therein, especially as the form possesses structural characters by which it may be distinguished from *Chrysops*.

Chrysops Meigen.

These are the so-called deer-, sheep-, or pine-flies. They are black or black and yellow flies, usually with conspicuously marked wings. They frequent at least partially shaded situations and most of them swarm about moving warm-blooded animals, seeking an opportunity to bite. In the case of man, at least, they usually desert their intended victim when he comes to rest.

Key to the Species.[3]

A. Abdomen mostly dark.
  B. Wing with more or less distinct dark markings.
    C. Apex of wing beyond crossband more or less distinctly infuscated especially bordering costal margin.
      D. Apical spot consisting of a linear band along costal margin, barely extending into second submarginal cell, hyaline triangle extending broadly across first submarginal cell ..... *brimleyi*
      DD. Apical spot occupying at least four-fifths of second submarginal cell.
        E. Abdomen immaculate; length about 8 mm..... *parvulus*
        EE. Abdomen with one or more yellowish stripes.
          F. Hyaline triangle barely extending to the first submarginal cell..... *univittatus*
          FF. Hyaline triangle extending nearly to costal margin.
            G. Apical spot encroaching on first posterior cell; hyaline triangle semilunate. Abdomen dark brown bearing 3 obscure yellowish stripes in the variety *morosus*, one in the typical form..... *lugens*
            GG. Apical spot not touching first posterior cell; hyaline triangle wider. Abdomen with a single median yellow stripe..... *obsoletus*

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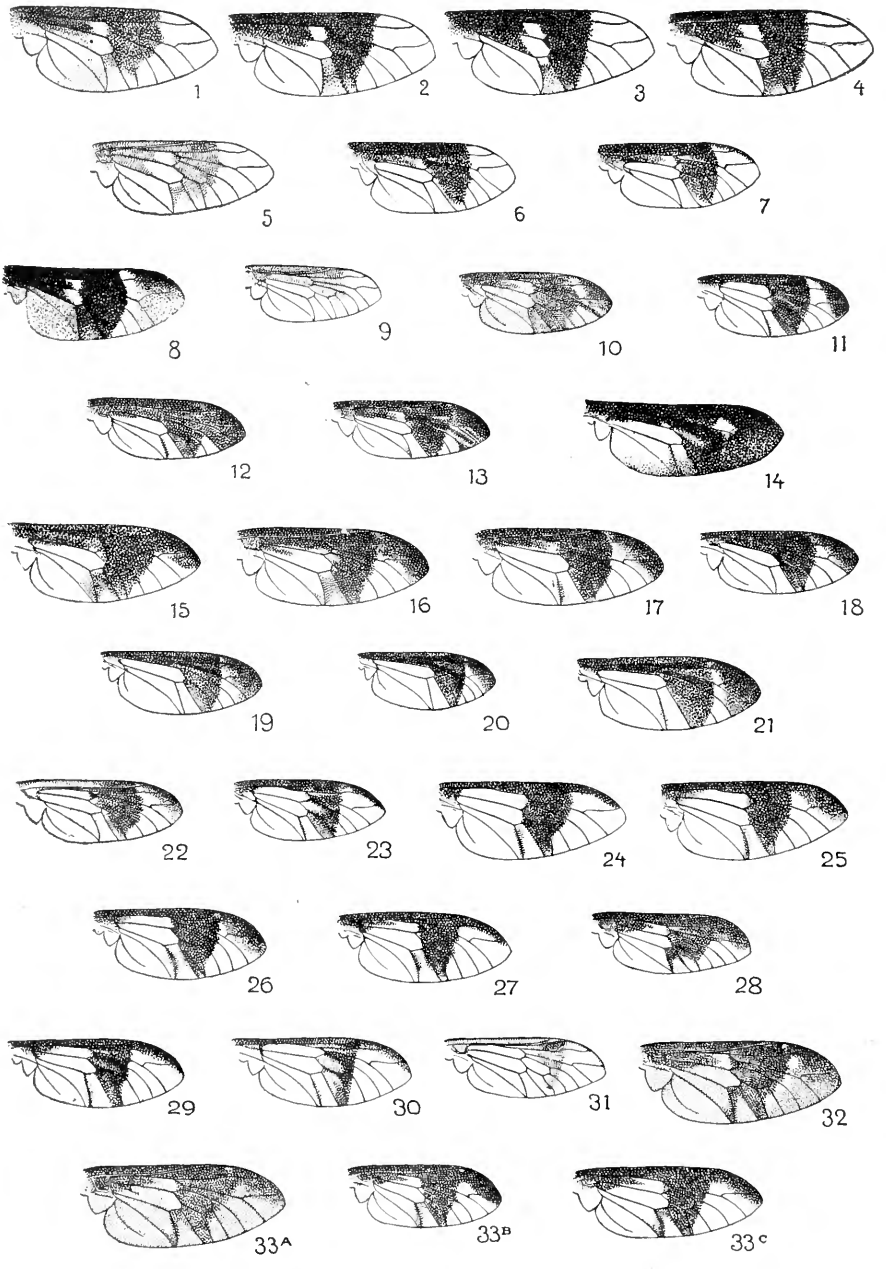
[3] The key includes *C. indus* and *C. mitis* which have been collected at Potomac Run, Va. and which may occur in this fauna.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Explanation of Plate 10

Published by courtesy of Entomological News and the Author, Mr. Daecke. Original publication, Ent. News, April, '07, Vol. XVIII pp. 139-146.

Wing Pictures of Chrysops.

1, excitans	13, univittatus	25, dimmocki
2, celer	14, bistellatus	26, montanus
3, carbonarius	15, indus	27, saekeni
4, mitis	16, vittatus	28, frigidus
5, cuclux	17, striatus	29, pudicus
6, niger	18, sequax	30, cursim
7, brimleyi	19, lugens	31, fulvistigma
8, amazon	20, parvulus	32, brunneus
9, nigribimbo	21, hinei	33a, flavidus
10, plangens	22, obsoletus	33b, flavidus
11, fallax	23, delicatulus	33c, flavidus
12, moechus	24, callidus	

CC. Apex of wing beyond crossband entirely hyaline.
H. Second basal cell entirely hyaline.....*niger*
HH. Second basal cell infuscated for at least half its length.
I. Abdomen with grayish yellow spots at sides of segments 1–2; wing markings light brown.....*cuclux*
II. Abdomen and wings not so marked.
J. Fifth posterior cell with a small circular hyaline spot at base.....*carbonarius*
JJ. Fifth posterior cell without such spot.
K. Thorax with conspicuous lateral tufts of orange pile.....*celer*
KK. Thorax without such tufts.....*mitis*
BB. Wing entirely hyaline.....*vitripennis*
AA. Abdomen mostly yellowish, with dark markings.
L. Body markings strongly contrasting, wing picture pronounced.
M. Dark markings on second segment distinctly convergent or united, thus becoming inverted u-shaped, those on third to last segments tending to be transverse and usually enclosing a median series of more or less triangular areas.
N. First basal cell in large part hyaline.
O. Infuscation of wing beyond crossband confined to a narrow band along costal margin; abdominal triangles large.....*callidus*

OO. Infuscation beyond crossband spread over a large part of first and second submarginal cells.

P. Hyaline triangle extending almost to costal margin.....*fallax*

PP. Hyaline triangle broadly separated from costal margin.

Q. Yellow triangles on segments 2-4...*montanus*

QQ. Yellow triangle only on segment 2; remaining segments black with narrow yellow hind margins.....*dimmocki*

NN. First basal cell almost entirely infuscated; infuscation beyond crossband almost entirely filling out first submarginal cell.....*indus*

MM. Dark markings of abdomen consisting of 2 or more series of longitudinal lines or dashes.

R. Hyalin triangle extending beyond first posterior cell.

S. Scutellum largely black or plumbeous in color.....*striatus*

SS. Scutellum largely yellow or yellowish gray.

T. Hyaline triangle extending through first submarginal cell, nearly to costa.....*sequax*

TT. Hyaline triangle never extending more than halfway through first submarginal cell.....*vittatus*

RR. Hyaline triangle not extending beyond first posterior cell.....*moechus*

LL. Yellowish brown species, of faded appearance; wing picture dilute.

U. Basal segment of antenna swollen; abdomen brown above with small yellow triangles.....*brunneus*

UU. Basal segment of antenna not swollen; abdominal markings more contrasting.....*flavidus*

C. brimleyi Hine.—Beltsville, Md., May 28, 1916; Four-mile Run below Cowden, Va., female on flowers of *Apocynum medium*, June 11, 1916; Virginia near Plummers Island, Md., May 8, 1915, McAtee; Falls Church, Va., May 18, 1913, C. T. Greene.

C. callidus Osten Sacken.—Common; extreme dates June 4 and July 13; on June 11, 1916, a male was taken on *Apocynum* flowers along with specimens of the former species, McAtee; the female has been taken on flowers of *Ceanothus*, Nathan Banks. (V. P. I.)

C. carbonarius Walker.—Common; season, May 28 to July 14; a male was taken on chinquapin flowers, at Falls Church, Va., May 30 by Nathan Banks, and females by C. T. Greene, June 12. (V. P. I.)

C. celer Osten Sacken.—Common; extreme dates of collection, May 22 and July 1. (V. P. I.)

C. cuclux Whitney.—Beltsville, Md., May 28, 1916 McAtee; June 17, 1917, Walton; Branchville to Beltsville, June 4, 1914, L. O. Jackson.

C. dimmocki Hine.—Great Falls, Va., July 10, Wm. Palmer; Riverdale, Md., June 15, 1916, F. R. Cole.

C. fallax Osten Sacken.—Common; season, June 9 to July 17. Males have been taken at Falls Church, Va., June 9 and 19, and both sexes on flowers of *Ceanothus*, Nathan Banks. A female was captured at light, July 10, 1912, on Plummers Island, Md., by E. A. Schwarz and H. S. Barber.

C. brunneus Hine.—New Alexandria, Va., July 1907, Wm. Palmer; another at Falls Church, Va., no date, Nathan Banks.

C. lugens Wiedemann.—Abundant; extreme dates of collection June 3 and August 5. A female was taken on *Ceanothus* flowers, at Dead Run, Va., June 18, 1914, R. C. Shannon. (P. I.)

C. moechus Osten Sacken.—Abundant; season May 22 to August 25. Males were collected at Great Falls, Va., May 22, June 5, 19 and 21, Nathan Banks; June 11, 1910, Wm. T. Davis; and one was taken at light on Plummers Island, Md., June 8, 1914, E. A. Schwarz and H. S. Barber.

C. montanus Osten Sacken.—Chain Bridge, Va., June 14, S. A. Rohwer; Washington, D. C., June 7, 1900, June 9, 1899, and another specimen without date.

C. niger Macquart.—Very abundant; extreme dates, May 14 and July 7. The female has been taken on chinquapin flowers, Falls Church, Va., June 2 and on *Ceanothus* June 16, Nathan Banks; June 12, C. T. Greene; both sexes were collected on flowers of *Apocynum medium*, along Four-mile Run, below Cowden, Va., June 11, 1916, McAtee. (P. I.)

C. obsoletus Wiedemann.—Mt. Vernon, Va., July 13, 1917, McAtee; Falls Church, Va., July 12, female at honey dew on tulip tree, Nathan Banks; Vietch, Va., July 18, 1915; Four-mile Run, Va., August 7, 1910, F. Knab; Eastern Branch near Bennings, D. C., August 29, 1915; Washington, D. C., July 7, 1899, J. S. Hine; July 5, August 19, 1911; Hyattsville, Md., July 18, 1909, F. Knab; July 4, 1899, J. S. Hine, Lakeland, Md., July 5, 1909, F. Knab; Plummers Island, June 28, 1914, McAtee.

C. parvulus Daecke.—Dead Run, Va., June 23, Nathan Banks; Beltsville, Md., June 18, 1916, McAtee, July 4, 1916, McAtee, Walton; July 6 and 14, 1916, F. R. Cole; July 13, 1912, McAtee.

C. sequax Williston.—Maryland near Plummers Island, August 22, 1916, McAtee; Marlboro, Md., June 19, 1916, R. C. Shannon; Falls Church, Va., male August 2, Nathan Banks; August 12, 1912, C. T. Greene; Washington, D. C., August 19, 1911, F. Knab.

C. striatus Osten Sacken.—Great Falls, Va., June 27, 1909, F. Knab.

C. univittatus Macquart.—Very abundant; season, May 31 to August 10. Males taken at Falls Church, Va., June 19 (on *Ceanothus*), and July 23; at the same locality also a female on chinquapin flowers, May 30, and another, at honey dew on tulip tree, July 12, Nathan Banks. (P. I.)

C. vittatus Wiedemann.—Very abundant; extreme dates, June 4 and September 10, thus being taken later in the fall than any other *Chrysops*. (P. I.)

C. vitripennis Shannon.—Originally described from Beltsville, Md. Taken there June 9, 1915, Nathan Banks; June 18, 1916, McAtee; June 25, 1916, R. C. Shannon; July 6, 1916, F. R. Cole. This species inhabits the peculiar Powdermill bogs, and seems to spend all its time on grass and other vegetation only a few inches above the water surface. Its flight is slow and feeble, and its whole behavior differs widely from that of all the other local species of the genus.

Merycomyia Hine.

M. whitneyi Johnson.

Tabanus whitneyi Johnson, C. W., Psyche, Vol. 11, pp. 15–16, Feb. 1904; [Wellesley, Mass., N. Y.].

Merycomyia geminata Hine, J. S., Ohio Naturalist, Vol. 12, No. 7, May 1912, pp. 515–516.

A single female of this interesting species was collected at Dyke, Va., July 16, 1916, McAtee.

Tabanus Linnaeus.

These are the horse-flies—all but 2 species of which are vigorous, swift-flying, robust insects. *T. bicolor* and *T. flavus* are soft-bodied and weak-winged compared to the others, and they are crepuscular in habit. Only one of our species habitually attacks man, namely *T. pumilus*. *T. costalis*, *T. nigrovittatus*, and *T. lineola* share this habit to some extent, joined occasionally by the larger species, as *T. sulcifrons*.

Key to the Species.

A. Body almost entirely yellowish; wings weak, hyaline, with yellowish costa; unusually soft, feeble species.

B. Anterior branch of 3rd vein ending in a free stump, joined to posterior branch by a short cross-vein; all cross-veins dark clouded ..... *flavus*

BB. Anterior and posterior branches of 3rd vein joining in a fork; cross veins not dark clouded.....*bicolor*

AA. Body not chiefly yellowish; wings strong; robust species.

C. First three segments of abdomen chiefly yellowish red, remainder black.....*cinctus*

CC. Abdomen otherwise.

D. Abdomen without a median line of light spots or other longitudinally arranged pale markings.

E. Wings wholly blackish.....*atratus*

EE. Wings otherwise.

F. Wings dark brown at base, smoky apically, with dark spots at forks of 3rd and 4th veins..*nigrescens*

FF. Wings smoky along costa, without dark spots.

G. Wings hyaline apically; abdominal segments with pale posterior margins.....*americanus*

GG. Wings brownish yellow; abdominal segments without pale margins.....*giganteus*

DD. Abdomen with longitudinally arranged pale markings.

H. The pale markings form or include a continuous central stripe the whole length of abdomen.

I. Costal cell hyaline; front of female distinctly convergent anteriorly.....*lineola*

II. Costal cell yellowish.

J. Flies 15 mm. or more in length, more robust.

K. Front narrow; upper angle of 3rd antennal joint prominent.....*fulvulus*

KK. Front broad; upper angle of 3rd antennal joint very low.....*sagax*

JJ. Flies usually 12 mm. or less in length, more slender.

L. Thorax gray; hind tibiae faintly brownish at tip; lateral rows of spots on abdomen usually faint.....*nigrovittatus*

LL. Thorax yellowish; hind tibiae distinctly black at tip; lateral rows of spots on abdomen usually conspicuous.....*costalis*

III. The pale markings do not include such a stripe but consist of more or less separated triangles or spots.

M. The pale markings consist chiefly of a single median row of white triangles or spots.

N. Triangles only on segments 3 to 5.....*trimaculatus*

NN. Triangles or spots on all abdominal segments, though sometimes small on 1, 2 and 6.

O. Posterior margins of abdominal segments pale.

P. General color of abdomen reddish brown.

Q. 3rd joint of antenna longer and more slender, basal process slightly falcate; antennae wholly pale; abdomen abruptly narrowed from base, dark reddish brown, somewhat shining, with narrow triangles..... *recedens*

QQ. 3rd joint of antenna not so slender, basal process not falcate; basal joints and tip of third joint dark; abdomen not as above.

R. Dividing line between coarse and fine facets of eye of male high, leaving an almost semicircular portion of eye below it; wings brownish at base and along veins, but the interior of cells grayish-white.. *sulcifrons*

RR. Dividing line not so high, portion of eye below it broadly sigmoid; wings similar to those of last species, but interior of cells not so whitish. *abdominalis*

PP. Abdomen blackish-brown or black.

S. Triangles ending abruptly on 4th segment, never more than faintly indicated on 5th and 6th; thorax mostly black; wings blackish..... *trispilus*

SS. Triangles on all abdominal segments.

T. Triangles distinctly larger on segments 3 to 5, very small on 2; scutellum densely white pollinose.... *molestus*

TT. Triangle on segment 2 large.

U. Tibiae chiefly gray, length over 15 mm..... *melanocerus*

UU. Tibiae chiefly blackish, length under 15 mm..... *coffeatus*

OO. Posterior margins of abdominal segments not pale.

V Thorax and scutellum chiefly livid gray; abdomen blackish; wings smoky... *superjumentarius*

VV. Thorax, scutellum and abdomen brownish... *acteon*

MM. The pale markings form 2 or 3 longitudinal rows of triangles or spots.

W. Upper angle of 3rd antennal joint drawn out in a long process..... *hirtioculatus*

WW. Upper angle of 3rd antennal joint not so produced.

X. Cross-veins at middle of wing, apex of discal cell, and furcation of 3rd vein distinctly dark clouded.
Y. Abdomen blackish-brown with small faint median triangles and yellowish lateral spots, especially large on segments 1 to 3.....*lasiophthalmus*
YY. Abdomen otherwise.
Z. Front broad, lower part of callosity squarish; triangles on abdomen not connected along posterior border of segments, not conspicuous.....*reinwardtii*
ZZ. Front narrow, lower part of callosity elliptical; triangles on abdomen very large, bright white, their bases touching across posterior borders of segments.....*cymatophorus*
XX. These wing veins not dark clouded.
a. Face immediately above insertion of antennae denuded and shining.....*carolinensis*
aa. Face immedately above insertion of antennae pollinose
b. Central light markings of abdomen are large triangles, almost or quite reaching anterior margins of segments.
c. Third joint of antenna long slender, basal angulation prominent, acute and slightly falcate, brown except at tip; general color brownish..*longus*
cc. Third joint of antenna short, stout, basal angulation neither prominent, acute nor falcate.
d. Antennae black; tibiae gray; length about 16 mm.....*vivax*
dd. Antennae largely orange yellow; tibiae black; length about 12 mm.....*astutus*
bb. Central light markings of abdomen are merely shallow expansions of the narrow pale hind margins of segments.
c. Length, 12 mm. or more; eyes unmarked, *sparus*
cc. Length usually 10 mm. or less; eyes banded.....*pumilus*

T. acteon Osten Sacken.—Washington, D. C., August 14, 1917, at light, H. F. Wickham; Plummers Island, Md., August 31, 1907, McAtee; Beltsville, Md., September 10, 1916, both sexes, F. R. Cole, McAtee; August 22, 1917, C. T. Greene. The specimen collected on Plummers Island was one of a number taking part in a peculiar and very interesting performance. The flies poised about 20 feet above the ground in an opening that had been cut through

the trees in front of the house. Sometimes they remained stationary, again they shifted position rapidly; their most unusual feat, however, was darting over the roof of the cabin and back through the 2 open doors or vice-versa. So swiftly was this done that a fly would scarcely be missed from its place before it was back again. This behavior was seen during only a few days in late summer 1907, and has not again been observed. The Beltsville specimens found by McAtee were sitting on the road.

T. americanus Forster.—Laurel, Md., July 17, 1914, E. B. Marshall; Beltsville, Md., July 30, 1916, Walton. A specimen seen mashed on a porch floor at Dunn-Loring, Va., August 30, 1916, McAtee.

T. astutus Osten Sacken.—Beltsville, Md., June 18, 1916, McAtee; Chain Bridge, D. C., September 7, 1913, C. T. Greene.

T. atratus Fabricius—Beltsville, Md., June 23, 1909, McAtee; July 14, 1916, F. R. Cole; October 1, 1916, McAtee; Woodridge, D. C., August 29, 1915, E. R. Kalmbach; Washington, D. C., June 11, Wm. Palmer; Corner Conduit and Potomac Roads, Md., June 29, 1913, McAtee; Plummers Island, Md., June 9, 1914, R. C. Shannon; Falls Church, Va., August 22, 1917, C. T. Greene; A species more often seen than captured; a male was seen at a mud puddle in road, at Mt. Vernon, Va., August 20, 1916, McAtee.

T. bicolor.—Wiedemann.—Washington, D. C., July 7, 1899, J. S. Hine; another specimen without date, M. L. Linell.

T. carolinensis Macquart.—Common; season May 9 (male, first female May 28) to July 18. (P. I.)

T. cinctus Fabricius.—Beltsville, Md., July 4, 1916, Walton; Laurel, Md., July 17, 1914, E. B. Marshall.

T. coffeatus Macquart.—Odenton, Md., July 4, 1913; Beltsville, Md., July 4, 1916, McAtee; July 6, 1916, (including 1 male), F. R. Cole, C. T. Greene; August 6, 1916, McAtee; Hyattsville, Md., male, June 19, 1915, B. P. Currie; Bladensburg, Md., July 17, 1916, R. C. Shannon; Maryland near Plummers Island, July 27 and August 22, 1916, McAtee; Great Falls, Va., June 5, Nathan Banks.

T. costalis Wiedemann.—Beltsville, Md., July 10, 1909, Branchville to Beltsville, Md., June 4, 1914, McAtee; Linnieville, Md., July 5, 1913, R. C. Shannon; Maryland near Plummers Island, July 11, 1909, July 27, 1916, McAtee; Washington, D. C., June 18, 1897, July 3 and 7, 1899, J. S. Hine; Maywood, Va., July 16, 1916, McAtee; Falls Church, Va., June 20, July 4, 25 (male) and 28, and August 5, male at honeydew on tulip tree, Nathan Banks; July 3, 1916; on *Ceanothus*, June 24, 1916, C. T. Greene.

Atylotus baal Townsend (see bibliography) is related to *costalis* or *fulvulus*, but its exact identity cannot be made out except by study of the type.

T. cymatophorus Osten Sacken.—A striking and handsome species for which there is only one record, Poolesville, Md., July, 1898, F. C. Pratt.

T. flavus Macquart.—We are at the northern edge of the range of this peculiar species (usually called *mexicanus L.*), and there is but a single record, namely, Garrett Park, Md., July 4, 1899, W. R. Maxon. Mr. Maxon says this specimen probably was swept from vegetation on low wet ground.

T. fulvulus Wiedemann.—Common; extreme dates of collection, May 20 (male, first female, June 11) to August 28. Males taken also in June, July, and August (16th). (P. I.)

T. giganteus DeGeer.—Beltsville, Md., July 30, 1916, Walton; Plummers Island, Md., August 27, 1905, McAtee; Falls Church, Va., August 27, 1912, C. T. Greene.

T. hirtioculatus Macquart.—Branchville to Beltsville, Md., June 4, 1914, L. O. Jackson, McAtee; Beltsville, Md., July 4, 1916, Walton, July 9, 1916, McAtee; Cabin John Bridge, Md., July 1, 1916, R. M. Fouts, Plummers Island, Md., June 6, 1906, Va., near Plummers Island, June 19, 1909, McAtee; Dead Run, Va. June 19, 1915, R. C. Shannon; Great Falls, Va., June 27, 1909, Glencarlyn, Va., June 11, 1911, F. Knab; Falls Church, Va., May 27, 1916, J. N. Knull; Washington, D. C., June, 1898.

T. lasiophthalmus Macquart.—Branchville to Beltsville, Md., June 4, 1914; Beltsville, Md., May 28, 1916; McAtee; June 1, 1916, R. C. Shannon; June 18, 1916, McAtee; Plummers Island, Md., male at light, June 16, 1916, R. C. Shannon; Washington, D. C., May 23, G. E. Quinter; June 3, 1913, McAtee; Falls Church, Va., May 18, June 11, Nathan Banks.

T. lineola Fabricius.—Common; season May 18 to September 17; males taken, June 4 and 23 and September 3 on the last date, at light, Plummers Island, Md., H. S. Barber. (P. I.)

T. longus Osten Sacken.—Bethesda, Md., July 17, 1913, J. C. Crawford; Plummers Island, Md., August 19, 1906, McAtee; Rock Creek, D. C., August 3, 1913, R. C. Shannon.

T. melanocerus Wiedemann.—Beltsville, Md., June 18, 1916, D. C., Mabbott; July 6, 1916, C. T. Greene; July 14, 1916, F. R. Cole; July 26, 1918, Walton; August 6, 1916, August 21, 1917, McAtee; Falls Church, Va., male, June 13; female on flowers of *Ceanothus*, June 23; July 17, Nathan Banks; Mt. Vernon, Va., June 27, 1915, McAtee.

T. molestus Say.—Common; extreme dates of capture June 14 and August 11; a male taken June 25, 1915, Beltsville, Md., R. C. Shannon. (P. I.)

T. nigrescens Palisot de Beauvois.—Fairly common; season June 24 to August 24; males taken, July 6 and 28. (P. I.)

T. nigrovittatus Macquart.—Maryland near Plummers Island, July 11, 1909 and July 27, 1916; McAtee; Falls Church, Va., female on flowers of chinquapin, June 29, Nathan Banks; Four-mile Run, Va., male, May 31, 1914; McAtee. Said to be distinct from *costalis* in the maritime part of its range; here it is but feebly differentiated.

T. pumilus Macquart.—Very abundant; extreme dates of collection May 30 and August 21; males taken July 2 and 6. Hovers about the head like a *Chrysops*. (P. I.)

T. recedens Walker.—Branchville to Beltsville, Md., June 4, 1914, McAtee; Beltsville, Md., June 23, 1917, C. T. Greene.

T. reinwardtii Wiedemann.—Maryland near Plummers Island, July 27, 1916, McAtee; a very neatly colored species.

T. sagax Osten Sacken.—Beltsville, Md., June 18 and August 6, 1916; Maryland near Plummers Island, July 27, McAtee.

T. sparus Whitney.—Beltsville, Md., June 18, 1916, McAtee, identified by Jas. S. Hine; Maryland near Plummers Island, June 29, 1913, J. D. Hood; Eastern Branch, D. C., May 30, H. S. Barber.

T. sulcifrons Macquart.—Abundant, extreme dates of collection June 28 and October 1; males taken July 6, 7, 13, 20, 26 and August 10, 20, and 26. (P. I.)

Osten Sacken predicated *T. abdominalis* upon specimens with closed first posterior cell.[4] This is an adventitious character and due to giving it great weight, his conception of the species probably is faulty. Apparently we have two species or perhaps subspecies of this group, separable on the relative extent of the coarse and fine facets of the eyes of the males. Neither original description of *abdominalis* or *sulcifrons* mentions the males. The descriptions of the females are so alike that it is little wonder Osten Sacken seized avidly on the supposedly definite character of closed cell (which was mentioned only incidentally by another than the original describer.)

It seems wise, however, for the reason mentioned above, to place no reliance on this character. This procedure renders the name *exul* O. S. unnecessary. Since there is no appreciable difference in the original descriptions of *abdominalis* and *sulcifrons*, it seems base to base these forms on the character of the eyes in the males as pointed out by Osten Sacken. In *T. sulcifrons* the dividing line between the fine and coarse facets of the eyes lies much higher than in *T. abdominalis*, at about the middle of the height of the head. The portion of the eye below the line

[4] Osten, Sacken, C. R. Prodrome of a Monograph of the Tabanidae of the United States. Part II, The genus Tabanus. Mem. Bost. Soc. Nat. Hist. II, pp. 434–436, 1876.

forms almost a semicircle. In *T. abdominalis*, however, (as designated by Osten Sacken) this dividing line lies below the middle of height of head and the portion of a single eye below it is broadly sigmoid in outline.

Indications of intergrading occur, however, in this otherwise satisfactory structural character. The appearance of females collected with males of the two forms certainly suggests that the two will eventually be found to be fully connected by intergrades. The only difference at all apparent between two series of females is the more pronounced whitish appearance of the wing membrane, and less brownish suffusion along costa and veins in *sulcifrons* (as here separated).

T. superjumentarius Whitney.—Beltsville, Md., June 18 and July 4, 1916, July 10, 1909, McAtee; Chain Bridge, Va., July 19, 1916, T. E. Snyder; Falls Church, Va., July 1, 1914, Wm. Middleton.

T. trimaculatus Palisot de Beauvois.—Odenton, Md., July 4, 1913, Beltsville, Md., June 18, 1916, July 10, 1909, McAtee; Maryland near Plummers Island, July, 1907, Wm. Palmer; Plummers Island, Md., male, July 2, 1907, H. S. Barber; July 21, 1907, A. K. Fisher; Washington, D. C., male June 23, 1898, no collector given; June 24, 1906, McAtee; Great Falls, Va., June 12; Falls Church, Va., June 10 and 24, Nathan Banks.

T. trispilus Wiedemann.—Odenton, Md., July 4, 1913, McAtee; Beltsville, Md., male, June 25, 1915, R. C. Shannon; July 4, 1916, Walton, McAtee; July 16, 1916, Walton; Bladensburg, Md., June 23, 1916, R. C. Shannon; Maryland near Plummers Island, July 2, 1916, A. K. Fisher; Virginia near Plummers Island; Md., June 15, 1908, McAtee; Falls Church, Va., male on flowers of chinquaqin June 10, 1913, C. T. Greene; female on flowers of *Ceanothus*, June 14, Nathan Banks; Glencarlyn, Va., June 26, 1910, male on *Ceanothus* flowers, F. Knab.

T. variegatus Fabricius.—This species, which is related to *abdominalis* and *sulcifrons*, is not well understood and as noted in the discussion of *sulcifrons* the names for this group are confused. A thorough overhauling of this section of the genus is needed. *T. variegatus* is recorded from the District of Columbia by Osten Sacken. (See Bibliography.)

T. vivax Osten Sacken.—Beltsville, Md., August 8, 1915, Maryland near Plummers Island, July 2, 1916; Scotts Run, Va., July 25, 1915, McAtee; Falls Church, Va., July 3, 1916, J. N. Knull.

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Records *Chrysops niger, fallax* and *univittatus* and *Tabanus melanocerus* from Falls Church and vicinity, p. 109.

HINE, JAMES S. Tabanidae of Ohio, with a catalogue and bibliography of the species from America north of Mexico. Ohio Ac. Sci., Special paper, No. 5, 57 pp., 2 pls., May 1, 1903.

Six species of *Chrysops* and two of *Tabanus* listed from District of Columbia.

KNAB, F. What is Tabanus mexicanus? (Diptera, Tabanidae). Inseeutor Inscitiae Mens. 4, 1916, pp. 95–100.

Records *T. flavus* Maeq., from Garrett Park, Md.

MCATEE, W. L. Facts in the life history of Goniops chrysocoma. Proc. Ent. Soc. Wash. XIII, No. 1, (1910), 1911, pp. 21–29, Pls. 1–3.

Date of appearance and egglaying, egg guarding, parasites, habits on Plummers Island, Md. Part of these notes presented at meeting of July 7, 1910, see p. 70 same volume.

OSTEN-SACKEN, C. R. VON. Prodrome of a monograph of the Tabanidae of the United States. Mem. Boston Soc. Nat. Hist. 2.

Part 1. The genera Pangonia, Chrysops, Silvius and Haematopota, pp. 365–397, April 1875.

Chrysops moechus and *C. striatus* originally described from material in part from the District of Columbia; *C. univittatus* recorded.

Part 2. The genus Tabanus, pp. 421–479, April 20, 1876.

Five species recorded, one being *T. variegatus* Fabr., for which we have no other record.

Supplement, pp. 555–560, March 2, 1878.

Describes *Tabanus exul* from material collected at 4 localities, one of which is the District of Columbia. This is a synonym of *T. abdominalis*.

TOWNSEND, C. H. T. Contributions to the Dipterology of North America II—Tabanidae, Conopidae, Tachinidae, etc. Trans. Am. Ent. Soc., 22, pp. 55–60, March, 1895.

Gives local records for two species of *Chrysops*, and two of *Tabanus*, besides *Atylotus baa*[1] which is described as new.

A NEW COLLETID BEE FROM ECUADOR.

BY T. D. A. COCKERELL.

Colletes rohweri, new species.

Male.—Length about 8 mm., anterior wing 5.8 mm.; black, the head and thorax with long hair; head broader than long; malar space square; mandibles chestnut-red apically; labrum with two obtuse ribs; clypeus with

a median pit; antennae reaching metathorax; flagellum very obscurely brownish beneath, the middle joints much longer than broad; cheeks and front with long white hair, face with black and yellowish white mixed; hair of mesothorax grayish-white and black mixed, of scutellum black, of posterior part of thorax white, of sides of thorax grey, with a patch of black on mesopleura; mesothorax and scutellum shining, with sparse and rather small but distinct punctures; area of metathorax with a very strong transverse keel, above which are about six enclosed quadrangular shining spaces; posterior face of metathorax polished in middle, but coarsely rugosopunctate laterally; tegulae black; wings conspicuously brownish; second submarginal cell very broad, receiving first recurrent nervure about the middle; legs black, the tarsi reddish apically; abdomen with the first two segments smooth and shining, but the others with a very fine but evident sculpture; under the microscope the first segment is seen to have very sparse and minute piliferous punctures, the second has closer piliferous punctures, but the third has a minute transverse striation; first segment with long white hair at sides; segments 1-5 with apical white hair-bands, falling in middle of first.

Zaruma, Ecuador (*Frank W. Rohwer*), one, collected August, 1915. Apparently the only *Colletes* previously recorded from Ecuador is *C. rutilans* Vachal, a species with bright red hair on head and thorax. *C. rohweri* resembles *C. intermixtus* Swenk in the broad hind basitarsi, but the hind tarsi are much longer, and the spurs are normal. I do not know any very closely related S. American species; it is very distinct from those I have seen from Peru, and does not agree with any Central American or Brazilian form. Type in the author's collection.

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