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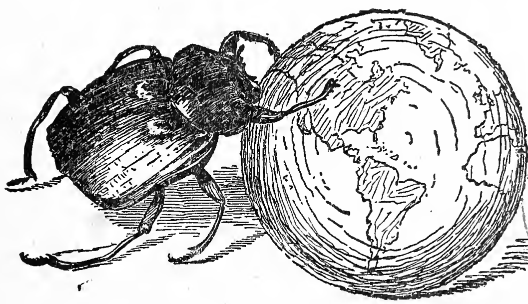

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CONTENTS

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THE EXTERNAL MORPHOLOGY OF THE PRIMITIVE TANYDERID DIPTERON PROTOPLASA FITCHII O. S., WITH NOTES ON THE OTHER TANYDERIDÆ[1]

By Inez W. Williams

INTRODUCTION

The purpose of this thesis is to furnish a complete description of the external anatomy of one of the most primitive representatives of the order Diptera, *Protoplasa fitchii* O. S., and to summarize the literature dealing with the family Tanyderidæ; in addition, to present a revised key to the genera of this family.

The material for morphological study consisted of alcoholic and dried specimens kindly furnished by Dr. G. C. Crampton and dried specimens from the collection of Dr. C. P. Alexander. With the exception of two of the Tanyderid wings which have been figured, all of the wash drawings were made from wing mounts contained in Dr. C. P. Alexander's unrivaled crane-fly collection.

ACKNOWLEDGMENTS

The writer wishes to express sincere thanks to Dr. G. C. Crampton not only for specimens but also for his kind suggestions and most generous help in the morphological study and the preparation of the plates and manuscript. The study of the

[1] Submitted as a thesis to the faculty of the graduate school in partial fulfillment of the requirements for the degree of Master of Science at the Massachusetts State College, June, 1932.

family Tanyderidæ was made possible through the kindness of Dr. C. P. Alexander who loaned the writer wing mounts from his extensive collection and, in addition, generously granted the use of his complete literature on the group. To him the author is indebted for his criticism of this thesis and his aid in the revision of the key to the genera.

EXTERNAL MORPHOLOGY

GENERAL APPEARANCE.

The adult of *Protoplasa fitchii* O. S. is predominantly grayish-brown in color, is relatively slender and measures about eight millimeters in length. The head is gray tinged with black and the sixteen-segmented antennæ are smoky gray-brown with a blackish tinge. The large, black, compound eyes are of particular interest because they have many short setæ arising between the ommatidia causing a "hairy-eyed" condition which is characteristic of the Tanyderids. The most conspicuous structures of the head are the long, brown, maxillary palpi which lie at the sides of the proboscis. Except for three faint brown stripes on the prescutum and the pale scutellum, the thorax is gray tinged with black. The wings are about eight millimeters in length and are striking in appearance due to the pattern which is composed of three bands of ring-like brown spots with paler brown centers. A supernumerary crossvein present in cell M_3 of the wing is the character which distinguishes *Protoplasa fitchii* from all other members of the family. The halteres are rather inconspicuous, pale, with brown clubs. The legs are long and slender and are yellowish-brown except the distitarsus and the distal portions of the femur and tibia which are dark brown. They have short, rather sparse setæ and conspicuous tibial spurs. The abdomen is brown with the posterior margins of the segments pale. The dististyles of the male hypopygium are bifid and have several strong setæ at the tip of the inner margin of the longer process.

HEAD.

There are no distinguishing sexual differences in the head and mouthparts of *Protoplasa fitchii,* so that the head of the male here figured will serve to illustrate the parts for both sexes.

In general the head is irregular in outline but the region of the head capsule behind the fronto-clypeus is subglobose. The occiput *ocp* is the part of the head capsule immediately behind the compound eyes *e* and dorsad of the occipital foramen *of* (Figs. 1, 2, and 4). On each side of the occiput there is a small structure called the occipital condyle *occ* which provides a point of articulation of the head with the laterocervicale *lc* possibly facilitating a nodding movement.

The occipital foramen *of* shown in Fig. 4 is the posterior opening of the head capsule through which the alimentary tract and nerves pass caudad into the thorax. Dorsally and laterally the occipital foramen is bounded by "chitinized thickenings" *th* which Peterson (1916) believes "arise from the ental surface of the paraocciput, a narrow piece about the dorsal and lateral margin of the occipital foramen." Figs. 3 and 4 indicate that these thickenings extend into the region of the gular pits *gp*.

Cephalad of the occiput in the dorsal region of the head is the vertex *v* (Fig. 1) which extends forward between the compound eyes to the posterior limits of the antennal fossæ. In its anterior portion the vertex is curved convexly. On the area behind the antennal fossæ are two protuberances (Figs. 1 and 2) which are more pronounced in some individuals of the species than in others.

The lateral margin of the antennal fossa bears a small projecting portion, the antennifer *anf* (Figs. 1 and 2) which is roughly triangular in shape and serves as pivot for the antenna. The anterior margin is bordered by the narrow gena *ge*.

The fronto-clypeus *fc*, an irregularly shaped sclerite cephalad of the genæ and the antennal fossæ, is formed by the fusion of the frons and clypeus. This portion of the head capsule is strongly curved and apparently serves as a shield for the bases of the mouthparts which are situated directly ventrad of it. Anteriorly the fronto-clypeus is bordered by the labrum *l*. The sclerotization of the labrum is reduced to a rather slender and indefinite medial portion while the remaining area is membranous. The labrum extends between the maxillary galeæ and is closely associated with the epipharynx.

The ventral regions behind the compound eyes *e* are the postgenæ *pge*. Between the postgenæ is the membranous gular region on each side of which is a gular pit *gp*.

Fig. 3 shows the head capsule with the dorsal portion removed to expose the internal structures. The tentorium *tnt* is reduced to two slender rods which probably represent the fused anterior and posterior arms. These rods extend from the gular pits or the mouths of the invaginations forming the posterior arms into the region of the fronto-clypeus.

APPENDAGES OF THE HEAD.

Antennæ. Osten-Sacken (1859) in his original description of *Protoplasa fitchii* recorded the antennæ as having fifteen segments. Alexander (1927b) states that they are sixteen-segmented. Fig. 7 clearly shows the scape, pedicel, postpedicel and thirteen flagellar segments, totaling sixteen. The scape *sca* is a relatively short and wide segment with a projection which serves as a pivot for the second segment, the subglobose pedicel *pd*. The postpedicel *ppd* is subovoid. With the exception of the terminal segment of the flagellum, the remaining segments are subcylindrical and vary in width, thereby appearing to taper somewhat. The terminal segment, however, is more slender than the preceding ones.

Mouthparts. The mouthparts include the labium, maxillæ, hypopharynx, and epipharynx; the mandibles are lacking.

As is shown in Fig. 9 there is no trace of a sclerotized gula and submentum. The mentum *mn* is reduced to a small and weakly sclerotized area which merges with the surrounding membrane. The sclerite labelled "*pgr*" is formed by the uniting palpigers. However, the fusion of the palpigers is not complete because the sclerites are still separated by a suture.

As in Mecoptera, the labial palpi are two-segmented. Together, the two segments form the labellum *lbl*. The basal segments are separated by membrane and are termed the basilabellum *bl*. The distal segments which form the distilabellum *dl* are weakly sclerotized with their inner margins membranous.

In comparison with the slender labium of *Tanyderus* (figured by Crampton, 1925b) that of *Protoplasa* is relatively short and stout and lacks the ligula or united glossæ and paraglossæ. The mentum of *Tanyderus* is definite, elongate, and well sclerotized. The underlip of *Macrochile* is also elongate and has a definite and well sclerotized mentum.

The maxillæ lie at the sides of the labium with the well developed maxillary palpi *mxp* extending some distance beyond the distilabellum (Figs. 6, and 9). These palpi are composed of five segments, the first of which is subglobular in shape; the succeeding two segments are subequal in length, while the fourth is shorter. The terminal or fifth segment is the longest and is rounded at the tip. Between the maxillary palpus and the basilabellum is the maxillary galea *ga* which is blade-like and extends forward a distance equaling the length of the distilabellum. A small sclerite labelled "*pfr*" which lies between the first segment of the palpus and the stipes probably represents the palpifer. The stipes *sti* is extremely long and slender extending caudad nearly to the region of the gular pits.

Ventrad of the labrum-epipharynx and closely associated with it is the hypopharynx *hp* (Fig. 8). As is shown in Fig. 8, the hypopharynx is lance-shaped and is divided into a distal, unpaired, median piece and a proximal paired area (Peterson, 1916). According to Peterson (1916), the salivary duct *sd* enters the proximal end of the hypopharynx just dorsad of its attachment to the labium and extends through it to its distal end.

The epipharynx *ep* (Fig. 5) is attached laterally to the membranous area of the labrum and is composed of a sclerotized median piece and lateral sclerotized pieces. Peterson termed these lateral structures "tormæ" *to*. The bases of the tormæ have a hinge-like connection with the basipharynx.

The basipharynx *bp* (Fig. 8) or the fulcrum is a sclerotized tube-like structure. It is closely associated with the basal portions of the epi- and hypopharynx and Peterson (1916) believes that it is formed by the fusion of the basal regions of these two structures. The posterior part of the basipharynx is extended to form two projections called the "cornua" *cu*. In the membranous region between these projections the oesophagus *oes* opens anteriorly.

THORAX.

The thorax of *Protoplasa fitchii* has been figured by Crampton (1925a and 1926b). In his 1926 publication he also includes figures of the thoraces of the Tanyderid genera *Macrochile, Tanyderus,* and *Péringueyomyina,* and in general the thoraces of these genera bear a striking resemblance to one another. The prothorax and metathorax are greatly reduced while the mesothorax or wing-bearing segment is large to accommodate the muscles of flight. The metathorax bears the halteres.

Neck Region. The walls of the membranous neck region which is cephalad of the prothorax are strengthened by two large plates, the laterocervicalia *lc* (Fig. 10). In *Protoplasa* these plates are relatively short and broad. In *Tanyderus,* however, they are long and slender, thereby forming an extremely long neck region. *Macrochile* and *Péringueyomyina* have small laterocervicalia which are more or less closely associated with the prothorax. The neck of *Protoplasa* is intermediate between the long-necked condition of *Tanyderus* and the shorter one of *Macrochile* and *Péringueyomyina.* On its anterior border the laterocervicale has a ventral finger-like projection, the cephaliger *ce* (Fig. 2), which articulates with the occipital condyle of the head. Its posterior border reaches the prothorax. A ventral view (Fig. 6) shows that each laterocervicale has a small and nearly elliptical, membranous area which has been called the "laterocervical fenestra" *lcf* (Crampton, 1925c).

Prothorax. The pronotum *pn* or dorsal area of the prothorax is divided into the antepronotum *apn* or anterior portion and the postpronotum *ppn* or posterior portion. The postpronotum is the restricted area between the prescutum of the mesothorax and the membrane surrounding the mesothoracic spiracle. The prothoracic pleuron is composed of an episternum *es* or anterior sclerite and an epimeron *em* or posterior sclerite. Dorsally the episternum *es* is fused with the antepronotum although its dorsal limit is the region of the notch into which the dorsal part of the laterocervicale fits. The epimeron *em* is demarked from the episternum by an indistinct suture and extends dorsad from the region of the coxa to fuse with the postpronotum. The sternum of the prothorax is demarked into a presternum, basisternum and furcasternum. The presternum is the most anterior and is a small ovate sclerite lying between the caudal limits of the latero-cervicalia. Between the prothoracic coxæ and caudad of the presternum is the basisternum which is rather small and nearly square. The furcasternum is shield-shaped with the anterior portion lying in the area between the coxæ and its posterior portion extending caudad between the ventral limits of the mesothoracic sternopleura. The coxa cx_1 is subcylindrical and about equals the size of the eucoxa of the mesothorax or the coxa of the metathorax.

Mesothorax. The mesothoracic spiracle *sp* lies in the membrane between the postpronotum and the anterior division of the mesothoracic anepisternum. In the mesonotum the prescutum, scutum, and scutellum are demarked by sutures. The prescutum psc_2 and the scutum sc_2 together form a dome-like region. The prescutum occupies the anterior and dorsal extent of this dome-like region and the scutum occupies the remainder. The scutum is divided into an anterior and posterior portion by a transverse scutal suture *ss*. The scutellum sl_2 is lobe-like and is separated from the postscutellum by a membranous area. Sutures divide the postscutellum into a median sclerite or mediotergum mt_2 and two lateral sclerites or pleuroterga pt_2. The pleural suture *c* which extends from the region of the eucoxa ec_2 dorsad to some indefinite point near the base of the wing, divides the mesothoracic pleuron into an episternal and an epimeral region. Cephalad of this suture is the episternum which is divided by the anepisternal suture *a* into a dorsal region, the anepisternum aes_2 and a ventral region, the sternopleurum spl_2. A membranous cleft which extends downward as far as the anepisternal suture *a* splits the anepisternum into an anterior part, which is fused with the sternopleurum, and a posterior part. In *Tanyderus* the membranous cleft is short and broad while in *Macrochile* it is represented only by a suture. The anepisternal suture in both of these genera extends cephalad only as far as this cleft as is the case in *Protoplasa.* The ventral portion of the episternum is fused with the sternum and is termed the sternopleurum spl_2.

The small irregular subalifer *saf* lies between the anepisternum and the anepimeron with its posterior limit demarked by the pleural suture *c*. Close relatives of the Tanyderids (the Psychodids and Ptychopterids) as well as other Tanyderids figured by Crampton (1925a and 1926a) have the subalifer clearly demarked and of the same contour as that of *Protoplasa*. The epimeron is the posterior region of the pleuron and is demarked by the transverse anepimeral suture *b* into a dorsal area or anepimeron aem_2 and a ventral area or meropleurum mpl_2. The meropleurum is formed by the fusion of the meron and the katepimeron. This fusion of the meron with the epimeron to form the meropleurum is characteristic of Nematocerous families Tanyderidæ, Ptychopteridæ and Psychodidæ. No other Nematocera with the exception of the Blepharoceridæ exhibit this condition. Although the sternum of the mesothorax lacks a presternal region, there is a small basisternum lying between the sternopleura and a relatively large furcasternum which separates the eucoxæ. The eucoxa ec_2 alone forms the basal segment of the mesothoracic leg, the meron having fused with the epimeron as mentioned above.

Metathorax. Like the prothorax, the metathorax is greatly reduced. The metanotum mtn_3 is a narrow region extending along the posterior border of the postscutellum of the mesothorax. Dorsad of the episternum of the metathoracic pleural region is the metathoracic spiracle *sp*. The episternum es_3 is reduced to a wedge-shaped sclerite and is demarked from the narrow and elongate epimeron em_3 by a pleural suture. The metasternum is represented in lateral view by a small triangular sclerite labelled st_3. In ventral aspect, however, it is composed of a small basisternum which is faintly demarked and fused with the poorly defined furcasternum caudad of it. The coxæ cx_3 lie at the sides of the furcasternum.

APPENDAGES OF THE THORAX.

The legs of the *Protoplasa* are essentially the same, therefore that of the prothorax has been figured as representative. It is very slender and longer than the body. Fig. 13 shows that the coxa *cx* is of moderate size and that the trochanter *tr* is small. The coxa of the mesothorax differs from the coxæ of the other segments in that it is composed of the eucoxa alone. The femur *fe* and the tibia *ti* of the prothoracic leg are subequal in length. At the distal end of the tibia there are two well developed and moveable spines. The basitarsus *bta* is equal to about three-fourths of the length of the tibia, and like the tibia bears two spines distally. The second tarsal segment is about one-half the length of the basitarsus and bears two spines; the third segment is about one-half the length of the second or preceding one and also bears two spines; while the fourth segment is smaller than the third and has no spines. The distitarsus *dta* or terminal segment bears several spines and two ungues or claws *un*.

The wing of *Protoplasa fitchii* has been figured many times and its venation is recognized as being very primitive. Fig. 13 shows the various distinguishing features interpreted according to Tillyard. With the exception of the supernumerary crossvein of cell M_3 most of the characters are present in Tanyderids in general.

The subcosta is two-branched $Sc_{1,2}$; the radius is five-branched $R_{1,2,3,4,5}$; the media four-branched $M_{1,2,3,4}$; and the cubitus *Cu* has one branch. There are two anals *1st A* and *2nd A*. Cell R_2 is shorter than its petiole and has its base lying beyond the midlength of the distal section of R_1. Cell *1st* M_2 is long, broadened distally and is closed. The two cells beyond are comparatively short. Cell M_3 has a supernumerary crossvein peculiar to *Protoplasa*. Between the cubitus *Cu* and the first anal *1st A* there is an indefinite vein or fold which runs close to *Cu* for about three-fourths of its length and is labelled *pa* in Fig. 12. According to Tillyard this would be Cu_2 but according to Comstock it is *1st A*. Crampton (1926a) calls it the "preanal." The second anal *2nd A* forms the so-called "T" vein characteristic of the Tanyderids as a whole. The radio-medial crossvein *r–m* has what appears to be the stub of a vein at its anterior end. Crampton (1926a) suggests its possible phylogenetic significance. The medial crossvein *m* is always present in the Tanyderids. The humeral *h* and the medio-cubital *m–cu* crossveins are of no particular importance.

The haltere *ha* (Fig. 11) is stalked and knob-like at the end. Basally it is mostly membranous and the stalk is only weakly sclerotized. The distal end is subglobose with a transverse suture or fold which divides it into two distinct hemispherical parts, the dorsal one of which is the larger and overlaps the other. The smaller portion bears three setæ.

ABDOMEN.

The abdomen of *Protoplasa fitchii* has nine distinct segments; the tenth and eleventh are fused and indefinite. Crampton (1926a) has indicated the same condition in *Macrochile,* and in his 1931 publication (Crampton 1931a) the figures show that the primitive Mecopteran, *Notiothauma,* which is closely allied to the Diptera, is strikingly similar. There is a marked "telescoping" of all the segments and this condition tends to make them appear more variable in length than they are actually. Fig. 20 shows that the first, second, and eighth segments are relatively short; the third, fourth, and fifth are intermediate; while the sixth and seventh are the longest. The ninth and the fused tenth and eleventh are indefinite because of their modification. Figs. 16, 19, and 20 show clearly that the first eight segments are composed of a dorsal sclerotized region or tergite *1t* to *8t* separated from the ventral sclerotized area or sternite *1s* to *8s* by a lateral membranous area. In this membrane between the tergite and sternite, the spiracle *sp* of the segment is borne. The first abdominal spiracle, however, is situated more dorsally in the membrane between the metathoracic epimeron and the first abdominal tergite.

In the male there is a strong twisting or torsion of the terminal segments to facilitate mating. Fig. 20 shows this twisted condition as a result of which the tergites of the seventh, eighth, and ninth segments occupy a lateral position instead of being dorsal as they are normally. The male differs from the female in that the ninth segment is the first to show modification. The ninth tergite *9t* which Crampton (1926a) termed the "epandrium" in *Macrochile,* is bilobed (Figs. 18, 19, and 20). In *Macrochile* the lobes are not so pronounced as they are in *Protoplasa.* The cerci *bc* of the male are reduced to one segment. These basicerci, as they are called, lie in the membrane behind the ninth tergite and at the sides of the area which corresponds to the anus-bearing proctiger of *Macrochile.* The basicerci represent the basal portions of the cerci. In *Macrochile* the cerci are likewise one-segmented but the proctiger or anus-bearing structure is more clearly demarked. The gonopods or copulatory limbs are composed of two segments. The basal segment *bst* (Figs. 14, 18, 19, and 20) of the gonopod is variously termed by different authors as basistyle or coxite. As yet it is unsettled whether the basal segments are coxites or merely segments of the style. In *Protoplasa* these so-called coxites or basistyles *bst* are either united basally or fused with adjacent structures such as the ninth sternite, etc., as Crampton suggests in the case of *Macrochile.* The distal portion *dst* of the gonopod variously termed the style, gonostyle, dististyle, or clasper is rather deeply forked in *Protoplasa,* forming a comparatively short basal process *sap* and a longer distal process *ap* which bears a peculiar tuft of spines at the tip of its inner margin. Like *Protoplasa, Macrochile* has a forked style or dististyle with an elongate distal process and a rather short basal process. In *Tanyderus* and *Péringueyomyina* the style or dististyle is not forked. It is short in *Tanyderus,* but in *Péringueyomyina* it is very long and slender and has a series of spines along its inner margin. Each coxite or basistyle has on its dorsal surface a weakly sclerotized, lobe-like structure *int* which perhaps corresponds to the interbase (Figs. 14, 17, and 18). The so-called gonapophyses *gap* are probably represented by a pair of elongate projections flanking the aedeagus and having their bases imbedded in the basal region of the coxites or basistyles (Figs. 14, 17, 18, and 19). A sclerotized process *aed* with three prongs shown in Figs. 14, 17, and 18, together with a supporting collar-like portion may represent the aedeagus. This structure lies in the membranous area between the coxites or basistyles and the basicerci. The aedeagus in *Macrochile* is an elongate and bifid structure.

Differentiation of the terminal segments of the female of *Protoplasa* begins in the eighth abdominal sclerite which is not so much reduced as in the male. The eighth sternite *8s* bears a pair of lobe-like projections *vv* but these apparently are not homologous with the structures called the ventral valves in *Macrochile.* There is a small sclerite *ls* between the ninth tergite and the eighth sternite which may possibly be the reduced ninth sternite. In *Protoplasa* there is no structure homologus to the mediogynium or projection between the ventral valves of *Macrochile.* Unlike that of the male, the cercus of the female has two segments, the basicercus *bc* and the disticercus *dc.* Both of these segments are relatively large and rounded. In *Macrochile* the disticercus is reduced to a pointed process and the basicercus is bilobed.

GENERAL ACCOUNT OF THE FAMILY TANYDERIDÆ

The family Tanyderidæ represents a group of the most primitive of all living Diptera. Osten-Sacken (1859, 1869, 1880, 1886) and Philippi (1865) considered that its members belonged to the family Tipulidæ. Handlirsch (1909), however, grouped them with the Ptychopteridæ as the subfamilies Tanyderina and Macrochilina. Enderlein (1912), Alexander (1913), and Riedel (1921) likewise classified them as a subfamily under the Ptychopteridæ. In 1919, Alexander in a key to the crane-flies of Northeastern North America included these flies as a distinct family, the Tanyderidæ, characterized by possession of five branches of the radius which reach the wing margin and by the presence of a single anal vein. Crampton (1926b) showed that because of their close affinities to the Psychodidæ, these primitive flies should be placed in the superfamily Psychodoidea rather than in the Tipuloidea as was formerly the case. Studies of the recently discovered immature stages of *Protoplasa fitchii,* which is considered representative of the family, proved the group to be isolated from either the Psychodidæ or the Ptychopteridæ (Alexander, 1930a; Crampton, 1930a, 1930b). The Bruchomyiinæ which are now placed as a subfamily of the Psychodidæ (Alexander, 1928a; Crampton, 1925a, 1926a; Tonnoir, 1922) were previously considered as representing a subfamily of the Tanyderidæ (Alexander, 1920c, 1927b).

Knowledge of the immature stages of the Tanyderids was lacking until June, 1929, when Alexander (1930a) and Crampton (1930a, 1930b) discovered the larva and pupa of *Protoplasa fitchii* on the Gaspé Peninsula, Quebec. Prior to this time, a unique Dipterous larva from the vicinity of Washington, D. C., described by Alexander (1920c) as the "supposed larva" of *Protoplasa fitchii* was the only immature form considered as possibly representing the family. Because of the recent discovery of the larva and pupa of *Protoplasa fitchii,* students of Diptera are at a loss as to the exact affinities of this "supposed larva."

Phylogeny. The oldest known Tanyderid is the Baltic Amber *Macrochile spectrum* Loew. Crampton (1926a) places this insect at the base of one of the lines of descent of Diptera which leads to the Psychodoids. Handlirsch (1909) derives *Macrochile* from the Archiptychoptera in the latter part of the Cretaceous period and, according to him, from *Macrochile* arise *Protanyderus, Protoplasa, Tanyderus, Radinoderus,* and *Mischoderus* in the Tertiaries. According to Alexander (1932), the Lower Tertiary Etoptychoptera (Handlirsch, 1910) shows certain points of resemblance to *Macrochile* in the nature of the radial and medial fields of the wing but has two anal veins. The Mesozoic Eoptychopteridæ also differ from the Tanyderidæ. Tillyard's *Permotipula* described from the Permian deposits of New South Wales (Tillyard, 1929) shows a highly modified radial field of the wing and indicates that Diptera arose in the Palæozoic era.

Genera. The genera composing the Tanyderidæ number ten living and one fossil. *Macrochile* Loew (1851), the fossil genus, was the first to be described. It is known only from the Lower Oligocene Baltic Amber. For some time Osten-Sacken and Meunier thought this genus to be synonymous with the recent genus *Protoplasa.* In 1859 *Protoplasa* was described by Osten-Sacken. Philippi (1865) defined the genus *Tanyderus* in which most of the known species were placed until Handlirsch (1909) proposed *Protanyderus, Mischoderus,* and *Radinoderus* as new generic groups. Alexander (1927b) regarded these groups proposed by Handlirsch as valid subgenera and added *Neoderus* for the Neotropical *Tanyderus patagonicus* Alexander (1913) and *Nothoderus* for the Australasian *Tanyderus australiensis* (Alexander, 1922). In 1928, however, Alexander (1928b) recognized these subgenera as having full generic rank. *Péringueyomyina* was described by Alexander in 1921 as a new and very striking genus. *Eutanyderus* was described by him in 1928 (Alexander, 1928b) and *Araucoderus* in 1929 (1929b).

The following key to the genera of the Tanyderidæ is a revision of that given by Alexander (1928b).

KEY TO THE GENERA OF THE TANYDERIDÆ

1. Front prolonged into a slender rostrum that is longer than the combined head and thorax, the reduced mouthparts being borne at the extreme apex; wings immaculate; male hypopygium with the styli very elongate. (*Ethiopian:* Cape Colony.)
PÉRINGUEYOMYINA Alexander (Fig. 22)
Front not greatly prolonged, the rostrum relatively short, any elongation that exceeds the head in length being due to the palpi and other mouthparts; wings pictured in all recent species; male hypopygium with the styli short........2
2. Wings immaculate. (*Fossil:* Lower Oligocene, Baltic Amber.)
MACROCHILE Loew. (Fig. 21)
Wings pictured, the pattern usually crossbanded brown and subhyaline...3
3. Wings with the free tip of *Sc* preserved. (*Australasian:* Tasmania.)
NOTHODERUS Alexander (Fig. 28)
Wings with free tip of *Sc* atrophied........4
4. Cervical sclerites shorter than the pronotum, the neck-region short; male hypopygium with the dististyle more or less bifid........5
Cervical sclerites elongate, equal to or exceeding the pronotum, the two together form a conspicuous neck-region; male hypopygium with the dististyle simple, terete........6
5. A supernumerary crossvein in cell M_3 of the wing. (*Eastern Nearctic.*) ....*PROTOPLASA* Osten-Sacken (Fig. 33)
No supernumerary crossveins in any cells of the wing. (*Western Nearctic; Palæarctic.*)—*PROTANYDERUS* Handlirsch (Figs. 30, 31, 32)
6. No supernumerary crossveins in any cells of the wing........7
Supernumerary crossveins in two of the radial cells of the wing........9
7. Wings with a short fusion of veins R_{2+3+4}, basal section of R_5 subequal to this element. (*Australasian:* Pupa, Australia.)
RADINODERUS Handlirsch (Figs. 35, 36, 37)
Wings with R_s before the level of $r\text{–}m$, the elements R_{2+3} and R_{4+5} being entirely separate........8
8. Antennæ 15-segmented; cell R_2 of the wings shorter than its petiole. (*Australasian:* Victorian.)........*EUTANYDERUS* Alexander (Fig. 26)
Antennæ 18-segmented; cell R_2 of the wings longer than its petiole. (*Neotropical:* Chile.)........*ARAUCODERUS* Alexander (Fig. 29)
9. Wings without a supernumerary crossvein in cell R_4, these being in cells R_3 and R_5. (*Neotropical:* Patagonia.)
NEODERUS Alexander (Fig. 27)
Wings with supernumerary crossveins in cell R_4........10
10. Wings with supernumerary crossveins in cells R_4 and R_5; a short element R_{2+3+4}. (*Neotropical:* Chile.)......*TANYDERUS* Philippi (Fig. 34)
Wings with supernumerary crossveins in cells R_3 and R_4; R_s forking far before the level of $r\text{–}m$, veins R_{2+3} and R_{4+5} distinct. (*Australiasian:* New Zealand.)........*MISCHODERUS* Handlirsch (Figs. 23, 24, 25)

SPECIES OF THE TANYDERIDÆ.

The genus *Araucoderus* contains a single species *A. gloriosus* Alexander (1929b) which is Neotropical from Central Chile (Fig. 29).

Eutanyderus has but one species *E. wilsoni* Alexander (1928b) which is Australasian being found only in the mountains of Victoria, Australia (Fig. 26).

Macrochile is likewise a monotypic genus. *M. spectrum* Loew (1851) was described from the Lower Oligocene Baltic Amber. Fig. 21 is copied from Crampton (1926a).

Mischoderus has five species, all of which are Australasian, being confined to New Zealand. *M. annuliferus* was described by Hutton (1900) (Fig. 24); *M. forcipatus* by Osten-Sacken (1880) (Fig. 23); *M. marginatus* Edwards (1923) and *M. neptunus* Edwards (1923) which may not represent distinct species but merely variations of *M. forcipatus;* and *M. varipes* Edwards (1923) (Fig. 25).

Neoderus has but one species, *N. patagonicus* Alexander (1913) which is Neotropical, occurring only in Patagonia. Fig. 27 is after that of Alexander (1913).

Nothoderus is likewise represented by a single species, *N. australiensis* Alexander (1922) which is Australasian, occurring in the mountains of southern Tasmania (Fig. 28).

Péringueyomyina has one species, *P. barnardi* Alexander (1921), from Cape Colony in the Ethiopian region (Fig. 22).

Protanyderus has four species, all of which are Holarctic. *P. beckeri* Riedel (1920) was taken in Turkestan (Fig. 31); *P. vanduzeei* Alexander (1918) (Fig. 30) and *P. vipio* Osten-Sacken (1877) (Fig. 32) were taken in western North America;

FIGURE 1. Wing of *Protanyderus esakii* Alex.

and the recently described *P. esakii* Alexander (1932) is from Japan.

Protoplasa has a single species, *P. fitchii* Osten-Sacken (1859), occurring in the Eastern Nearctic region (Fig. 33).

Radinoderus includes seven species, all from the Australasian region. *R. dorrigensis* Alexander (1930b) is from northern New South Wales (Fig. 35); *R. mirabilis* De Meijere (1915) is from New Guinea (Fig. 37); *R. occidentalis* Alexander (1925) is from western Australia; *R. oculatus* Riedel (1912) is from New Guinea; *R. ornatissimus* Doleschall (1858) is from Amboina, Obi; *R. solomonis* Alexander (1924) is from the Solomon Islands (Fig. 36); and *R. terræ-reginæ* Alexander (1924) is from Queensland (Fig. 38).

Tanyderus as now restricted is represented by a single species, *T. pictus* Philippi (1865), which is Neotropical, being found only in Central Chile.

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ABBREVIATIONS

a —anepisternal suture
aed —aedeagus
aem —anepimeron
aes —anepisternum
anf —antennifer
ap —apical or outer process
apn —antepronotum

b —anepimeral suture
bc —basicercus
bl —basilabellum
bp —basipharynx
bst —basistyle
bta —basitarsus

c —pleural suture
ce —head bearing process (cephaliger) of the lateral cervical plate
cu —cornua
cx —coxa

dc —disticercus
dl —distilabellum
dst —dististyle (claspers)
dta —distitarsus

e —compound eye
ec —eucoxa
em —epimeron
ep —epipharynx
es —episternum

fc —frontoclypeus
fe —femur
fl —flagellum

ga —galea
gap —gonapophysis (paramere)
ge —gena
gp —gular pit

ha —haltere
hp —hypopharynx

int —interbase

l —labrum
lbl —labellum
lc —lateral cervical plate (laterocervicale)
lcf —laterocervical fenestræ
ls —? 9th sternite

mn —mentum
mpl —meropleurum
mt —mediotergum
mtn —metanotum
mxp —maxillary palp

occ —occipital condyle
ocp —occiput
oes —oesophagus
of —occipital foramen

pd —occipital condyle
pfr —palpifer
pge —postgena
pgr —palpiger
pn —pronotum
ppd —postpedicel
ppn —postpronotum
psc —prescutum
pt —postalare or pleurotergum

s —sternite
saf —subalifer
sal —subalare
sap —basal process of dististyle
sc —scutum
sca —scape
sd —salivary duct
sl —scutellum
sp —spiracle
spl —sternopleurum or katepisternum
ss —scutal suture

st —sternum
sti —stipes

t —tergite
th —thickening
ti —tibia
tnt —tentorium
to —tormae
tr —trochanter

un —ungues or claws

v —vertex
vv —lobes of 8th sternite of female

1st A —first anal
2nd A—second anal
C —costa
Cu —cubitus
h —humeral crossvein
m —medial crossvein
M_1 —1st branch of media
M_2 —2nd branch of media
M_3 —3rd branch of media
M_4 —4th branch of media
m–cu —medio-cubital crossvein
pa —"preanal vein"
R_1 —1st branch of radius
R_2 —2nd branch of radius
R_3 —3rd branch of radius
R_4 —4th branch of radius
R_5 —5th branch of radius
R_s —radial sector
r–m —radio-medial crossvein
Sc_1 —1st branch of subcosta
Sc_2 —2nd branch of subcosta

PLATE I

Fig. 1—Dorsal view of the head
Fig. 2—Lateral view of the head
Fig. 3—Head with dorsal portion removed to show tentorium
Fig. 4—Caudal view of the head
Fig. 5—Epipharynx
Fig. 6—Ventral view of the head
Fig. 7—Antenna
Fig. 8—Hypopharynx
Fig. 9—Labium and maxillæ

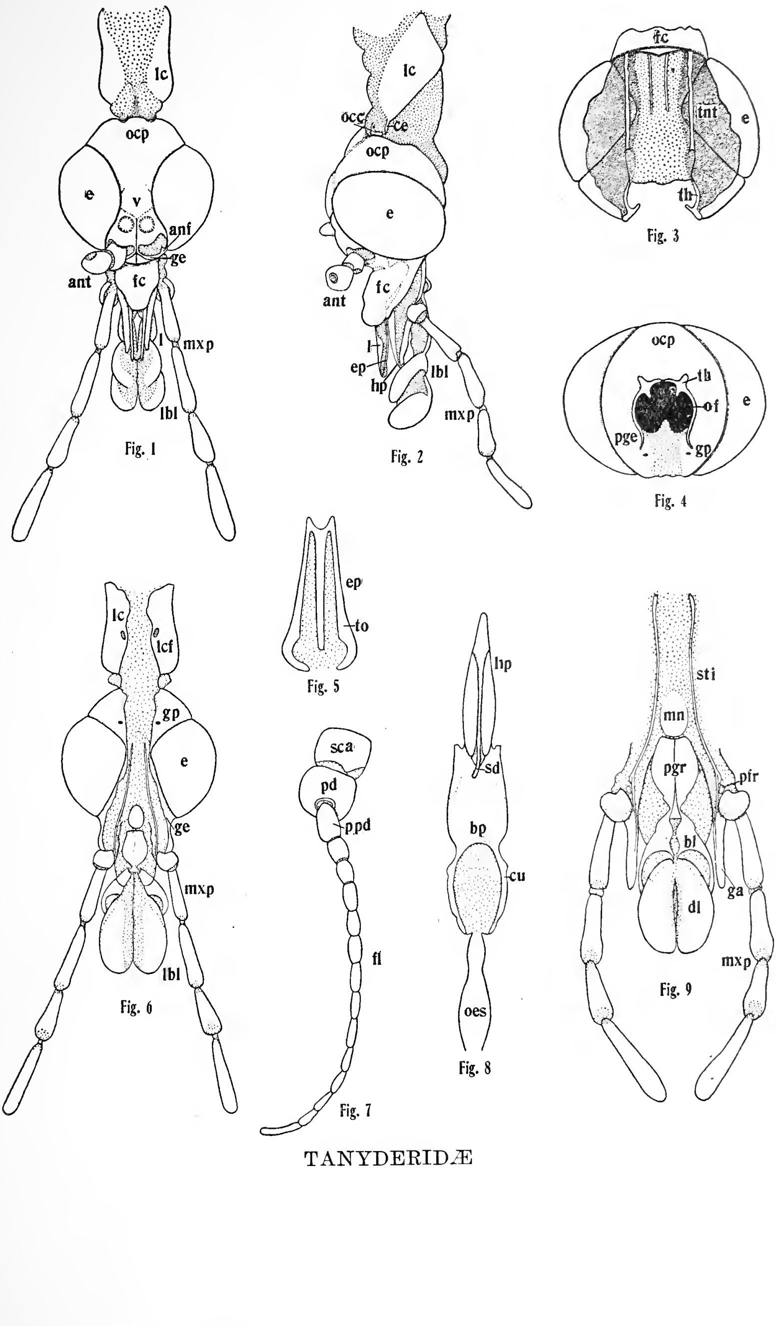

Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5 Fig. 6 Fig. 7 Fig. 8 Fig. 9

TANYDERIDÆ

PLATE II

Fig. 10—Lateral view of the thorax
Fig. 11—Haltere
Fig. 12—Wing
Fig. 13—Prothoracic leg of male

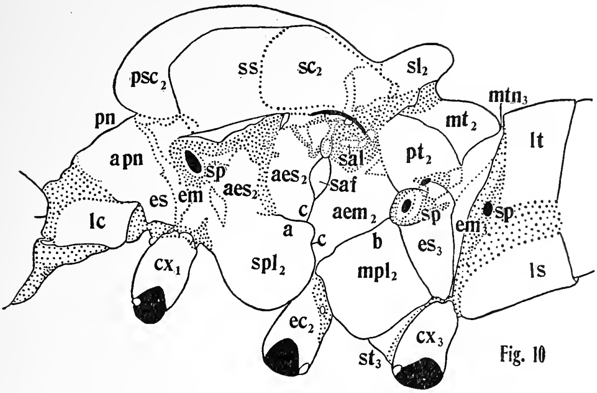

Fig. 10

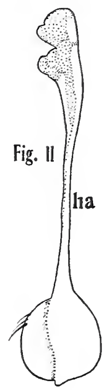

Fig. 11

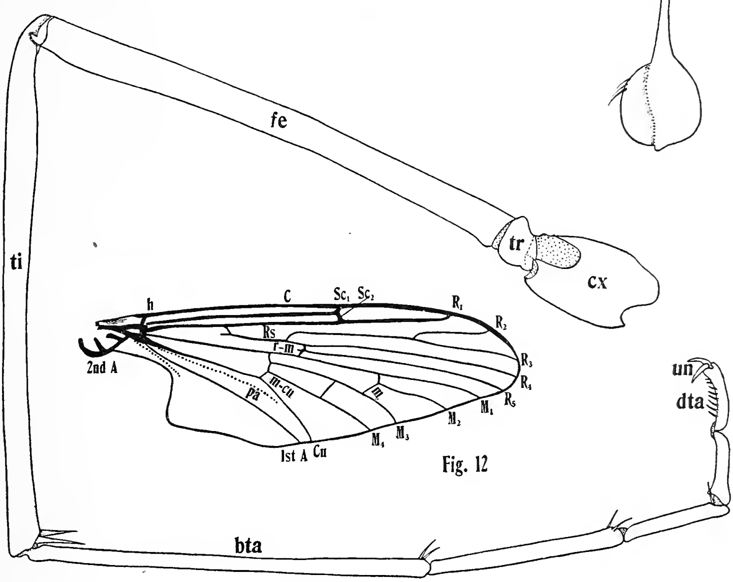

Fig. 12

Fig. 13

TANYDERIDÆ

PLATE III

Fig. 14—Ventral view of the terminal abdominal structures of the male
Fig. 15—Ventral view of the terminal abdominal structures of the female
Fig. 16—Lateral view of the terminal abdominal structures of the female
Fig. 17—Dorso-caudal view of the terminal abdominal structures of the male
Fig. 18—Dorsal view of the terminal abdominal structures of the male
Fig. 19—Lateral view of the terminal abdominal structures of the male
Fig. 20—Lateral view of the abdomen of the male

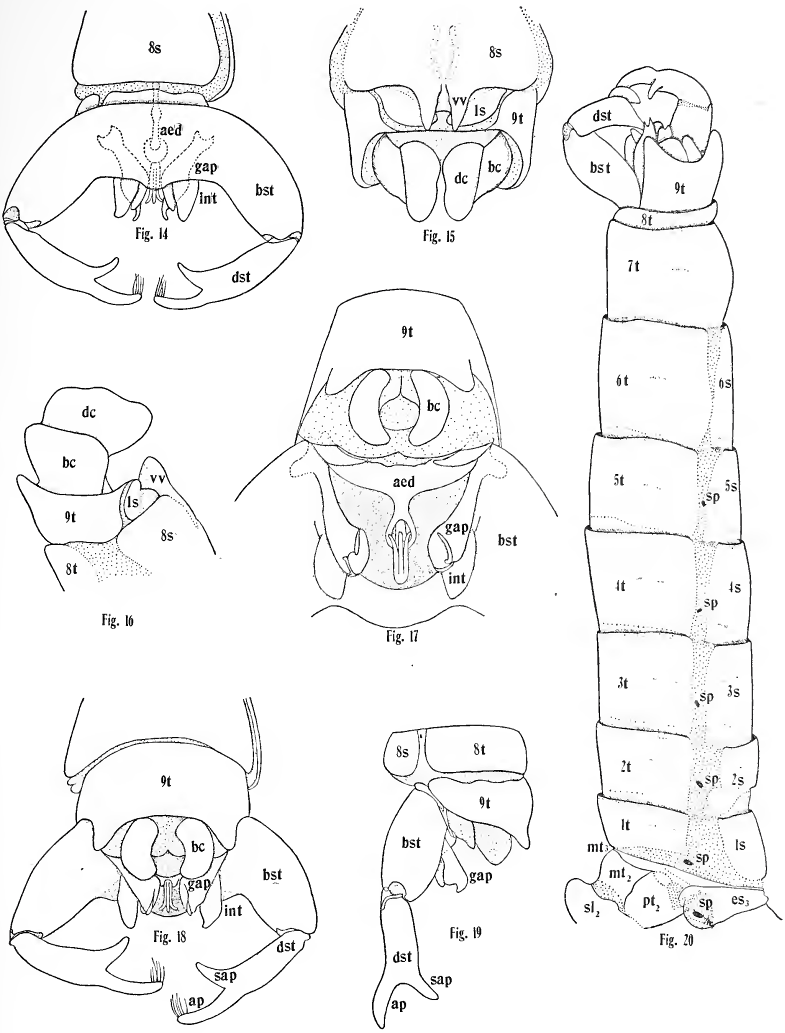
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Fig. 14
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Fig. 18
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gap
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sap
ap
Fig. 19

TANYDERIDÆ

PLATE IV

Fig. 21—Wing of *Macrochile spectrum* Loew (copied from Crampton's figure)
Fig. 22—Wing of *Péringueyomyina barnardi* Alex.
Fig. 23—Wing of *Mischoderus forcipatus* O. S.
Fig. 24—Wing of *Mischoderus annuliferus* Hutt.
Fig. 25—Wing of *Mischoderus varipes* Edw.

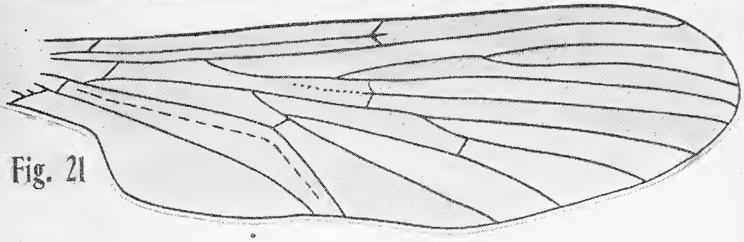


Fig. 21

Fig. 22

Fig. 23

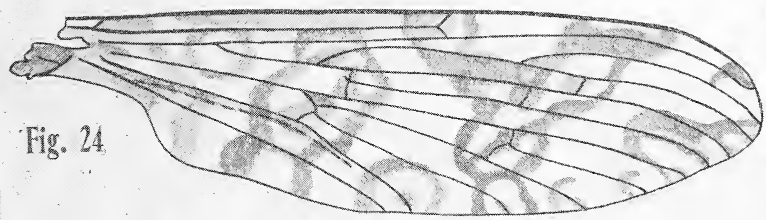


Fig. 24

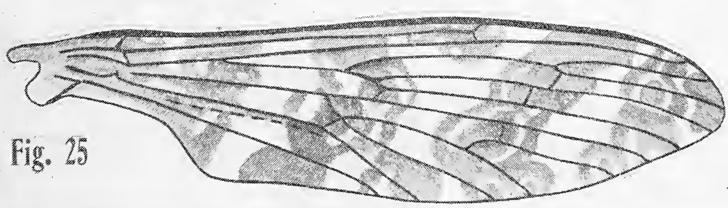
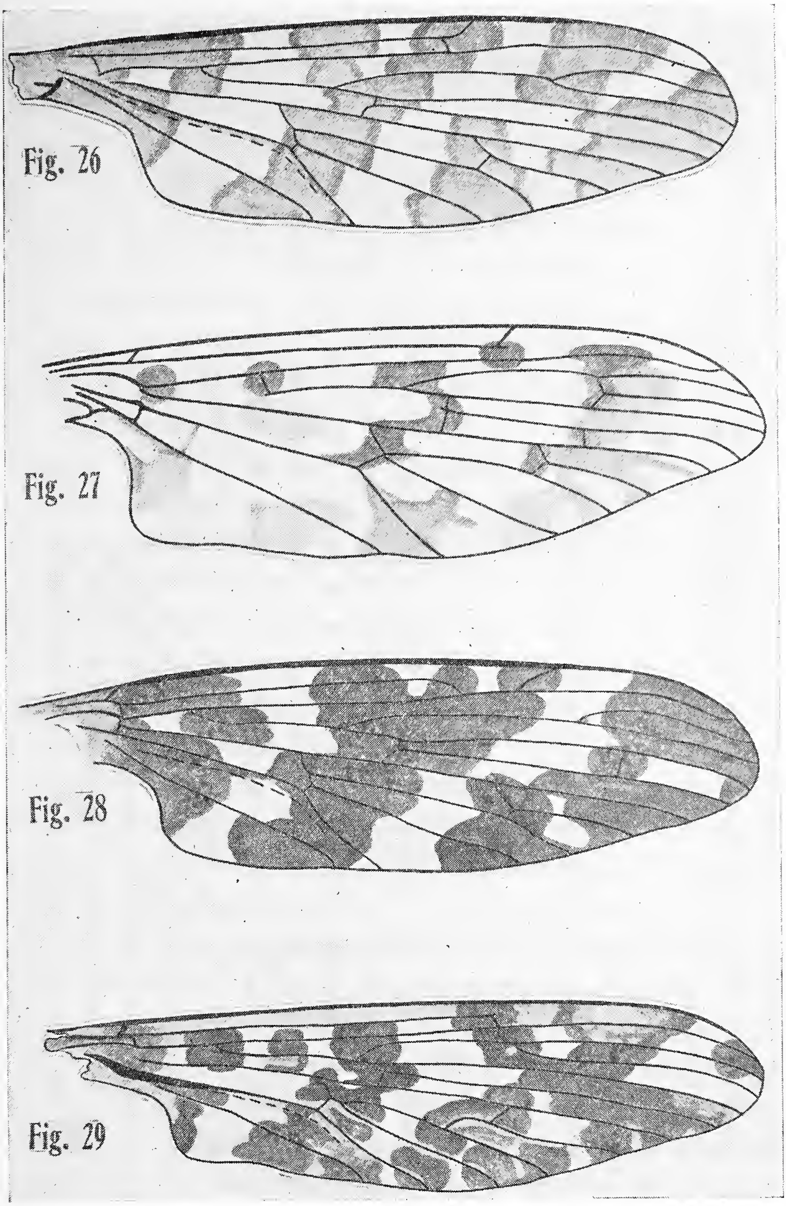


Fig. 25

TANYDERIDÆ

PLATE V

Fig. 26—Wing of *Eutanyderus wilsoni* Alex.
Fig. 27—Wing of *Neoderus patagonicus* Alex. (after Alexander)
Fig. 28—Wing of *Nothoderus australiensis* Alex.
Fig. 29—Wing of *Araucoderus gloriosus* Alex.



TANYDERIDÆ

PLATE VI

Fig. 30—Wing of *Protanyderus vanduzeei* Alex.
Fig. 31—Wing of *Protanyderus beckeri* Riedel.
Fig. 32—Wing of *Protanyderus vipio* O. S.
Fig. 33—Wing of *Protoplasa fitchii* O. S.

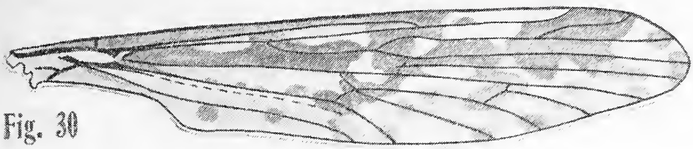


Fig. 30

Fig. 31

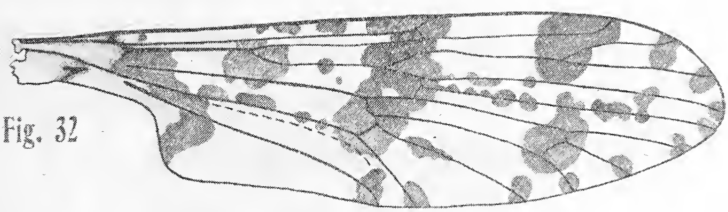


Fig. 32

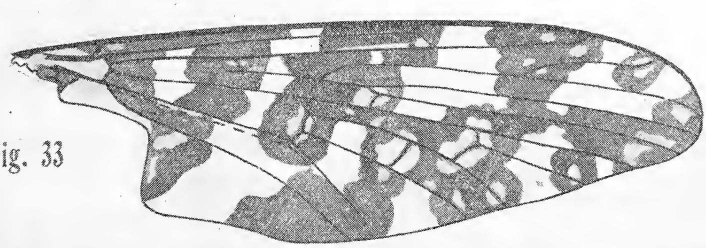


Fig. 33

TANYDERIDÆ

PLATE VII

Fig. 34—Wing of *Tanyderus pictus* Phil.
Fig. 35—Wing of *Radinoderus dorrigensis* Alex.
Fig. 36—Wing of *Radinoderus solomonis* Alex.
Fig. 37—Wing of *Radinoderus mirabilis* De Meij.
Fig. 38—Wing of *Radinoderus terræ-reginæ* Alex.

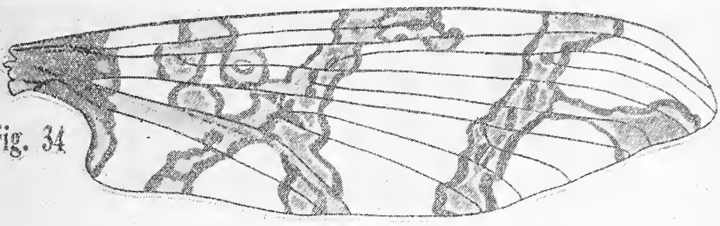


Fig. 34

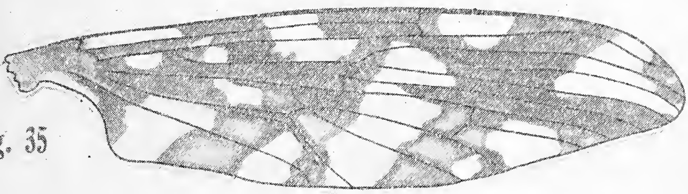


Fig. 35

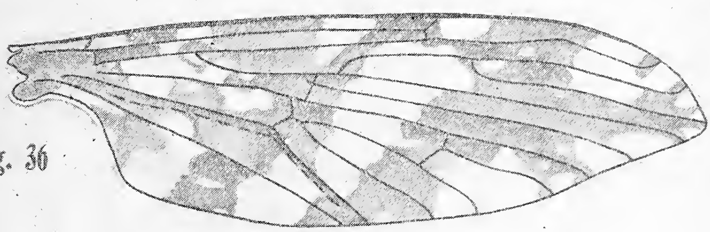


Fig. 36

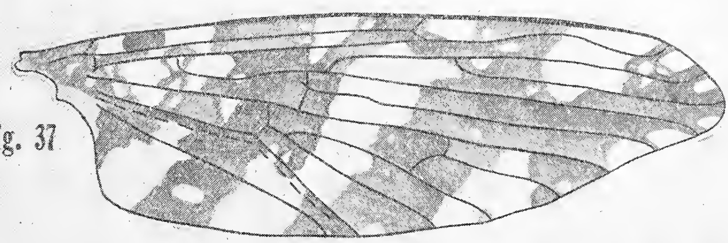


Fig. 37

Fig. 38

TANYDERIDÆ

A SYNOPSIS OF THE GENUS POLYCESTA SOLIAR WITH THE DESCRIPTION OF ONE NEW SPECIES[1]

(ORDER COLEOPTERA, FAMILY BUPRESTIDÆ)

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The genus *Polycesta* as found in the United States is a small, distinct group of *Buprestidæ* comprising six species, one of which is herewith described as new.

The members of the genus are evidently rare and not well represented in collections. Through the kindness of Dr. H. E. Burke, Dr. E. C. Van Dyke, Mr. C. A. Frost and Mr. F. T. Scott, I have been able to bring together some seventy-five specimens representing all the described species in sufficient series to enable one to make a rather comprehensive study. To the above I wish to extend my thanks for their cooperation in the loan of this material.

Polycesta angulosa Duval (2).[2]

Fisher (16) has given a rather complete description of this species and pointed out the probability of Kerremans (12) being in error in placing it as a synonym of *P. excuvata* Blanchard, which was described from Argentine Republic.

Angulosa is at once distinguished from all other indigenous species by the densely pubescent, oval spot, on the first ventral segment and it is the only species known from Florida.

The distribution in Leng's Catalogue is given as Alabama and Florida. I have seen no specimen from Alabama. The following localities in Florida are represented: Miami, Metacomba Key, Elliott Key, Key Largo and Buck Key. The only dates noted were April and May.

[1] Published as technical paper No. 178 with the approval of the director of the Oregon Experiment Station. A contribution from the Department of Entomology.

[2] Numbers refer to the literature cited in the bibliography.

Champlain and Knull (14) report the species as boring in the heartwood of dead pigeon plum (*Coccolobis laurifolia*) at Miami, Florida, in April.

Schaeffer (11) points out that the description of *obtusa* described by Leconte (4) seems to more nearly fit *angulosa* than *velasco*, with which it has been placed in synonymy. Later Fall (13) definitely settled this point by examining the type and pointing out that it possessed the typical pubescent spot on the first ventral segment. The locality "Philadelphia" was no doubt due to the specimen emerging from wood brought from the south or was due to mislabeling.

Polycesta velasco Gory (1).

This species, with *angulosa* and *arizonica*, falls into a group in which the pronotum is without prominent sulcations and in which the last ventral segment of the males have a raised or lobe-like process, which is faint or lacking in the females.

In *velasco* the sides of the thorax are arcuate, widest behind the middle thence quite sharply constricted; surface coarsely punctate, more densely at the sides where there is a tendency for them to coalesce. The faint median sulcation is indicated by a narrow, smooth area which is always more or less broken, never complete and often noticeable only near the base. Ventral surface more densely pubescent, with silvery hair, than the other species. Elytral spines more numerous and regular. The species are of large size. Of the ten specimens before me, the largest is 27 mm. long, 9.2 mm. wide and the smallest is 17.5 long and 6 mm. wide, while the average length is 22.9 mm. and the average width is 7.5 mm.

The last ventral of the male (Fig. 1, B) is wide at the base with regularly rounding sides for two-thirds of its length, then produced into a narrow lobe with parallel sides. The last ventral of the female (Fig. 1, C) is broadly rounded at the tip. The first ventral suture is variable but usually is quite straight in the ♂ and somewhat arcuate in the ♀.

All of the costæ are elevated, giving the species a very different appearance than the others which have at most only the alternate costæ prominent.

The distribution of *velasco* has been given (17) as Arizona, California, Texas, Lower California and Mexico. The type locality is given as Mexico. Horn (7) gives El Chinche, Baja California (2000 ft.) and a specimen in the Beyers collection is labeled Santa Rosa, Lower California, 2000 feet. The California records are but two, to my knowledge. Fall (8) records it from Indio, and there is a specimen in the collection of Mr. Geo. Fields of San Diego, California, labeled San Diego county. The specimens from Texas are also rare. Carmel and Hermit Co., Laredo and Encinal are the localities noted. The majority of the specimens come from the mountains of southern Arizona. Sabino Canyon, Catalina Mts., Florence and Yuma, Tuscon and Ft. Huachuca are the exact localities, while a number of specimens bear simply the label "Ariz."

The information regarding hosts is due to the work of Dr. Burke and his assistants in Arizona, where the species was bred from mesquite, (*Prosopis juliflora*), cat's claw (*Acacia greggii*) and palo verde (*Cercidium torreyanum*). The dates of capture are June for Texas, July and August for Arizona, although bred specimens emerged from April 3 to December 30.

Polycesta arizonica Schaeffer.

This species is well described by Schaeffer (11) and although very similar to *velasco* it is quite readily distinguished. The median smooth line on the prothorax is not broken up. The last ventral segment is quite distinct as shown in Fig. 1 D and E. The sides of the thorax are quite regularly arcuate; only the alternate costæ are prominent and the species averages much smaller than *velasco*. The largest of six specimens before me is a female beaten from oak in the Catalina Mountains of Arizona by myself in July, 1925. It measures 18 by 5.6 mm. The smallest is a male sent me by Dr. Burke taken at Redington, Arizona, June 30. It measures 11.8 by 4 mm. The average length is 14.7 mm. and the average width is 4.8 mm.

The larvæ apparently work in oak although there is no record of specimens having been bred. Most of the known specimens are recorded as having been taken on oak. Aside from the male from Yuma, California,[3] mentioned by Fall (10), all specimens

[3] I do not find Yuma, California, on any available map.

seen came from the mountains of southern Arizona. The exact localities are Redington on *Quercus hypoleuca;* Cochise Co. VII–20; Huach Mts. (2 specimens from the type series) VI–15; Santa Rita Mts., VII–26 on oak and one specimen labeled "Arizona."

The following three species fall into a group which is at once separable by the sculptured prothorax; the first ventral segment being swollen at the middle and but finely and sparsely punctate in this area, and the first ventral suture is arcuate in the males. In the case of the female, there is considerable variation, in *elata* it is arcuate in *cyaneous* and *californica* it is practically straight.

Polycesta elata Leconte (4).

Polycesta cavata Lec. is placed as synonym of *elata* by Crotch (6). If this is true, the locality "Alabama" must be an error.

This species averages larger than the others, is more roughly sculptured. The median suture extends from the anterior to the posterior margin of the pronotum, is coarsely, confluently punctate. The ridges at either side have few punctures and these are large and deep. The smaller sulca at either side extend from the base about one-half the way forward. The thorax is widest about one-third from the base. In most specimens there is a more or less continuous smooth line or area extending along the bottom of the median depression. Elytra with the intervals between the costæ wide. The last ventral segment of the female (Fig. 1, G) is quite long and regularly arcuate at the end. In the male (Fig. 1, F) the base of the segment is broad, thence rounded and rapidly constricted to form an almost parallel sided lobe. The concave front, as mentioned by Fall (9), is in some specimens so slight as to be of little value in separating the species.

Elata is a Texan species. Of the ten specimens before me, five are labeled simply Texas, others bear the following locality labels: Burnett Co.; Colorado Co.; Fedor, Lee Co. and Alpine. Other localities are Cypress Mills, El Paso and Bethage. One specimen examined years ago was labeled Kitt's Peak, Arizona, but since this was prior to the describing of *P. arizonica* it probably belongs to that species. Dates of capture range from April

2 to May 11 and December. The latter is on a specimen evidently bred out in the laboratory.

The recorded hosts are Post Oak (*Quercus obtusifolia*), Arizona oak (*Q. arizonicus*), Emory oak (*Q. emoryi*), white leaf oak (*Q. hypoleuca*), Wright's sycamore, (*Platanus wrightii*), Hackberry (*Celtis reticulata*), Mesquite (*Prosopis juliflora*). I do not know of any record of *elata* having been actually bred from any of these hosts and doubt very much that all serve as breeding places.

I am indebted to Mr. C. A. Frost, of Framingham, Mass., for the loan of several specimens of this species including two homotypes, compared by Mr. Frost and said to be counterparts of Number 3 and 4 of the Leconte series.

Measurements of the 10 specimens show the largest 26.8 by 10 mm. and the smallest 17.8 by 6.3 mm., while the average is 22.03 by 7.95 mm.

Polycesta cyaneous new species.

Form broadly elongate, front nearly flat, very coarsely closely punctate, ♀ with three irregular elongate elevated smooth areas which are almost entirely lacking in the male. Situated above the center of the clypeus is a prominent pit larger in the female; clypeus but slightly sinuate at the center.

Thorax a trifle wider than the elytra; sides prominently angulated in the ♀, more uniformly rounded in the ♂; pronotum with a distinct median depression and two smaller lateral ones. Surface coarsely closely punctured, except on the elevations at each side of the depression, which are smooth with a few scattering punctures which show no indication of coalescence. There is evidence of a median line along the bottom of the depression in the female which is almost entirely lacking in the male. Elytral intervals wide, deeply, closely punctate. The punctures deeper and more round than in either *californica* or *elata*. Second and fourth costæ are narrow, high, somewhat cristiform and prominent, balance much flattened.

Elytra sides slightly sinuous, of approximately uniform width for 2/3 their length, then broadly rounded in the male, female with sub-parallel sides for 3/5, thence constricted to form a rather sharp apex, which is denticulate, the teeth being smaller and less numerous than in other species. The color is bluish black or dull black, with no bronze reflections.

Of the six specimens, the largest, a female, is 18.4 by 7.2 mm. The smallest, a male, is 10.9 by 4.1 mm. The specimens show a great sexual difference in size, but are quite uniform within the sex. The females vary from 16.1 to 18.4 mm. in length and 6.1 to 7.2 in width, with an average of 16.97 by 6.7 mm. The males are even more uniform in size. Length 10.9 to 12.0 mm. and width 4.1 to 4.7 mm. and the average is 11.48 by 4.4.

The dull blue black color, distinct shape of the thorax, the round punctures of the striæ and the shape of the last ventral segment (Fig. I, H and I) all help in separating this species. The last ventral of the male is lobed at the center; that of the female is conical. Six specimens, 3 females and 3 males, are before me. All were collected by Mr. F. T. Scott in June, 1930, in the Sequoia National Park of California.[4]

Type ♂ and ♀ in the collection of the author, a pair of paratypes deposited with the California Academy of Science and a pair in the collection of Mr. Scott.

Polycesta californica Leconte (3).

P. cribrana Mots. (5), described from California is a synonym, Dr. Leconte's description of 1857 being unknown to Motschulsky in 1859. I can find no reason for Obenberger's subspecies *bernardensis* (15) as it is founded primarily upon characters which are extremely variable. Size, form, shape of thorax, elytral sculpture, etc.

Californica is the only species of the genus which may be considered at all common. Its known range[5] extends from southern Oregon to Los Angeles county, California. The Texas records in literature are very questionable.

The species is closely related to *elata* Lec. and *cyaneous*, n. sp. It is on the whole much narrower, lateral margins of the thorax quite reguarly arcuate or but slightly angulated, last ventral segments (Fig. 1, J and K) quite distinct. Elytral striæ punctures smaller and more numerous; smooth areas of the pronotum much more punctate with punctures tending to coalesce especially anteriorly. The largest specimens of *californica* are rarely as large as the smallest of *elata*. Of the 25 specimens examined the largest was 19.1 mm. long by 6.2 mm. wide, another measures

[4] Since writing the above, Mr. Scott has submitted a further series of *Polycesta* taken in 1931. Mr. Scott states that one specimen was dug from oak (*Quercus* sp.?) near Three Rivers and the balance were taken from the waters of a power line ditch near Potwisha in the Sequoia National Park.

[5] Essig—Insects of Western N. Amer., p. 395, gives Alaska. It is not likely that a member of this genus would occur in Alaska, except by accident.

18 mm. long and 7.0 mm. wide. The smallest is 11.2 mm. long by 3.9 mm. wide. The average length is 15 mm. and the average width 5.2 mm.

Due primarily to the breeding work carried out by the forest insect laboratory under Dr. Burke, we have a number of hosts for this species: Kellog oak (*Quercus kellogii*), canyon live oak (*Q. chrysolepis*), Douglas oak (*Q. douglasii*), Garry oak (*Q. garryana*), California black oak (*Q. californica*), highland oak (*Q. wislizeni*), madrona (*Arbutus menziesii*), Fremont poplar (*Populus fremontei*), white alder (*Alnus rhombifolia*), mountain mahogany (*Cercocarpus parvifolius*), apple (*Pyrus malus*), pear (*P. domestica*), almond (*Prunus amygdalus*), broad leaf maple (*Acer macrophyllum*), Christmas berry (*Heteromeles arbutifolia*), red bud (*Cercis occidentalis*), manzanita (*Arctostaphylos viscida*) and cat's claw (*Acacia gregii*).

Exact localities of capture noted are: *Orgeon:* Ashland, October; Gold Hill, July; *California:* Yreka, June; Trinity County, Mariposa County, Placerville bred from various hosts January to March by Burke; Yosemite, June; North Fork, Sequoia National Park, July; Los Gatos, Mt. Wilson and Los Angeles.

With the aid of the following key I believe our species may be identified:

KEY TO THE SPECIES OF POLYCESTA

1. Prothorax without evident median and lateral depressions 2

   Prothorax with evident median and smaller lateral depressions ... 4

2. First ventral segment with a densely punctate, oval area which is densely covered with long brown pubescence. Habitat, Florida .... *angulosa* Duv.*

angulosa Duv.*

   First ventral without this pubescent area 3

3. Alternate costæ obsolete; thorax with median smooth unpunctate line complete, lateral margins regularly arcuate. Habitat, southern Arizona .... *arizonicus* Sch.

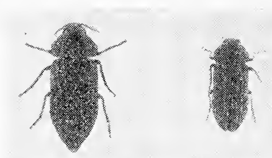
arizonicus Sch.

Alternate costæ evident; thorax with median smooth unpunctate line broken, lateral margins broadest about 1/3 from the base, thence sharply constricted. Habitat, Arizona ....

velasco Lec.

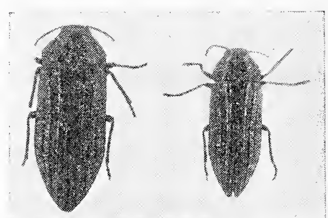
4. Color bronze; species elongate, length about 3 times the width; size usually larger than the next 5

Color bluish black with no bronze reflections, species small and broad, seldom exceeding 16.5 mm. in length for the ♀'s and 11.5 mm. for the ♂. Length $2\frac{1}{2}$ times width. Habitat, California ....



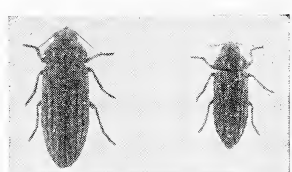
cyaneous n. sp.

5. Elevations at each side of thoracic median depression have but few large shallow punctures which seldom coalesce. Last ventral segment of the male with prominent truncate lobe (Fig. 1, F.) Length usually 18 mm. or more. Habitat, Texas and Arizona ....



elata Lec.

Elevation at each side of thoracic median depression with punctures smaller, more numerous and at least some are contiguous. Last ventral segment of the male with short rounded lobe (Fig. 1, J.) Length rarely as much as 18 mm. Habitat, California ....



californica Lec.

* All figures are natural size.

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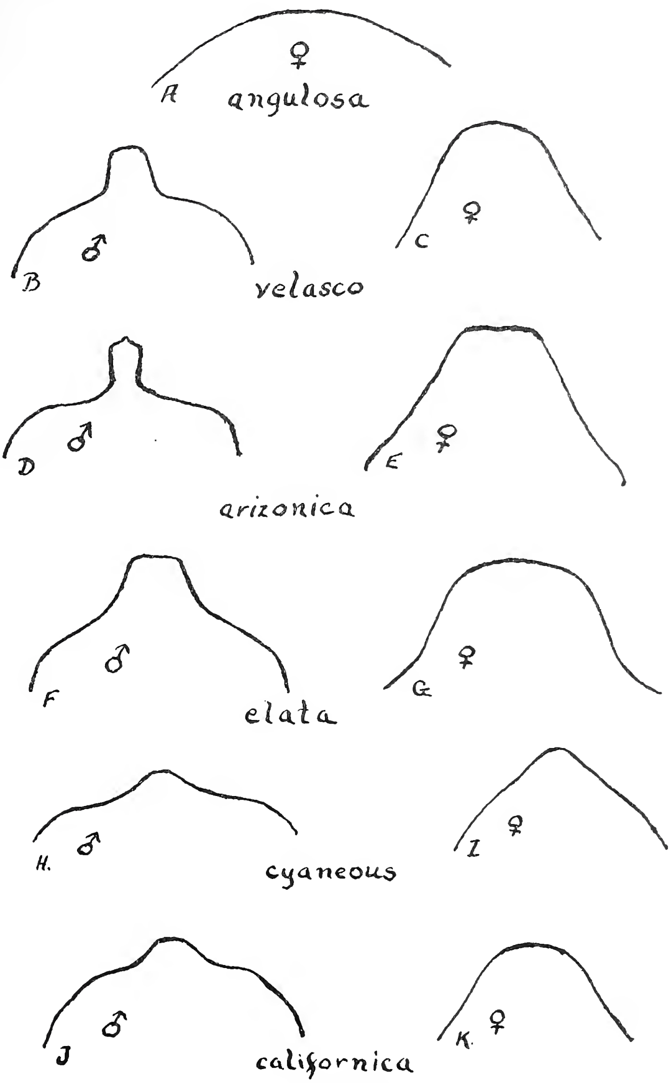
PLATE VIII

Outline sketches of the last ventral segment of the various species of *Polycesta* found in the United States. There is considerable variation within the species in some cases. The above are given as typical for the species named.

This plate is referred to in the text, as Fig. 1.


♀
A
angulosa
♂
B
♀
C
velasco
♂
D
♀
E
arizonica
♂
F
♀
G
elata
♂
H.
cyaneous
♀
I
♂
J
californica
♀
K.

POLYCESTA

A NEW OPILIONID FROM FLORIDA (ARACHNIDA, CYPHOPHTHALMI)

By NORMAN W. DAVIS

In the course of a survey of the Opilionid fauna of Florida an especially interesting species was discovered.

Only one species of the suborder Cyphophthalmi has been previously described from America, namely *Holosiro acaroides* Ewing (Ent. Soc. Am. Ann. 16: 387, 1923) from the Coast Range Mountains in western Oregon. Another representative of this suborder was discovered in the ravine at "Camp Torreya." This locality is situated about one and one-half miles south of Rock Bluff Landing and about three miles southwest of Rock Bluff Post Office, Liberty County, Florida.

The deep ravines cut back from the Appalachicola River Valley into the sandy uplands which border the valley on the east, harbor an assemblage of plants which constitutes a very unusual habitat. These ravines are densely forested with large beeches and magnolias and the small-tree stratum consists largely of the "Stinking Cedar," *Tumion taxifolium* (formerly known as Torreya). This is a conifer belonging to a genus widely distributed in Cretaceous times but now nearly extinct. Two members of this genus occur in China and in Japan, one in California and a fourth only in the ravines in the east bank of the Appalachicola River for a distance of forty miles in extreme southern Georgia and in Florida. This region is also the only locality in which the Florida Yew (*Taxus floridana*) has survived.

It is of interest to note that the only close relatives of this cyphophthalmid are found in southern Europe where they have survived the rigorous climate of the Pleistocene which was fatal in that region to the magnolia, locust, sassafras, bald cypress, black walnut, butternut, and Torreya. These were, however, able to survive in the southeastern United States.

Siro americanus new species

Male. Length 2 mm.; chelicera, 1.4 mm.; palpus, 1.6 mm.; leg I, 2 mm.; leg II, 1.8 mm.; leg III, 1.7 mm.; leg IV, 1.9 mm.

Relative lengths of segments

	trochanter	femur	patella	tibia	metatarsus	tarsus	claw
Palpus	17	27	20	24		20	3
Leg I	15	41	23	26	25	28	7
Leg II	16	37	17	23	17	23	10
Leg III ...	14	26	16	21	20	21	12
Leg IV	20	35	22	25	23	25	12

Relative lengths of segments of chelicera, I, 50; II, 65; III, 19.

Dorsum with an anterior medial collar-like protrusion which has in turn a somewhat concave anterior margin. Extending caudally from the "collar" to or nearly to a point midway between the stink-gland tubercles is a low rounded ridge. On either side of this median ridge, just caudad of the "collar," the dorsum is strongly depressed dorso-laterally. A number of wrinkles are usually present running from either side of the "collar" to a point just below the stink-gland tubercles. Inner margin of coxa I with a dorsal keel which fits into a notch in a flange-like protuberance of the margin of the carapace.

Eyes entirely lacking. Stink-gland tubercles higher than their basal diameter, tapering proximally and set at a distance slightly less than their basal diameter from the lateral margin of the carapace. Openings of the stink-gland tubercles (apical nodules) large and prominent. A strongly curved groove (posterior thoracic suture) present arching caudally across the carapace from the spaces between the third and fourth coxae.

Maxillary lobe of coxa I extending about two-thirds of the total length of the coxa. Beside this and parallel to it a single row of hairs. Maxillary lobe of coxa II very large, broader than long, deeply constricted posteriorly. Coxae I and II movable; coxae III and IV fixed. Coxa I wider than coxa III; coxa III very slightly wider than coxa II; coxa IV distinctly wider than coxa I. A depressed line curving across proximal portion of coxa IV.

Genital opening roughly elliptical, armed laterally with a black process on either side. Each spiracle enclosed on inner and caudal sides by a curved impressed line (lateral suture).

Eighth and ninth sternites so completely fused as to be indistinguishable. Eighth sternite very narrow medially, enclosing about three-fourths of the anal operculum. Ninth tergite extending from the caudal extremities of the eighth (and ninth) sternite around the caudal margin of the anal operculum in the form of a lunate band. Venter uniformly granulated. A few scattered hairs on coxae.

First segment of chelicera laterally compressed; dorsal and ventral surfaces rounded and granulated; mesal surface flat and smooth; ventral surface anterior to large conical eminence also flat and smooth. Dorsal surface as seen from side with a deep depression near proximal end into which the "collar" of the cephalothorax fits. Just anterior to this a low rounded eminence (which in dorsal view appears as a transverse ridge). Anterior to this ridge the dorsal margin is nearly straight and is armed with a single hair just in front of the eminence and a group of one to three hairs on the distal part. Ventral margin as seen from mesal side has a low tubercle near base in front of which there is a deep depression bounded in front by a high conical eminence, granulated on its anterior face. Second segment smooth, cylindrical, armed with a group of one to three hairs on disto-mesal surface. Chelate portion slender, furnished with a row of about six or eight small denticles. Third segment slender, furnished with about six small denticles on distal half.

Trochanter of palpus curved dorsally, strongly incrassate distally, armed with a few long hairs. Femur only slightly enlarged distally, curved a little ventrally, armed with a number of hairs on ventral surface. Patella distinctly wider distally, not noticeably curved. Tibia a little thicker distally, nearly straight. Tarsus fusiform, straight, terminating in a short straight claw.

Legs granulated and garnished with hairs which are more numerous on tarsi than on other segments. Claw of leg II denticulate; others smooth. Claw of leg IV more strongly curved than those of the other legs. Dorsal eminence of tarsus IV with a short cylindrical basal part from which a long, slender process projects. A fine hair projects from basal part close to and parallel with the long process.

Body and chelicerae uniform reddish-brown to dark brownish-black. Other appendages a little lighter in color (particularly noticeable when specimens are in alcohol).

Female very similar to male but differing in the following respects. Genital opening directed forward rather than downward. Processes arming sides of genital opening very short and blunt. Tarsus of leg IV laterally compressed, dorsal eminence lacking.

Immature specimens with body somewhat flattened dorso-ventrally. Stink-gland tubercles abruptly truncate at apex. Body uniform yellow-brown. Appendages yellow-white.

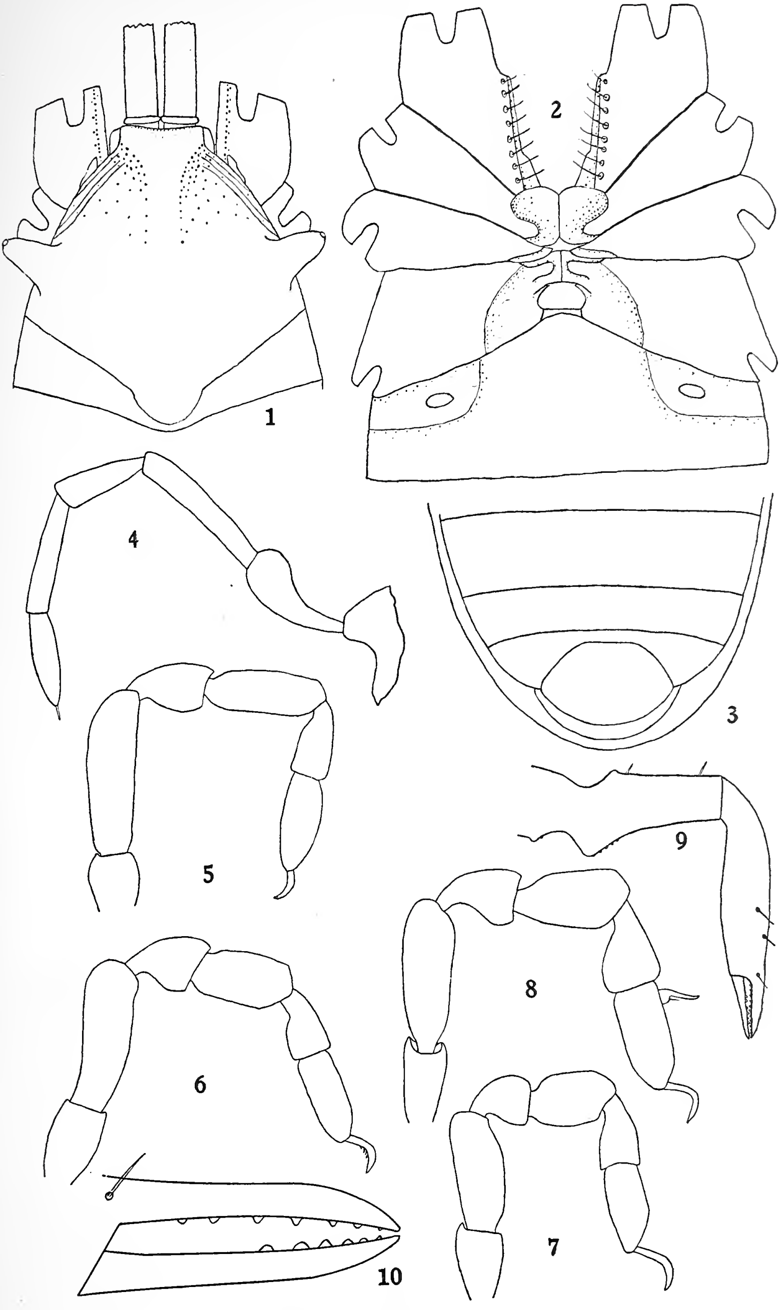
Holotype male, allotype female, collected from leaf mold in a Berlese funnel, April 12, 1930 and May 29, 1931. About 80 specimens in all. All material in Cornell University collection.

This species is related to Siro by the presence of the posterior thoracic suture, in having the stink-gland tubercles conical and remote from the margin of the cephalothorax. It is related to Parasiro by the form of the anterior margin of the cephalothorax, and in having one of the tarsal claws dentate. The arrangement of sclerites in the corona analis differs from both of these genera but is more like that found in Parasiro. Because of the discovery of this intermediate form it may become necessary to reunite Siro and Parasiro.

PLATE IX

Siro americanus male

Figure 1. Cephalothorax, dorsal view.
Figure 2. Cephalothorax, ventral view.
Figure 3. Abdomen, ventral view.
Figure 4. Palpus, right.
Figure 5. First leg, right.
Figure 6. Second leg, right.
Figure 7. Third leg, right.
Figure 8. Fourth leg, right.
Figure 9. Chelicera, left, mesal view.
Figure 10. Chelicera, left, tip.



SIRO AMERICANUS

The Brazilian collections of H. H. Smith.—I have just received a paper by C. J. Drake and H. M. Harris, describing several new species of *Velia,* from specimens in the Carnegie Museum, collected at Chapada, Brazil. No reference is made to the collector, undoubtedly H. H. Smith. This is the second time, quite recently, that I have noted the same omission. The specimens bear a printed label Chapada, but no indication of the collector. Thirty or forty years ago this did not matter, because we were all familiar with the wonderful work of H. H. Smith in South America, and knew where his specimens were. But now a new generation has arisen, to whom the magic word "Chapada" has no special meaning, and to whom the name of H. H. Smith is unknown. I am sorry that this should be so, and would urge that in future, when new species are described from these collections, due credit should be given.—T. D. A. COCKERELL.

THE PHYLOGENY OF SOME MAYFLY GENERA*

BY HERMAN T. SPIETH

ABSTRACT

The phylogenetic relations of twenty-five North American genera have been studied. The data for this study have been derived from the following characters: wings, genitalia, gills, and mouth parts. Intensive study of the wings supports Lameere's view of the primitive insect wing structure. By boiling the wings in KOH, it has proved possible to separate the two surfaces, and thus show that the mayflies possess every major vein that was to be found in the Dictyonuridæ. Apparently the Ephemerida have the most primitive wings of all living insects. The genitalia and mouth parts have been interpreted in accordance with the findings of Crampton and Walker. The gills have been of great value as phylogenetic indicators.

Four distinct lines of development are recognized within the family. Two of these are monotypic and are represented by *Caenis* and *Baetisca*, respectively. The Heptageniidæ, the Baëtidæ, and the genus *Siphlonurus* make up the third branch. The Ephemeridæ, *Blasturus*, *Leptophlebia*, *Choroterpes*, *Tricorythus*, and *Ephemerella* constitute the fourth evolutionary stem.

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ticular, has given me considerable aid in methods of collecting and in offering kindly criticism, as well as providing inspiration.

INTRODUCTION

This paper deals with the generic relationships and relative phylogenetic position of some of the genera of Ephemerida found in the United States. Former workers, including Eaton, have created a linear arrangement for the classification of the Ephemerida, and the workers since Eaton have not differed greatly from the Eatonian classification. While all of these workers have attempted to show relationships of genera by means of the classification, the result has nevertheless been more or less artificial and incomplete, since obviously the evolution of the group did not take place in such a manner as that indicated by a linear arrangement.

The data presented here have been acquired by the intensive study of four characters, *i.e.*, gills and mouth parts of the nymphs, and wings and genitalia of the adults. The genera that have been studied are all represented in North America and are as follows: *Siphlonurus, Isonychia, Heptagenia, Ecdyonurus, Epeorus* (in the broad sense, including *Iron*) *Rhithrogena, Baetisca, Caenis, Ephemerella* (including *Chitonophora* and *Drunella*), *Tricorythus, Blasturus, Choroterpes, Leptophlebia, Potamanthus, Hexagenia, Ephemera, Polymitarcys, Pentagenia, Campsurus, Callibaetis, Baëtis* (including *Acentrella* and *Heterocloëon*), *Pseudocloëon, Centroptilium,* and *Cloëon.* Naturally a complete phylogenetic picture can not be drawn until all the species in existence are available for study. Nevertheless these twenty-five genera are sufficiently representative of the various and diverse lines of evolution that have taken place within the family to create a frame-work around which the complete classification can be built when sufficient material is available. The present study also opens up several biological problems which need to be solved.

The material for this study has been collected during a period of the past five years in the following states: Indiana, Ohio, Michigan, Illinois, Missouri, Kentucky, Maryland, Virginia, West Virginia, North and South Carolina, Georgia, Florida, Alabama, and Tennessee. During this time between 25,000 and 30,000 individuals, both nymphs and adults, have been collected. In all of the above named genera, both nymphs and adults have been available for study. A few of the genera (*i.e., Pentagenia, Cloëon, Pseudocloëon,* and *Centroptilium*) are represented in my collection by less than a score of individuals per species. *Ecdyonurus* and *Hexagenia* are each represented by thousands of individuals, and the remainder of the genera by at least 100 specimens each.

PHYLOGENETIC DATA

Wings

In these delicate, thinly chitinized insects, the wings are better and more easily preserved than any other parts of the insect. They are less subject to distortion and discolorization than other parts of the body. In the abundant veins and diverse shapes and sizes of the wings, they present characters which have undergone great modification in several directions during the evolution of the group, while retaining their primitive basic venation. Further, the investigation of the wings is not restricted to the adult but can also be extended to the nymph, for by studying the tracheation of the wing pads the nymphal stages can be correlated with those of the adults. Of prime importance also is the fact that there exists an abundance of fossil wing material of mayflies, of mayfly ancestors, and of other closely related groups.

In this paper the phylogenetic significance of the wing in the existing forms will be discussed, and an outline will be given of the evolution of the wing and a demonstration of certain facts that help to elucidate the nomenclature and homologies of the wing veins.

The insects that are generally accepted as the ancestors of the mayflies, namely, *Triblosoba* and the Protereismidæ, exhibit hind wings which are similar in size and shape to the fore wings. The wings are elongate oval in shape as in the Paleodictyoptera (Fig. 1), lacking the definite apex and the anal angle of the present day forms. From the tip of the wing to the base, the posterior margin presents a long arc.

In the present day forms, the flight function has undergone a decided cephalization, with a consequent great reduction of the size of the hind wings. In some genera, *Pseudocloëon, Cloëon, Caenis,* and *Tricorythus,* the hind wing has completely disappeared. In the most primitive existing North American genus, *Siphlonurus* (Fig. 4), the hind wings are of moderate size (more nearly the size of the fore wing than in any other living forms) and roughly oval in form. The fore wings (Fig. 3) are roughly triangular in shape and exhibit definite apical and anal angles. The distance from the anal angle to the apex is comparatively great. The Baëtidæ (Figs. 17, 18, 23, 25, 26), which are undoubtedly specialized genera, have either lost or have greatly reduced hind wings, but seem to have somewhat re-assumed the primitive shape of the fore wing. Other genera which are intermediate in respect to wing size show a shortening of the posterior margin (distance between the base of the wing and the anal angle) that parallels the reduction in hind wing size, *e.g., Heptagenia, Leptophlebia, Choroterpes,* and *Ephemerella* (Figs. 13, 21, 29, 55). Consequent with the reduction of the posterior margin in these genera, there is also the re-assumption of the primitive wing shape of the fore wing which reaches completion in genera which entirely lack the hind wing.

This cephalization of flight function and reduction in hind wing size, judging from present fossil evidence, have all occurred since the Paleozoic.

Nomenclature and Homologies. The homologies of the veins of the ephemerid wings have been points of contention for several years. Eaton, in his monograph of the group, employed a notation of his own which did not attempt to homologize the plan of venation found in the mayflies with that found in any other group, but he did, however, correctly homologize the veins of the hind wings with those of the fore wing.

Eaton's system was modified by Redtenbacher in 1886, by Comstock in 1888, and by Kellogg in 1895. In 1898 Comstock and Needham published their *Wings of Insects,* in which they advanced a nomenclature that was founded upon a study of the nymphal tracheæ and the correlation with the conditions found in other insects.

In 1912 Miss Anna Morgan, after making an intensive investigation of the nymphal tracheation of the mayflies and having correlated it with the adult venation, published a paper in which she interpreted the median and radial sector in the same manner as Needham had interpreted them in Odonata.

Tillyard (1922) re-worked the whole subject in correlation with his work on the veins of the Odonata. He employed not only the venation and tracheation of modern mayflies but also the paleontological evidence as presented by Permian fossils.

Lameere (1923) published a paper dealing with the veins of the Paleodictyoptera, Odonata, and mayflies, in which he advanced the hypothesis of a posterior median and cubitus and anterior median and cubitus, in which the posterior member bears the same relationship to the anterior as the radial sector bears to the radius.

Martynov (1922, published 1924) holds a view very similar to that of Lameere but differs slightly from him as to the fate of certain veins. Tillyard (1926), influenced by Lameere's hypothesis, modified his earlier system. Working with the Kansas Permian insects, Tillyard (1931) again made a few changes in the nomenclature. In our own work we find evidence in support of Tillyard's interpretations and in the present paper will employ the nomenclature advanced by Tillyard in 1931.

In determining homologies of the various veins, there are three distinct methods of approach: (1) fossil evidence; (2) distribution of the tracheæ in the wing pads of the nymphs; (3) convexity and concavity of the veins. To this latter method of interpretation the following data are of significance.

The wing of a mayfly consists essentially of a sacular outpocketing of the body wall, into which, during the immature stages, tracheæ, blood vessels, and nerves penetrate. In the adult, this sac becomes flattened, greatly extended, and very thin, and veins have been laid down. By soaking an adult wing in a strong caustic soda solution for 24 to 48 hours, the connections between the two sides of the wings are broken and the wing separates into its component dorsal and ventral part. By careful manipulation, the two surfaces can be cut apart and the parts then mounted for study. Hagen (1889) separated the two surfaces of the wing of an Odonata. He accomplished this by injecting water between the two surfaces of a teneral wing. He reported that he had also achieved the same end with other insect wings.

The striking feature to be noted is that all the convex veins belong to the dorsal surface of the wing and the concave veins to the ventral surface of the wing. The cross veins belong principally to the dorsal surface, *i.e.*, at the base where they join the concave veins a stump of the cross vein is attached to the main vein, while on the dorsal surface the cross veins are always complete and vigorously developed. The single exception to this condition is in the area between the costal edge of the wing and the sub-costal vein. Here the cross veins are better developed on the ventral wing surface, or at least developed equally on both surfaces of the wing. It is important to note that veinlets at the edge of the wings are always restricted to the dorsal surface. Calvert, working with a mature wing pad of a larva of *Cora* (Odonata), determined that all the concave veins were located on one side of the wing and all the convex veins on the other side, with the exception of the costa which was equally developed on both sides. Several other veins showed on both sides of the wing pad but always more faintly on one side than on the other. Thus, if the vein were concave it would be heaviest on the side where the other concave veins were located and faintest on the side where the convex veins were located.

Bearing in mind the distribution of the veins on the two surfaces of the wing, let us turn to a discussion of the nomenclature and homologies of individual veins.

Costa. In the mayflies known from the Permian (Protereismidæ) (Fig. 2), the costal vein consisted of a very short vein that forked on its distal end, with the two branches running almost at right angles to the parent vein. The anterior fork met the anterior edge of the wing and the posterior fork went back to the subcostal vein. In living mayflies (Fig. 3) the costal seems to have migrated to the anterior wing edge with the consequent disappearance of the anterior fork, and the posterior branch of the ''Permian'' costal has given rise to the humeral brace. From the humeral brace out to the apex, the wing edge is strikingly different from that part of the margin which is thickened by the true costal vein. This apical section of the margin consists of a slightly thickened, folded wing membrane, and bears a number of minute spines. It is to be noted that the costal trachea arises much later than the other principal tracheæ in the ontogeny of the individual (Tillyard, 1922).

Subcosta and Radius. The subcosta (Sc) is a concave, unbranched vein that extends from the wing base to the apex, while the radius (R_1) which runs parallel and close behind it is similar except that it is a convex vein.

Accompanying the convex and concave system of vein placement is the triadic type of branching found in the mayflies, so that whenever a vein forks there is interpolated between the fork a vein of opposite position (Fig. 8). For example a concave vein forks into two concave branches, the interpolated vein is convex, and the regular alternation of convex and concave veins is preserved. Thus the radial sector, which is a concave vein lying between two convex veins, the radius and the anterior median, may be viewed as the middle concave member of a convex triad.

Radial Sector.—In the paleodictyopteran family Dictyoneuridæ (Fig. 1) and the presumed ancestors of the mayflies (Eubleptidæ, Metropatoridæ), the radial sector (Rs), a concave vein, arises from the radius about one-third of the distance from the base to the apex. In the Permian *Triblosoba* (Fig. 9) the point of origin has migrated back toward the base of the wing and in the Protereismidæ (Figs. 2, 3) and present day mayflies, it has moved still farther toward the base and is no longer attached to the radius, but rather *abuts* against the anterior median near its base.

Distally the radial sector (Fig. 3) branches into three primary branches. Between these, which are concave, there are two interpolated convex veins which are designated by Tillyard as IR_2 and IR_3b. These are the interpolated convex veins which lie behind the first (R_2) and second (R_3) *primary* branches of the radial sector. R_1 is the first primary branch of the radius; and R_2, which is the second branch of the radius but the first branch of the sector, is an unbranched vein and seems always to have been so throughout the history of the group. R_3, the second branch of the sector, is unbranched in the Carboniferous families Eubleptidæ, the Metropatoridæ, and *Triblosoba* (Fig. 9), but branched as early as the Permian (Fig. 2) into a simple triad with an interpolated convex vein IR_3a. The last primary branch of the sector is designated as R_{4+5} in order to keep the nomenclature homologous with that of other groups. Judging from fossil evidence, the R_{4+5} has always been an unbranched vein.

Regarding the origin, significance, and interpretation of the so-called interpolated veins IR_2 and IR_3b, a few salient points may now be discussed. Both veins are convex and thus are to be found on the dorsal surface of the wing. Thus they are both in the same position as IR_3a which is a convex vein. IR_3a is, as noted above, the interpolated vein of the triad which was formed by the branching of R_3. In *Triblosoba* (Fig. 9), R_3 is undoubtedly unbranched, but in the Permian mayflies (Fig. 2) it has branched and IR_3a is present. In the present-day species (Fig. 3), IR_2, IR_3a, and IR_3b have lost their basal connections and terminate freely in the wing membrane. In the Permian mayflies (Fig. 2) however, IR_2, IR_3a, and IR_3b were all distinctly joined to concave members of their respective triads. Thus, fundamentally there is no difference between these three interpolated branches, and since in a sense we have a record as to how IR_3a arose, it is perfectly logical to hypothesize that IR_3b and IR_2 both arose in a like manner, viz., as convex members of a concave triad.

Median. The mayflies possess a complete, archaic median with a convex anterior median (MA) and a concave posterior median (MP). Martynov (1922) considered the anterior median of the mayflies to have been lost and Lameere (1923) thought that both the anterior median and anterior cubitus had been lost. Lameere hypothesized that along with the loss of the anterior median the posterior median had shifted from a concave vein to a convex vein. Now, by separating the wing into its two component parts as described above, we find that all the convex veins lie on the dorsal surface and all of the concave veins on the ventral surface. It is very difficult, under these circumstances, to conceive of the mechanics by which a "down" vein might become an "up" vein, which perforce would have to happen if the posterior median had shifted from a concave to a convex position. Further, in *Triblosoba,* which possesses an unbranched anterior median, we also find that R_3 is unbranched; but in the Permian Protereismidæ we find both R_3 and MA forming simple triads. Is it any more difficult to conceive of MA branching and forming a simple triad than it would be for R_3 to form a triad (which it undoubtedly did)? Thus, MA which was an unbranched, convex vein in the Paleodictyoptera and *Triblosoba* is to be found in the Permian fossils and in the present-day species as a convex vein which has branched distally and formed a simple triad.

Behind the anterior median lies a concave triad which represents the posterior median. In the primitive paleodictyopterid family, Dictyoneuridæ (Fig. 1), this vein was unbranched. In the ephemerid stock as early as the Upper Carboniferous (*Triblosoba,* Fig. 9), this vein had formed a triad and the same condition presents itself in the Permian fossils (Fig. 2) and the present living members of the group. Apparently there has been a tendency for the point of branching to take place nearer and nearer the base of the wing. *Siphlonurus* (Fig. 4) which is undoubtedly the most primitive genus to be found in America exhibits a condition like that found in the Permian Protereismidæ. However, in some genera, *Hexagenia* and its relatives (Figs. 34, 37, 39, 41, 43), the posterior branch of the triad arises at right angles to the anterior member and after traversing the wing membrane almost (*Hexagenia,* Fig. 41) or all the way (*Ephemera,* Fig. 39) to the anal, it swings outward and runs to the outer wing edge. Since the posterior median is a concave vein and since cross veins are restricted primarily to the dorsal surface, separation of the two sides of the wing shows that in *Hexagenia,* etc., the basal connection of the posterior limb (MP_2) of the triad with the anterior limb (MP_1) is not a true part of the triad, but is a cross vein. Thus the basal part of MP_2 has actually been lost in these genera.

A word needs be said here about the relation of the median of the mayflies to its homolog in other groups of insects. As Tillyard has pointed out, the posterior median is Comstock's median.

Cubitus. The cubitus in the Dictyonuridæ (Fig. 1) gives rise to two unbranched veins, an anterior CuA and a posterior CuP, in which the forking takes place at about one-third the way out from the base of the wing. There is a tendency for the point of branching to take place closer and closer to the wing base so that in the Carboniferous genus *Triblosoba* (Fig. 9) the branching takes place almost at the very base. In this extraordinary insect, the two branches are simple and run parallel from the base to the edge of the wing. The Protereismidæ (Fig. 2) exhibit a posterior cubitus similar to that found in *Triblosoba* but the CuA, or the anterior cubitus, has formed a simple triad. In the present-day forms (Fig. 3), along with the formation of the anal angle the two veins have been pulled apart at the wing edge. CuA ends in the distal wing edge while CuP ends in the anal or posterior edge of the wing (except in Baetisca). Among different genera CuA meets the wing edge at various distances from the base of the wing.

The Permian Protereismidæ (Fig. 2) have the anterior cubitus divided into a triad, and this same triad can be identified in the existent genus *Siphlonurus* (Fig. 3). In other genera it has been obscured by various modifications, usually consisting of a series of pectinated veins running posteriorly from the anterior member of the cubitus. These were barely indicated in the Protereismidæ. By separating the two surfaces of the wing with KOH, in *Hexagenia* (Fig. 41) where a series of pectinated veins runs posteriorly from CuA_1, the vein nearest the root of the wing can be recognized as the original fork of the triad or CuA_2. In other more specialized genera, various modifications have taken place until the triad has been obscured.

In the fossil *Triblosoba* (Fig. 9) and Protereismidæ (Fig. 2), it is impossible to tell exactly what is the fate of the medial and cubital veins at the wing base. According to Lameere's hypothesis of the origin of the veins, the anterior median should join the posterior median and likewise with the cubitals. In present-day mayflies of more specialized genera, the course of the veins has been so shifted that it is impossible to tell their exact position. Turning, however, to the primitive genus *Siphlonurus* (Fig. 3) we find the very condition which Lameere hypothesized. The anterior median distinctly joins the posterior median and it is clear that the posterior cubitus meets the anterior branch.

Anals. As pointed out by Martynov, in the Dictyoneuridæ, the anals consist of 3–4 fairly homologous veins, each shorter than the preceding, but in more specialized members of the family A_1 begins to assume dominance and the remaining veins become less distinct. In *Triblosoba* (Fig. 9) A_1 and A_2 stand out, as long veins with numerous branches. Whether one of the veins which appears as a branch of A_2 is in actuality A_3, it is impossible to determine. If the base of the wing were present we might find the posterior branch of A_1 is in reality IA_1. The Protereismidæ (Fig. 2) are much like *Triblosoba* with a tendency for A_1 to stand out, and A_2 and A_3 to become less distinct. Present-day forms show a highly variable state of affairs. In all genera A_1 is present, but further than that the distribution varies with the genus under consideration. Thus, in *Siphlonurus* (Fig. 3), three anal veins and two interpolated veins can be distinguished, while in the Baëtidæ (Fig. 23) only A_1 is present. It is needless to say that along with cephalization of flight, and the triangularization of the anterior wings the anal area has been gradually reduced. Thus, in the living examples, *Siphlonurus* possesses the largest anal area and the most primitive distribution of the veins.

Hind Wings. In the above discussion only the anterior wings have been taken into consideration. The reduction in size of the hind wings of the mayflies took place during the Jurassic. Some of the fossils from that period had both pairs of wings equal (*Mesephemera*), while members of the genus *Paedephemera* exhibited hind wings about two-thirds or three-fourths as large as the front wings. The reduction has resulted in the hind wings assuming, in the more generalized forms, a somewhat oval shape. In the reduced hind wings the cubital and anal veins are distributed somewhat as in the primitive ancestors, the reduction of the wing having been accomplished by the loss of the distal portion of the wing. Of course, in some specialized forms (*Baëtis*) where the hind wing is minute, the entire wing has been greatly modified. However, in most of the genera the anterior part of the wing has undergone a change in shape, especially near the base where it has been extended to enlarge the costal and subcostal areas. The costal spur is a remnant of this in the greatly reduced wings of *Baëtis*.

Thus, since hind wing reduction did not appear until late, the above wing discussion covers both fore and hind wings of the Paleodictyoptera, *Triblosoba*, and Protereismidæ. The hind wings of present-day forms need to be discussed here in a brief manner.

The costa, subcosta, and radius in the hind wings are similar to these veins in the fore wings, except that the costa and subcosta in the hind wings are strongly arched forward at a short distance from their base (Fig. 11). With the shortening of the wing, the area served by the Rs has become smaller so that the sector consists of a simple triad, R_3 having disappeared and only R_2, R_{4+5} and the long interpolated vein IR_2 being present (Figs. 4, 7, 11). Basally, Rs in some genera is connected to MA, but in others it ends on a Ma–R_1 cross vein (Figs. 7, 14). In *Ecdyonurus* (Fig. 7), *Heptagenia* (Fig. 14), *Isonychia* (Fig. 11), and *Siphlonurus* (Fig. 4), MA forms a simple triad, while in *Hexagenia* (Fig. 40), *Ephemera* (Fig. 33), *Pentagenia* (Fig. 36), *Polymitarcys* (Fig. 42), *Campsurus* (Fig. 44), *Baetisca, Blasturus* (Fig. 32), *Choroterpes* (Fig. 30), *Ephemerella* (Fig. 47), and *Leptophlebia* (Fig. 22), it is a simple unbranched vein, reminding one of the same vein in the hind wing of *Triblosoba* (Fig. 9). MP, as in the fore wing, is a simple triad (Figs. 4, 7, 16, 47). CuA and CuP are much like the same veins in *Triblosoba* (Fig. 9), *i.e.*, simple veins, running nearly parallel, with or without interpolated veins, depending upon the genus under consideration. As in the fore wings, so in the hind, the first anal stands out clearly while the other anals and the interpolated veins exhibit extremely variable conditions (Figs. 4, 16, 35, 47).

Significance of Veins. Concerning the importance of the various veins in demonstrating relationships between the diverse genera and their evolutionary significance, a few words may be said.

In the fore wing the costa, subcosta, and radius are of no value in showing relationships, since they are homogeneous throughout all genera. As for the radial sector and its branches, the most primitive existing type is that found in *Siphlonurus* (Fig. 3) and *Baetisca* (Fig. 54), where R_2 and R_3 still retain their primitive connection, and the R_3 triad has not been greatly modified even though R_{3a} has been disconnected at its base. Specialization in this group of veins consists in the basal disjunction of R_3 and the modification of the R_3 triad. The anterior median is uniform throughout the family except in *Baëtis* (Fig. 17) and its allies where the posterior fork of the triad has been detached from its anterior member.

The posterior median forms a triad, members of which are designated as MP_1 and MP_2, which displays a tendency for the forking of the main vein to take place closer and closer to the wing base while MP_2 seems to have a tendency to pull away posteriorly from its anterior member. Naturally the most primitive type most closely approaches a typical triad, a condition to be found in the genus *Siphlonurus*.

The cubital veins, anterior and posterior, which have been designated in this paper as CuA and CuP, respectively, are perhaps the most variable and important set of veins in the wing, so far as phylogenetic value is concerned. Judging from the fossil evidence and from the hypothetical ancestral wing of insects, these two veins should meet at the base, CuP should be simple and CuA should form a triad at its distal end. Such a condition is actually found in *Siphlonurus* (Fig. 3) and without a doubt represents the most primitive condition in the extant forms. Specialization within the group has involved the obscuring and even complete obliteration of the CuA triad, and the shifting of the roots of the cubitals within the wing base so that they have completely lost their primitive aspect in many forms.

The anals have always been a variable group, but apparently the mayfly ancestors had three convex anal veins with at least two interpolated veins. Such a condition is now present in *Siphlonurus*. Various modifications exist in the group, the extreme condition being the reduction to a single anal vein which is simple.

The hind wings have undergone greater modification than the fore wings. Here the subcosta becomes significant, for the strong forward arching and consequent enlargement of the Sc–R area is a specialization, while the condition found in *Siphlonurus* (Fig. 4), where the Sc runs more nearly parallel to the radius, is primitive. The radius, as in the fore wing, presents a homogeneous condition throughout the group. While the Rs was important in the anterior wings, it fails to display phylogenetic significance in the hind wings. As remarked before, Rs has been reduced to a triad which is uniform throughout the group, except in cases of excessive wing reduction. The anterior median is found in two conditions, either simple or forked as a triad, of which the unbranched form probably represents the specialized condition. The behavior of MA and R at the base of the wing gives us some clue as to relationships. In *Siphlonurus* (Fig. 4) and *Isonychia* (Fig. 11), these two run into the base without fusing, while in some other forms, *Ecdyonurus* (Fig. 7), *Hexagenia* (Fig. 40), etc., they fuse into a common trunk before reaching the base. Throughout the entire group, except in some genera where the hind wing is greatly reduced or even lacking, the posterior median forms a typical triad. CuA and CuP are unbranched veins, whenever present. Judging from fossil evidence, those forms such as *Siphlonurus,* etc., which possess no interpolated veins in the Cu area, are more primitive than those that do.

As in the fore wing, the anals in the hind wings present a highly variable condition; but forms in which there are three anals and two interpolated veins with a network of cross veins behind the true anal veins have been considered most primitive.

This discussion of the hind wing veins assumes that the hind wings possess vein for vein those that are found in the fore wing. Needless to say, those forms which lack some of the veins are specialized and those possessing a full complement of veins in the hind wings are primitive so far as wings are concerned. More will be said about the loss of veins in the hind wings in our section on Shape of Wings, and in the discussions of the various genera which follow.

Tracheation. Miss Morgan (1913) made an extensive study of the tracheae of mayflies and their relation to the veins of the adults. She utilized nymphs that were well developed, but did little work with younger stages, and thus fell into the error of incorrectly homologizing in some genera the Cu tracheae with the subsequent veins. She also stated that the alar loop consisted of only a single straight trachea entering the wing pad. Tillyard (1924) pointed out her error and also showed that in the younger stages some genera, at least *Ameletus, Coloburiscus,* and *Oniscigaster* (occasionally), possess a complete, looped alar trachea as in other insects. Martynov (1924) gave an excellent critique of Miss Morgan's work and reinterpreted her data.

It suffices to say here that there is an enormous amount of individual, specific, and generic variation in the tracheation and that a detailed study of many species, employing various nymphs of various ages, is greatly needed.

Cross Veins. A word needs to be said about the cross veins and veinlets, and their phylogenetic significance.

The amount of cross venation, except in *Polymitarcys,* has constantly decreased since the Pennsylvanian. The extent and abundance of the venation, so far as can be determined at present, offers little help in the solution of generic relationships. *Siphlonurus* (Fig. 3), *Baetisca* (Fig. 54), *Hexagenia* (Fig. 41), *Pentagenia* (Fig. 37), *Potamanthus* (Fig. 34), *Ephemera* (Fig. 39), *Campsurus* (Fig. 38), all the Heptageniidæ (Figs. 6, 12, 13, 15), *Blasturus* (Fig. 31), *Leptophlebia* (Fig. 21), *Choroterpes* (Fig. 29), and *Ephemerella* (Fig. 55) all possess an abundant cross venation. *Tricorythus* (Fig. 46) has the cross venation restricted to the inner part of the wing disk. *Caenis* (Fig. 45) and the Baëtidæ (Figs. 17, 18, 23, 25, 26) have the amount reduced greatly, while *Polymitarcys* (Fig. 43) possesses almost a superabundance of cross veins.

The arrangement of the cross veins is, however, of considerable phylogenetic significance. The mayfly wing on the anterior edge is slightly concave, with the deepest part of this concavity coming about mid-way between the apex and the base or in the region known as the bulla. Sometimes there is an accumulation —a sort of piling together—of the cross veins in this area. This accumulation at the bulla has not entailed the addition of more cross veins, but is due entirely to cross veins having migrated into the vicinity of the bulla. Naturally, since no veins have been added, the area between the veins of such a group and the veins outside of the group is larger than any to be found in a wing where the cross veins are evenly distributed. Thus, within the *tripunctata* complex of the genus *Ecdyonurus,* we find species (Fig. 6) with accumulations of veins that extend from the costa to the anterior median. Each accumulation consists of three or four cross veins in each of the anterior vein areas (costal, subcostal, radial$_1$, and radial$_2$). Each accumulation of veins, within a primary vein area, lies directly behind the same group in the preceding vein area. In one specific complex in *Ecdyonurus* (Fig. 12) there is no sign of such a vein aggregation. All of the members of the *Heptagenia maculipennis* complex (Fig. 13), with the exception of one species, show similar aggregations. In this *maculipennis* complex, however, the cross veins posterior to R_2 are not pulled together, but are distributed exactly as in the rest of the wing. Members of the *Ecdyonurus interpunctata* complex (Fig. 5) present a condition exactly similar to that found within *maculipennis* except that a longitudinal black streak is to be seen intersecting these cross veins in the area between R_1 and R_2. This congregating of cross veins in the bulla area seems to be restricted, in American genera, to the Heptageniidæ, and even then only to certain species. Thus, within the single genus *Ecdyonurus,* there are, as far as wings are concerned at least, three lines of evolution. In the *Heptagenia maculipennis* complex, there are two lines of development.

A peculiar arrangement of the cross veins within the genus *Baëtis* (Fig. 17) and its allies indicates that these several genera are very closely related, but these characters in these genera offer no bases for distinguishing the lines of evolution in this group.

The veinlets, however, indicate something more than do the cross veins. Between the primary veins these short veinlets run inward from the margin. In *Baëtis* and *Pseudocloëon* (Figs. 17, 18) these veinlets are paired; in *Centroptilium* and *Cloëon* (Figs. 25, 26), they are single.

Wing Shape. As stated before, the wings of the Protereismidæ (Fig. 2) lacked both a definite apex and the anal angle which are to be found in all present-day forms with the exception of

Baëtis (Fig. 17) and its allies. Accompanying the reduction of the hind wing there has been a modification of the fore wing, until now the edge of the wing between the anal angle and the base of the wing follows a comparative straight line. It should be expected that the most primitive extant genus would show some relationship in form to the ancestral type or at least should be nearer the ancestral type than the more highly specialized types. This we find to be so, and the genus *Siphlonurus* (Fig. 3) exhibits a wing which is elongate and triangulate. The outer edge has undergone practically no modification, and if the edge of the wing from the base to the anal angle were *arched,* instead of straight as it is, the wing would approach the Protereismidæ wing in shape. The important fact to note is that the proportions of the wing have not changed, as demonstrated by actual measurements, with the result that while the wing of *Siphlonurus* is triangulate it is elongated and narrow.

Isonychia (Fig. 10) is like *Siphlonurus* except that the wing is broader and thus more broadly triangulate.

All other genera of the family Heptageniidæ (Figs. 5, 6, 12, 13, 15) have wings that are similar in shape to those of the genus *Isonychia,* except that the distance between the anal angle and the wing root has been reduced, thus shifting the anal angle toward the wing base and making the distance between the apex and the anal angle comparatively greater.

The tendency toward a broadly triangular wing reaches its extreme development in the family Ephemeridæ (Figs. 34, 37, 38, 39, 41, 43), in which all the genera possess wings that are broad; as an accompanying result the outer margin is long, and the angle formed at the base of the wing by the anal and anterior margins is greater than that in *Siphlonurus,* while the anal angle is more acute.

As mentioned before, the Baëtidæ have somewhat the shape of the ancestral wing, but the venation is highly specialized and different from the primitive venation. Apparently the primitive shape has been secondarily acquired, accompanying the extreme reduction of hind wing. This is indicated by the fact that in other genera that have an anal angle and hind wing the smaller the hind wing the more nearly the fore wing approaches the shape found in the genera of the Baëtidæ, for example *Choroterpes* (Figs. 21, 22), *Ephemerella* (Figs. 55, 47), and *Heptagenia maculipennis* (Figs. 13, 14).

Caenis and *Tricorythus* have lost their hind wings, and while they have lost all indication of an anal angle the wing has not assumed the primitive shape due to the fact that at the base of the wing the posterior part has developed the so-called recurrent membrane, by which the wing is broadly attached to the body of the insect. This reaches its maximum development in *Caenis* (Fig. 45).

Blasturus (Fig. 31) is much like *Isonychia* as far as wing shape is concerned but is not as wide. The outer margin is comparatively long and the anal margin short. In *Choroterpes* (Fig. 29), *Leptophlebia* (Fig. 21), and *Ephemerella* (Fig. 55) where the hind wings have been greatly reduced, the anal margin is distinctly shorter than in *Blasturus,* the anal angle is no longer distinct, and the wing approaches that of the Baëtidæ in shape. *Baetisca* (Fig. 54) stands alone and distinct in wing shape. The outer margin is exceptionally long, the anal margin short, but the anal angle is distinct, while the width of the wing is not excessive.

Genitalia

The genitalia of the male mayfly consist of (1) the styliger plate, which is borne on the terminal end of the ninth sternum; (2) the forceps, which arise from the posterior edge of the styliger plate; and (3) the paired penes, which are commonly considered to arise from the ninth segment and which protrude between the ninth and tenth segments. In the female there are no external organs and the oviducts simply open to the outside between segments 7 and 8.

The phylogenetic history of the insect genitalia and of their homologies between the various insect groups is difficult of interpretation and at present far from complete. The findings and interpretations given here for the mayflies will need modification as still further studies are made. In the mayflies the styliger plate has been interpreted as the tenth sternite by former workers. Evidence advanced by Crampton (1919 and

1920) and Walker (1919) indicates that this structure is in reality a process of the ninth sternum.

In such primitive insects as Thysanura, each sternum consists of a small basal piece or sternite to which are attached posteriorly two plates which are commonly accepted as representing coxites of abdominal legs. From these coxites arise posteriorly directed, unsegmented styli. These styli may represent exopodites of abdominal limbs. *Grylloblatta* presents a similar condition, which is especially evident in the immature stages. In many groups, however, the ninth sternite consists of a single plate which often is expanded posteriorly. This plate has been termed the hypandrium. It may or may not bear styli. Thus, Walker states that in the orthopteroid insects unjointed styli occur in the Blattoidea, Mantoidea, Isoptera, Grylloblattidæ, and Tettigoniidæ. Crampton believes that "in the higher insects a pair of styli form the outer ventral pair of claspers between which the penes valves are located."

The styliger plate of the mayflies is interpreted by Crampton and Walker as representing coxites, which have fused together to form a single structure. This structure, however, is separate from the ninth sternite. A parallel condition is to be found, according to Walker, in the Phasmoidea and Acridoidea, except that in these groups the styli are lacking.

The mayflies of the family Baëtidæ, i.e., *Baëtis* (Fig. 65), *Callibaëtis, Centroptilium, Cloëon,* and *Pseudocloëon,* and the genus *Isonychia* (Fig. 59) all have divided styliger plates. This condition appears to be of secondary origin and will be discussed later.

From the postero-lateral corners of the styliger plate arise the styli or forceps. These are 2–4 jointed in all the mayflies with the exception of the aberrant genus *Caenis.* Thus, while the styli of Thysanura and the orthopteroids consist of a single segment, the styli of the mayflies are jointed.

Since the mayflies belong to the heterometabola, it should be expected that the nymphs of different ages would display the styliger plate and forceps in their various stages of development. In a general way this is true, but there exist some striking differences between the appearance of the genitalia in the nymphs and adults. The styliger plate, as found in the nymphs, appears as a prolongation of the ninth sternum. Both males and females possess such a structure. More striking than this is the fact that the styliger plate during the nymphal period is shaped much like the ventral prolongation of the ninth sternite of the adult female. The styliger plate of the male, however, undergoes modification during the last instar and the adult state is quite different from the nymphal condition. In most genera the styliger plate is, during nymphal life, roughly cone shaped, with the forceps arising from the sloping sides. In the Baëtidæ (Fig. 73), however, it is completely lacking while in *Hexagenia* (Fig. 85), *Ephemera* (Fig. 81), *Potamanthus* (Fig. 79), and *Polymitarcys* (Fig. 86), it is reduced to a narrow band-like structure.

The forceps, as externally visible organs, do not appear until rather late in the nymphal life of the individual. Their earliest indications are small papillæ borne on the posterior edge of the styliger plate. They are unsegmented when they first appear. In some species they subsequently segment; in others they remain unsegmented throughout nymphal life.

In mature nymphs of all species, the forceps consist of finger-like processes. They may or may not be segmented. Thus in *Blasturus* (Fig. 74), *Leptophlebia* (Fig. 80), *Choroterpes* (Fig. 78), *Ephemerella* (Figs. 92, 93), *Tricorythus* (Fig. 94), they are unsegmented. In *Potamanthus* (Fig. 79), *Heptagenia* (Fig. 50), *Ecdyonurus* (Fig. 51), *Epeorus* (Fig. 66), and *Isonychia* (Fig. 57), they are two-jointed, consisting of a long basal segment and a short terminal segment. This terminal joint of the nymphs corresponds to the two short terminal joints of the adult. In *Siphlonurus* (Fig. 58), *Hexagenia* (Fig. 85), *Ephemera* (Fig. 81), and *Polymitarcys* (Fig. 86), the nymphal forceps are three jointed, with a short basal joint (corresponding to the basal joint of the adult), a long second joint and a short terminal joint.

The members of the family Baëtidæ during the nymphal state lack the styliger plate, and either lack or have greatly reduced the forceps. The nymphs of *Callibaëtis* (Fig. 56) are exceptional and exhibit a tiny, cone-shaped forceps which is borne on a slight, posteriorly directed out-pocketing on the ninth sternite. In the remaining genera, the only visible indication of genital organs in the nymphs consist of slight out-pocketings of the ninth sternum (Fig. 73). In mature mymphs which are just ready to emerge, the adult forceps and coxites can be seen through the thin chitin of the sternum. The forceps, due to the restricted amount of space in which they lie, are folded back against the coxites. The point where the forceps are folded is located a short distance from the base of the forceps, and this place in the adult forceps superficially appears as an articulation. It has been interpreted thus by former workers, but careful study will show that this is not a true articulation and is in reality due to the effects of the nymphal development. The genus *Caenis* has genitalia so different both in the nymphal and adult stages as to demand separate consideration. I do not have male nymphs of *Baetisca, Campsurus,* and *Pentagenia.*

The number of segments of the forceps during nymphal life is always less than during the adult state. Thus, in the Heptageniidæ (Fig. 53), *Tricorythus* (Fig. 87), and *Ephemerella* (Fig. 88), the adult forceps are articulated near the base but there is no indication of this in the nymphal forceps. The nymphal forceps, however, of *Siphlonurus* (Fig. 58), *Polymitarcys* (Fig. 86), *Hexagenia* (Fig. 85) and *Ephemera* (Fig. 81) have short basal segments that correspond to the short basal segments of the adult forceps. Of these four genera, the nymphs of the latter three, which belong to the family Ephemeridæ, display relationships not only in the segmentation of the nymphal forceps, but also in their method of attachment to the styliger plate, and in the shape of the nymphal styliger plate. In regard to the forceps and styliger plate, both during the adult and nymphal stages, *Siphlonurus* differs so much from the three other genera as to warrant the belief that its type of forceps segmentation has arisen independently.

In *Blasturus* (Fig. 74), *Choroterpes* (Fig. 78), and *Leptophlebia* (Figs. 80), during the nymphal life the forceps consist of a single segment, but the adult forceps are three-jointed, having two short distal segments and a long basal segment. *Ephemerella* (Fig. 93) and *Tricorythus* (Fig. 94) have unjointed nymphal forceps but the adult forceps have a short distal joint. The nymphal forceps of *Siphlonurus* (Fig. 58), the Heptageniidæ (Figs. 50, 51, 52, 57, 66, 67), and the Ephemeridæ (Figs. 81, 85, 86) all have short distal segments which correspond to the two small distal segments of the adult forceps. It should be noted that *Potamanthus* (Figs. 79, 77) stands intermediate between *Blasturus* (Figs. 74, 72), *Choroterpes* (Figs. 78, 63), *Leptophlebia* (Figs. 80, 68), and the remainder of the Ephemeridæ (Figs. 85, 76, 81, 71, 86, 83), in the shape of the forceps, the number of forceps segments, their points of attachment to the styliger plate, and the shape of the styliger plate. This holds for both adults and nymphs.

The peculiar *Caenis* has the adult styliger plate (?) arising from the anterior end of the ninth segment (Fig. 89). It is a narrow, band-like structure with two slender arms arising from the postero-lateral corners. These arms bear unjointed, blade-like forceps (?). In the mature nymph these structures can be seen through the thin chitin of the ninth sternum (Fig. 90). The sternum is produced posteriorly and into this extend the forceps.

What is the phylogenetic history of the styliger plate and forceps? In the Thysanura the styliger plate is represented by two coxites. According to Walker, in all the orthopteroids, with the exception of *Grylloblatta,* these coxites have fused either together or with the ninth sternite. Similarly in all the ephemerid genera under consideration, with the exception of the Baëtidæ and *Isonychia,* the coxites have fused together to form the styliger plate, and this was apparently the primitive condition among mayflies. The divided condition of the styliger plate in the Baëtidæ has been secondarily derived. The lack of a styliger plate and forceps during nymphal life seems also to be a specialization in the Baëtidæ that has been derived from the condition found in more generalized forms. This is substantiated by the fact that the most primitive genus of this family, *Callibaëtis* (Fig. 56), still retains a tiny nymphal forceps. In a mature *Baëtis* nymph, the members of the adult styliger plate can be seen through the thin chitin of the ninth sternite. They are compressed and even the ninth sternite of the adult is reduced almost to one-half the length of the nymphal sternite. It is probable that the divided styliger plate of the adult of *Isonychia,* a genus not closely related to the Baëtidæ, also represents a secondary condition. This plate is undivided in the nymphs of *Isonychia* (Fig. 57). This genus belongs to the Heptageniidæ and none of the other genera which are included in this family has a divided styliger plate in either the nymphal or adult stages.

Turning to the forceps, we find that their homologues, the styli, are unsegmented in the Thysanura and in all the orthopteroid insects where they are present. In the mayfly nymphs the forceps are 1- to 3-jointed, depending on the genus. The adult forceps are 1- to 4-jointed. It seems feasible to believe that in the primitive mayflies the forceps were unjointed. As shown above, the amount of segmentation of the adult forceps exceeds that of the nymphal forceps. Also, segmentation of the forceps has taken place separately and independently in various stocks of the family. For instance, the short basal segment has been developed four different times: (1) in *Siphlonurus,* in which it appears during nymphal life; (2) in the Heptageniidæ, and in this case it does not appear until the adult state is reached; (3) in the *Ephemerella-Tricorythus* stock, in which the basal segment similarly does not differentiate until the adult stage is reached, but the forceps and styliger plate in this group differ so much from the parts in the Heptageniidæ as to warrant the belief in the separate origin of the basal segmentation in the two groups; (4) in all genera of the Ephemeridæ, except in *Potamanthus,* the most primitive genus of this family. In at least three genera of the Ephemeridæ, namely, *Hexagenia, Ephemera,* and *Polymitarcys,* the segmentation appears during the nymphal stage.

The ædeagus, as stated above, arises from the ninth segment on the ventral surface of the abdomen. In the adult it lies just dorsal to the styliger plate and extends posteriorly between the forceps. The nymphal penes of *Blasturus* (Fig. 74), *Leptophlebia* (Fig. 80), *Choroterpes* (Fig. 78), *Ephemerella* (Figs. 92, 93), *Tricorythus* (Fig. 94), *Ecdyonurus* (Fig. 52), *Heptagenia* (Fig. 50), *Epeorus* (Fig. 66), *Isonychia* (Fig. 57), and *Siphlonurus* (Fig. 58) appear as two posteriorly directed, finger-like processes that lie close together and parallel to each other. In the mature nymph of the Ephemeridæ, the penes approach in shape the structures found in the adult. The nymphs of the Baëtidæ lack all indications of penes. In mature nymphs of the aberrant *Caenis* the penes can be discerned through the thin chitin of the ninth sternite as a rectangular organ. It seems probable that the primitive mayfly penes consisted of two, finger-like protuberances. Palmen (1888) states that the penes arise as two protuberances of the hypodermis at the points where the vasa differentia are inserted into the hypodermis. Further, the nymphal penes of all the more primitive genera consist of two, finger-like processes. In the nymph there are no external signs of parameres and spurs which are to be found in the adults of some species.

In the adult the ædeagus consists of the paired penes and accessory organs. The penes have undergone considerable modification during the history of the group so that the various genera now show a great diversity of forms and shapes. Basally the penes are more or less united on their inner surfaces. In *Ephemerella* (Fig. 88), *Tricorythus* (Fig. 87), and *Baetisca* (Fig. 75), the penes form a tubular organ. That this condition has been secondarily derived is evident at least in the case of *Ephemerella* and *Tricorythus* in which, during the nymphal stage, the penes are clearly separate (Figs. 92, 93, 94). In the specialized family Baëtidæ, the genera *Baëtis* (Fig. 65), *Callibaëtis* (Fig. 48), and *Pseudocloëon* (Fig. 70) have internal penes, while *Cloëon* (Fig. 64) and *Centroptilium* (Fig. 69) have small, humped organs representing the penes. In the family Ephemeridæ the penes have run rampant. Accessory organs are present in some and absent in others. If present, they consist of lateral parameres, and of heavily chitinized spurs which are on the inner surfaces of the penes. Parameres or spurs, or both structures, may be present or absent. Thus, in *Siphlonurus* (Fig. 61) both the parameres and spurs are present. In the Heptageniidæ (Figs. 49, 53, 60, 62) and *Ephemera* (Fig. 71), the spurs alone are to *thus* (Fig. 137), *Caënis* (Fig. 141), *Baëtisca* (Fig. 144), and *Leptophlebia* (Fig. 68) may represent parameres. In the remaining genera considered in this paper, all traces of parameres and spurs are lacking.

Mouth Parts

The mouth parts of the mayfly nymphs consist of labrum, hypopharynx, mandibles, maxillæ, and labium. Of these five parts the following three will be discussed in this paper: the maxillæ, the labium, and the mandibles. As is commonly known, the mayfly mouth parts degenerate just before the emergence of the adult, and the resultant imago possesses mere rudiments of the formerly vigorously developed mouth parts. According to Miss Murphy (1922), there is also a progressive degeneracy of the remnant adult mouth parts. The rudimentary mouth parts of the adult are of no value for the interpretation of generic relationships.

Mandibles. The generalized mandible of a mayfly consists of a strong, sturdy organ which distally bears a dentation that is divisible into two distinct and diverse parts: (1) an outer or ventral incisor area, and (2) an inner or dorsal molar surface (Fig. 95). The molar surface serves as a grinding organ and is made up of a series of ridges and troughs which alternate with each other. The incisors, or canines as they have been called, probably serve as cutting and grasping organs. There are two incisors on each mandible, an outer incisor and an inner incisor. Between the incisors and the molars is a small body known as the lacinia mobilis. It lies close to the inner incisor and is partly surrounded by the latter in some genera. The mandibles of any individual are always asymmetric, both in shape and in regard to the construction of the molars, lacinia, and incisors.

The mandibles are so placed that the long axes of the organs are directed ventrally and inwardly. The incisors are thus located ventral to the molars. In the primitive mayflies the axes of the mandibles are vertical. In the genera *Hexagenia* (Fig. 105), *Ephemera* (Fig. 109), *Polymitarcys* (Fig. 106), and *Pentagenia* (Fig. 110), the axes have become horizontal, but the molars and incisors in these latter genera have so shifted their positions on the mandibles that they are in the same vertical position as in the primitive groups. This warping of the mandibles has been necessitated by the development of a long tusk on each mandible. In *Potamanthus* (Fig. 104) the tusks are short, and the warping of the mandibles is slight.

As stated above, the incisors are bipartite, consisting of two prongs. Terminally each prong gives rise to a number of teeth, the number differing in different genera. In *Baëtis* and *Cloëon* (Figs. 103, 107), the prongs of the incisor have more or less fused to give rise to a single sturdy organ.

The lacinia mobilis assumes a variety of shapes. Among species of the same genus the general pattern seems to be very constant. The exact function of this organ has never been definitely determined and I have no information to add to this phase of the subject. It has been interpreted by Eaton (1883) and Heymons (1896) as a mandibular palp, but as a prostheca by Lestage (1917). According to Crampton (1921) this can not represent a true palp on the mandible, comparable with a palp found on the maxillæ; but it must correspond to the fusion of the hairs making up the gnatho-fimbrium.

In the Ephemeridæ (Figs. 186, 187, 189, 190, 191) the lacinia mobilis consists of a sturdy, trunk-shaped organ of variable size, wholly or partially covered with short or long hairs. Distally it terminates either bluntly or with a tapered point. Sometimes it bears a number of tooth-like structures at the distal end. In the case of the Heptageniidæ (Fig. 174), if present it is slender, resembling a gigantic seta. Some genera of this family completely lack a lacinia mobilis, while in others the organ consists of a number of seta-like processes (Fig. 185). The main body of the lacinia is invariably more or less arched, sometimes near the base, sometimes distally, and the curve may be sharp or gradual.

The studies of Crampton (N. Y. ENT. SOC. 29: 63–97) indicate that the entire mandible represents a single endite or gnathobase, the mandible itself being equal to the maxillary lacinia which also is a complete endite, while the stipes is another complete endite. Thus the various parts of the mandible can not be homologized with parts of the maxillæ. Crampton points out that the mayfly nymphs have very primitive mandibles, which, in some respects, approach those found in the crustacea.

On such a basis the type of mandible that is to be found in *Siphlonurus* seems to be primitive. The incisor region of this sort of mandible is divided into two distinct parts, with the molar areas moderate in size while the laciniæ mobiles are both similar.

Several distinct lines of specialization can be distinguished within the order: (1) the Ephemeridæ with their long anteriorly directed tusks; (2) the Baëtidæ with the more or less fused incisors; (3) the Heptageniidæ lacking the lacinia mobilis or having it reduced to a seta-like structures. The remaining genera present more or less generalized conditions, although each genus displays distinctive shape and structure.

The Maxillæ. The galea, lacinia, stipes, and palpifer are fused in all existing mayflies and form a lacinia-galea. The line of fusion of the galea and lacinia has been completely obliterated in almost all cases. Miss Murphy (1922) reports that it can be identified in *Hagenulus,* and some specimens of *Siphlonurus* show slight indications of the suture. The lacinia-galea bears several heavily chitinized pointed processes on its distal termination which are known as the dentes of the lacinia (Fig. 118), while the inner edge may bear numerous setæ (Fig. 118) which vary in number, length, arrangement, and structure according to the genus under consideration. As a general rule, however, the greatest number is to be found near the terminal end in the vicinity of the lacinial dentes, while a sparse group of long slender hairs is often to be found in the proximal region just opposite the base of the palp. Near the distal end, on the inner edge, amongst the hairs is to be found a number of strong, long, sharply pointed spines. As with the setæ, they vary according to the genus considered.

On the terminal edge of the lacinia-galea, on the part contributed by the galea, there is a patch of setæ which vary greatly in size, length, number, and distribution in the various genera (Figs. 118, 119, 124, 131, 135).

The shape of the lacinia-galea, the number of maxillary palpal segments, and the arrangement, etc., of the various hairs and spines are the structures that will be employed to demonstrate relationship in the following section.

In attempting to determine what is the most primitive maxilla it must be remembered that even the most primitive maxilla of the mayflies (as is patent from the nature of the lacinia-galea) is specialized as compared with more generalized insect types.

Further, some parts of the maxillæ may have undergone specialization while other parts may have remained primitive.

The 3-jointed palp has been considered more primitive than the 2-jointed. There is no definite evidence to support this view or the opposite view. The mayfly genera, however, that are most specialized in other respects have a 2-jointed palp. Further, in *Machilis* the maxillary palp is 4-jointed, while in the crustacea the generalized types possess more than three segments to the endopodite, so that it seems feasible that the reduction is a specialization. Thus, the 3-jointed maxillary palps as found in *Siphlonurus* (Fig. 118), the Ephemeridæ (Figs. 133, 138, 139, 140), *Blasturus* (Fig. 129), *Leptophlebia* (Fig. 132), *Choroterpes* (Fig. 131), *Ephemerella* (Fig. 135), *Tricorythus* (Fig. 137), *Caenis* (Fig. 141), and *Baetisca* (Fig. 144) would be more primitive than the 2-jointed type of the Heptageniidæ (Figs. 120, 121, 124, 125, 128, 130) and the Baëtidæ (Figs. 122, 123, 126, 127). Besides the number of maxillary palp segments, the shape and size indicate relationships.

The ancestral mayfly nymphs crawled around on the bottoms of pools and other relatively still bodies of water, living in habitats similar to those in which *Blasturus* and *Siphlonurus* now dwell. Two distinct lines of evidence support this view: (1) although only few fossil mayfly nymphs are known, judging on the basis of the shape of their bodies, the unprotected gills, and the caudal filaments possessing setæ on both the inner and outer sides, these individuals doubtlessly lived in such a habitat; (2) the mayfly ancestors were terrestrial insects and have secondarily adapted themselves to the water. It appears logical that they made this transition gradually, and that the ancestral nymphs which possessed unprotected gills, and thus were unable to live in swiftly running water or to burrow, or even crawl under flat objects which were closely adhering to the bottom, must have lived in clear, well aerated, still or slowly flowing waters. On these bases, and at the same time keeping in mind the origin of the lacinia-galea, a maxilla which appears more nearly like the ancestral type than any other to be found within the family is possessed by *Siphlonurus*. The body of the organ in this genus (Fig. 118) is more or less straight, unexpanded, and somewhat cylindrical, with a row of well developed setæ on the terminal edge of the part of the structure contributed by the galea. The lacinia dentes in *Siphlonurus* are moderately developed, the lacinial spurs and setæ evenly distributed along the lacinal portion of the fused structure, and finally there is a slight indication of the suture between the two elements in the structure.

Several definite and distinct lines of development of the lacinia-galea can be distinguished within the family: (1) a broadly flattened type, with the characteristic curve to the galea, as found in the Heptageniidæ (Figs. 120, 124, 130); (2) a type in which the structure is heavy and massive, with the lacinial dentes strongly developed and the setæ and lacinial spurs restricted to the terminal end, as found in *Ephemerella* (Fig. 136), *Tricorythus* (Fig. 137), *Caënis* (Fig. 141), *Baëtisca* (Fig. 144), and the Baëtidæ (Figs. 122, 127); and (3) a type in which the structure is more or less flattened, roughly rectangular, with the lacinial dentes reduced, with heavy, dense setæ on the galeal portion as well as on the lacinial portion, a condition which is characteristic of *Blasturus* (Fig. 129), *Leptophlebia* (Fig. 132), *Choroterpes* (Fig. 131); and all the Ephemeridæ except *Ephemera* (Fig. 138) and *Hexagenia* (Fig. 139). These latter genera have a slender, curved lacinia-galea which is very distinctive.

Labium. The insect labium, as is commonly known, consists of the fused second maxillæ, and the various parts of each half can be identified as homologous to the corresponding parts of the first maxillæ. In the Ephemerida the glossæ and paraglossæ, unlike their first maxillary homologues, have not fused but are separate and distinct organs. In this paper the mentum, palpiger, and the ligula (which have fused to form a single structure) will be termed the internal lobe.

The labial palp, with few exceptions, parallels the maxillary palp in the number, shape, and relative proportions of its segments. The exceptions occur in highly specialized genera, such as *Hexagenia* (Fig. 161) which has only two segments to the labial palp, although it has a 3-jointed maxillary palp. *Tricorythus* (Fig. 158) and *Ephemerella* (Fig. 164) have labial palps which are much more generalized than the maxillary palps. In the more primitive genera (especially *Siphlonurus*

(Figs. 118, 143) the maxillary and labial segments correspond closely.

The internal lobe with its appendages, the glossæ and paraglossæ, assumes a diversity of shapes and arrangements. It may be greatly expanded as in *Ephemerella* and *Tricorythus* (Figs. 164, 158), or small as in *Siphlonurus* (Fig. 143). The paraglossæ may be finger-like as in *Siphlonurus* (Fig. 143), and the Baëtidæ (Figs. 150, 154, 157), or broadly expanded as in *Blasturus* (Fig. 151), *Choroterpes* (Fig. 155), *Leptophlebia* (Fig. 159). In the Ephemeridæ (Figs. 152, 153, 156, 160, 161) they are expanded and postero-laterally produced, or they may be small and reduced as in *Tricorythus* (Fig. 158) and *Ephemerella* (Fig. 165), or characteristically flattened as in the Heptageniidæ. The glossæ never exceed the paraglossæ and are usually much smaller, especially in the case of the Heptageniidæ (Figs. 142, 145, 146, 147, 148, 149), Ephemeridæ (Figs. 152, 153, 156, 161), *Blasturus* (Fig. 151), *Choroterpes* (Fig. 155), and *Leptophlebia* (Fig. 160).

Since the various modifications that the labium has undergone parallel those of the maxillæ, *Siphlonurus* appears to have the most primitive mayfly labium in existence.

Gills

The gills of present-day mayflies are highly diverse and present many adaptations to the environmental conditions in which the nymphs live. The two mayfly species known from the lower Permian (belonging to the genus *Phthartus*) had nine pairs of slender, unbranched, finger-like gills. *Mesobaëtis sibricia* Brauer of the lower Jurassic (Dogger series) is very similar to *Phthartus,* while *Mesobaëtis antiqua* Brauer, Redtenb., Ganglb. possesses seven pairs of small, leaf-like gills. *Ephemeropsis orientalis* Eichwald of the Malm series of the Jurassic has eight pairs of simple gills like those found in *Phthartus*. *Phacelobranchus,* also of the Malm, has only eight pairs of gills, but they are compound. There are never more than seven pairs of gills in any present-day species, and these are located on the first seven abdominal segments. This is generally the number in present-day forms. In a few genera, such as *Ephemerella, Baetisca,* and *Caenis,* there are less than seven pairs. These exceptions would, however, appear to have been derived from an ancestral stock that possessed at least seven gills.

Drucken (1907) advanced the view that the gills were serially homologous with the wings, but works by Heymons (1896) and Borner (1908) have led to the general acceptance that the gills are homologous with the legs. Thus, the gills are ambulatory appendages that have been modified for respiration. Recent work by Snodgrass (1927) has added support to this theory. In this connection it is interesting to note that gills have been developed upon the maxillæ of *Isonychia* (Fig. 119) in the region of the union of the cardo and stipes. In the genus *Oligoneuria* gills are also developed on the maxillæ.

From the paleontological evidence, plus the facts demonstrated by the rearing of various species, it would appear that the primitive gills of the ancestral mayflies were simply slender tubular structures, into which the tracheæ enter, and that the compound structures of the present-day forms have arisen as modifications of this primitive type. The two principal ends attained by these modifications are a superior respiratory organ and protection for the gills. In some cases, as in *Caenis* (Fig. 250), *Tricorythus* (Fig. 249), and *Ephemerella* (Fig. 245), whole gills or parts of gills are given over in the main to protection.

The modifications that the gills have undergone include the flattening of the gill into a foliaceous organ and the changing of the gill from a simple, finger-like out-pocketing into a double organ consisting of two leaves lying against each other. This doubling seems to have been accomplished by the gill developing a small lobe at the base which develops into the posterior or inferior lamella. The two leaves may be similar [as in *Leptophlebia* (Fig. 228), *Hexagenia* (Fig. 230), *Blasturus* (Figs. 225, 226), *Choroterpes* (Figs. 222, 223), etc.], or they may be very different [as in *Heptagenia* and *Isonychia* (Figs. 200, 205)].

It will be helpful in determining the mutual relationships between genera to follow the fate of the gills in the younger post-embryonic stages. Work of this type in every instance (Vayssiere, 1882; Lubbock, 1863–66; Gros, 1923; Murphy, 1921, and Wiebe, 1926) shows that the newly born larvæ do not display any indications of gills but that these arise later as simple out-pushings of the dorso-lateral abdominal wall. These later differentiate into the various shapes characteristic of the several species. Although only a few species have been studied, it seems likely that the gills of all mayflies arise as simple outpushings. To learn just how these simple gills develop into the highly complex gills of such forms as *Caenis, Tricorythus, Ephemerella,* etc., would be of enormous value in determining relationships between various genera.

I have incubated the eggs of *Hexagenia limbata* Guerin and reared the nymphs until they were half grown. Due to difficulties resultant from the method of handling the nymphs, I was not able to preserve specimens of every instar, but a complete enough series was taken to enable me (with the aid of Wiebe's findings) to demonstrate how the gills grew into the highly compound structure of the adult nymph. The gills arose as described above during the second instar. The gill analogues increased in length and in diameter. In a nymph eleven days old (Fig. 236) filaments, irregularly placed and spaced, extend laterally from the body of the gill. The main trunk is still cylindrical. Near the base on the posterior side there arises a short finger-like projection that extends caudally. This is slightly larger than any of the other filaments. As the nymph grows older (Fig. 235) this projection, which becomes the posterior gill lamella, grows much faster than the main trunk so that by the time the insect is twenty-five days old the two lamellæ are of equal size, just as in the adults. Meanwhile these two lamellæ have become flattened laterally and the filaments have become localized along the edge with a regular arrangement. When the nymph is about twenty-two days old, the gills are very similar in appearance to those found in *Potamanthus* (Fig. 229), and by the time the nymph is thirty days old the gills are identical in shape, proportions, and arrangement of the filaments with those found in the adult *Hexagenia* nymphs (Figs. 231, 232).

From Gros and Vayssiere's descriptions of species of *Heptagenia,* it is evident that the history of the compound gills in these species is parallel to that in *Hexagenia,* although the resultant gill is quite different in shape.

(To be continued)

A NEW ENEMY OF THE PINEAPPLE MEALYBUG AND A LIST OF GALL MIDGE ENEMIES OF MEALYBUGS

BY E. P. FELT

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Specimens of a small gall midge, predacious on the pineapple mealy bug, *Pseudococcus brevipes,* were received in early fall of 1932 from Mr. Carl T. Schmidt of the Experiment Station of the Association of Hawaiian Pineapple Canners, through Dr. Harold Morrison, in Charge of Taxonomic Investigations, United States Bureau of Entomology, Washington, D. C. They were labeled Kunia, Oahu, Q. C. Chock. This species was introduced from Mexico, into the Hawaiian Island in 1930 and has been distributed over the Islands since that time. A study of this series of 24 specimens, representing both sexes, leads us to consider it a new species and to tentatively refer it to the genus *Lobodiplosis* Felt.

Lobodiplosis pseudococci new species

Male. Length 1 mm. Antennae as long as the body, thickly haired, dark brown; 14 antennal segments, the fifth with stems having a length three-fourths and one and one-fourth their diameters. The basal enlargement subglobose, the rather stout loops of the circumfila extending to the base of the distal enlargement, which latter is stoutly subpyriform, with a length about one-fourth greater than its diameter, with subbasal and subapical circumfila, the loops of the distal circumfilum extending to the base of the following segment. The basal enlargement of the terminal segment disc-like, with a length one-half the diameter. The basal portion of the stem slender, with a length twice its diameter, the distal enlargement subcylindric, with a length about twice it diameter. Palpi; the first segment short, stout, the second and third subequal, the fourth about one-half longer than the second, dilated apically. Mesonotum fuscous brown, the submedian lines narrow, sparsely haired. Scutellum and postscutellum a variable fuscous yellowish. Abdomen fuscous yellowish, the basal segment lighter, with sparse coarse hairs. Wings hyaline, costa dark brown, subcosta uniting with the anterior margin at the basal third, the third vein just before the apex, the fifth vein joining the posterior margin at the distal fourth, its branch at the basal third. Halteres fuscous apically, yellowish basally.

Legs mostly dark brown, the femora basally and coxae yellowish. Claws stout, curved at right angles, the anterior unidentate, the pulvilli rudimentary. Genitalia; basal clasp segment short, stout, quadrate, with the apical dorsal angle produced and a long, somewhat decurved process, both this and the basal clasp segment with numerous, rather stout hairs. Terminal clasp segment short, stout, obtuse apically, dorsal plate deeply and triangularly incised, the lobes narrowly oval, ventral plate deeply and triangularly incised, narrowly rounded apically.

Female. Length 1.5 mm. Antennae extending to the middle of the abdomen, sparsely haired, fuscous yellowish; 14 segments, the fifth with a stem about one-fifth the length of the subcylindrical basal enlargement, which latter has a length two and one-half times its diameter, the terminal segment with a rudimentary knob-like process. Mesonotum light brown, sparsely haired, the submedian lines pale yellowish. Scutellum and postscutellum yellowish. Abdomen yellowish red, sparsely haired, ovipositor yellowish, with a length about half that of the abdomen, the terminal lobes narrowly oval. Other characters practically as in the male.

Types deposited in the United States National Museum. Type Cat. No. 44774.

The predacious habits of gall midges have remained comparatively unknown up to recent years. Dr. H. F. Barnes,[1] of the Rothamsted Experimental Station, England, has compiled data recently, in addition to describing species, in relation to the predacious habits of gall midges, and lists 50 species living upon aphids, one species upon tingids, two upon psyllids, one upon aleyrodids and 50 upon scale insects or coccids. These lists give an idea of the predacious habits among gall midges, and in addition, a number of species are known to prey upon acarids, better known as red spiders or spider mites. There are, as might be expected, a number of widely separated genera possessing these predacious habits.

The species attacking mealybugs are of special interest in this connection and are listed below, the host and the distribution also being recorded:

Coccidomyia erii Felt from *Amonostherium lichtensioides,* California.

Dicrodiplosis californica Felt from *Pseudococcus* species on Solanum, Riverside, Calif.

Dicrodiplosis coccidarum Felt on *Pseudococcus citri,* Porto Rico.

[1] Bull. Ent. Research, 20: 433–442; 21: 319–329; 22: 205–207, 1930 and 1931.

Lobodiplosis coccidarum Felt on *Pseudococcus citri,* St. Vincent, W. I.

Lobodiplosis pseudococci Felt on *Pseudococcus brevipes,* Hawaii.

Triommata coccotroctes Barnes on mealybug, Sierra Leone, Africa.

Silvestrina koebelei Felt on *Pseudococccus gahani,* Riverside, Calif., introduced from Sydney, N. S. W.

Karschomyia cocci Felt on *Trionymus sacchari,* Porto Rico.

Acaroletes pseudococci Felt on *Pseudococcus citri,* Sicily.

Diadiplosis coccidivora Felt from *Pseudococcus* on *Tephrosia hookeriana,* Ceylon.

Diadiplosis hirticornis Felt on *Pseudococcus vapor.,* Japan.

Diadiplosis indica Felt from *Pseudococcus filamentosus* var. *corymbatus,* India.

Diadiplosis pseudococci Felt from *Pseudococcus bromeliae,* British Guiana.

Schizobremia formosana Felt from *Pseudococcus* on pineapple, Formosa.

Schizobremia malabarensis Felt from *Ferrisia virgata* on pepper, Malabar.

Arthrocnodax walkeriana Felt from *Pseudococcus* on coffee, Ceylon.

Feltodiplosis hirta Felt from *Pseudococcus* on *Mimusops hexandra,* Ceylon.

Adelgimyza dactylopii del Guer. from *Pseudococcus,* Italy.

Cecidomyia coccidarum Ckll. from *Pseudococcus virgatus,* Jamaica.

Coccodiplosis pseudococci de Meij. from *Pseudococcus adonidum, P. citri,* Java.

There are undoubtedly other species which prey upon mealybugs. Some of them may be important natural enemies. It is worthy of notice that most of these records are from tropical or subtropical regions.

UNDESCRIBED SPECIES OF ERIOPTERINE CRANE-FLIES FROM THE UNITED STATES AND CANADA (TIPULIDÆ, DIPTERA), PART II[1]

By Charles P. Alexander
Amherst, Massachusetts

The first part under this general title was published in 1929 (Journ. New York Ent. Soc., 37: 49–58). The present report is based on extensive collections made in the southeastern United States by Professor J. Speed Rogers and Mr. Henry Townes, Jr., and additional series taken by the writer and Mrs. Alexander in New England and eastern Canada and by Mr. Owen Bryant in Alberta. Where not otherwise indicated, the types are preserved in the collection of the author.

Genus *Rhabdomastix* Skuse

Subgenus *Sacandaga* Alexander

Rhabdomastix (Sacandaga) subarctica new species

Allied to *caudata;* general coloration gray; vein R_2 present as a weak element; veins R_3 and R_4 not widely divergent, cell R_3 narrow, especially at base; vein R_3 long, oblique; macrotrichia on veins R_{2+3+4}, R_{3+4}, R_3, R_4 and outer end of *Rs*.

Female. Length about 4.5–5 mm.; wing 5–5.5 mm.

Rostrum dark brown; palpi black. Antennae short, black. Head brownish gray.

Pronotum dark brown, pruinose; anterior lateral pretergites yellowish brown. Mesonotum grayish brown, the praescutum with poorly indicated darker brown stripes. Pleura dark gray. Halteres pale throughout. Legs with the coxae and trochanters brownish yellow; femoral bases obscure yellow; remainder of legs dark brown. Wings grayish, the stigma slightly darker; base of wing restrictedly milky-white; veins brown. Macrotrichia of veins relatively numerous, occurring on R_{2+3+4}, R_{3+4}, R_3, R_4 and outer end of *Rs*. Venation: Sc_2 lacking; R_2 present as a pale element, without macrotrichia; R_{2+3+4} and R_{3+4} subequal; veins R_3 and R_4 not strongly divergent, cell R_3 at margin about one-third wider than cell R_2; vein R_3 long, oblique

[1] Contribution from the Entomological Laboratory, Massachusetts State College.

in position; cell *1st* M_2 rectangular; *m-cu* at or shortly beyond the fork of *M*.

Abdomen dark brown.

Habitat.—Eastern Quebec (North Gaspé).

Holotype, ♀, Ruisseau Castor, June 27, 1931 (C. P. Alexander).

Paratopotypes, 2 ♀♀. The same species was seen but not captured on the same day at Cape Morne.

This interesting northern *Rhabdomastix* occurred along small streams pouring down the steep mountain slopes. It was associated with other crane-flies of the Hudsonian life-zone, as *Tipula gaspensis* Alexander, *Dicranota petiolata gaspeana* Alexander, and others. The fly is most nearly allied to *Rhabdomastix* (*Sacandaga*) *caudata* (Lundbeck), differing especially in the venation of the radial field and the more abundant macrotrichia of the veins.

Rhabdomastix (Sacandaga) hudsonica new species.

Size large (wing, ♂, over 7 mm.); general coloration yellow, the center of vertex, three praescutal stripes, centers of scutal lobes, posterior portion of postnotal mediotergite and areas on pleura conspicuously grayish brown; tips of femora and tibiæ and all of tarsi dark brown; wings subhyaline, the veins brown; R_2 lacking.

Male. Length about 6–7 mm.; wing 7.5–8.5 mm.

Female. Length about 7 mm.; wing 8.5 mm.

Rostrum obscure yellow. Antennae with the scape yellow, the remainder black. Head yellow, the vertex with a conspicuous dark brown median area.

Pronotum yellow, trivittate with brown; anterior lateral pretergites conspicuously light sulphur-yellow. Mesonotal praescutum light yellow to obscure yellow, with three grayish brown stripes, the median one ending far before the suture, the interspaces reduced to linear strips or lacking; pseudosutural foveae and tuberculate pits black; scutum yellow, each lobe with a grayish brown area that is a caudal prolongation of the lateral praescutal stripe; median area of scutum restrictedly darkened; scutellum testaceous-yellow; postnotal mediotergite brownish gray, more yellowish antero-laterally. Pleura and pleurotergite yellow, variegated with grayish brown areas on ventral sternopleurite, meron, anepisternum and ventral pleurotergite. Halteres yellow. Legs with the coxae and trochanters yellow, the fore coxae darkened; femora yellow, the apices broadly brown; tibiae brown, the tips narrowly darkened; tarsi dark brown. Wings subhyaline, the veins brown, conspicuous. No macrotrichia on *Rs*, R_{2+3+4}, R_3 or R_4. Venation: R_3 transverse, perpendicular or nearly so, less than one-third the long, nearly straight R_4.

Abdomen brown; caudal margins of outer sternites broadly yellow; hypopygium obscure yellow.

Habitat.—Eastern Quebec (Gaspé).

Holotype, ♂, Ste. Anne des Monts, north shore, June 26, 1931 (M. M. Alexander).

Allotopotype, ♀.

Paratopotypes, 8 ♂♂; paratype, 1 ♂, Chandler, south shore.

Rhabdomastix (*Sacandaga*) *hudsonica* is another species of the Hudsonian life-zone, well-distinguished from the other regional members of the subgenus by its large size and conspicuous dark pattern of the head and thorax. The types were taken while flying in a small swarm on the shores of the Gulf of St. Lawrence.

Rhabdomastix (Sacandaga) brittoni new species.

Male. Length about 4–4.2 mm.; wing 4.8–5 mm.

Female. Length about 5.5 mm.; wing 5.5 mm.

Related to *R.* (*S.*) *flava* (Alexander), differing most evidently in the small size and details of venation and trichiation of the wings.

Color of body light sulphur-yellow, the praescutum with scarcely indicated darker stripes. Wings nearly hyaline, the veins pale and difficult to delimit; stigma lacking. Macrotrichia on distal half of the gently curved vein R_4.

Habitat.—Connecticut.

Holotype, ♂, Kent Falls, Litchfield Co., July 23, 1931 (C. P. Alexander).

Allotopotype, ♀.

Paratopotypes, 3 ♂♀.

Occurred along the relatively small Kent Brook, where it was swept from rank herbage, in association with *Cryptolabis paradoxa* O. S. I take great pleasure in naming this fly in honor of Dr. W. E. Britton.

Rhabdomastix (Sacandaga) mediovena new species.

Size small (wing, ♀, 6 mm.); general coloration light yellow; wings pale yellow, subhyaline, stigma lacking; Sc_1 ending about opposite three-fourths the length of *Rs;* vein R_4 subequal to or longer than R_{2+3+4}, only gently curved, with macrotrichia over most of its length.

Male. Length about 4.5 mm.; wing 5 mm.

Female. Length about 5.5 mm.; wing 6 mm.

Rostrum yellow; palpi brownish black. Antennae with the scape yellow; pedicel and flagellum dark brown; flagellar verticils elongate. Head light sulphur-yellow (♂) to more grayish brown (♀).

Mesonotum obscure yellow, the praescutum and scutum with more reddish stripes, darker in ♀. Pleura yellow, more obscure in ♀. Halteres yellow. Legs yellow, the outer tarsal segments slightly darker. Wings pale yellowish subhyaline, iridescent; veins pale and little evident. Vein R_4 with about eight macrotrichia distributed over most of its length. Venation: Sc_1 ending about opposite three-fourths the length of *Rs*; R_4 slightly curved, subequal to or longer than R_{2+3+4}; outer section of M_{1+2} arcuated at origin; *m-cu* at near one-third the length of cell *1st* M_2.

Abdomen pale yellow, somewhat more brownish yellow in female.

Habitat.—South Carolina.

Holotype, ♂, Greenville, June 16, 1931 (Henry Townes, Jr.).

Allotopotype, ♀.

The three small species of *Sacandaga* described at this time as *brittoni, mediovena* and *brachyneura* are most readily told among themselves by the wing-venation, especially the length of *Sc* in relation to *Rs*. In *brachyneura, Sc* is shortest, Sc_1 ending between one-third and one-half the length of *Rs;* in *mediovena,* Sc_1 is opposite or close to three-fourths the length of the vein; in *brittoni,* Sc_1 is opposite or close to four-fifths the length of the vein. The present fly is further told from *brittoni* by the long and only gently arcuated vein R_4, with macrotrichia distributed over most of its length.

Rhabdomastix (Sacandaga) brachyneura new species.

General coloration brownish yellow, the mesonotum with more grayish brown areas; antennal flagellum with very elongate verticils; halteres pale yellow; wings with a grayish suffusion, the stigma pale brown; macrotrichia on entire length of veins R_{2+3+4} and R_4; *Sc* very short, Sc_1 ending opposite or just beyond midlength of *Rs;* R_3 short and nearly perpendicular, approximately one-fourth as long as R_4; distal section of M_{1+2} beyond cells *1st* M_2 but little arched.

Male. Length about 5 mm.; wing 6 mm.

Rostrum and palpi black. Antennae with the scape black, the remaining segments dark brown; flagellar segments with very long black verticils that are nearly three times as long as the individual segments. Head blackish gray.

Mesonotum brownish yellow, the praescutum with more grayish brown stripes. Pleura yellowish brown. Halteres pale yellow. Legs with the coxae and trochanters reddish brown; remainder of legs chiefly pale yellow. Wings with a grayish suffusion, the oval stigma somewhat darker; wing-base restrictedly more whitish; veins pale brown. Macrotrichia of veins relatively numerous, including series on the entire length of veins R_{2+3+4} and R_4, but none on R_3. Venation: *Sc* unusually short, Sc_1 ending between one-third and one-half the length of *Rs*; R_4 a little longer than R_{2+3+4}; R_3 very short, about one-fourth R_4, nearly perpendicular; distance on costa between R_{1+2} and R_3 subequal to length of the latter; vein M_{1+2} beyond cell *1st* M_2 but little arched; *m-cu* at nearly its own length beyond the fork of *M*.

Abdomen dark brown, the hypopygium slightly brighter in color.

Habitat.—South Carolina, North Carolina.

Holotype, ♂, River Falls, near Greenville, altitude about 3000 feet, July 1, 1931 (Henry Townes, Jr.). Paratype, ♂, Highlands, Macon Co., North Carolina, altitude 4000 feet, June 22, 1930 (J. S. Rogers); in Rogers collection.

Rhabdomastix (*Sacandaga*) *brachyneura* is distinguished from other regional species by the length of the antennal verticils and by the details of venation, notably the unusually short *Sc*. In the general features of venation and trichiation of the veins, the fly seems to be allied to *R.* (*S.*) *fasciger* Alexander and a few related species in western North America. The holotype specimen appears to be slightly teneral and there may be a faintly darkened cloud on the anterior cord of wings, not mentioned in the above description.

Genus *Erioptera* Meigen

Erioptera (Erioptera) osceola new species.

Allied to *septemtrionis*; general coloration reddish brown; knobs of halteres darkened; wings narrow, tinged with brown; male hypopygium with both dististyles simple, appearing as flattened blades.

Male. Length about 3–3.2 mm.; wing 3.5–3.7 mm.

Rostrum, palpi and antennae pale brown, the scape and pedicel darker. Eyes (♂) large, broadly contiguous beneath. Head light brown, the orbits more yellowish.

Mesonotum chiefly light reddish brown; posterior sclerites of mesonotum and the pleura more testaceous, with a faint grayish cast. Halteres pale, the knobs infuscated. Legs with the coxae and trochanters pale; remainder of legs brownish yellow, the terminal segments darkened. Wings narrow, faintly tinged with brown; veins and macrotrichia darker. Venation: As in the subgenus, the cells unusually narrow due to the conformation of the wing.

Abdomen dark brown, the sternites and hypopygium brighter. Male hypopygium with the tergal plate depressed, its caudal margin broadly notched. Both dististyles simple, the outer longest, slender, on distal third dilated into a smooth blade; inner style a shorter, flattened blade, the apex obliquely truncated, obtuse. Gonapophyses appearing as simple curved horns.

Habitat.—Florida.

Holotype, ♂, Gainesville, Alachua Co., April 6, 1928, (J. S. Rogers); Coll. No. 230.

Paratopotypes, several ♂♂, February 2–April 25 (J. S. Rogers); paratypes, 2 ♂♂, "Camp Torreya", Liberty Co., April 25, 1924 (J. S. Rogers).

Type in the Collection of the University of Michigan.

The only allied regional species of the subgenus with the knobs of the halteres darkened are *E.* (*E.*) *septemtrionis* O. S., which has a hypopygium with an acutely pointed outer dististyle and a bifid inner dististyle; and *E.* (*E.*) *uliginosa* Alexander, which has much broader and darker wings, a darker body-coloration, and with a male hypopygium having a small pointed inner dististyle.

Erioptera (Erioptera) seminole new species.

Belongs to the *chlorophylla* group, most closely related to *E.* (*E.*) *furcifer* Alexander and *E.* (*E.*) *subfurcifer* Alexander, differing especially in the structure of the male hypopygium.

Male. Length about 4.3–4.5 mm.; wing 5–5.2 mm.

Eyes (♂) large, contiguous beneath. Head yellowish green, the antennae chiefly pale.

Mesonotal praescutum yellowish, presumably green in living individuals, with four more reddish stripes that cover most of the disk; scutal lobes extensively reddish brown; posterior sclerites of mesonotum and the pleura yellowish green, paling to whitish yellow in dried specimens. Halteres pale, the knobs more greenish. Legs chiefly yellow, tinged with green. Wings strongly suffused with yellow, with greenish tints persisting; veins darker yellow.

Abdomen pale green, the hypopygium paler. Male hypopygium with the outer dististyle a flattened blade that expands outwardly, its apex subobliquely truncated and weakly blackened; outer apical angle a little more produced, the remainder of apex with microscopic spinulae. Inner dististyle profoundly bifid, as in *furcifer* and allies, entirely glabrous. Gonapophyses appearing as unusually slender rods, pale at base, gradually narrowed outwardly, the distal half with microscopic spinulae.

Habitat.—Florida.

Holotype, ♂, Gainesville, Alachua Co., April 20, 1929 (J. S. Rogers); Coll. No. 259.

Paratopotypes, several of both sexes, chiefly in the Rogers Collection.

Type in the Collection of the University of Michigan.

Erioptera (*Erioptera*) *seminole* has the inner dististyle of the male hypopygium of a form that is found only in *furcifer* and *subfurcifer* among the described species of the group. *E.* (*E.*) *furcifer* is readily told by the narrow outer dististyle, the conspicuous setiferous spine of the inner dististyle, and the broader gonapophyses. *E.* (*E.*) *subfurcifer* has the outer dististyle somewhat as in the present species but the apex of the inner style is provided with microscopic erect setulæ, while the gonapophyses are broad and of an unusually powerful construction. There are now eight species of light green *Erioptera* in the eastern United States and Canada. Of these, *chlorophylla, chlorophylloides, gaspeana, subfurcifer* and *viridula,* are more northern in their range, with all but the fourth having been taken in Canada; while the remaining three species, *furcifer, seminole* and *subchlorophylla,* are confined to the Carolinian and Austroriparian zones.

Erioptera (Mesocyphona) evergladea new species.

Closely allied to *knabi,* differing especially in the narrower wings, general coloration of body and structure of male hypopygium.

Male.—Length about 2.8–3 mm.; wing 3.6–3.7 mm.

Female.—Length about 3.5 mm.; wing 3.5 mm.

Antennae pale yellow to brown. Mesonotal praescutum almost covered by grayish brown stripes that are confluent or nearly so, the humeral triangles conspicuously yellow; median region of scutum and adjoining medial portion of praescutum before suture obscure yellow; scutellum obscure whitish; postnotal mediotergite dark, the lateral margins narrowly but conspicuously yellow. Pleura dark brown, with two conspicuous whitish longitudinal stripes, the more dorsal including the dorso-pleural region, wing-root and most of the pleurotergite; the ventral stripe begins behind the fore coxa, passing to abdomen, including the root of the haltere. Femora with the distal half darkened, especially the broadly blackened tip which is preceded by a narrow but conspicuous yellow ring; tibiae and tarsi yellow, the tips of the latter darkened. Wings of the general pattern of *knabi* but much narrower, the cells, especially the Anal cells, correspondingly narrowed. Male hypopygium with the inner dististyle ending in a small, conical point, not produced into a long terminal spine, as in *knabi.* Gonapophyses longer and more slender than in *knabi,* bent mesad, the tips conspicuously pale.

Habitat.—Florida.

Holotype, ♂, Charlotte Co., October 22, 1928 (J. S. Rogers).

Allotype, ♀, Fort Myers, Lee Co., October 20, 1928 (J. S. Rogers).

Paratopotype, 1 ♂; paratypes, 6 ♂♂, with the allotype.

Type in the Collection of the University of Michigan.

Erioptera (*Mesocyphona*) *evergladea* differs from *E.* (*M.*) *knabi* Alexander (Middle America) by the thoracic pattern and structure of the male hypopygium. The general coloration is more like that of *E.* (*M.*) *hubbelli* Rogers (Oklahoma-Kansas), which differs more especially in the broader wings and details of the male hypopygium, notably the gonapophyses. These three flies form a compact group of species that agree well in the general features of wing- and leg-patterns.

Genus *Ormosia* Rondani

Ormosia albertensis new species

General coloration gray; antennae (♂) elongate, if bent backward extending about to midlength of the abdomen; wings with cell M_2 open by atrophy of basal section of M_3; vein *2nd A* sinuous on distal third and thus extending generally parallel to *1st A;* male hypopygium with the gonapophyses appearing as broad, flattened plates, the tip of each produced into a stout spinous point.

Male.—Length about 4.5 mm.; wing 5.5 mm.; antenna about 3 mm.

Rostrum and palpi dark brown. Antennæ (♂) elongate, if bent backward extending to about opposite midlength of the abdomen, dark brown throughout; flagellar segments elongate-fusiform. Head gray.

Pronotum light brown; anterior lateral pretergites almost white. Mesonotum dark brown, sparsely pruinose, the small pseudosutural foveæ black; humeral region of præscutum restrictedly brightened; scutellum brownish yellow. Pleura brown, with a paler longitudinal stripe crossing the dorsal sternopleurite. Halteres dusky, with yellow setæ. Legs with the coxæ and trochanters yellow; remainder of legs brown. Wings with a grayish tinge; stigmal region damaged in mounting and so undescribable; veins pale brown. Venation: Cell M_2 open by atrophy of basal section of M_3; vein *2nd A* arcuated on distal third and so extending generally parallel to *1st A* for this distance.

Abdomen brown, the hypopygium somewhat brighter. Male hypopygium with the dististyles much as in *longicornis* and allied forms; outer style small, ear-like; inner style slender, pale, narrowed to the obtuse apex. Gonapophyses appearing as broad flattened plates, the apex of each produced into a stout spinous point.

Habitat.—Alberta.

Holotype, ♂, Banff, Upper Hot Spring, July 13, 1928 (Owen Bryant).

Type returned to Mr. Bryant.

Ormosia albertensis is allied and generally similar to *O. longicornis* (Doane), differing in the shorter antennæ of male and the structure of the male hypopygium, especially of the gonapophyses.

Ormosia townesi new species

Allied to *nimbipennis;* mesonotal præscutum reddish brown, the posterior sclerites of mesonotum and the pleura dark brown; wings strongly tinged with brownish; cell *1st* M_2 open by the atrophy of basal section of M_3; vein *2nd A* sinuous; male hypopygium with two elongate dististyles; ædeagus tridentate at apex.

Male.—Length about 4.5 mm.; wing 5.8 mm.

Female.—Length about 5 mm.; wing 6 mm.

Rostrum and palpi black. Antennæ short in both sexes, pale brown. Head brownish gray.

Mesonotal præscutum light reddish brown, without distinct stripes; posterior sclerites of mesonotum dark brown. Pleura dark brown, sparsely pruinose. Halteres pale yellow. Legs with the fore coxæ dark, the remaining coxæ and all trochanters obscure yellow; remainder of legs brownish yellow. Wings with a strong brownish tinge, the costal region somewhat darker; stigma conspicuous, dark brown; veins dark, narrowly and vaguely seamed with brown. Venation: Forks of cells beyond cord deep; cell *1st* M_2 open by atrophy of basal section of M_3; cell *2nd* M_2 approximately four to five times its petiole; vein *2nd A* sinuous.

Abdomen dark brown; male hypopygium very slightly brighter. Male hypopygium with two distinct dististyles, the outer a long, slender, nearly straight rod that is a little expanded outwardly, abruptly narrowed at apex into an acute black spine. Inner dististyle a longer, curved, slender rod, not very different in form from the corresponding structure in *nimbipennis.* Gonapophyses appearing as four blackened horns, the longer pair gently curved, the inner pair about one-half as large, nearly straight. Aedeagus unequally trifid at apex, the median spine being much smaller than the laterals.

Habitat.—North Carolina.

Holotype, ♂, Cedar Mt., Transylvania Co., altitude about 2700 feet, August 28, 1931 (Henry Townes, Jr.).

Allotopotype, ♀, August 27, 1931.

I take great pleasure in naming this very distinct *Ormosia* in honor of the collector, Mr. Henry Townes, Jr., who has discovered several new and rare Tipulidæ in the Carolina Mountains. The species is most nearly allied to *nimbipennis* Alexander, differing very conspicuously in the elongate outer dististyle of the male hypopygium. In *nimbipennis,* and allied *O. ingloria* Alexander, the outer dististyle is reduced to a tiny thimble-like structure, so small as to appear almost lacking. The tridentate ædeagus of the present species is very similar to that found in *nimbipennis.*

NOTE ON A COLLECTION OF OLD ENTOMOLOGICAL PAINTINGS

BY G. W. BARBER AND J. S. WADE

Recently, while examining the collection of relics in the St. Augustine (Florida) Historical Society and Institute of Science, the authors chanced upon a series of old insect paintings in oil which proved to be of so much interest that it is deemed worth while to place on record a note regarding it. The collection consists of forty-seven canvases uniformly 34 by 22 inches in size. Most of the paintings are in excellent condition aside from fading of the colors apparently due to long exposure to light. The wooden frames, about two inches wide on which each canvas is mounted, are much decayed and eaten by wood insects, and in a few instances the canvases are torn and the legends sometimes partly illegible. Neither the curator of the museum, Mr. W. J. Harris, nor the assistant secretary and librarian, Mrs. A. W. Underwood, had any information whatever as to the age or origin of the collection, it having come into possession of the society some time subsequent to 1894, through the disruption of a privately conducted museum owned by Mr. George H. Chapin, a publisher in St. Augustine who was said to have formerly lived in Boston. The only description of this museum available to the writers consisted of a brief advertisement printed in "The Standard Guide to St. Augustine," by Charles B. Reynolds, 1894, on the first page of advertising matter following its subject matter. This advertisement states that the museum was located in St. Augustine opposite Fort Marion and comprised "100,000 curiosities of interest to lovers of natural history . . . birds, animals and reptiles of Florida."

The paintings seem to have been carefully executed with considerable fidelity to detail. Each canvas represents a single insect many times enlarged, bearing hand-printed technical name of the species illustrated and in some instances its habitat. In view of the unusual excellence of the technical work, it is of more than passing interest to speculate upon the possible identity of the person or persons who made these paintings especially when one remembers the fact that St. Augustine is one of the very oldest towns in the United States and the further fact that a number of itinerant artists and naturalists at various times roamed over and studied the fauna of Florida.

The following is an exact transcription of the legends on these various paintings: Coleopteres Labidostomis hybrida; Pentatoma rutilans—Sierra Leone; Dipteres—Bombylius maculipennis; Prionus cervicornis—Brazil; Lepidopteres—Saturnia atlantica; Lepidopteres—Deilephila euphorbiæ; Tremex columba—New York; Coleopteres—Labidostomis signatipennis; Harpax ocellaria —Africa; Anthrenus scrophularie—Britain (much torn); Hymenopteres—Hedicrum micans; Necrophorus humator—Britain (wings partly spread); Acrocinus longimanus—Brazil; Phasma necydalos—Tropics; Lucanus cervus—Britain; Coleopteres—Purpuricenus barbarus; Cassida echinata—Java; Cicada septendecim—N. America; Curculio myrmosarius—S. America; Scarabæus atlas—Java; Cassida micans—Java; Coleopteres—Helodes pulchella (torn); Coleopteres—Purpuricenus dumerilii; Cerbus flaveolus—Sierra Leone; Cassida sexpustulata—Brazil; Blatta petiveriana—W. Indies; Centrotus biclavatus—S. America (Membracid); Scarabaeus macropus—S. America; Scarabaeus tityus—N. America; Raphigaster incarntus—China; Locusta flava—Cape of Good Hope; Coleopteres—Phytoecia malachytica; Coleopteres—Phytœcia warnieri; Empusa lobipes—Coast of Coromandel; Orthopteres—Hetrodes guyonii; Orthopteres—Pamphagus numidicus (wingless form); Anisosceles hymeniphera—Brazil; Scutellera dispar—China; Hymenopteres—Scleroderma ruficornis; Coleopteres—Aromia rosarum; Rhynchites populi—England (torn in upper right corner); Anostostoma australasiae—New Holland; Hemipteres—Phy— (remainder obliterated); Deroplatys disiccata—Malacca; Pterophylla ocellata—Surinami; Hymenopteres—Chrys— afnensis—(partly obliterated); Scarabaeus hercules—Guiana.

It is an interesting coincidence that this series of paintings chance to be located in an institution of which the late Charles W. Johnson was one of the founders and where he did much of his early work. A framed portrait of Doctor Johnson occupies a conspicuous place of honor on its walls and bears the following legend:

CHARLES W. JOHNSON

Greatest living authority on insect life,
Born and educated in St. Augustine.
One of the originators and first Curator of the
Historical Society and Institute of Science.
Now with the Boston Society of Natural History.

Crayon portrait made and presented to the Society by:
Miss Emily L. Wilson of St. Augustine.

HEPTAGENINE MAYFLIES OF NORTH AMERICA[1]

JAY R. TRAVER

The subfamily Heptageninæ, as the term is used in this paper, comprises those mayflies in which two pairs of free intercalaries are present in the cubito-anal region of the forewing. Each tarsus is composed of five freely movable joints. The eyes of the males are more or less remote from one another, and are never divided to form an upper turbinate and a lower portion. Nymphs of this group have more or less flattened bodies and wide flattened heads. The term Heptageninæ as thus used corresponds to Dr. Ulmer's family Ecdyonuridæ. North American genera considered to be of this subfamily are: Heptagenia, Ecdyonurus (perhaps), Epeorus (perhaps), Rhithrogena, Iron, Cinygma, Arthroplea, Anepeorus, Pseudiron, and the new genus Stenonema.

There has been much confusion in the literature dealing with this group, as to the characters on which the genera should be recognized. Unfortunately, all are so closely allied that characters of venation are of little use. I follow Dr. Needham and Dr. McDunnough in the use of the relative lengths of the fore-tarsal joints of the imagoes as primary generic characters, rather than the tarsal joints of the third leg, as used by Eaton. The type of the male genitalia is of great importance in determining the genus. Whether or not the likeness or unlikeness of the fore claws of the male imagoes will prove of generic value in this group is at present doubtful. Anastomosis of cross veins in the pterostigmatic area of the forewing is useful in separating species, but seems to be a constant character only in the one genus Rhithrogena. Characters of the nymphs, correct association of nymphs and imagoes as determined by rearing, and definite correlations between nymphal characters and those of the imago, are essential to a real knowledge of the genera of this group. As regards nymphal characters, the structure of mouthparts, claws, and the presence or absence of lateral abdominal spines are very important, as well as gill characters. The gills, although

[1] Contribution from the limnological laboratory, Cornell University.

more fragile than chitinized parts and thus more subject to injury, serve as easy recognition marks of the genera, and seem relatively constant for each genus.

The rearing of many species of mayflies from the nymphal stage has convinced me of the great importance of correlating nymphal characters with those of the imago. Whenever it becomes possible, after careful study of any genus in its nymphal and imaginal stages, to predict accurately from the characters of the imago those characters to be expected in the nymph, and *vice versa,* such a genus is well established and has good claim to existence. Lack of evidence upon which to make such predictions leads to doubt as to the validity of the genus under consideration. Much rearing work remains to be done, however, before we will be able to make such predictions in several of the genera concerned. Such predictions can at present be made with apparent certainty and accuracy in the genera Heptagenia, Stenonema and Rhithrogena. While nymphs of Cinygma are known, too few species have been reared to make it possible to predict more than the generic characters of the imago from a given nymph. Nymphs of Anepeorus and Pseudiron are as yet unknown. Although but one species of Arthroplea has been reported from North America, the characters of both nymph and imago are so striking as to make it probable that others of this genus could be readily recognized in either stage. In the species of the Epeorus-Iron group there is still much confusion as to what characters are of generic value, or even whether two genera are concerned. Even more doubtful is the status of the genus Ecdyonurus. These difficulties are discussed at more length in later paragraphs dealing with the groups in question.

My present conceptions of the relations of the genera of the Heptagenine group are presented in the following keys and the discussions of the genera. Further study has led me to believe that my use of the terms Heptagenia and Ecdyonurus in my previous key to the nymphs of the mayfly genera (J. Elisha Mitchell Soc. 47:101) is incorrect. The term Stenonema should replace Heptagenia, and the term Heptagenia should be used in the place of Ecdyonurus. In the key to the male imagoes, in that paper, I used primarily the characters of the tarsal joints of the third legs, in dealing with this group. The present keys, therefore, supplant those I have published previously.

KEY TO MALE IMAGOES[2]

1. First joint of fore tarsus considerably shorter than second joint (not more than $\frac{2}{3}$ of 2nd) 2
   First joint of fore tarsus equal or almost equal to second joint, or slightly exceeding it in length 5
2. First joint of fore tarsus very short ($\frac{1}{6}$ to $\frac{1}{4}$ of second) 3
   First joint of fore tarsus longer ($\frac{1}{3}$ to $\frac{2}{3}$ of second) 4
3. Lobes of penes separated from one another very near the base, thus appearing as two long narrow projections. Cross veins of pterostigma tend to anastomose .... *Rhithrogena*
   Lobes of penes joined together except near apex; broad, often somewhat angulate laterally and distally, never as above. Cross veins of pterostigma not anastomosed .... *Heptagenia*
4. First joint of fore tarsus rather more than $\frac{1}{2}$ of second. Claws of fore leg blunt, similar .... *Anepeorus*
   First joint of fore tarsus varying in length from $\frac{1}{3}$ to $\frac{2}{3}$ of second. Claws of fore leg dissimilar (one blunt, one smaller and pointed). *Stenonema*
5. First joint of fore tasus not quite equal to second. Wings often amber-tinted .... *Cinygma*
   First joint of fore tarsus as long as or longer than second. Wings not amber-tinted 6
6. Forceps five-jointed; basal joint short, second very long, the three terminal joints together not equalling second in length .... *Arthroplea*
   Forceps four-jointed; basal joint short, second long, the two terminal joints together not quite equalling second 7
7. Fore claws dissimilar; one blunt, one sharp .... *Iron*
   Fore claws similar, blunt .... *Epeorus*

KEY TO NYMPHS[3]

1. Tails two, in mature nymph 2
   Tails three, in mature nymph 3
2. Gills rather small, not overlapping; first and last pair smaller than others. No triad of spines at tip of galea-lacinia .... Nameless genus
   Gills large, tending to overlap; last pair, also first pair usually, as large or larger than others. Triad of stout curved spines at tip of galea-lacinia .... *Iron, Epeorus*
3. Gills of seventh pair slender tapered threads or spines; tracheæ, if present, without lateral branches .... *Stenonema*
   Gills of seventh pair flat and plate-like; tracheæ always present, bearing lateral branches 4

[2] Does not include the doubtful genus Ecdyonurus.

[3] No attempt to distinguish between Iron and Epeorus

4. Head definitely emarginate in front. Gill filaments wanting, or reduced to few tiny threads 5
   Head not emarginate in front. Fibrillar portion of gill present, at least on segments 1–6; well developed 6
5. Second joint of maxillary palp more than four times the length of the lacinia; bears long movable hairs of spines .... *Arthroplea*
   Second joint of maxillary palp less than twice as long as lacinia; bears only short curved spines .... *Cinygma*
6. Gills of first and last pairs much enlarged, converging beneath body of nymph .... *Rhithrogena*
   Gills of first and last pairs not as large as some of the central pairs; directed laterally, not converging beneath body of nymph 7
7. Postero-lateral margins of pronotum prolonged backwards in epaulet-like extension .... *Eodyonurus*
   Postero-lateral margins of pronotum not prolonged backwards. *Heptagenia*

HEPTAGENIA WALSH 1863

In this paper I follow Dr. McDunnough, as regards the species considered to belong to the genus Heptagenia. As I use the term at present, the genus includes those Heptagenine species in which the first fore tarsal joint of the male is $\frac{1}{6}$ to $\frac{1}{4}$ the length of the second joint (rarely almost $\frac{1}{3}$), and in which the male genitalia are never of the Rhithrogena type. In Rhithrogena, the penes are long slender projections united only at the base. In the genitalia of Heptagenia, the penes are relatively wide, and separated only near the tips. One to three pairs of spines are present, of which one pair is situated centrally between the two divisions of the penes. Nymphs of this genus do not have the pronotum prolonged backwards at the postero-lateral angles. The seventh pair of gills is similar in form to preceding pairs, slightly smaller than the central pairs but larger than the first pair. In this last pair of gills, the lamellæ or blade-like portion is always present, although the filaments may be wanting. Mouthparts vary somewhat in the different groups of the genus. Those of *marginalis* Bks. are quite similar to Eaton's figures of mouthparts of the nymph from North America which he tentatively referred to Ecdyonurus (Monograph, Pl. 61).

If the genus Ecdyonurus proves to be a synonym of Heptagenia, as seems at present not unlikely, a modification of the statement of the generic characters may be necessary.

Examination of my reared species of North American Heptagenia nymphs shows clearly that the nymph of *H. gallica* Etn., as figured by Eaton (Monograph, Pl. 60) is not similar to any of these. True Heptagenia nymphs were figured by Eaton, however, on Pl. 61, as Ecdyonurus, and Figs. 24 and 25 of Pl. 62 of the Monograph, as a nameless genus. It is probable that the nymph shown on Pl. 59 is also a true Heptagenia, although I have found none which correspond exactly to it. I doubt that the nymph which Eaton figures on Pl. 60 occurs in North America. I feel sure that rearing will prove it to be of a genus different from the true Heptagenia of Walsh. If the genitalia figured on Pl. 24, Fig. 45a, of the Monograph, are really of the same species as the nymph figured as *H. gallica,* I think there can be no doubt that Eaton's conception of the genus Heptagenia is different from Walsh's conception of that genus, and that *H. gallica* is not a Heptagenia.

The great confusion which has arisen regarding the genera Heptagenia and Ecdyonurus is due in part, I think, to the fact that Eaton did not know Walsh's Heptagenia, at least in the nymphal stages, and hence has used the nymph of a different genus to represent it. It is due also to the fact that European and American workers in this group have seemingly been referring to different genera under the same name, and have tried vainly to make Eaton's figures of nymph fit the corresponding figures and descriptions of the imagoes. Thus the North American genus for which I am proposing the name Stenonema has been referred to the genus Ecdyonurus, on the basis of the similarity in the shape of the male genitalia and the relative lengths of the fore tarsal joints, without regard to the discrepancy between the nymphal stages of this genus and Eaton's Ecdyonurus. The same genus had previously been included in Heptagenia. There are still several points to be cleared up. The rearing of many species of nymphs to imagoes, and the definite linking of nymphal and imaginal characters, will in time set the matter straight. It may then develop that Ecdyonurus is a true synonym of Heptagenia, as Dr. McDunnough has suggested, in correspondence with me on this subject.

On the basis of the male genitalia, the twenty-seven species of the genus Heptagenia which have thus far been described may be separated into at least five groups or subdivisions. These I term the *maculipennis* group, the *flavescens* group, the *elegantula* group, the *inconspicua* group and the *persimplex* group. The genitalia of *H. kennedyi* McD. are rather different from any other species in the genus, and may well represent a sixth group. An undescribed species which I have from North Carolina evidently represents a seventh group. Figures of the genitalia of the species mentioned above, as representatives of different groups, have been published in connection with the descriptions or notes on the species, by Dr. McDunnough, with the exception *H. elegantula* Etn.

As might be expected from the different types of genitalia found in this genus, the nymphs likewise show structural differences separating them into groups corresponding somewhat to the grouping given for the imagoes. Unfortunately the nymph of *H. flavescens* Walsh, the genotype, is as yet unknown. Judging by the similarity in genitalia, *H. marginalis* Bks. is closely allied to *flavescens,* and as the nymph of this species is definitely known, I use it as a representative of the *flavescens* group. A large nymph from the Mississippi River, which has many of the same characters as *marginalis,* appears to belong also in this group. It may be the true *flavescens,* but this can be determined only by rearing. No nymphal material of the *persimplex* group, of *kennedyi* nor of the North Carolina species which represents the seventh group, is available for study. However, I have made a comparative study of nymphs of three species of the *maculipeenis* group, three of the *elegantula* group, two of the *inconspicua* group and the two of the *flavescens* group mentioned. The structural characters observed in each species studied, as well as the type of genitalia of the imagoes, are presented in the following table.

The pronotum of the nymphs in the *maculipennis* and *inconspicua* groups is widest near or at the center, while in the *elegantula* and *flavescens* groups it is definitely widest at the anterior margin. A difference in claws occurs between these same two groups, the *masculipennis* and *inconspicua* groups

NYMPHS OF HEPTAGENIA

Species	Abd. spines on 8	on 6–7	Claw with spines	Filaments on 7 gill	Pronotum widest	Genitalia type
marginalis	No	Yes	No	Yes	Front	Flaves.
Sp? from Fairport, Ia.	No	No	No	Yes	Front	?
elegantula	No	No	No	Yes	Front	Elegant.
Sp? from North Carolina	No	No	No	Yes	Front	Elegant.
pulla	No	No	No	Yes	Front	Elegant.
maculipennis	Yes	Yes	Yes	No	Middle	Maculip.
aphrodite	Yes	Yes	Yes	No	Middle	Maculip.
juno	Yes	Yes	Yes	No	Middle	Maculip.
lucidipennis	Yes	Yes	Yes	No	Middle	Inconsp.
Sp? from Calif.	Yes	Yes	Yes	No	Middle	Inconsp.

possessing teeth or spines near the tip of the claw, while such spines are not present in members of the *flavescens* and *elegantula* groups. In all species observed, one large spinous projection is present on the claw, about the center of the inner margin. The presence or absence of gill filaments on the seventh pair of gills follows the same grouping. Abdominal spines on the sixth to seventh segments are present in the *maculipennis* and *inconspicua* groups, and in *marginalis* of the *flavescens* group, but absent in the *elegantula* group and the nymph from the Mississippi River. Until more nymphs of each of these groups have been studied, as well as nymphs of the groups not here represented, it will be impossible to draw definite conclusions as to how far the species of nymphs follow the groups of the species of imagoes, as based on genitalic differences.

Eaton's figures 24 and 25 of Pl. 62, in the Monograph, seem to represent a nymph of the *elegantula* type, a species close to *pulla* Clem. Clemens has figured *lucidipennis* Clem. and a species of the *maculipennis* group (not the true *maculipennis*, however) under Ecdyonurus (Canad. Ent. 45; Pl. 6, Figs. 4 and 5). In the same paper he figures *pulla* (Pl. 5, Fig. 10) also in Ecdyonurus.

ECDYONURUS EAT. 1868

It is quite possible that this genus may fall as a synonym of Heptagenia. I am considering the two genera distinct, however, until I have been able to study specimens of *E. venosus* Etn., the genotype, which is a European species, and to rear a species of nymphs I took in North Carolina. These latter nymphs correspond very closely to the figures of Eaton, Pl. 62, Figs. 1–23, and Figs. 2–3, in the Monograph, of nymphs of Ecdyonurus. There are many points of similarity, however, between these nymphs from North Carolina and nymphs of the *maculipennis* and *inconspicua* groups of Heptagenia. The principal distinguishing feature is the presence, in the North Carolina nymphs, of the peculiar epaulat-like backward extension of the pronotum,—a character which Eaton mentioned as distinctive of Ecdyonurus. Dr. Schoenemund has used this character as the primary distinguishing feature between nymphs of Ecdyonurus and Heptagenia. (Zool. Anz. 90: 45. 1930.) It is of course quite possible that his reference to Heptagenia is to a nymph of the type figured by Eaton as *H. gallica,* which is most certainly not a true Heptagenia. Eaton mentions the fact (Monograph, pg. 277) that North American nymphs he has seen, and considered to be Ecdyonurus, lacked this extension of the pronotum.

As regards the genitalia of Ecdyonurus, I have not seen, in any of the North American species of the entire subfamily Heptageninæ, any forms which are similar to Eaton's figures (Pl. 24, Figs. 46 a to e, of the Monograph). Species of the genus Stenonema possess boot-shaped or L-shaped penes, it is true, which superficially resemble Eaton's figures. But in none of them are there any small spines or teeth on the *inner margin* of the penes, such as are present in all of Eaton's figures. Further, the nymphs of Stenonema are entirely different from Eaton's Ecdyonurus and also from Walsh's Heptagenia. They are, in fact, the nymphs which Eaton figured on Pls. 57 and 58 of the Monograph, as nameless genera from North America.

Until I have more evidence, in the form of reared material in which nymph and imago are correctly associated, I hold the matter in abeyance, tentatively considering Ecdyonurus as a valid genus. It seems to be very sparingly represented in North America, if indeed it is represented here at all. It must not be confused with Stenonema, which is abundantly represented in the eastern and central portions of Canada and the United

States. No species of Ecdyonurus (as considered above) has been described from North America, and it is solely because of the nymphs from North Carolina that I consider it here at all.

STENONEMA[4] TRAVER, 1933

This is a new name for those species of Heptagenine mayflies of North America, some of which have been included in Heptagenia (by Drs. Banks, Needham and Clemens) and by Dr. McDunnough and others in the genus Ecdyonurus. I designate *tripuncatum* Bks. as the genotype. To this genus belong the following twenty species:—*tripunctatum* Bks., *femoratum* Say, *pudicum* Hag., *vicarium* Wlk., *ithaca* Clem., *fuscum* Clem., *subaequalis* Bks., *rubromaculatum* Clem., *luteum* Clem., *pulchellum* Wlsh., *placitum* Bks., *ruber* McD., *mediopunctatum* McD., *bipunctatum* McD., *terminatum* Wlsh., *integer* McD., *interpunctatum* Say, *canadensis* Wlk., *carolina* Bks., and *frontalis* Bks.

To this genus I assign those species, so abundant in the United States and Canada, in which the nymphs bear on the seventh segment a single spine-like or thread-like filament, with or without a tracheal branch. This single gill is always much smaller than the gills of the first pair. Male imagoes have the first fore tarsal joint $\frac{1}{3}$ to $\frac{2}{3}$ the length of the second, and penes which are L-shaped or boot-shaped, without spines on the inner margin. A pair of stout spines is present near the median line of the penes, between the two divisions. The subanal plate of the female imago is truncate at the tip, usually very slightly retuse.

At least three groups of nymphs may be recognized in this genus, and corresponding differences in the penes of the males are observable. In the first group, which I term the *interpunctatum* group, the first six pairs of gills of the nymphs are pointed distally. The seventh gill is not fringed laterally, and possesses a single unbranched tracheal trunk. Male imagoes have boot-shaped penes bearing bristles or spines on the lower lateral margins, below the boot-shaped portion. Mouthparts and gills are figured by Eaton on Pl. 57 of the Monograph, as a nameless genus from North America. These have also been figured by

[4] The name is given in allusion to the slender and thread-like character of the seventh gill. It is neuter gender.

Clemens in Heptagenia (Canad. Ent. 45: Pl. 7). To this group belong *interpunctatum* Say, *canadensis* Wlk., *frontalis* Bks., and several undescribed species.

Mr. Y. C. Hsü, who has studied this genus intensively, has found that the two species *tripunctatum* Bks. and *femoratum* Say belong to a second group, which he terms the *tripunctatum* group. The first six pairs of gills of the nymphs are rather rounded at the tip. The seventh gill is fringed laterally, and has a forked tracheal branch. The penes of the imago show some slight variation from those of the third or *vicarium* group, to which they are more similar than to the *interpunctatum* group.

All other described species of the genus except *carolina* Bks. belong in the third or *vicarium* group. The first six pairs of gills are square or truncate at the tips. The seventh gill is fringed laterally, and lacks tracheae. Imago males have L-shaped penes entirely lacking the lateral spines of the *interpunctatum* group. Nymphs of this group have been figured by Eaton on Pl. 58, as nameless nymphs from North America. Clemens figured the structures of the nymphs and genitalia of the imago on the same plate referred to above.

The male of *carolina* Bks. has penes which are allied to the *interpunctatum* type, but differ in that the lateral spines are very minute. The outer margin below the boot-shaped portion thus appears to be merely slightly roughened. This is the only described species which possesses these features, but two undescribed forms from North Carolina are similar in structure. As

NYMPHS OF STENONEMA

Species	Gills 1–6	Gill on 7 Fringed	Trachea	Claw with spines	Genitalia type
tripunctatum	Rounded	Yes	Yes	Yes	Tripunct.
femoratum	Rounded	Yes	Yes	Yes	Tripunct.
interpunctatum	Pointed	No	Yes	No	Interpunct.
frontalis	Pointed	No	Yes	No	Interpunct.
Sp? from Kirtland, Ohio	Pointed	No	Yes	No	Interpunct.
ithaca	Truncate	Yes	No	No	Vicarium
vicarium	Truncate	Yes	No	No	Vicarium
fuscum	Truncate	Yes	No	No	Vicarium
pudicum	Truncate	Yes	No	No	Vicarium

the nymph of none of these three species is known, it is not possible to be certain whether or not a fourth group is here represented.

Twenty species of this genus have thus far been described, and there are in the Cornell University collection several others as yet undescribed. I have studied several reared species in both nymphal and imaginal stages, as well as species of unreared nymphs and imagoes of which the nymphs are not known. The preceding table, of species known in both stages, summarizes the differences between the first three groups.

RHITHROGENA ETN. 1881

The genus Rhithrogena, as here used, contains those Heptagenine mayflies in which (1) the first fore tarsal joint of the male imago is $\frac{1}{6}$ to $\frac{1}{4}$ the length of the second joint; (2) the cross veins of the pterostigma show definite and constant anastomosis; and (3) the male genitalia consist of two long narrow projections separated from one another near the base. The length of the first fore tarsal joint is similar to that of Heptagenia, but the structure of the penes, and the seemingly constant presence of anastomosed cross veins in the pterostigma serve to separate the two genera. It is interesting to note that species of this genus other than those found in North America show no such anastomosis of cross veins. The genotype, *R. semicolorata* Curtis, is a European species.

Nymphs of the North American species of this genus accord well with Eaton's figures and descriptions of the European forms. On Pl. 54 of Eaton's Monograph these structures are excellently portrayed. Mouthparts are sufficiently different from those of other genera to serve as good generic characters. The enormous numbers of "diatom rakers" on the maxillary palp, and the very short incurved inner canine of the mandible, are distinctive of this genus. The first pair of gills is always greatly enlarged in the anterior portion, the forward edges of this pair meeting beneath the body of the nymph. Similarly, gills of the last pair meet beneath the body. In the other pairs of gills, each gill touches the one before and the one behind, so that there is formed a complete oval "adhesive disc" beneath the abdomen of the nymph. A slight variation in gill structure is found in the red-gilled nymph described and figured by Dr. Needham from the Logan River, Utah, as *R. mimus* Etn. (probably a new species). See Utah Agri. Exp. Sta. Bull. 210: 13. In nymphs of this species, each gill on segments 2–6 has a secondary lobe-like projection not observed in any other species of this genus which I have studied.

Genitalia of the male imagoes of this genus, as represented in North America, seem to be of three types. To the *brunnea* group belong the species *brunnea* Hag.; *flavianula* McD.; *morrisoni* Bks.; and *doddsi* McD. In each of these a large lateral spine is present at the base of each division of the penes. Smaller spines may be present near the middle of each penial lobe, usually nearer the inner than the outer margin. Species of the second or *jejuna* group lack the large lateral spine characteristic of the first group. To this group belong *jejuna* Etn.; *undulata* Bks.; and *impersonata* McD. The third type is represented by *robusta* Dodds, and in somewhat modified form by *anomala* McD. In *robusta* the lateral spines are present, but are situated higher up on each lobe of the penes than in the *brunnea* type. Each is blunt at the apex, and indistinctly serrate. The inner apical margin of each lobe of the penes bears one long inwardly directed spine, and a much more slender short spine directed upward, lying almost parallel to the lobe of the penes. The lobes of the penes customarily diverge widely from one another, instead of turning inward, as shown in Dr. Dodds' figure (Trans. Amer. Ent. Soc. 49: Pl. 8, Fig. 12). In *anomala* McD. the blunt lateral process is distinctly serrate at the apex, and borne halfway between the base and the apex of each lobe of the penes. The inner apical margin of each lobe bears three or four short spines directed inward and downward.

Sufficient nymphal material is not available for a comparative study of nymphal characters. Nor is it possible to determine whether or not there are structural differences in the nymphs which correspond to the differences in male genitalia.

EPEORUS ETN. 1861; IRON ETN. 1883

These two genera are quite distinct from others of the Heptagenine group thus far recorded from North America. Nymphs of these genera have but two tails. Mouthparts of nymphs of the two genera are strikingly similar to one another, and differ from those of all other genera, in the peculiar triad of large curved spines at the tip of the galea-lacinia of the maxilla. Nymphal differences between the two genera were based by Eaton primarily on the shape and size of the first and last pairs of gills. In Iron, the first and last pairs are much enlarged, as in Rhithrogena, and members of each pair approach one another closely beneath the body of the nymph. In Epeorus, the gills of the first and last pairs are not greatly enlarged, and members of these pairs do not approach one another closely.

According to Eaton, the first fore tarsal joint of the male imago of Epeorus equals the second joint in length, while in Iron the first fore tarsal joint is slightly longer than the second. It would seem from Eaton's descriptions that he did not consider the two genera similar as regards the structure and appearance of the male genitalia, since he compares the genitalia of Iron to those of Thalerosphyrus, Bleptus and Rhithrogena, but does not mention their similarity to Epeorus. So also he speaks of a ''gibbous enlargement'' at the base of each forceps lobe, in Epeorus, not mentioned in Iron. Nor do the accounts of the so-called forceps-bases agree, for the two genera. In Epeorus, the fore claws of the male are similar and blunt, while in Iron they are dissimilar. In females of both genera, all claws are dissimilar.

On the basis of the descriptions and figures of the nymphs of the two genera, as given by Eaton, students of this group in many parts of the world have selected two types of nymphs, one to represent Epeorus, the other Iron. In North American nymphs at least, of the so-called Iron type, the head of the nymph is widest near the anterior margin, while in nymphs of the Epeorus type the head is widest at or near the middle. Besides this head character, differences have been noted in the structure of those margins of the gills which are appressed to the surface on which the nymph clings. Likewise, the amount of development of the lateral abdominal spines has been noted, these spines being very long and sharp in members of the Epeorus group, and much less developed in Iron. Femoral flanges of the second and third pairs of legs are sharp and spine-like at the tip in Epeorus, but blunt and rounded in Iron.

Known species of North American nymphs which exhibit the characters indicated for the Epeorus group are *humeralis* Morgan; *modestus* Bks.; and a new species from North Carolina which I designate as Sp? No. 1. The nymph of *albertæ* McD. has not been reared, but is tentatively associated with the imago of that species by Dr. McDunnough. The other species have been reared. To the so-called Iron group belong *longimanus* Etn.; *fragilis* Morgan; and *pleuralis* Bks. Many other species of nymphs, unreared, are present in the Cornell University collection. Examination of these nymphs, including seven species I took in North Carolina, shows that it is not always possible to assign a definite nymph to either of the above types, on the characters stated. Thus, four of the North Carolina species, as well as two others from the Rocky Mts., have gills of the so-called Epeorus type, but heads, lateral abdominal spines and femoral flanges are of the Iron type. Should these be considered an intermediate group?

A study of the genitalia of known North American species of this group shows that there are at least three, and perhaps four or five, types. Most of the species are similar in form either to *nitidus* Etn. or *longimanus* Etn. However, *deceptiva* McD. (Canad. Ent. 56: 132) has genitalia of a third type. *I. grandis,* McD., while similar in a general way to the *nitidus* type, shows some variations. *E. albertæ* McD. has penes of the *longimanus* type, but differs from all others of this type in the shape of the distal margin of the subanal plate, which in *albertæ* does not project forward in the typical high rounded process found in other species. The species described as *petulans* Seemann evidently does not belong in the Epeorus-Iron group. In none of the above types do we find anything exactly similar to the figures given by Eaton for the genitalia of *torrentium* Etn., the genotype of Epeorus, nor for *E. psi* Etn. (Monograph, Pls. 24, Fig. 44a, and 65, Fig. 7).

Seven species of the Epeorus-Iron group of which the life history is fully known, have been studied in both nymphal and imaginal stages. Results of this study are presented in the following table. In all seven of these species, the fore claws of the males are dissimilar.

NYMPHS OF EPEORUS-IRON

Species	Gills meet	Abd. spines	Head widest	Femor. flange	Genitalia type
longimanus	Yes	Short	Front	Blunt	Longim.
pleuralis	Yes	Short	Front	Blunt	Longim.
fragilis	Yes	Short	Front	Blunt	Longim.
humeralis	No	Long	Middle	Sharp	Nitidus
modestus	No	Long	Middle	Sharp	Nitidus
N. C. Sp? No. 1	No	Long	Middle	Sharp	Nitidus
N. C. Sp? No. 2	No	Short	Front	Blunt	Nitidus

From this tabulation it would appear that the structures of the nymphs can be correlated with the types of male genitalia only on the character of the first and last pairs of gills. This is the character Eaton used to separate the genera Epeorus and Iron. Yet these species would seem all to be Iron. The N. C. Sp? No. 2, alone of the species here listed, has the Epeorus-type of gills correlated with other features usually found in the Iron type. As mentioned before, other species of nymphs have been found which show this same condition. This species has genitalia of the *nitidus* type. Unfortunately, nymphs of those species which show marked variation from the two types here studied, as to genitalia, are not available for study.

Tentatively I regard all North American species of this group except *albertæ* McD. as belonging to the genus Iron. The latter I consider, on the basis of the differences in genitalia, and the similar blunt claws of the male, as the only possible North American representative of the genus Epeorus. It is quite possible that the genus Iron may prove not worthy of generic rank, in which case the likeness of fore claws of the male would not be a character of generic value. The great similarity in the structures of the nymphs of the two genera would seem to indicate that they are in reality but one. However, since nymphs with the characters given by Eaton for both genera occur in North America, along with some intermediate forms, and yet no single species of these agree entirely with Eaton's figures for the genitalia of Epeorus, there remains the possibility that Eaton's Epeorus is really quite different from Iron. It may even not be represented in North America. I leave this question likewise in abeyance, until type material from Europe can be examined.

CINYGMA ETN. 1885

In this genus, the first fore tarsal joint of the male imago is slightly shorter than the second joint. In some species, the lobes of the penes are separated from one another almost from the base, much as in Rhithrogena, each division tending to turn outward from the median line. At least one pair of spines is usually present, sometimes located on the outer margin, but in other species on the inner margin of the penial lobes. In two other species of this genus, the penes are roughly lyre-shaped.

As far as I have been able to determine, *ramaleyi* Dodds is the only species reported as having been reared from the nymph. I have recently reared *atlantica* McD., in the vicinity of Ithaca, N. Y. Several other species of nymphs are known, however, but are not yet definitely associated with known species of imagoes. All of these nymphs have definite structural characters in common, which separate them from nymphs of all other North American genera. The expanded margins of the head fail to cover the mouthparts completely, so that portions of the maxillary palps usually protrude on each side, and all but the extreme basal portion of the labrum protrudes in front. This protrusion of the labrum is due to a distinct emargination of the front border of the head at the median line. This is a character by which nymphs of Cinygma may be readily separated from all of the other Heptagenine group except Arthroplea. The gills are relatively large and conspicuous, consisting almost entirely of the upper plate-like portion. The filaments may be entirely wanting, or reduced to two or three inconspicuous threads. Gills of the first pair are about as wide as long, the lobes on each side about equally produced on each side of the base. Other gills are longer than wide, and pointed at the tip. Each extends backward almost as far as the center of the third segment behind.

Three tails are present, about equal in size and length. Claws, in those species available for study, bear one large spine toward the base and two or three shorter spines or teeth near the tip on the inner margin. They are very similar in this respect to claws of Rhithrogena and Iron. The maxillæ are rather similar to Rhithrogena, but the "diatom rakers" do not cover so large an area of the palps. Each individual hair or spine composing the raker is simple instead of pectinate. The outer canine of the mandible is likewise much as in Rhithrogena. But the inner canine is much longer than in that genus, being at least one-half the length of the outer. It is not strongly recurved as in Rhithrogena, and is stouter than in Heptagenia. The hypopharynx is very like that of the Epeorus-Iron group. Labrum and labium resemble those of Rhithrogena.

Nymphs of this genus are more cylindric in body form than others of the Heptagenine group, and are relatively slender. The nymph of *ramaleyi* Dodds is figured by Dodds and Hisaw (Ecology 5: Pl. 2, Fig. 10).

On the basis of the male genitalia, at least two groups or subdivisions are recognizable in this genus. To the *integrum* group belong *integrum* Etn. the genotype, and *lyriformis* McD. The fore claws of the males are dissimilar, the wings are not distinctly amber-tinted, and the costal cross veins are "divided by a fine line running just below the costa" (McDunnough). Genitalia, as figured by Dr. McDunnough (Canad. Ent. 58: Pl. 3, Fig. 10; *op. cit.* 56, Pl. 5, Fig. 1) are quite distinctive, and differ markedly from others of the group, being somewhat lyre-shaped.

To the second or *mimus-par* group belong the other known North American species of Cinygma. Genitalia of these have the lobes of the penes separated near the base and divergent distally. Costal cross veins are usually anastomosed. The wing membrane is often distinctly amber-tinted. Dr. McDunnough writes me that the fore claws of *par* Etn. and *hyalina* McD. are dissimilar, but that *mimus* Etn., *confusa* McD., *ramaleyi* Dodds, *tarda* McD., and *atlantica* McD. all have similar blunt fore claws in the male imago. This character I had observed in *mimus* Etn., but did not have specimens of all of the other species for examination.

As the genus was characterized by Eaton, the fore claws of the male were dissimilar. It is conceivable that some of the species now listed under Cinygma may, as Dr. McDunnough has suggested (Canad. Ent. 58: 302), fall into another genus. If, however, the character of likeness of fore claws is specific only and not of use in separating genera, perhaps all the species now placed in Cinygma rightfully belong there. Only rearing of all known species from the nymphal stage will determine this point.

It should be noted that the nymph figured by Dr. Needham (Utah Agri. Exp. Sta. Bull. 201: 13) as *Rhithrogena mimus* is a true Rhithrogena, probably of a new species, and not *Cinygma mimus* Etn. with the imagoes of which it was erroneously associated.

ARTHROPLEA BGTN. 1909

This genus is represented in North America by the single species *bipunctata* McD. The first four joints of the fore tarsus of the male imago are approximately equal in length. The forceps are five-jointed,—a character unique in the subfamily Heptageninæ. The penes are separated from one another near the base, but often lie closely appressed, in which case they present the appearance of an hour-glass, of which the base is much wider than the apex. Slender lateral spines are situated about midway between the base and apex.

The nymph differs from all others of this sufamily (1) in the very greatly elongated second joint of the maxillary palp, and (2) in the appearance of the labium. The mandible also is not typical, bearing a closer resemblance to the Baetinæ than to the Heptageninæ. Gills are simple, consisting of the upper blade-like portion only. Each gill is pointed at the apex, and more or less cordate at the base, where its margin is produced into an anterior lobe. The nymph somewhat resembles Cinygma in that some of the mouthparts protrude from beneath the margins of the head, which is likewise emarginate in front. The very long maxillary palp should serve as an easy recognition mark for the nymph of this genus.

ANEPEORUS McD. 1925

Two species of this genus are known, *rusticus* McD. the genotype, and *simplex* Wlsh (in Heptagenia). Male imagoes have similar blunt fore claws, as in Epeorus and some species of Cinygma. The first fore tarsal joint of the male is rather more than one-half the length of the second, which is longer than the third. Forceps are four-jointed, as is usual in the Heptageninæ. Penes are "united and broadly triangularly expanded at the base, apically forming two simple cyindrical lobes, separated by a V-shaped incision'' (McDunnough—Canad. Ent. 57: 190). The apical portion consists of three superimposed projections. The basal plate of the forceps is unlike all others of the Heptagenine group in North America, in being deeply carved out at the apical margin. Nymphs of this genus are unknown.

PSEUDIRON McD. 1931

This genus, represented by the single species *centralis* McD., is known in the female sex only. In the female imago, the tarsi of the hind legs are fully as long as the tibia. The first tarsal joint of all the legs is slightly longer than the second, and all femora exceed the tibiæ in length. Dr. McDunnough states that this genus ''is probably best placed close to Siphloplecton'' (Canad. Ent. 63: 91). However, the wings have ''typical Heptagenine venation.'' As I am considering Siphloplecton and its allies as members of the subfamily Baetinæ rather than of the Heptageninæ, it is possible that the genus Pseudiron may properly belong to the Baetine group. The nymph is unknown.

NAMELESS GENUS

In 1927, Mrs. Seemann described and figured a two-tailed Heptagenine nymph from California as *Iron petulans* Seemann (J. Ent. and Zool. 19: 42– Pl. 4). Similar nymphs are in the Cornell collection. An examination of the figures and the nymphs shows that this species is not an Iron and presumably not an Epeorus. Nor is it the nymph of any known Heptagenine genus, unless it be Pseudiron or Anepeorus, the nymphs of which are not known. Characters of the nymph which distinguish it from the Iron-Epeorus group are:—(1) the double row of dorsal abdominal spines; (2) the absence of the characteristic triad of stout curved spines at the tip of the galea-lacinia; (3) the shape of the pronotum, which in this nymph is much widened at the anterior margin; (4) the shape and appearance of the gills, of which the first and last pairs are smaller than any of the central pairs; (5) the shape of the hypopharynx; (6) the shape of the labrum; and (7) the appearance of the mandible.

Fortunately one male nymph of this species in the Cornell collection was killed as it was transforming to the subimago stage.

It was possible to remove the subimago carefully from its nymphal skin, and mount the genitalia. The penes consist of two long slender processes, united only at the base, much as in Rhithrogena. These processes diverge at the tip. There is no slightest evidence of lateral or other spines, which are always visible in subimagoes of those species of Rhithrogena which bear spines. The first fore tarsal joint is slightly longer than the second. The second and third joints are subequal, the fourth slightly shorter, the fifth about equal to the fourth. Claws of all legs are dissimilar. Femur and tibia of the third leg are subequal, the tarsus shorter than the tibia. The wings are so crumpled that it is impossible to determine the character of the costal cross veins of the stigmatic region. In lengths of tarsal and other joints, this species does not agree with Anepeorus nor Pseudiron. Further, the genitalia are of a different type than those of Anepeorus.

Several male imagoes taken at Cucumonga Canyon the same spring that some of Mrs. Seemann's specimens were collected are also in the Cornell collection. These are definitely Rhithrogenas. The first fore tarsal joint is about one-sixth of the second; the cross veins of the stigmatic area anastomose; the penes are typical long slender processes, divergent at the tips and bearing rather prominent lateral spines. These male imagoes agree well with the description of the male imago of *I. petulans* Seemann. Further, the genitalia are similar to the published figure of that species.

Since the male genitalia of the male subimago taken from the nymphal skin bears no lateral spines, it seems doubtful if the genitalia figured on Pl. 4 (J. Ent. and Zool. 19) really belong with the nymph figured there. While there is no direct nor conclusive evidence, it seems not impossible that the nymph and imago of *petulans* have been erroneously associated. Although Mrs. Seemann reports rearing this species from San Dimas Canyon, she found others of the same species at Evey's Canyon (the male subimago in its nymph skin was of her collection) and at Cucumonga. Imagoes of this entire group look much alike until examined critically. If the reared specimen had been defective, it is possible that others which looked superficially like it might have been used as the basis for the description and figures. Until other nymphs of this species have been reared, and associations clearly established between nymph and imago, I consider the species *petulans,* based on the description of the male imago, as a Rhithrogena. I think it is a valid species of that genus, and not synonymous with any previously described species. The nymph, however, I remove both from the genus Iron, and from all connection with the imago of *petulans,* and consider it a representative of a new genus. No name is given to this genus, until more evidence regarding its life history can be obtained.

THE AFFINITIES OF THE ARCHAIC ORTHOPTEROID FAMILY GRYLLOBLATTIDAE, AND ITS POSITION IN THE GENERAL PHYLOGENETIC SCHEME

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The grylloblattids are among the most important of living insects, from the phylogenetic standpoint, since they not only combine in themselves numerous primitive or "ancestral" features occurring in the different orthopteroid groups, but they also constitute a "key" group, furnishing excellent clues for determining the origins of the lines of descent of many of the higher orders as well. Because of their extraordinary interest and value for the study of insect phylogeny, it is of the utmost importance that the grylloblattids should be properly placed in the general phylogenetic scheme, and I would therefore emphasize the fact that their closest affinities (among living forms—*i.e.*, excluding the fossil Protorthoptera) are with the saltatorial family Stenopelmatidæ, rather than with the cursorial family Blattidæ (sensu lato), with which they are allied by Silvestri, 1927 and 1931, and by Imms, 1926 and 1927 (both of whom follow Walker, 1914, in this matter), who have recently reopened the discussion of the systematic position of the Grylloblattidæ.

Numerous figures of all of the important details of the external anatomy of the grylloblattids have already been published, and the evidence for determining the real relationships of the grylloblattids definitely, and conclusively, is ample and fully adequate for the purpose so that subsequent studies can do little more than confirm this evidence. Detailed drawings of the head capsule, antennæ, mouthparts, thoracic sclerites, legs, abdominal segments and the terminal abdominal structures of both sexes of the Grylloblattidæ will be found in the publications listed in the appended bibliography, which likewise includes references to the publications in which all of the important structures of the insects which are in any way related to the grylloblattids, are figured. By comparing the figures of the structural details of the grylloblattids with those of the parts of allied orthopteroid insects, any one may easily determine for himself what the real relationships of the grylloblattids are, from this easily available evidence; but in making such a comparison, one should avoid assigning any real value to highly variable or trivial characters of no importance for a phylogenetic study of the insectan orders.

It is quite obvious that features which are so variable, or trivial, that they are of no value for placing other insects in their proper orders, will likewise be of no value for placing the grylloblattids in their proper order either. In this category of highly variable, or trivial, features belong the modifications (or lack thereof) of the legs for leaping, the number of tarsal segments, etc., which are of no value for placing the grylloblattids in their proper order either.

That the number of the tarsal segments is a trivial feature, not of ordinal value in other insects, is shown by the fact that some true Coleoptera have five segmented tarsi, while other true Coleoptera have fewer tarsal segments, yet this does not prevent our placing both types of Coleoptera in the same order Coleoptera, since other features indicate that both types are too closely related to place them in distinct orders. Similarly, the fact that the grylloblattids have five-segmented tarsi should not prevent our placing them in the same order, Orthoptera, with the Stenopelmatidæ, which have only four segments in the tarsi, if other features indicate that both grylloblattids and stenopelmatids are sufficiently closely related to be included in the same ordinal group. The fact that the Stenopelmatidæ have one more tarsal segment than the Gryllidæ does not prevent our placing both stenopelmatids and gryllids in the same order Orthoptera (sensu stricto), and similarly, the fact that the Grylloblattids have one more tarsal segment than the Stenopelmatidæ should not prevent our placing the grylloblattids and the stenopelmatids in the same order Orthoptera, as many entomologists seem to think!

The modifications of the legs for leaping—or the lack of such modifications—is another feature of no importance for placing other insects in their proper orders, and is therefore of no value for placing the grylloblattids in their proper order either. Thus, for example, the jumping plant lice (psyllids or Chermidæ) are not placed in another order from the aphids simply because the aphids lack the saltatory modifications exhibited by the psyllids, nor are the flea-beetles placed even in a distinct family from the rest of the chrysomelids, simply because they exhibit saltatorial modifications not developed by other chrysomelid beetles. Some mantids such as *Ameles* from Portugal, according to Wood-Mason, can leap a foot straight upward (as nymphs), and in some cases the hind femora are distinctly enlarged as in the Orthoptera Saltatoria, yet no one would suggest that this fact is sufficient grounds for removing these mantids from the rest of their allies and placing them in a distinct order.

Coming still closer to the Grylloblattidæ, we find that certain Protorthoptera such as *Oedischia,* etc., described by Handlirsch (*loc. cit.*), had saltatorial hind legs, with distinctly enlarged femora, while other Protorthoptera lacked these modifications; and even among living Orthoptera Saltatoria, such "Locustidæ" as the peculiar Australian *Phasmodes ranatriformis,* Westwood, figured by Caudell, 1912, (Genera Insectorum, 138me. Fasicule, Fig. 1, Plate 2) in his description of the "Locustid" Saltatoria, may lack the saltatorial enlargement of the hind femora, so that in the true Orthoptera and their relatives, as in other orders of insects as well, the saltatorial modifications of the hind legs, or the lack of such modifications, are trivial features, having absolutely no bearing upon the question of where to place an orthopteroid insect in its ordinal position; and similarly in the Grylloblattidæ, the lack of saltatorial modifications in the hind legs should not prevent our placing them next to their close relatives the Stenopelmatidæ, which are saltatorial, not cursorial, Orthoptera.

In this connection, it should be noted that the orthopteroid group Cursoria, (in which the Grylloblattidæ are placed by the entomologists who emphasize the trivial characters supposedly separating them from the saltatorial stenopelmatids) is a heterogeneous conglomeration of remotely related forms separated from their closest allies and lumped together by those who stress trivial characters above fundamental ones. Thus, for example, the group Cursoria as constituted by these entomologists, does *not* contain the Isoptera, which are the closest allies of the blattids and mantids, and according to them, it *does* contain the phasmids, which are the closest allies of the Saltatoria instead, despite their pentamerous tarsi and cursorial legs. As Handlirsch (*l.c.*) points out, the embryonic development, venation, and a host of other characters, ally the phasmids with the saltatorial Orthoptera infinitely more closely than with the other orthopteroids (Cursoria), and Handlirsch was so impressed with this obvious relationship of the phasmids to the Saltatoria, that he even proposed to derive the phasmids directly from the Saltatoria themselves, although the more primitive features of the phasmids clearly indicate that they arose from ancestral types at the base of the lines of descent of the Saltatoria (*i.e.,* from forms like the grylloblattids, in many respects) rather than from the Saltatoria themselves. The actual relationships of these different orthopteroid groups, however, will be discussed more fully later on, since at this time I merely wish to emphasize fact that the tarsal segments, saltatorial modifications, or the lack thereof, etc., are trivial features, of no value for placing the Grylloblattids (or any other insects for that matter) in their proper order!

The asymmetrical development of the male genitalia is not a feature of sufficient importance to necessitate the separation of the Gryllobattidæ from the Stenopelmatidæ (which has secondarily developed symmetrical genitalia in the males), since in certain other insectan orders, such as the Diptera, forms with asymmetrically developed male genitalia are included with those having the genitalia symmetrically developed; and even among the orthopteroids themselves, it is evident that the phasmids with asymmetrically developed male genitalia, are the closest allies of the Saltatorial Orthoptera with symmetrically developed male genitalia (as is attested by all of the fundamental features of the anatomy of the phasmids), so that the asymmetrical development of the male genitalia in the grylloblattids is not of sufficient importance to separate them from their closest allies, the Stenopelmatidæ, with which the phasmids should also be grouped (in the superorder Panorthoptera) despite their asymmetrically developed male genitalia.

The occurrence of one-segmented, or of multiarticulate cerci is not a feature of great importance in determining the ordinal position of an insect, since some Blattidæ (sensu lato) have cerci composed of but one segment, while others have multiarticulate cerci, and similarly in the orthopteroid group Plecoptera, some forms have cerci reduced to one or two segments, while others have multiarticulate cerci, and these differences are considered of no importance for placing the insects in different orders. Furthermore, all Saltatoria do not have the cerci composed of a single segment, since such saltatorial Orthoptera as *Tridactylus variegatus,* are figured by Saussure and Zehntner, 1894 (Fig. 22, Plate XVI of Vol. II of the Revue suisse de zoologie) as having at least two distinct segments in the cerci, and a marked annulation of the cerci, suggesting traces of a former multiarticulate condition, is indicated in Fig. 30, Plate XVII, of the terminal structures of the saltatorial orthopteron *Rhipipteryx mexicana,* figured by these authors. According to Walker, 1919 (Annals Ent. Soc. America, Vol. XII, p. 279), in the males of the Saltatorial genus *Pristoceuthophilus* (*e.g., P. cercalis* Caudell), "a few small segments are present at the apices of the cerci." In fact, Karny, 1925 (p. 310 of his "Methoden der phylogenetischen Forschung" in Lieferung 177, Abt. IX, Teil 3, Heft 2, of the "Handbuch der biologischen Arbeitsmethoden") refers to the cerci of *Pristoceuthophilus* as "mehrgliedrige," thus implying that they are multiarticulate. Since the number of segments composing the cerci is not of ordinal value in these insects, and since the cerci of such Saltatoria as *Pristoceuthophilus* may also be referred to as multiarticulate, it is evident that the fact that the cerci of the grylloblattids are composed of eight segments should not preclude our placing them next to the Stenopelmatidæ in the Orthoptera Saltatoria.

Another feature stressed by those who seek to divide the orthopteroid forms into Cursoria and Saltatoria, is the absence of sound-producing organs in the Cursoria and the presence of these organs in most Saltatoria. Handlirsch, 1925, however, (p. 186 of Vol. 3 of Schroeder's "Handbuch der Entomologie") points out that very primitive Saltatoria such as the fossil Elcanidæ, which he considers to be ancestral to the tridactylids and phasmids, exhibited no stridulatory modifications on any of the wings, and we would therefore naturally not expect that any very primitive Orthoptera Saltatoria would exhibit stridulatory modifications of the wings (which are the organs usually involved in the production of sound), so that this feature has no bearing on the systematic position of the Grylloblattidæ, which, furthermore, are wingless, and this precludes our deducing anything concerning the sound-producing modifications, or lack thereof, in their immediate relatives, since a consideration of the nature of the wings is barred from all discussions of the systematic position of the wingless grylloblattids, from the very nature of the case!

Venational studies, even when used to the exclusion of all other valuable and desirable sources of information, have nevertheless yielded such strikingly admirable results in the field of insect phylogeny, that the specialists in wing-venation alone have apparently come to feel that all other sources of information on the subject are not worth considering—even as corroborative evidence for that of the wing-veins; and, through a continued excessive devotion to this one phase of the subject, their capacities for appreciating and applying any other type of evidence have become so atrophied, that they are reduced to a state of hopeless impotency when confronted with the problem of assigning to its proper place in the general phylogenetic scheme, any new synthetic form which has been so negligent as to fail to supply a set of wing-veins for the purpose. Any orthopterist, for example, is sufficiently familiar with the fundamental distinction between the wing of an embiid and the wing of one of the gryllotalpid Saltatoria, to be able immediately and infallibly to place the wing of one of these orthopteroid insects in its proper group, yet, through a surprising lack of familiarity with the fundamental construction of the rest of the body of one of these orthopteroid insects, it was nevertheless possible for such an experienced orthopterist as Giglio-Tos, 1914, (Ann. Mus. Genova, Vol. 46, p. 81) actually to suggest, in all seriousness, that a perfectly good, though wingless, gryllotalpid orthopteron, *Cylindracheta*, might in reality be an embiid (see discussion by Crampton, 1928, in Vol. XVII of the Entomologische Mitteilungen for July, 1928, p. 252)! This illustration is cited, not as a reproach to Giglio-Tos, whose general studies of Orthoptera are excellent, but it is offered as an example of what is bound to happen in dealing with unfamiliar apterous insects, if one does not prepare himself for their study by familiarizing himself with the comparative morphology of the fundamental features of the body in general, in order to be able to distinguish between the trivial and the significant features in attempting to place these wingless forms in their proper systematic positions; and this principle applies to *Grylloblatta,* as well as to *Cylindracheta,* or any other wingless insect. Such a study, in the case of the apterous Gryllobattids, involves the comparison of the head and its appendages, the thorax and its appendages, and the abdomen and its appendages throughout the orthopteroid series, paying particular attention to the modificational tendencies, or *specialization* trends characteristic of and peculiar to a few groups, rather than to the general basic features common to most of them, since these general basic features may be merely retentions of features present in the remote ancestors of all of them, while peculiarities of specialization exhibited by two or more groups would indicate a more immediate community of descent, and consequently a closer relationship between the forms in question. The phyolgenetically significant specializations indicating the closest affinities of the grylloblattids may be considered under the following headings.

(1) Head Capsule. The details of the head capsule of *Grylloblatta* are figured by Crampton, 1926, on page 81 of Psyche (Fig. 2) for June 1926, and the head capsule of *Grylloblatta* is compared with the heads of all the principal orthopteroid types from the standpoint of phylogeny, in a paper by Crampton, 1932 (Bulletin of the Brooklyn Ent. Society). Yuasa, 1920, has likewise figured the structural details of a number of Orthoptera, but *Grylloblatta* was not discussed in this paper.

In the paper published in Psyche for 1926, the fact was stressed that the pyriform head of *Grylloblatta* is forficuloid in its general features, rather than blattoid, and this would naturally throw the grylloblattids with the orthopteroid relatives of the Dermaptera rather than with the blattids, where other entomologists are inclined to place the grylloblattids. The more comprehensive analysis of all of the orthopteroid types given in the Bulletin of the Brooklyn Entomological Society for 1932 indicates that the head of *Grylloblatta* is not only forficuloid, but is definitely orthopteroid (and not blattoid) as may be seen by comparing the head of *Grylloblatta* shown in Fig. 18 of the "Bulletin" mentioned above, with the head of the Orthopteron *Gryllotalpa* (*l.c.* Fig. 20) and the orthopteron *Stenopelmatus* (*l.c.* Fig. 22). A somewhat pyriform head capsule, with isopteroid compound eyes located further down the sides of the head, and with the antennae situated far down near the bases of the mandibles is typical of such Orthoptera as the grylloid *Gryllotalpa* (*l.c.* Fig. 20); and the head capsule of *Grylloblatta* (*l.c.* Fig. 19) has the same type of pyriform head, with isopteroid compound eyes situated further down the sides of the head, and with the antennae located far down near the bases of the mandibles. The character of the head capsule would therefore indicate very clearly that *Grylloblatta* is more closely allied to the saltatorial Orthoptera (such as *Stenopelmatus, Gryllotalpa,* etc.) than it is to the blattids, which have differently shaped head capsules, with typically reniform eyes located more dorsally, and with the antennae situated further dorsad, instead of being located down near the bases of the mandibles.

In the primitive Phasmid *Timema* shown in Fig. 18 of the above-mentioned paper, the eyes are likewise Isopteroid and are located far down the sides of the head, and the antennæ are situated down near the bases of the mandibles, as is characteristic of the head capsule of *Grylloblatta* (*l.c.* Fig. 19). Furthermore, *Timema* has temporal sutures demarking the temporal areas above and behind the eyes, and indications of similar temporal sutures are likewise exhibited by *Grylloblatta,* indicating a close relationship between Grylloblatta and the Phasmid relatives of the Orthoptera. The resemblance between the head of *Grylloblatta* and the forficulids has already been mentioned, and all of these facts are in agreement with the view that *Grylloblatta* is much nearer to the Orthoptera and consequently to the other near relatives of the Orthoptera, the phasmids and Dermaptera, than it is to the blattids, with which it is placed by those who accept the grouping of insects into the division called Cursoria.

As was pointed out in the "Bulletin" for 1932, when we trace the head capsules of *Grylloblatta* and related orthopteroids back to their more immediate precursors, the Isoptera, rather than the blattids, appear to be the forms standing more directly in line with the ancestral Orthoptera. In fact, the compound eyes of all the orthopteroids related to *Grylloblatta* are more Isopteroid than anything else, although in exceptional cases some Blattids such as *Cryptocercus* have the large reniform eyes of typical roaches reduced to a form more suggestive of the Isopteroid type; but in the case of *Cryptocercus* the reduction would appear to be due to the selective action of its life in tunnels in rotten logs, and the main trends in the compound eyes of blattids are not suggestive of those of the Isoptera and the orthopteroids related to *Grylloblatta*. I would interpret this as indicating that the Isoptera represent a step away from the blattid type, and toward the orthopteroid type, although the Isoptera are clearly more closely allied to the Dictyoptera (including the blattids and mantids) than they are to the Orthoptera and their allies.

I have pointed out on page 80 of the June 1926 issue of Psyche, that the head-contour, relation of the eyes, antennæ, bases of the mandibles, etc., are strikingly similar in the gryllids and Isoptera, and that the evidence from the thorax, etc., "would lend support to that of the head capsule in indicating that the Isoptera are very like the Protoblattoid ancestors of the orthopteroid group of insects," so that Knight, 1928, in discussing the head capsule two years later (in Bulletin No. 298, page 198, of the Univ. of Maryland Agr. Exp. Station, dealing with "Recent Investigations" in the University) is mistaken in considering that his preliminary note is the first to call attention to the fact that "The termites, from a standpoint of the head, are much more similar to the Orthoptera than commonly supposed, pointing to a possible common ancestry" (Knight, 1928, p. 298). Furthermore, Knight was not the first to perceive (as he maintains) that the gular region of termites is derived from the submental plate of the labium (which becomes later attached to the head capsule) since I described this process in termites in

1921, on page 76 of the Annals of the Entomological Society of America, Vol. 14, and discussed it in detail on page 8 of the Journal of Entomology and Zoology, Vol. 21, for 1928. In fact, the various studies of the comparative morphology of insects carried out through a wide series of structures in the different orders of insects have convinced me that the Isoptera are anatomically intermediate between their near relatives, the blattids and mantids, on the one side, and the grylloblattids with their orthopteroid relatives, on the other; and the Isoptera are very like the ancestral forms in the common protorthopteron-protoblattid stem, from which the protorthopteroids leading to the true Orthoptera, arose.

(2) EYES AND OCELLI. The compound eyes of *Grylloblatta* (see Fig. 19 in the "Bulletin" for 1932) are much more like those of the true Orthoptera such as *Stenopelmatus* (*l.c.* Fig. 22) than they are like the reniform eyes typical of the Blattids (*l.c.* Fig. 7, 9, etc.) in outline, position, etc., and this is an important point which should not be wholly ignored in attempting to assign *Grylloblatta* to its proper position in the general phylogenetic scheme. The nature and position of the compound eyes are likewise similar in *Grylloblatta* (*l.c.* Fig. 19) and the other orthopteroid relatives of the Saltatoria, such as the phasmids (*l.c.* Fig. 18), *Dermaptera* (*l.c.* Fig. 17), etc., thus agreeing with the view that the grylloblattids are nearer to the Orthoptera and their relatives than they are to the blattids.

In lacking ocelli, *Grylloblatta* is likewise more like a stenopelmatid (or the related Dermaptera, etc.) than it is like a blattid, since the blattids typically, but not always, retain at least two ocelli. Some primitive Saltatoria such as the gryllacrids (as well as the gryllids, etc.) have retained the ocelli, which *Grylloblatta* has lost, and the immediate ancestors of the Orthoptera undoubtedly had three ocelli, but the specialization tendency to suppress the ocelli was apparently very strong in the stenopelmatids, grylloblattids and forficulids, and may have been latent in their common stock (expressing itself when the gene composition became favorable). While this is admittedly not a strong argument in favor of the orthopteran affinities of *Grylloblatta*, taken in conjunction with the many other features exhibited in common by the grylloblattids, stenopelmatids and forficulids, it may be cited to show that still another common tendency adds its weight to the rest in pointing to a closer relationship among the grylloblattids, stenopelmatids and Dermaptera.

(3) ANTENNÆ. The antennæ of *Grylloblatta* have been figured in detail by Crampton, 1917, (Canadian Entomologist, June, 1917, p. 219) in a paper in which the segments have been compared individually with those of an antenna of *Embia major* to show that the antennæ of *Grylloblatta* depart from the flagelliform type characteristic of the Blattids (in which there are over a hundred more segments than there are in the antenna of *Grylloblatta,* and the segments tend to retain the annular form in the blattids) and approach the embiid type strikingly closely in every respect, even to the number of segments composing the antennae (which are twenty-nine in both *Grylloblatta* and *Embia major*). It was pointed out that the segments of the antenna of *Grylloblatta* are essentially of the same type as those of the phasmid *Timema,* and that they are likewise similar in many respects to those of certain Saltatoria such as the Acrididæ, etc. The evidence of the antennæ is thus unmistakably on the side of a closer relationship between *Grylloblatta* and the immediate relatives of the Orthoptera, instead of pointing to a closer relationship between the grylloblattids and blattids, and the evidence is so striking and easily seen, that it should convince any one who takes the trouble to examine the evidence. As further corroborative evidence in this respect may be mentioned the fact that the antennifer, or projection of the antennal sclerite acting as a pivot for the movements of the antenna, is situated laterad of the base of the antenna in *Grylloblatta, Timema, Echinosoma* and other forms related to the saltatorial Orthoptera, while the antennifer is situated more ventrad (and tends to shift to a mesad position) in relation to the base of the antenna in the blattids and their allies, as was pointed out in a discussion of the heads of these insects by Crampton, 1917, (Ent. News, XXVIII, p. 398). The position of the antennifer, however, is a very variable feature, and too much weight cannot be given to this type of evidence. So far as it goes, however, it seems to support the orthopteroid rather than the blattoid affinities of

Grylloblatta, and when taken in conjunction with the other evidence cited, it is not wholly without significance.

(4) MAXILLÆ. A very complete series of maxillæ figured throughout the orders of insects, and including those of all the orthopteroid groups, has been furnished by Crampton, 1923 (Journal of the N. Y. Ent. Society, XXXI for June, 1923, p. 77), so that the evidence of the maxillary structures is readily available to any one who will take the trouble to consult the reference in question. Imms, 1937 (Psyche, XXXIV, p. 38) dismisses the matter with the brief and misleading statement that "The mouthparts (of Grylloblatta) yield no decisive data although in some particulars they exhibit slight but unconvincing resemblances to those of the Gryllidæ." Dr. Imms has never included a reference to this paper in any of his publications, and I can only conclude that he has not seen the evidence presented in it, demonstrating clearly and unmistakably that the maxillary structures of *Grylloblatta* are remarkably like those of the Gryllotalpidæ (*not* the Gryllidæ) and Forficulidæ etc., while they are wholly unlike those of the blattids and their allies, in their *modificational* tendencies (*i.e.* in their *specializations,* not in the general fundamental features shared by all orthopteroid insects in common). Thus in the blattid and mantid maxillæ shown in Figs 47 and 48 of the above cited paper, the galea is stout and fleshy and markedly overtops the much shorted lacinia, which is also comparatively stout and broad; and the basicardo, or basal sclerite of the cardo, is longer than the disticardo, or distal sclerite of the cardo in these blattoid insects. In *Grylloblatta* (Fig. 41 of this paper), on the other hand, and in the gryllotalpid and forficulid insects shown in Figs. 34 and 35 (*l.c.*) the galea is very slender and does not overtop the slender lacinia, which is shaped alike in *Grylloblatta, Gryllotalpa* and the dermapteron there figured, while the distal sclerite of the cardo (disticardo) is longer than the basal sclerite of the cardo (basicardo) in *Grylloblatta, Gryllotalpa,* etc. *Grylloblatta* and its allies thus differ from the blattids and their allies in all of these modificational features in which they resemble each other, and the evidence of the maxillæ is so obvious and convincing to any one accustomed to apply the principles of comparative

morphology, that it would seem as though those who minimize this evidence must have neglected to investigate it at all!

(5) LABIUM. The terminology here employed for comparing the different parts of the labium in the orthopteroid series is that given in a description of the labium of insects in general published in the Journal of Entomology and Zoology, Vol. 21, p. 1, which, with the exception of the usage of the designation labial stipites for Yuasa's "stipulæ" and Imms' "prementum," is the same as the terminology used by Yuasa, 1920 (*l.c.*) and Imms, 1924 (General Textbook of Entomology). With the exception of Yuasa and Imms, other recent investigators seem to be intent upon mixing up the old familiar and long established applications of the well-known terms submentum, mentum, etc., so confusingly that no one will be able to tell what sclerites are referred to when these disignations are used. The disturbing and unwarranted innovations attempted by those who would institute these confusing changes include the application of the term "mentum" to the labial stipites, and the application of the term "submentum" to the true mentum, etc., and in some cases the designation "submentum" is stretched to include both the submentum and the mentum, leaving the mentum, with no designation to refer to it in comparing this important sclerite throughout the orthopteroid series!

The labium of the orthopteroid insects is built on essentially the same plan throughout the series, the chief modificational peculiarities of value for indicating the relationships of the different groups being largely in the nature of the mentum and the submentum (with the gular region). As is shown in Fig. 31, Plate 18, of Vol. 21 of the Journal of Ent. and Zool. for 1928, the mentum of a typical blattid fits into the deeply concave anterior margin of the submental plate behind it, without an appreciable expanse of membrane intervening between the mentum and the submental plate. On the other hand, in a typical *Gryllotalpa* such as the one shown in Fig. 14, Plate 4 of Vol. XVII of the Entom. Mitteilungen for 1928, or in a typical stenopelmatid such as the one shown in Fig. 13 of Vol. VI, of the Pan-Pacific Entomologist for 1930, the mentum is a narrower transverse plate not fitting into the anterior margin of the submental plate behind it, and it is separated from the submental plate behind it by a rather wide expanse of membrane. Similarly the mentum of *Grylloblatta* shown in Fig. 2 of Psyche, Vol. XXXIII for 1926, is a narrower transverse plate not fitting into the anterior margin of the submental plate behind it, and it is separated from the submental plate behind it by a wide expense of membrane. Thus, in the only significant feature of the structure of the labium, *Grylloblatta* is definitely similar to the saltatorial Orthoptera in its modificational tendencies, and differs from a typical blattid in just these significant features.

It may be noted in passing, that the modifications in the submental plate of a phasmid such as *Diapheromera* are rather suggestive of those which have resulted in the production of an almost crescent-shaped submental plate in their close relatives the grasshoppers (Acrididæ). Furthermore, the fact that the gular region is apparently a part of the head capsule (instead of being a part of the detached submental plate) in the embiids and soldier termites (in both of which the mentum is only weakly demarked) would indicate that the Isoptera adumbrate certain modificational tendencies occurring in the embiids, but in so doing, the Isoptera depart from the typical blattids in these respects.

From the foregoing discussion of the character of the head and its appendages, it should be quite evident that every significant modification points to the fact that the grylloblattids are much more closely related to the saltatorial Orthoptera and their allies, than they are to the blattids and their allies; and in those features in which the grylloblattids are approached by such intermediate forms as the Isoptera, etc., these intermediate forms depart from the blattid type in proportion to the closeness with which they approach the Grylloblattids and their saltatorial relatives—which would not be the case if the grylloblattids were the most closely allied to the blattids, as others would maintain.

(6) CERVICAL SCLERITES. The neck plates are not subject to so many modifying influences as the other external features of the body are, since the specializations of the neck plates are not a matter of vital importance to the insect as are the mouthparts, for example, which are necessary for feeding the individual or the legs, which are necessary for seeking food, or escaping its

enemies, or the terminal abdominal structures which are involved in the reproduction of the species, etc. Being thus exempt, to some extent, from the selective influences which hasten the development of modifications which are of value in the struggle for existence, these cervical sclerites tucked away in the sheltered region of the neck, are of great value for indicating the affinities of the various orthopteroid groups by the peculiar patterns which they preserve as the result of less modified hereditary tendencies, and their evidence is of prime importance in any phylogenetic study—perhaps of more importance than any one set of structures in wingless insects, for placing them properly in their ordinal positions.

As is shown in Figs. 29 and 28 of Plate XII, and in Fig. 66 of Plate XIV of Vol. LII of the Transactions of the American Ent. Soc. for October 1926, the patterns presented by the lateral cervical sclerites of the blattids, mantids and Isoptera are characteristic of and peculiar to the group of insects to which these forms belong, and no one with any experience in these matters would ever mistake this pattern if he had ever seen it before. This "pattern" consists of a division of the lateral cervical sclerites into three plates (the third is usually folded under the posterior border of the second, and is sometimes reduced or obsolete) with the second pair of these sclerites produced mesally in such a way that their mesal projections tend to touch in the midventral line of the body in a peculiar and characteristic fashion which any student of comparative morphology with any experience in the study of insect phylogeny, would instantly recognize as a common peculiarity of the group, of the greatest importance for determining if any other insects belong in this group (Panisoptera).

When, on the other hand, we study the salatorial Orthoptera of the stenopelmatid or gryllid type (see Trans. Amer. Ent. Soc., 1926, Fig. 86), we find in them the same kind of lateral cervical sclerites as occur in *Grylloblatta* (see Ent. News, Vol. XXVI, Plate XIII, 1915, or Fig. 9, Plate XXVII, of the Ent. News, Vol. XXVIII for 1917, or Fig. 65, Plate XIV of Vol. LII of the Trans. Amer. Ent. Soc. for 1926) which has lateral cervical sclerites with a peculiar demarked marginal area along the dorsal border, and an intermediate plate does not become detached from the anterior lateral cervical sclerite as in the blattids, etc., (though the posterior lateral cervical sclerite is present in practically all of the orthopteroid groups) nor does the principal lateral cervical plate become prolonged mesally to become approximated to its fellow from the opposite side so that these two sclerites would touch in the midventral line of the neck as they do in the blattids and their allies (although this condition is suggested in a few rare instances by peculiar stenopelmatids from Madagascar). In other words, the Stenopelmatidæ (with the Gryllidæ) and the Grylloblattidæ are alike in the modifications of their lateral cervical plates, while they are both unlike the blattids, mantids and Isoptera in these features.

The striking resemblance between the cervical sclerites of *Grylloblatta* and the embiids is discussed in the Transactions of the Amer. Ent. Society, Vol. LII, p. 199, and the no less striking resemblances of the neck plates and neighboring structures of *Grylloblatta* to those of the phasmid *Timema,* the dermapteron *Echinosoma,* and other forms related to the Orthoptera (sensu stricto), have been discussed in detail in Vol. XXVIII, p. 398, of the Ent. News for 1917, so that it is not necessary to describe again the features in which these insects approach the true Orthoptera and differ from the blattids, mantids and Isoptera. The evidence of the neck plates is shown by these studies to indicate clearly and unmistakably that the grylloblattids are more closely related to the Orthoptera and their allies than they are to any other forms, and that they should be placed in the superorder Panorthoptera (with Saltatoria, phasmids, etc.) instead of the superorder Panisoptera (with the blattids, mantids and Isoptera).

(7) THORACIC SCLERITES. While the neck plates probably represent detached parts of the thorax, it is more convenient to discuss the prothoracic and other thoracic sclerites separately. The pronotum covers the greater portion of the pleural region of the prothorax in the saltatorial Orthoptera, but this is not the case in their near relatives the phasmids, Dermaptera, embiids, etc., in which the prothoracic structures are much more like those of *Grylloblatta* than is the case with these structures in the blattids, etc. The pronotum, with its pecularly demarked narrow anterior transverse region labelled *pt* in Fig. 6 (Plate XXVII

of Vol. XXVIII of the Ent. News for 1917) of the prothorax of *Embia* is strikingly like the dermapteroid pronotum of *Grylloblatta* shown in Fig. 9 of this paper, and the parts of the eutrochantin labelled a, b and c, and the peculiar "curvipleurite" labelled e in Fig. 9 of *Grylloblatta,* Fig. 6 of *Embia.* Fig. 8 of *Timema* and Fig. 5 of *Echinosoma* (in the paper cited above) are strikingly similar in these grylloblattids, embiids, phasmids and Dermaptera, and are wholly different from the sclerites of the blattid and isopteron shown in Figs. 5 and 6 of this paper. The clear-cut and unmistakable evidence of these peculiarly modified structures demonstrates conclusively that *Grylloblatta* is infinitely closer to the forms related to the Orthoptera (sensu stricto) than it is to the blattids and their allies. In just one feature of the prothorax, namely in the nature of the sternal region is *Grylloblatta* closer to the Isoptera (compare Figs. 65 and 66 of Plate XIV in Vol. LII of the Trans. Amer. Ent. Soc. for 1926); but since the prosternal sclerites of *both* grylloblattids and Isoptera are *very different* from those of the blattids (and mantids) this fact can give small consolation to those who would place the grylloblattids next to the blattids, since, if the grylloblattids *differ* from the blattids markedly in any feature this fact *separates* them from the blattids instead of placing them near the blattids, even though they may resemble the Isopteran relatives of the blattids in this one feature. I would therefore claim, that the fact that the sternal sclerites of the prothorax of both *Grylloblatta* and the Isoptera are different from these sclerites in the blattids, clearly indicates that, in approaching the grylloblattids in this respect, the Isoptera depart from the blattid type by just this much; and instead of bringing the grylloblattids nearer the blattids through this slight resemblance to the Isoptera, this resemblance between the grylloblattids and Isoptera merely tends to remove the Isoptera slightly further from the blattids in this one respect than they are in other features of their make-up.

The mesothoracic structures may be taken as typical of the parts of the thorax posterior to the first thoracic segment, since what applies to the mesothorax applies in almost equal measure to the metathorax as well (save for the fact that the laterosternite is not distinct in the metathorax of most of the forms related to the Saltatoria, while it does remain distinct in the metathorax of *Grylloblatta*). The pleural sclerites (episternum and epimeron) are more nearly vertical in most saltatorial Orthoptera, while the blattids and their relatives the pleural sclerites (and the pleural suture between them) tend to assume a more horizontal position. Certain Isoptera, however, have a tendency toward a "straightening up" of the pleural sclerites (*i.e.* the pleural suture tends to approach the vertical position in some respects), and the grylloblattids exhibit a somewhat intermediate condition half way between the more horizontal and the more vertical position of the pleural suture. In some phasmids (which are related to the Saltatoria) the pleural suture may be practically vertical as in *Timema,* while in other phasmids the pleural suture (between the episternum and epimeron) is more nearly horizontal. In the forficuloid relatives of the Orthoptera, the pleural suture becomes somewhat more horizontal, so that all stages between the more vertical and the more horizontal position of the pleural suture occur among the relatives of the Orthoptera, and the position of the suture is not of great importance for determininm the affinities of the forms in question.

Between the mesothoracic episternum and the mesosternum of *Grylloblatta,* there occurs a distinct laterosternite or lateral plate labelled *ls* in the figures of the thoracic sclerites of *Grylloblatta* by Crampton, 1915 (Plate XIII of Vol. XXVI of the Ent. News for 1915—see also a similar plate in the metathorax of *Grylloblatta* labelled *ls* in Fig. 8, Plate XX of the Journal N. Y. Ent. Soc. for 1931). A similar laterosternite occurs in the meso and metathorax of the Isoptera (Fig. 28 of the Journal N. Y. Ent. Soc. for 1931) and Zoraptera (*l.c.* Fig. 31), and in the mesothorax of the gryllids and other Saltatoria a similar laterosternite occurs, although in the metathorax it tends to fuse with the neighboring plates (as is also the case in the Dermaptera which have a distinct mesothoracic laterosternite). The blattids and mantids have no such laterosternite between the episternum and sternum in any segment (although a posterior marginal sclerite is marked off in the precoxal bridge connecting the sternum and pleuron in the blattids), and the sclerites in this region are built upon an entirely different plan, so that the evidence of these parts clearly links the grylloblattids with the

Saltatoria, and separates them from the blattids (from which the Isoptera depart in this feature in which they approach the grylloblattids and their allies).

The trochantin is rather broad and is divided into an anterior and posterior region by an oblique suture in the blattids, mantids and Isoptera, and the trochantin of *Grylloblatta* is like that of the blattids, etc., in the mesothorax and metathorax (but not in the prothorax, in which it is more like that of the insects related to the Orthoptera). However, in the mesothorax and metathorax of *Timema,* which is a phasmid very closely related to the Orthoptera, the trochantin is also very broad like that of *Grylloblatta,* but in other phasmids the trochantin is typically narrower, like that of most Saltatoria, excepting the gryllids, which have a somewhat broader trochantin. The Dermaptera have a narrower trochantin in some cases, while in some of the segmeints of certain Dermaptera it is broad, so that the width of the trochantin is a very variable feature in the forms closely allied to the Orthoptera. The grylloblattids have a broad trochantin like that of the blattids, but the phasmid *Timema,* which is closely related to the Orthoptera also has a broad trochantin, so that *Grylloblatta* could not be separated from the close relatives of the Orthoptera and be placed next to the blattids because of this fact, since it resembles both *Timema* and the blattids in this respect.

(8) LEGS. The coxæ are broad and somewhat conical in such primitive insects as Lepisma; and certain of the orthopteroid insects, such as the blattids, mantids, Isoptera, grylloblattids, Zoraptera, and even some of the Holometabola, tend to retain the conical shaped mesothoracic and metathoracic coxæ (though the prothoracic coxæ are rather more cylindrical in insects in general). In the phasmids, Dermaptera and Orthoptera, the mesothoracic coxæ in particular tend to become somewhat ringlike, broader than long, but *Grylloblatta* does not exhibit a tendency toward this modification, since *Grylloblatta* remains more conservative in this respect, and retains the conical type, together with the Isoptera, Zoraptera, blattids, etc. This might be interpreted as a feature allying the gryllobattids more closely with the blattids, but I think that it is to be explained merely as the

retention of the original type of coxa present in the common ancestors of all of the orthopteroids, and since the rest of the leg does not bear out the idea that the grylloblattids are more closely related to the blattids, the latter explanation seems to be the more logical one. Thus, for example, the tarsi of the grylloblattid *Galloisiana* described by Caudell and King, 1924, (Proc. Ent. Soc. Washington, XXVI, p. 3) bear huge flange-like lobed tarsal pads like those of certain Saltatoria related to *Gryllacris,* and those of some of the Stenopelmatids, etc., while the typical Blattids do not exhibit such large flange-like tarsal pads. The distal segment of the tarsus bears a "pulvillus" or arolium between the claws in typical blattids, but this is absent in *Grylloblatta* and the Stenopelmatidæ, etc. The phasmids have five tarsal segments, so that the fact that *Grylloblatta* has retained five-segmented tarsi from the common ancestors of all the orthopteroids, is no reason for placing *Grylloblatta* with the blattids, rather than with the phasmids (the near relatives of the Orthoptera) which also have pentamerous tarsi. The number of tarsal segments is such a variable feature among the forms related to the Orthoptera, that the mere fact that the grylloblattids have one more tarsal segment than the Stenopelmatidæ, is no more reason for separating the grylloblattids from the stenopelmatids in the order Orthoptera, than the fact that the stenopelmatids have one more tarsal segment than the gryllids, would be for separating the stenopelmatids from the gryllids and placing them in a different order from these other Orthoptera.

In reviewing the evidence of the trochantin and the leg structures, it becomes apparent that the broad trochantin and conical mesothoracic and metathoracic coxæ of *Grylloblatta* do not ally it more closely with the blattids, because a broad trochantin is retained in the blattids, mantids, Isoptera, Zoraptera, the phasmid *Timema,* etc., as a heritage from the common ancestors of all the orthopteroid insects, and similarly the conical coxæ preserved by these insects is likewise to be interpreted as the retention of a primitive condition present in the common ancestors of all the orthopteroids, instead of being a *specialization characteristic* of the blattids, grylloblattids, etc. On the other hand, the development of the broad flange-like tarsal pads in the grylloblattid *Galloisiana* and in certain stenopelmatids, *Gryllacris*-like Saltatoria, etc., does represent a specialization tendency common to these latter insects, and this evidence of a relationship between the grylloblattids and stenopelmatids, etc., is much more significant than the resemblance of the coxæ of *Grylloblatta* to those of the Isoptera, etc., which is merely a retention of a primitive condition from the common ancestors of all the orthopteroids.

(9) ABDOMINAL SCLERITES AND SPIRACLES. The structure of the entire abdomen of *Grylloblatta* is shown in Fig. 10, Vol. III of the Jan., 1927, issue of the Pan-Pacific Entomologist (p. 134), where the abdomen of a gravid female is figured to illustrate the appearance of the abdomen when distended with eggs, and in Fig. 8, Plate XX of Vol. XXXIX of the Journal N. Y. Ent. Soc. for Sept., 1931, is figured an enlarged drawing of the posterior metathoracic and basal abdominal structures of *Grylloblatta.* As is shown in these drawings, the general contour of the abdomen of *Grylloblatta* is like that of a dermapteron or an oecanthid orthopteron (or one of the primitive stenopelmatids) instead of being like the broader flatter abdomen of a blattid, which it should resemble if *Grylloblatta* were more closely related to the blattids than they are to the Orthoptera. The shape of the tergites and sternites of *Grylloblatta* is not like that or the tergites and sternites of a typical blattid (see Fig. 14, Plate VI of Psyche, Vol. XXXII for 1925) in which the spiracles are borne in *sclerotized areas* called "subtergites" or "pleurites," which appear to be demarked lateral areas of the tergites, while the spiracles of *Gryllablotta* are borne in the *membrane* between the tergal and sternal regions of the abdomen, and the spiracles of *Grylloblatta* are very minute like those of certain saltatorial Orthoptera. In fact the abdominal structures of the grylloblattids are so obviously like those of the true Orthoptera, rather than those of the blattids and their allies, that no one who has made a comparison of these structures in the orthopteroid insects could fail to detect the difference. The details of the male genitalia, ovipositor, terminal abdominal structures, etc., can be better considered separately.

(10) GENITALIA OF THE MALE. Walker, 1919, (Canadian Entomologist, 51, p. 131) has given excellent figures of the male genitalia of *Grylloblatta campodeiformis,* and the terminal structures of several types of male grylloblattids have been figured by Crampton, 1927, (Pan-Pacific Entomologist, 3, p. 115). Figures of the genitalia of various orthopteroid insects will be found in a paper by Walker, 1922, (Annals Ent. Soc. America, 15, p. 1) and the genital structures of a typical blattid are shown in the figures in Plate VII of Vol. 32 of Psyche for 1925.

In the male of *Grylloblatta,* as shown by the above-mentioned investigators, the gonocoxites, or genital coxites of the ninth abdominal segment of the male are separate and distinct, but in the other orthopteroid insects the gonocoxites tend to unite with each other, and likewist become fused with the ninth sternite. In certain *Gryllacris*-like Orthoptera, the gonocoxites appear to be distinct distally (in the region where the styli are borne) but their basal portions unite with the ninth sternite or hypandrium, while in certain primitive Stenopelmatidæ, the gonocoxites tend to unite with each other, but their bases are separated from the ninth sternite by a region of weaker sclerotization. As I am hoping to show in a later publication, the gonocoxite and styli of these Orthoptera are more like the gonocoxites and styli of *Grylloblatta* than is the case in any blattids, and this feature is likewise in harmony with the view that the grylloblattids are nearer the saltatorial Orthoptera (*e.g.* the stenopelmatids) than they are to the blattids.

The phallic structures of the gryllobattids are very like those of certain blattids, but they are quite as markedly similar to these parts in the phasmid relatives of the Orthoptera, in which the phallic lobes, etc., are asymmetrically developed as in the grylloblattids, blattids, etc. So far as the phallic structures are concerned, therefore, the grylloblattids are fully as closely related to the phasmid allies of the Orthoptera as they are to the blattids, and when the genital coxites and styli are taken into consideration, the parts are more like those of the stenopelmatids, etc., in *Grylloblatta,* than they are like the parts of the blattids, so that when all of the features of the male genitalia are taken into consideration, it is seen that *Grylloblatta,* is nearer the Orthoptera (stenopelmatids, *Gryllacris,* etc.) and their immediate relatives the phasmids than it is to the blattids, and the feature of the male genitalia, which is considered to remove the grylloblattids from the Orthoptera and place them nearer the blattids, in reality indicates that the grylloblattids are more closely allied with the Orthoptera and their phasmid relatives.

(11) OVIPOSITOR AND NEIGHBORING PARTS. The ovipositor and the structures about it have been figured for *Grylloblatta* by Walker, 1919 (Annals Ent. Soc. America, 12, p. 267) and by Crampton, 1927 (Pan-Pacific Entomologist, 3, p. 115) and also by Crampton, 1919, in Vol. 37, p. 453, of the Journal of the N. Y. Ent. Society, where the terminal abdominal structures of female insects have been compared throughout the orders from the standpoint of phylogeny. The *details* of the ovipositor of *Grylloblatta* are not shown in the extensive work of Chopard, 1920, on the terminal structures of the Orthoptera, so that Chopard was unable properly to evaluate the evidence of the ovipositor and its neighboring parts for properly placing *Grylloblatta* in the general phylogenetic scheme.

The evidence of an extremely close relationship between the Grylloblattids and the stenopelmatid Saltatoria furnished by the study of the ovipositor valves, their basal sclerites, and the neighboring parts, is most impressive if one takes the time to study the minute resemblances in structural details, instead of dismissing the subject with the casual statement that "the grylloblattids have an exserted ovipositor which is longer than that of a blattid," or some such superficial statement betraying no discriminating knowledge of what is actually involved in the detailed resemblances between the parts of the ovipositors of a grylloblattid and a stenopelmatid.

In the ovipositor of *Grylloblatta,* as shown in Fig. 58 of the paper by Crampton, 1929, cited above, the dorsal valve for example is long and slender and tapers posteriorly, resembling that of *Ceuthophilus* shown in Fig. 62 of this paper, or that of the stenopelmatid shown in Fig. 33 of this paper, instead of resembling the more membranous and lobe-like dorsal valve of a typical blattid shown in Fig. 35 (*l.c.*) and the peculiar swelling at the base of the dorsal valve, labelled vb in Figs. 58 and 61 of *Grylloblatta* and *Gryllus* in this paper, are orthopteroid features not exhibited by the blattids and their relatives. The general shape of the ovipositor valves and the more dorsal sweep of their projecting portions suggest the types of valves exhibited by a phasmid (which is closer to the Orthoptera than it is to the blattids) such as the one shown in Fig. 52 (*l.c.*), while the valves of a mantid, such as the one shown in Fig. 27 (*l.c.*), which approaches the orthopteran type much closer than does that of a blattid, exhibit a decurved or downward-bending tendency, instead of projecting more horizontally backward or slightly upward, as the valves tend to do in the grylloblattids and their orthopteroid relatives (including the phasmids and Dermaptera).

In *Grylloblatta* (Fig. 58) and the stenopelmatids (Figs. 62 and 33) the ninth tergite extends downward on each side of the body to the base of the valvifer labelled *vf* in the figures of these insects shown in this paper, while in the blattid and mantid shown in Figs. 35 and 27 (*l.c.*) slender lora-like bands labelled v in these figures, extend from the tergites to the bases of the ovipositor in a fashion unlike that of the grylloblattids and stenopelmatids, showing that the modificational tendencies of these orthopteroids are not those characteristic of the blattids and mantids, as would be the case if the grylliblattids were more closely related to the blattids than they are to the Orthoptera. The eighth sternite tends to become reduced to a mere lobe at the base of the ovipositor in the blattids, mantids, etc., and, as is shown in Figs. 27, 32 and 35 of the paper cited above, the seventh sternite of the mantids, Isoptera and blattids (which are extremely closely related) becomes greatly enlarged to form a hypogynium, projecting backward and upward to cover the ovipositor and to carry the egg-packet in a characteristic fashion in these insects, while in the grylloblattids and stenopelmatids (Figs. 58, 62 and 33), on the other hand, the eighth sternite is not a mere lobe hidden beneath the seventh sternite, and the seventh sternite does not exhibit a pronounced tendency to form a hypogynium, as it evidently would if the grylloblattids were more closely related to the blattids than they are to the stenopelmatids.

(12) Vaginal Orifice. As was pointed out by Walker, in the paper cited above, the gonopore, or vaginal opening of the oviducts, discharges between the eighth and ninth sternite in the

grylloblattids and their phasmid and saltatorial relatives, while in the blattids, and in their relatives the mantids, the vaginal orifice is between the seventh and eighth sternite. If the grylloblattids were more closely related to the blattids than they are to the Saltatoria and their allies, the vaginal opening would be located in the typical blattid position, whereas it is located in the typical saltatorial position instead, and this fact, in addition to the multitude of other resemblances between the ovipositor and the neighboring parts, as cited above, clearly and unmistakably proves that the Saltatoria, such as the stenopelmatids, are the closest allies of the grylloblattids, while the blattids are more distantly related according to these features.

From the foregoing discussion it should be evident that in addition to the position of the vaginal orifice, the detailed peculiarities of the ovipositor and the neighboring parts in *Grylloblatta* point unmistakably to an extremely close approach to the orthopteran type, and a corresponding departure from the blattid type, and those who dismiss the matter with a brief reference to the fact that *Grylloblatta* has a somewhat elongated exserted ovipositor evidently have not studied the subject sufficiently to be able to appreciate the true nature of the evidence and its phylognetic significance.

(13) TERMINALIA AND CERCI. The tenth and eleventh segments constitute the terminalia, and these with the cerci, have been described in the Grylloblattids and related Orthopteroids by Walker, 1922, (Annals Ent. Soc. America, Vol. 15, p. 1) and Crampton, 1929, (Journal N. Y. Ent. Soc., Vol. 39, p. 323).

The tenth tergite, or epiproct, overlaps the greatly reduced eleventh tergite (suranale) in the Mantids, while the membranous region representing the eleventh tergite is overlapped by the tenth tergite in the blattids. In the Saltatoria, on the other hand, the tendency is for the region representing the eleventh tergite to remain free of the tenth tergite, and in the Grylloblattidæ the region representing the eleventh tergite is not overlapped by the tenth tergite, so that the grylloblattids are near the Saltatoria in this feature, which is the only outstanding one of the terminalia, which are built on much the same general plan throughout the orthopteroid orders (sensu lato). The paraprocts, or modified coxites of the eleventh segment (not of the tenth, as I formerly supposed) below and beside the cerci, are flanged with a lateral ridge in the typical blattids (see Figs. 14 and 19, Plate VI, Vol. 32 of Psyche for 1925); but in the figures of the paraprocts of *Grylloblatta* cited above, there are no lateral ridges of this description, as would be the case if *Grylloblatta* were more closely related to the blattids than to the Saltatoria (which also lack these lateral ridges of the paraprocts, present in typical blattids). The basicercus, or basal sclerite of the cercus is a median lateral plate hidden by the base of the cercus in typical blattids (see Fig. 19, Plate VI of Psyche, Vol. 32, 1925, where the sclerite in question is labelled bce), while in the Saltatoria and grylloblattids this sclerite is more lateral and is not thus hidden by the base of the cercus. The cerci themselves are more cylindrical in *Grylloblatta* and resemble the cerci of the Saltatoria in this respect more than they do the cerci of typical blattids (above mentioned paper in Psyche), in which the cerci are more triangular in cross-section, with a ridge extending along the lateral surface of the cercus. The segments of the cerci of typical blattids are more annular, while the segments of the cerci of grylloblattids are more elongated and cylindrical, thus differing from the blattids in this respect. Such Isoptera as *Archotermopsis* shown in Fig. 30, Plate XI of the Journal N. Y. Ent. Soc., 37, 1929, exhibit an approach to the grylloblattid type in the character and number of the component segments of the cerci, but in so doing, they depart from the typical blattids in those features in which they approach the grylloblattids, so that this is no argument for a relationship to the blattids themselves, on the part of the grylloblattids, which are approached by some Isopteran relatives of the Blattids, and merely indicates that the Isoptera represents a step away from the blattids in the direction of the grylloblattids and saltatorial Orthoptera (the Isoptera being intermediate forms serving to connect the blattids with the Orthoptera). The fact that the cerci of the saltatorial orthopteron *Pristoceuthophilus cercalis* Caudell, are "multiarticulate" (and even in the tridactylids the cerci are frequently composed of two segments) shows that the character of the cerci, rather than the number of segments composing them, is of greater importance for determining the affinities of the insects in question, since we would be unable to place Pristoceuthophilus with the rest of the Orthoptera with single-segmented cerci, if the number of segments composing the cerci were stressed. Even in the different stages of the same insect, the cerci may be first multiarticulate and then "uniarticulate," as is the case in such Dermaptera as *Diplatys,* which has multiarticulate cerci when immature (see Fig. 60, Plate 13, Vol. 37 of the Journal N. Y. Ent. Soc., 1929) while in its adult condition the cerci are composed of but one segment as in the saltatorial Orthoptera, and the character of the cylindrical multiarticulate cerci of this dermapteran relative of the Orthoptera is rather suggestive of the cerci of *Grylloblatta.* Since the number of segments composing the cerci is not of phylogenetic importance (some blattids have uniarticulate cerci, while others have multiarticulate cerci, and the same is true of such orthopteroid insects as the Plecoptera, etc., and even in the Saltatoria themselves the number of segments in the cerci varies from one or two to many), and since the character of the cerci of Grylloblatta is different from that of a typical blattid's cerci, this tends to separate the grylloblattids from the blattids instead of grouping them with the blattids if any importance is given to the character of the cerci. Thus the only significant features of the terminalia serve to separate the grylloblattids from the blattids and to ally them with the Saltatoria, while such features as the cerci, although furnishing no marked proof of a relationship to the Saltatoria, nevertheless do tend to remove the grylloblattids from the blattids, since their cerci differ from those of the blattids (and approach the larval Dermaptera which are related to the Orthoptera).

(14) GENERAL FACIES OR HABITUS. One reads much of the depressed or "flattened" supposedly blattoid appearance of the grylloblattids, but this characterization is both incorrect and misleading. Only the shrivelled dried specimens of Grylloblatta are markedly flattened, while the bodies of specimens preserved in alcohol are more suggestive of those of the Dermaptera, or the phasmid *Timema,* or the Plecoptera, all of which are related to the Orthoptera, rather than to the blattids (being only remotely related to the latter); and instead of having a *broad* flattened body, like that of a typical blattid, the grylloblattids have a slender body like that of the Dermaptera, Plecoptera,

Timema, etc., mentioned above; and the body of *Grylloblatta* is much more like that of an oecanthid orthopteron than it is like that of a typical blattid. The contour of the abdomen in particular in *Grylloblatta* seems to be much more like that of certain stenopelmatids than the blattids, for all of its tendency to become somewhat flattened, and this flattening is therefore not a blattoid feature at all, in *Grylloblatta,* but is rather a retention of the primitive slender character of the body which was probably characteristic of the ancestors of all of the orthopteroids such as the Dermaptera, phasmids, Plecoptera, etc., etc.

Seen in "profile" (*i.e.* laterally) the head of a typical Blattid is markedly opisthoganthous (*i.e.* the head is bent far over, with the mouthparts directed backward) and the pronotum tends to cover it above. A marked tendency in the same direction is exhibited by the mantid relatives of the blattids, and if the grylloblattids were at all closely related to the blattids, they would undoubtedly show some traces of this blattoid characteristic tendency. When we thus analyze the general appearance of the Grylloblattids more discerningly, it becomes at once apparent that there is nothing "blattoid" about them, but they rather resemble the types ancestral to the Dermaptera and other forms more closely allied to the Orthoptera than to the blattids!

(15) EGGS AND EGG-LAYING. The egg of *Grylloblatta campodeiformis* Walker, as figured and described by Crampton, 1927 (Fig. 6, p. 135 of the Pan-Pacific Entom., Vol. 3, No. 3, 1927) is orthopteroid in character (p. 120, *l.c.*) being somewhat more rounded at the posterior end and slightly more pointed at the anterior end, while the ventral contour is somewhat more convex than the dorsal side. The micropylar region and the opposite end of the egg bear tiny processes giving a roughened appearance to the surface of the egg in these regions. The eggs are black, as are the eggs of such orthopteroids as the phasmids, and they are laid singly, as is also true of the phasmid relatives of the Orthoptera. The eggs of *Grylloblatta* however, are laid in moss or similar substances during the nocturnal wanderings of the female, and these nocturnal habits of the grylloblattids are likewise shared by their stenopelmatid relatives (*e.g.* Ceuthophilus, etc.), though the blattids are also nocturnal. The blattids and mantids, however, deposit their eggs in oothecæ (the devel-

opment of the hypogynium, or seventh sternite, being an adaptation for holding the egg-packets) and even *Mastotermes* (a primitive termite) deposits an egg-mass, as described by Mr. Gerald Hill, and has the seventh sternite developed to form a hypogynium for carrying the eggs about before depositing them (the loosely formed egg-packet being carried protruding from the hind end of the hypogynium, as in blattids, in this remarkable termite). If the grylloblattids were at all closely related to the blattids, they would undoubtedly exhibit some trace of this characteristic tendency present in the close relatives of the blattids, whereas, on the other hand, the grylloblattids exhibit the typically orthopteran tendencies, instead, in their egg-laying habits and in their structures developed in connection with egg-laying. This fact is apparently not appreciated by those who seek to determine the closest affinities of the grylloblattids, yet it is a powerful argument in favor of the orthopteroid affinities of the grylloblattids, and a correspondingly weighty argument against placing them with the blattids.

(16) BEHAVIOR REACTIONS. Miss Ford (Canadian Entomologist, Vol. 58, p. 66, 1926) has described the behavior of *Grylloblatta* in captivity, and certain of its reactions are extremely significant for indicating its closest affinities (*i.e.* like behavior indicates a like chemico-physical make-up of the nervous system). Thus the habit of holding the abdomen high over the head, when irritated, is a peculiar reaction strongly suggestive of affinities with the Dermaptera (which are related to the Orthoptera), and this fact should be more strongly emphasized in analyzing the evidence for or against the orthopteroid affinities of the grylloblattids, as opposed to their blattid affinities. This dermapteroid (and hence orthopteroid) behavior of *Grylloblatta* is in line with its general dermapteroid habitus, the dermapteroid character of its head, mouthparts, thoracic sclerites, etc., and since no blattid is known to exhibit such a behavioristic response, this is a very weighty argument in favor of placing the grylloblattids further away from the blattids and much nearer the Dermaptera and their orthopteran allies. Another reaction indicating a relationship to the orthopteroids, rather than the blattoids, in *Grylloblatta,* is its "embarassment" reaction of nibbling the foot, cleaning the antenna, polishing the head, and similar actions of

elaborate "unconcern" upon coming face to face with one of its own kind, since such Saltatoria as *Decticus* behave in essentially the same manner under similar conditions, but no blattids have been observed to act in this way under these conditions. I would therefore maintain that not only structurally, but also "psychically," and every other way, the grylloblattids are infinitely nearer the orthopteroid insects (sensu stricto) than they are to the blattoids, although they naturally exhibit affinities with the blattoids also, since all were descended from the same ultimate ancestry in the common protoblattid-protorthopteran stem.

In Plate VI of the April 1928 issue of The Entomologist, Vol. 61, p. 82, I have endeavored to depict a three-dimensional phylogenetic tree illustrating the lines of descent of the orthopteroid insects arising from the common protorthopteron-protoblattid stem. Later investigations have shown that the supposed new order "Aeroplanoptera" is at least orthopteroid, if not actually orthopteran, and the supposed "Protohymenoptera" are in reality Megasecoptera, while the age of certain of the orders as shown in the figure must now be changed to agree with more recent discoveries (*i.e.* that the Diptera, for example, go back to the Permian, as do the Neuroptera, etc.) so that the phylogenetic tree there shown should be revised in the light of this newer knowledge. The tree, as it stands, however, will illustrate the evolution of the orthopteroids sufficiently accurately for the purpose of this discussion.

As is shown in this tree, *Synarmogoge* represents a stage intermediate between the Palaeodictyoptera and the common protorthopteron-protoblattid stem from which arose the lines of descent of the orthopteroid insects (sensu lato) and most of the other Neopterygota (*i.e.* the orthopteroids, hemipteroids and holometabolous insects, all of which are capable of laying the wings back along the abdomen in repose) as well. The members of this common protorthopteron-protoblattid stem, which may be referred to as the orthopteroid stem, were "archetypal" forms combining in themselves the primitive features of the protoblattids and Protorthoptera (which merge at their bases so completely that they are referred to as distinct orders merely for the sake of convenience in tracing the lines of development which follow the one or the other group more closely in diverging from the common stem), and the protoblattids have apparently departed somewhat less than the Protorthoptera have from this common stem (*i.e.* the protoblattids have preserved more of the primitive features from this common ancestry).

As the protoblattids and Protorthoptera emerged from this common stem as slightly divergent lines of evolution, the lines of descent of the ancestors of the other orthopteroid insects (sensu lato) tended to cluster about one or the other of these two principal focal centers represented by the emerging lines of descent of the protoblattids and Protorthoptera. The protoblattids and Protorthoptera intergraded so imperceptibly that they still merged into one ordinal group at this time, but subdivisions of family rank, etc., had now begun to adumbrate the modifications which were to become more and more strongly pronounced in the lines of descent of various other orthopteroid groups whose nascent lines of development likewise intergraded with the Protorthoptera and protoblattids. In fact, in the late lower Carboniferous (if not in the early upper Carboniferous), it is very probable that the nascent lines of development of all the Neopterygota converging upon the common protorthopteron-protoblattid stem intergraded imperceptibly with these, and indeed, at one time the originators of all of the lines of descent of the Neopterygotan insects merged into a single order, then into a single family and finally into a single species (in all probability) as we trace these lines of descent back to their ultimate sources, but for the present discussion the emergence of the intergrading Protorthoptera and protoblattids from the common orthopteroid stem is the important feature for tracing the lines of descent of the other orthopteroid forms, and, although the Protorthoptera and protoblattids were still so similar that they constituted a single order of insects, they must be considered separately because of the lines of descent which cluster about each separately.

The line of descent of the blattids is practically a direct continuation of the protoblattids, and merges imperceptibly with these as we trace them back into the Carboniferous, so that here again it is largely a matter of convenience that the blattids are regarded as a distinct order from the protoblattids. The mantids likewise arose from the protoblattids, and they are so similar to the blattids that these two living groups would be best considered as constituting the order called Dictyoptera by Bolivar (who thus grouped the blattids and mantids), this term being preferable to the later designation Oothecaria applied to them by Verhoeff.

The Isoptera are extremely closely related to the blattids (and also to the mantids) as is shown by the terminal structures of the females, the character of the cervical sclerites, the wings of *Mastotermes,* and numerous other features; but the venation of Mastotermes resembles that of certain Protorthoptera and protoblattids even more closely than it does a blattid wing, thus indicating that the common Protorthopteron-protoblattid stem was the source of their origin (rather than the line of descent of the blattids alone), and their thoracic sclerites, for example, could not possibly have been derived from the types occurring in any known blattid or mantid, since they are built on a much more primitive plan that was apparently characteristic of the ancestral types in the common orthopteroid stem, instead of a true blattid or mantid, and on this account it is impossible to derive the Isoptera directly from the blattids as some investigators seek to do.

In order to indicate that the blattids, mantids and Isoptera form a compact group more closely related to each other than to the rest of the orthopteroids, I have grouped them into a single superorder, the *Panisoptera* (also called Blatteiformia, Blattomorpha, etc.) characterized by a combination of features such as the meeting of the lateral cervicals in the mid-ventral line of the neck, the conical coxæ, undeveloped mesothoracic and matathoracic postscutellum, enlarged seventh abdominal sternite, short ovipositor, etc. The lines of descent of the members of this group cluster more closely about that of the protoblattids, which were the closest relatives of their ancestors in the common orthopteroid stem.

The embiids are the closest relatives of the Plecoptera, as is shown by their pleural thoracic sclerites, well-developed mesothoracic and metathoracic postscutellum, ring-like mesothoracic coxæ etc. Their lines of descent arising in the common orthopteroid stem (*i.e.* common protorthopteron-protoblattid stem) paralleled that of the Protorthoptera more closely than that of the protoblattids, so that their lines of descent and that of their close relatives the Hadentomida (fossil) cluster about the protorthopteran focal center, rather than the protoblattid one.

The embiids and Plecoptera are grouped in a superorder called the Panplecoptera (also called Perliformia or Perlomorpha) characterized by typically trimerous trasi, mesothoracic coxæ broader than long, mesothoracic and metathoracic postscutellum well-developed, lateral cervicals not touching in mid-ventral line, no ovipositor, and seventh abdominal sternite not enlarged to form a hypogynium.

The phasmids are more closely related to the saltatorial Orthoptera than they are to any other Orthopteroid group, as is indicated by their venation, thoracic sclerites, more ring-like mesothoracic coxæ, type of head capsule, lack of development of the seventh abdominal sternite to form a hypogynium (the subgenital plate is formed by the eighth sternite instead of the seventh) and other features. They are also closely related to the Dermaptera, and the primitive phasmid *Timema* in particular resembles a dermapteron in having the mesothoracic coxæ widely separated (instead of being approximated mesally, as in the roaches or mantids, with which they are allied by some entomologists) and broader than long. The head of *Timema* is essentially dermapteroid and resembles that of *Grylloblatta* as well. The cerci are composed of a single segment as in the Dermaptera and most Saltatoria and there are many other features allying the phasmids to the grylloblattids, Dermaptera and Saltatoria.

The Dermaptera are extremely closely allied to the grylloblattids as well as to the phasmids, and exhibit numerous features indicating a relationship to the saltatorial Orthoptera. The character of the head has already been mentioned, and the mouthparts are more like those of the Saltatoria and grylloblattids. The almost annular, widely separated mesothoracic coxæ clearly indicate a closer relationship to the phasmids and Saltatoria (Acrididæ, Tetigidæ, etc.), and the venation is clearly much closer to that of the phasmids and Saltatoria than to that of the blattids and their allies. The cerci have mesal prongs and are composed of a single segment in the adult, like the cerci of the

Saltatoria and their allies, and the abdominal segments in general are more like those of the phasmids, etc. The only disturbing feature is that the seventh abdominal sternite becomes enlarged to form a hypogynium as in the blattids and their allies, but the weight of evidence seems to be on the side of allying the Dermaptera more closely with the phasmids and grylloblattids (with which the Saltatoria are intimately connected) than with the Blattids and their allies. The Dermaptera also exhibit marked resemblances to the embiids and Plecoptera, as I have pointed out before, but taking their characters as a whole, the balance of evidence is on the side of allying them with the phasmids, grylloblattids and Saltatoria.

The affinities of the grylloblattids have already been discussed in detail, so that all that is necessary to state at this time is that their closest allies are the saltatorial Orthoptera (stenopelmatids, etc.), and next to these, their closest relatives are the phasmids and Dermaptera. Although at first included to consider that the grylloblattids represent a distinct order (the Notoptera or Archiorthoptera) I would now place them, with the Saltatoria, in the order Orthoptera (sensu stricto) as the representatives of a distinct suborder of this group. The grylloblattids are the more or less direct descendants of the protorthoptera, and if their wings had been preserved, would doubtless be found to be intermediate in character between those of the Prothorthoptera and the wings of the primitive stenopelmatids.

The Orthoptera (sensu stricto) appear to be the direct descendents of the Protorthoptera, and merge with these when their fossil representatives are compared with the Protorthoptera, so that the two groups are hardly of ordinal value. If we lumped the Orthoptera with the Protorthoptera, however, we would have to lump all of these with the protoblattids (with which the Protorthoptera merge) and also include the blattids and mantids with these. This would in turn involve the Isoptera, which merge to some extent with the protoblattids, and the Dermaptera, etc., would be involved with the Protorthoptera and so on until the "ordinal" group became so large and unwieldy that it would include at least all of the orthopteroid insects (sensu lato) and many other forms as well (such as the zorapterous psocids, etc., etc.). Under these conditions, the only sensible way of handling the matter is to divide these insects into orders which are grouped according to their natural affinities.

The Orthoptera (with the grylloblattids) phasmids and Dermaptera belong in the superorder Panorthoptera (also called Locustiformia and Locustomorpha) which is characterized by a forficuloid type of head, undeveloped mesothoracic postscutellum, mesothoracic coxæ usually broader than long, cerci usually single-segmented and frequently bearing mesal prongs, etc., seventh adbominal sternite not forming a hypogynium (except in certain Dermaptera), and other features. The Protorthoptera are the closest allies of the ancestors of the lines of descent of these insects in the common protorthopteron-protoblattid stem, and the lines of descent of these insects cluster about the Protorthoptera, rather than about the protoblattids, although they intergrade with the Isoptera and blattids more markedly than they do with the embiids and Plecoptera, which also cluster about the Protorthoptera and were also apparently derived from Protorthoptera-like ancestors in the common protorthopteron-protoblattid stem. The reasons for this will doubtless become more apparent when more is known of the fossil ancestors of the embiids, Plecoptera etc., and of the protorthopteroid insects connecting them with the ancestral types in the common orthopteroid stem.

All of the orthopteroid groups (comprising the Panisoptera, Panorthoptera and Panplecoptera, etc.) are gathered in a larger division called the Orthopteradelphia (or "Paurometabola," used in a different sense from that in which it is employed by other entomologists, who would exclude the Plecoptera, for example, from this group, and place them with the Odonata and Ephemerida, etc.) and these insects constitute the orthopteroid insects in the broader sense of the term—the orthopteroid insects in the narrower sense being the Panorthoptera alone. The zorapterous psocids are extremely closely allied to the Isopteran members of this group, and even the Thysanoptera are rather closely allied to the Orthoptera, so that it is a question as to where to draw the line separating the orthopteroid insects from the rest of the Neopterygota by which they are very closely approached (the Coleoptera, for example, approach the Dermaptera no less markedly than the zorapterous psocids approach the

Isoptera, etc., etc.), but the orthopteroid insects as here constituted, together with their fossil relatives, form a natural group which can be more conveniently considered in this way, than if the rest of their relatives were admitted, necessitating bringing in the close relatives of these in turn, until the group became too inclusive and unwieldy to be of any value, for after all, the whole of the Neopterygota, which were descended from the common Orthopteroid stem, would be found to merge with the orthopteroid insects etc., if we traced their lines of descent back far enough, and for practical purposes it is necessary to divide these into sections containing the most closely allied *living* forms, in such a discussion as this.

In studying the living forms which furnish synthetic features connecting the different groups of Orthopteroid insects (sensu lato), it should be noted that the grylloblattids are not the only forms of value for this purpose, and their usefulness should not be overemphasized to the exclusion of the consideration of other forms of equal (if not even greater) value in this connection. While the blattids have departed the least from the protoblattoid ancestors of the orthopteroid insects in general, the Isoptera surpass them in interest as connecting links annectant between the various orthopteroid groups, and even leading to the non-orthopteroid forms as well. Thus, the Isoptera approach the Dermaptera, grylloblattids and Saltatoria more closely than the blattids do in many respects. They are much closer to the embiids than the blattids are. They are extremely closely related to the zorapterous psocids (and the psocids in turn lead to the Mallophaga on the one side and to the Hemiptera on the other), and they have preserved many features suggestive of the ancestors of the Hymenoptera, etc.

The Dermaptera are not only closely allied to the phasmids, grylloblattids and Saltatoria, but they also approach the Isoptera, and to a less extent, the blattids as well. They exhibit many features in common with the embiids, and to a less extent, with the Plecoptera also. They approach the Coleoptera remarkably closely, among the non-orthopteroid forms, and as annectant types, they are almost of equal value with the Isoptera for connecting the different groups and indicating their closest contacts.

The embiids are somewhat more useful than the Plecoptera are for furnishing points of contact with the other orthopteroids, since the embiids are very like the Isoptera in many features, and also approach the Dermaptera in certain respects. The Plecoptera are more primitive than the embiids are, however, and furnish more clews for determining the nature of the protorthopteroid ancestors of both Plecoptera and embiids.

The phasmids are of considerable interest since they are extremely closely allied to the Saltatoria, and exhibit many features in common with the grylloblattids and Dermaptera, and even with the Plecoptera (which are rather like the primitive phasmid *Timena*), and I consider that the phasmid *Timema* is almost of as much interest from the phylogenetic standpoint as is *Grylloblatta!*

Among the Saltatoria themselves, the Stenopelmatidæ (with which the *Gryllacris*-like forms are grouped by many Orthopterists) are the most interesting forms since they are allied with the gryllids in some respects, and the *Gryllacris*-like members of their group approach the tettingoniids, which in turn may lead to the Acrididæ. The stenopelmatids are also the most like the grylloblattids of any of the saltatorial types, and therefore combine in themselves synthetic features of value for studying the lines of descent of the more important representatives of the true Orthoptera. Because of their "synthetic" character, the line of descent of the stenopelmatids should have been represented in the phylogenetic tree of the Orthoptera given on page 135 of the January, 1927, issue of the Pan-Pacific Entomologist in such a way as to indicate that the Stenopelmatidæ are intermediate between the grylloids (gryllids, gryllotalpids, etc.) on the one hand, and the tettigonioids (Tettigoniidæ, Phasmodidæ, etc.) on the other, with their strongest affinities somewhat on the side of the tettigonioids. The Tettigoniidæ have preserved certain features suggestive of the ancestors of the Acrididæ, but until the general anatomy of the tridactylids has been studied more in detail, it is impossible to decide just where the line of descent of the higher Orthoptera arose.

The conclusions here reached concerning the closest affinities of the Grylloblattids and their position in the general phylogenetic scheme may be briefly summarized as follows. Within the order Orthoptera (in which the grylloblattids might possibly be placed) the next of kin to the grylloblattids are the stenopelmatids. Outside of the order Orthoptera, the next of kin to the grylloblattidæ are the phasmids and the Dermaptera. Next to these, the grylloblattids are more closely related to the Isoptera which in turn serve to connect the grylloblattids with the Dictyoptera (including the blattids and mantids), so that the relationship of the grylloblattids to the blattids is rather remote. The embiids are more closely related to the grylloblattids than the Plecoptera are; and outside of the general orthopteroid group (Orthopteradelphia) the nearest relatives of the grylloblattids are the zorapterous psocids, with the Coleoptera as their nearest relatives among the Holometabola.

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MORPHOLOGY OF THE FEMALE REPRODUCTIVE SYSTEM OF INCURVARIA RUSSATELLA CLEMENS (LEPID.)

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INTRODUCTION

Most insects have a single opening to the female reproductive system, but in the higher Lepidoptera the vagina opens on the eighth segment and the oviduct on the ninth. Mr. August Busck (1932) has recently published a paper on the female reproductive system of the microlepidoptera based on dissections, and has been kind enough to place it at my disposal prior to publication. In some of the most primitive families certain questions have been raised, and so when appropriate material happened to be available Dr. Forbes asked me to make a histological examination to see what might be seen in serial sections. The results of this study are presented herein, but experimental rather than morphological data are what we need most.

The author would like to express his thanks to Dr. A. B. Klots for the material studied, and to Dr. W. T. M. Forbes, Dr. O. A. Johannsen and Mr. August Busck for reading the manuscript and in certain cases checking the slides themselves.

MATERIALS AND METHODS

Pertinent forms are rare in this region, and so only a small amount of material was available. These were collected by Dr. A. B. Klots at McLean, N. Y., in mid-July and fixed in Bouin's fluid, and then turned over to me. After double imbedding in paraffin-celloidin, serial sections were cut at six microns. In all five series were obtained: three cross and two longitudinal. Four of these were stained with Mayer's hæmatoxylin and counterstained with erythrosin, while the fifth, a very fragmentary set of cross-sections, was stained with Heidenhain's iron-alum-hæmatoxylin.

None of these sets is absolutely perfect, but one set of cross-sections is almost so and the other set slightly less so, while the longitudinal sections were somewhat less complete and more folded, but here also one fairly good set was obtained. Considerable shrinkage is obvious throughout as evidenced by the isolations of individual muscle fibers in cross-section. This was probably caused by shrinkage of the celloidin due to excessive drying of the slides before staining. However they are quite satisfactory for the morphological study made, and the reader may judge the technical limitations for himself from the microphotographs which are used as illustrations throughout.

DETAILED DESCRIPTION OF *Incurvaria russatella*

In figure 1 is given a diagrammatic reconstruction of the principal organs located in the abdomen. All parts are more or less reduced and spread apart for the sake of clearness; for the same reason only the bases of the Malpighian tubules are shown, and the fat, muscles, trachea and cuticular structures have been omitted altogether. The parallel lines "AA, BB," etc., represent the planes of sectioning of the corresponding microphotographs which follow. In referring to these it must be remembered that the diagram has been simplified as much as possible, and that the parts are crowded in the photos, especially the egg tubes and the spermathecal diverticulum which wind around extensively and are therefore cut more frequently than the diagram would indicate.

As shown by the heavy outer line there are nine distinct segments which are all somewhat telescoped, especially the eighth and ninth. It is interesting to note the extensive development of cuticular glands on the pleural membrane particularly in the intersegmental folds. These are to be seen in most of the sections, but do not show well at such low magnification (see especially Figs. 3 and 11–14).

DIGESTIVE SYSTEM: The midgut enters the abdomen from the thorax close to the ventral wall (Fig. 2); it soon decreases in diameter and gives off the two Malpighian tubules (the characteristic Tineoid number) which proceed slightly forward and then turn backwards and follow along the gut dorsally and then posteriorly as slender filaments which show a minute lumen under high power. Only the bases are shown in figure 1, but they can be seen in cross-section in figures 3 and 4 after their ascent along the gut. From the origin of the Malpighian tubules the small intestine extends dorsally and anteriorly in a long curve, and then doubles back on itself and extends directly posterior to where it opens into the large intestine from which the small intestinal cæcum extends anteriorly (Fig. 5). The large intestine is thin walled except for the glandular areas (Figs. 6–18), and after extending further posteriorly it decreases in diameter and moves dorsally to a position between the ventral apophyses (Fig. 7) where it passes over into the thin-walled rectum. The rectum extends posteriorly without interruption (Figs. 8–14) to what seems to be the anus (Fig. 15). In the serial sections there seems to be a minute opening on the dorsal side of the blade of the ovipositor (ninth segment), but the walls are so delicate and stain so faintly that I can not be certain (Fig. 15). Mr. Busck was unable to find such an opening in dissections, and I can not convince myself for certain in whole mounts either. The alimentary tract is functionless in the adult, but one would expect a means of extruding the meconium. Perhaps there is a cloaca, as has been suggested, but I think not in this form.

The *heart* or *dorsal vessel* was not particularly studied, but it can be followed easily as far as the fifth segment. A rather clear cross-section is seen in figure 4, with several large cells, presumably oenocytes, lying immediately beneath.

The *nerve cord* is closely appressed to the midgut, and in the photograph (Fig. 2) is almost indistinguishable therefrom. The ganglia are rather large and obviously double (Figs. 3 and 4). Since the base of the abdomen was badly torn in all of the specimens the number of ganglia is uncertain, but the last one (compound) is quite large and lies just posterior to the origin of the Malpighian tubules.

No attempt was made to study the individual muscles; in fact considering their complexity and the shrinkage apart of the fibers it would probably be a hopeless task in these sections. Two points, however, are of interest: 1. the longitudinal muscles extending the length of the apophyses (fig. 17 and in cross section Figs. 2–14), and 2. the great mass of transverse muscles (with two small lateral longitudinal sets) surrounding the duct of the spermatheca (Figs. 8–11). Presumably these latter are concerned with oviposition (eggs laid within leaf tissue), but it is difficult to see how this mass functions, especially when they are so separated from the more dorsal ovipositor. One might guess that they function indirectly in extending the ovipositor by altering the shape of the abdomen, and that the longitudinal muscles along the apophyses retract it, but that is merely speculation. Other muscles may be seen in the photos about as expected.

The REPRODUCTIVE SYSTEM, for convenience of discussion, will be divided into (1) the ovipositor and its apophyses, (2) the oviduct and egg tubes, (3) the bursa copulatrix, (4) the spermatheca and its diverticulum, and (5) the vagina.

(1) The *ovipositor* and its *apophyses:* The ovipositor is blade-like and fitted for laying the eggs within the tissues of leaves. Supporting it are three sets of apophyses. Apparently they are invaginations of the body wall with which they become continuous—their hollow structure would imply such. One set, the ventral pair, is located on the eighth segment and becomes continuous with the wall thereof (Figs. 11–13); the other two pairs belong to the ninth segment, and are sufficiently fused to appear as one in whole mounts. Mr. Busck says that these are to be regarded as a single branched or flanged pair. The dorsal pair of the ninth segment (the posterior pair?) are the larger, and extend from near the base of the abdomen to the anus. Throughout most of the length of the body this set is found without the more ventral set (Figs. 2–7), but then a ventral flange appears and at the end of this another apophysis which approaches and soon comes to lie in contact with the dorsal one (Figs. 8–14). Throughout the region where the two are together the dorsal set is much more heavily chitinized, but these dorsal ones die out just posterior to the anus (Fig. 15) and the ventral ones come together to form the heavy blade of the ovipositor. Longitudinal muscles surround these and become especially massive toward the base of the abdomen.

(2) The *oviduct* and *egg tubes:* There are only three egg tubes instead of the customary four, there being no trace of the

fourth anywhere. This is clearly shown in the cross-sections since the three all come together at one point to form the oviduct. The specimens sectioned were all worn, flown ones, and had two or three mature eggs in the oviduct and five to six in each egg tube with apparently little or no chance for the production of more if one may judge from the appearance of the anterior ends of the egg tubes. This means that an average of less than two dozen eggs is produced by each female. At first the oviduct is large and thin walled (region where mature eggs are stored—Fig. 6). Then it decreases in diameter and becomes a thick-walled, fimbriated tube (Fig. 7) which, as it passes below the central muscle mass, is pressed into a crescentic shape (Figs. 8-9). Finally it becomes a simple crescentic duct (Figs. 10–13) before joining with the common duct of the spermatheca and ductus bursae to form the vagina (Fig. 14).

(3) The *bursa copulatrix* is a large, bag-like structure near the base of the abdomen which being formed embryonically as a diverticulum of the vagina is lined with chitin and bears on its sides the two signa which appear as clusters of broadsword blades in this species. Unfortunately although they show clearly in the slides on proper focusing they would not photograph sharply with the green filter necessary for satisfactory work with the stains employed (Fig. 2). At first the intima of the ductus is much convoluted (Figs. 3–5), but then becomes a round chitinous shell for some distance (Figs. 6 and 7) before becoming soft and longitudinally folded again as it passes ventral to the muscle mass in contact with the crescentic oviduct (figs. 8–12 and 19). Then it is joined by the duct of the spermatheca (Fig. 13) shortly before fusing with oviduct to form the vagina (Fig. 14).

(4) The *spermatheca* is an oval body lying approximately in the middle of the abdomen on the right side (Fig. 6 and 17). Its spiral duct extends from its anterior end posteriorly along the median side of the spermatheca itself and through the center of the large mass of muscles (Figs. 8–9) to where it opens on a papilla into a larger duct before joining with the ductus bursæ (Fig. 18). The spermatheca is packed with what appear to be sperm, but they have taken the acidic instead of the basic dye (see under Discussion for this and other staining anomalies). The posterior end of the spermatheca becomes a thin attentuated

tube (empty) which passes far ventrally and then doubles back as a heavier tube (Fig. 17) which expands considerably and branches in this part of the abdomen (Figs. 7 and 18–20). From the end of one of the main branches a long, simple, blind tube extends posteriorly along the dorsal side of the central muscle mass (Figs. 8–11 and 17). This is a very peculiar structure which fits almost exactly with the description given by Philpott for one part of the system of Eriocrania,[1] but which is not included in the rather lengthy list of modifications figured by Berlese (Fig. 1170). The dilated portion is filled with a rather homogeneous secretion (?) which has taken up the basic dye uniformly, but which appears as though filled with oil droplets. At first this was thought to be the end of an egg tube and the secretion (?) to be embryonic yolk which it somewhat resembles in appearance in staining, but this was soon disproven. The author has no suggestion to make as to the true nature of this diverticulum, but would like to call attention to the fact that the walls of the dilated portion do not resemble secretory epithelial tissue in their histological structure. The simple, blind tubule extending along the dorsal side of the muscle mass is the only part that looks and stains like a gland. And finally that any secretion produced would have to pass out through the spermatheca itself which is now packed with sperm, unless, of course, it is of use to the sperm themselves. Speculations as to its nature seems rather futile, so we will content ourselves with what has been said.

(5) The *vagina* is formed by the confluence of the ducts of the spermatheca and bursa copulatrix with the oviduct as is shown in figures 14, 18 and 20. Posteriorly it passes along the ventral side of the ovipositor and opens ventrally just posterior to the anus (Fig. 16), the more posterior part of the ninth segment forming the solid, hard tip of the ovipositor. The extremely complicated foldings of its mucous lining are well shown in figure 15 where the vagina comprises approximately half the entire section.

[1] "Just beyond this structure a duct arises which soon expands into a globular vesicle, thence continuing it becomes much dilated for some distance, after which it returns to its original size and shortly terminates." 1927. p. 320.

Discussion

There is no doubt that the *Adeloids* have a "one-opening" female genitalia such as we find in the *Jugatae.* Mr. August Busck (1932) reports that this is also true for the *Tischeriidae, Nepticulidae, Heliozelidae, Opostegidae* and all *Jugatae.* He then divides the two suborders as to piercing *vs.* soft ovipositor: *Jugatae—Hepialidae, Micropterygidae,* and *Mnesarchaeidae* with soft ovipositor, and *Eriocraniidae* with piercing; *Frenatae —Nepticulidae, Tischeriidae,* and *Opostegidae* with soft ovipositor, and *Incurvariidae, Prodoxidae, Adelidae, Crinopterygidae,* and *Heliozelidae* with piercing. All other Lepidoptera have two genital openings and a soft ovipositor. It is not our purpose here to discuss this aspect other than to corroborate Mr. Busck's observations on the number of openings in this form.

Certain of the staining reactions obtained are quite curious. Throughout all of the tissues other than those to be mentioned below the stains acted as expected, *i.e.* the basic dye (haematoxylin—purple) staining the nuclei, and the acidic dye (erythrosin—red) staining the cytoplasm. On the whole the chitin did not take either very well, but when it did stain (lining of the vagina) it took the basic dye faintly. Unexpected results were obtained with the egg tubes and the spermatheca. The yolk of the eggs took the basic dye quite deeply and the nuclei took the acidic dye which is just the reverse of what one would expect. This is equally true of the youngest eggs in the tubes and the fully mature ones which have been extruded into the oviduct. The nurse cells have taken the two stains about equally in both cytoplasm and nucleus, and in favorable places each stain can be seen in considerable quantity (in the nucleus the chromatin granules stain deep purple, but the entire nucleus has a dark pinkish cast not usually found). In the spermatheca there is a great fibrous mass of what appear to be sperm when examined under an oil immersion lens. Yet they have taken the acidic dye quite deeply and not a trace of the basic—again just the reverse of what we would expect. Differential dyes occasionally do not give the expected results, but all four of the specimens differentially stained showed the same reaction. Whether this is due to the metabolic state of these specimens, or is a characteristic of the species, or is due to changes preceding or accompanying fixation can not be stated. Perhaps the use of appropriate buffer solutions immediately preceding staining would give "normal" results as it does elsewhere. However, from their structure I do not doubt that it is sperm which fill the spermatheca.

The present morphological study, as is frequently the case, has raised more questions than it has helped solve. As Snodgrass (1931) has recently pointed out we really know less about the abdomen than about either of the other two major subdivisions of the insect body, and while there is little to be gained by dwelling on our shortcomings here still there is one more question which seems worth raising. The general entomological texts state that the sperms are ejected into the bursa copulatrix and subsequently pass into the spermatheca where they are stored until the time of fertilization at egg laying. This scarcely seems possible here. The spermatheca is filled with sperm, but the bursa has only some amorphous "trash" of indeterminate nature (Mr. Busck suggests that this is "the remnants of the enveloping spermatophore"). I can not see how sperm once in the bursa would go down its long duct, then anteriorly, find a tiny opening on the tip of a papilla, and thence reach the spermatheca by chemotactic or any other kind of response. In none of the five mated specimens were any sperm found in the bursa although the spermatheca was crowded. Mr. Busck insists that freshly mated specimens would have sperm in the bursa, but unfortunately none such are available for examination. I look forward to the experimental verification of the function of the bursa and its dangerous looking signa.

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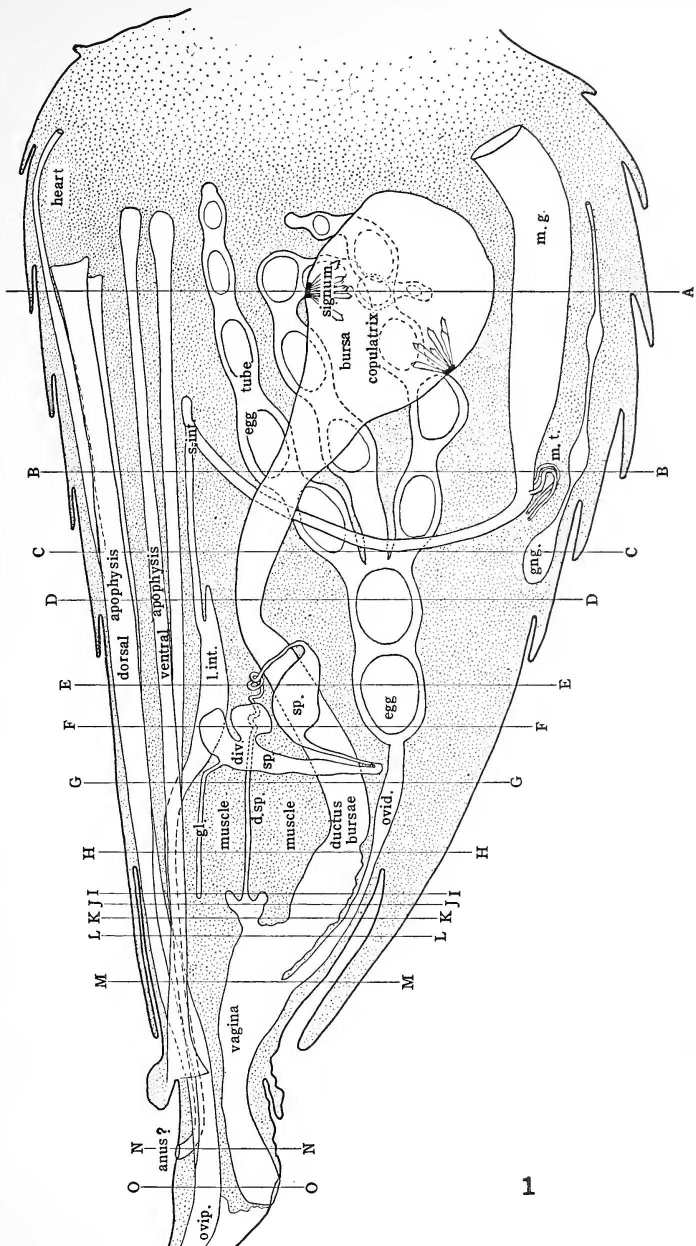
ABBREVIATIONS

a.	—anus ?	h.	—heart
b.c.	—bursa copulatrix	i.c.	—intestinal caecum
c.d.	—common duct of bursa and spermatheca	l.i.	—large intestine
		m.	—muscles
d.b.	—ductus bursae	m.g.	—midgut
d.s.	—duct of spermatheca	m.t.	—Malpighian tubules
d.t.	—dorsal apophyses (9 th)	n.	—nurse cells
dv.s.	—diverticulum of the spermatheca	n.c.	—nerve cord
		o.	—oviduct
e.	—egg	r.	—rectum
e.t.	—egg tube	s.i.	—small intestine
g.	—ganglion	sp.	—spermatheca
gl.	—gland from spermathecal diverticulum	v.	—vagina
		v.t.	—ventral apophyses (8 th)

PLATE X

1. A diagrammatic reconstruction of the principal organs found in the abdomen of *I. russatella* showing the reproductive system in details. The lines "AA, BB," etc. represent the planes of sectioning shown in the microphotographs which follow. For simplicity the body wall is shown only in outline (somewhat less telescoped than in normal retracted position); the Malpighian tubules cut off near their bases (they should follow along the gut dorsally and then posteriorly to about the middle of the large intestine); and the muscles, trachea and fat omitted entirely. Since the body wall is shown only around the edge it must be explained that the apophyses of the eighth segment pass into the cuticle of that segment and do not go further posteriorly.



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INCURVARIA RUSSATELLA

PLATE XI

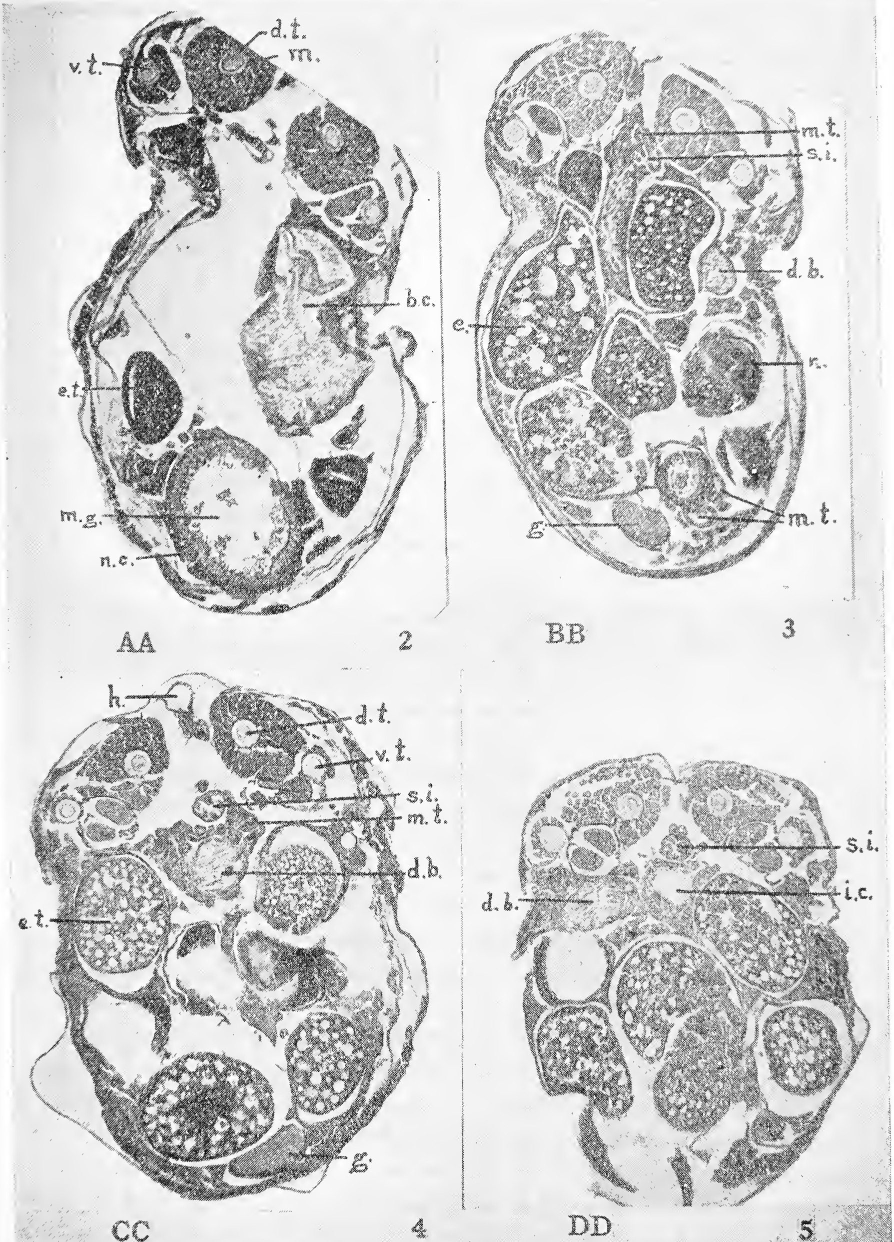
Microphotographs of sections cut at six microns and stained with Mayer's haematoxylin and counterstained with erythrosin. Photographed with a Wratten green filter and Process Pancromatic plates. Magnification 87.5 ×, except figures 15 and 16 which are 370 ×.

1. Section along line **AA** showing midgut, bursa, tips of two egg tubes, and the bases of the apophyses.

3. Section along line **BB** showing the Malpighian tubules, egg tubes, nurse cells, ductus bursae, ascent of gut (intestine), nerve ganglion and cuticular glands.

4. Section along line **CC** showing the heart, Malpighian tubules after ascent with gut, ductus, egg tubes, etc.

5. Section along line **DD** showing the intestinal caecum, etc.



INCURVARIA RUSSATELLA

PLATE XII

6. Section along line **EE** showing spermatheca and its duct, ductus bursae, oviduct, large intestine, etc.

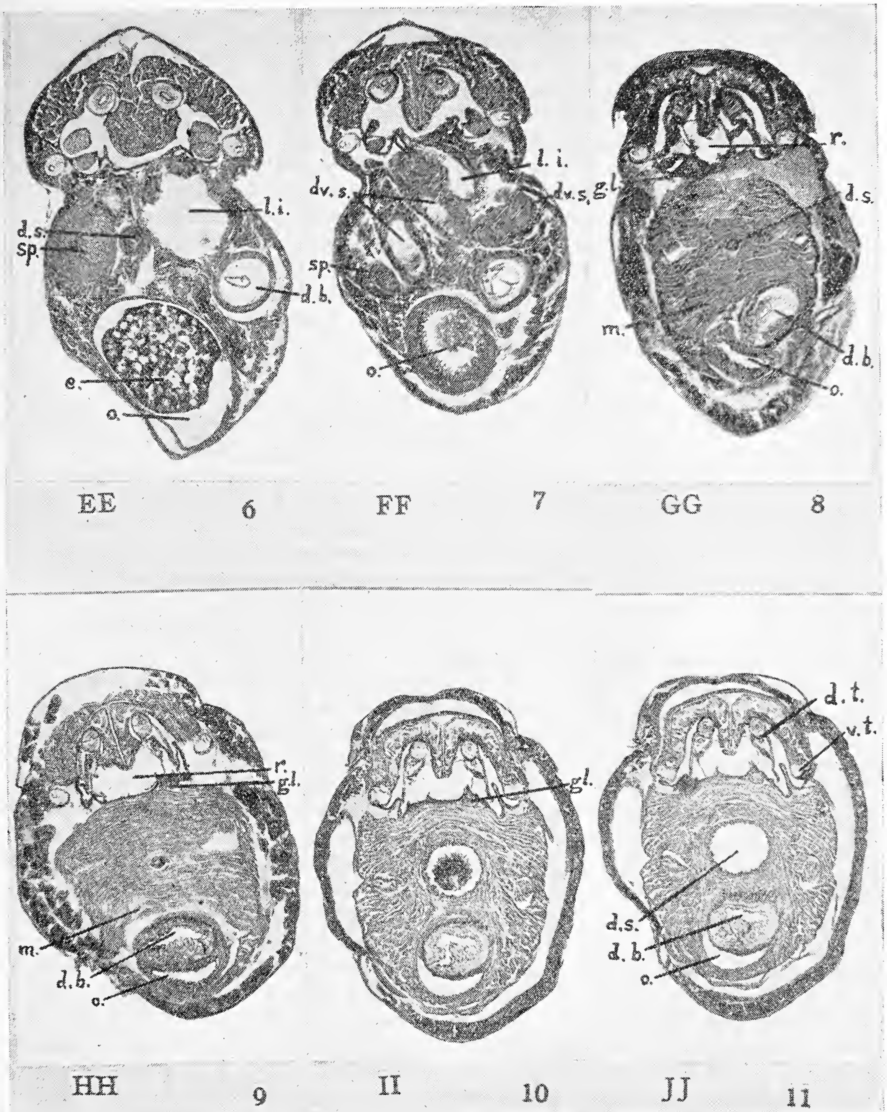
7. Section along line **FF** showing the peculiar diverticulum of the spermatheca, the final ascent of the gut, etc.

8. Section along line **GG** showing the beginning of the large transverse muscle mass with the duct of the spermatheca passing through it and the ductus bursae and oviduct being crowded ventrally. The gut has now assumed its final position just below the apophyses of the ninth segment.

9. Section along line **HH** showing the same parts as last.

10. Section along line **II** showing the final structure of the oviduct and the papilla on the tip of which the spermatheca opens. Also shows the eighth segment retracted into the seventh.

11. Section along line **JJ** showing these three ducts still distinct further posteriorly. Eighth segment retracted into seventh.



INCURVARIA RUSSATELLA

PLATE XIII

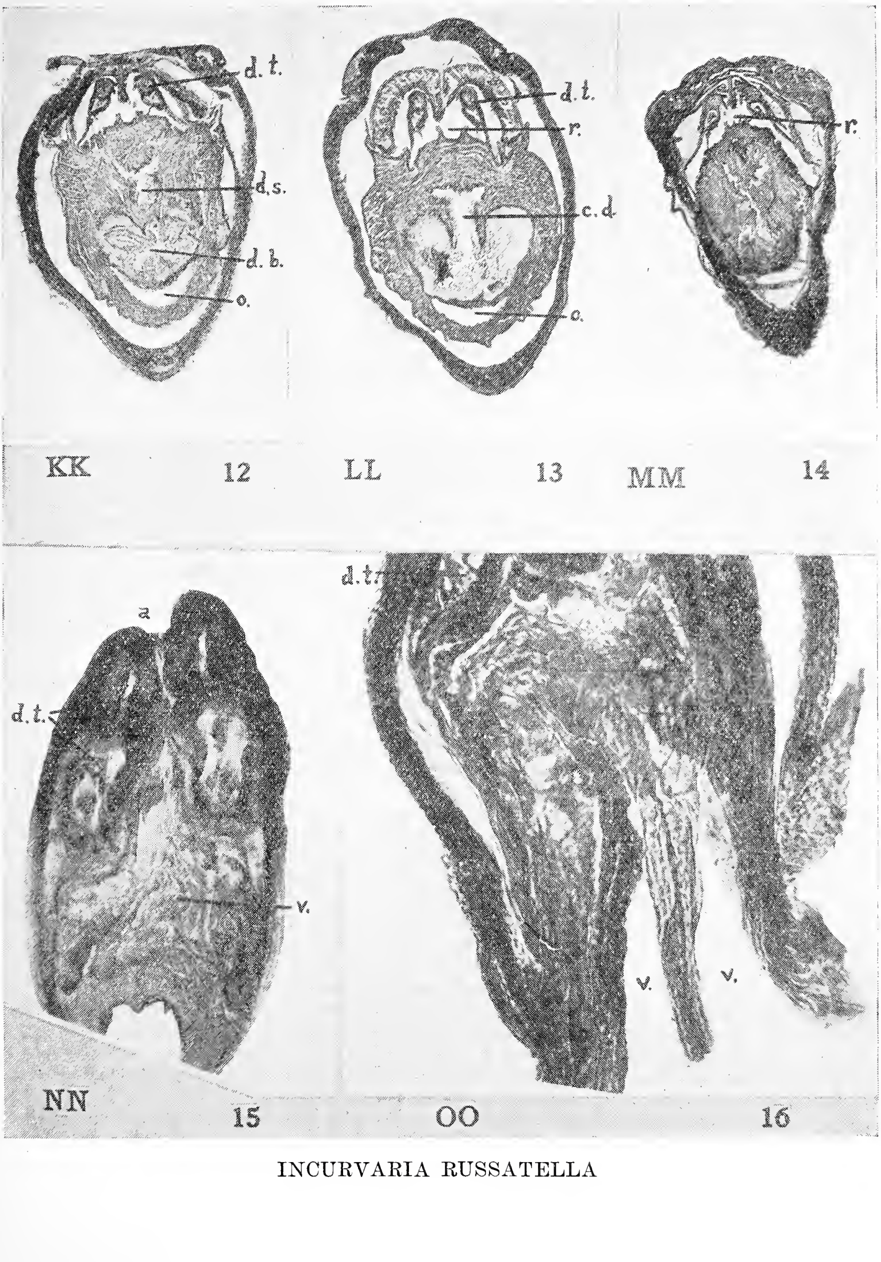
12. Section along line **KK** showing the final folded nature of the ductus bursae and duct of the spermatheca just before they join. Eighth segment retracted into seventh.

13. Section along line **LL** showing the union of the ductus bursae with the duct of the spermatheca. Eighth segment retracted into seventh. Note the cuticular glands on the seventh segment.

14. Section along line **MM** showing the formation of the vagina by the fusion of the common duct of the ductus bursae and duct of the spermatheca with the oviduct. Eighth and ninth segments retracted into seventh.

15. Section along line **NN** showing what I think to be the anus on the dorsal side of the ovipositor just as the one set of apophyses are dying out and the lower set becoming larger. The vagina with its extremely convoluted wall fills most of the interior. Only the ninth segment shown. Magnification 370 ×.

16. Section along line **OO** showing the opening of the vagina on the ventral side of the ovipositor. The apophyses are just out of the field dorsally. Ninth segment retracted within eighth. Magnification 370 ×.



INCURVARIA RUSSATELLA

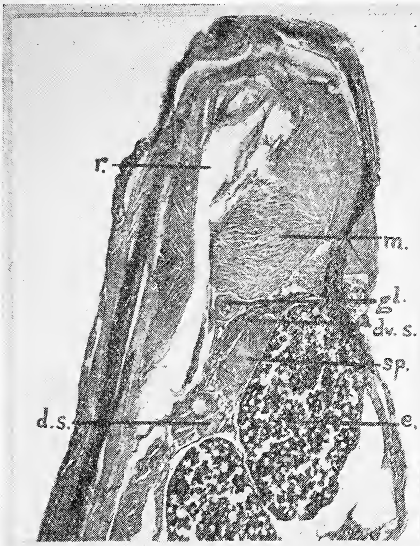
PLATE XIV

17. Longitudinal section showing eggs in oviduct, spermatheca and its duct, part of the diverticulum and the gland arising therefrom, the gut and muscle mass. The apophyses and longitudinal muscles are seen in slightly oblique section along the dorsal border (left in figure).

18. Longitudinal section showing the duct of the spermatheca passing through the center of the muscle mass in a spiral course, the union of this duct with that of the bursa and a cross-section of the diverticulum of the spermatheca.

19. Longitudinal section showing the opening of the lower part of the oviduct into the portion where mature eggs are stored, the descent and change in structure of the ductus bursae, and the diverticulum of the spermatheca.

20. Longitudinal section showing the union of the oviduct with the common duct of the ductus bursae and duct of the spermatheca to form the vagina. Also shows the diverticulum of the spermatheca.



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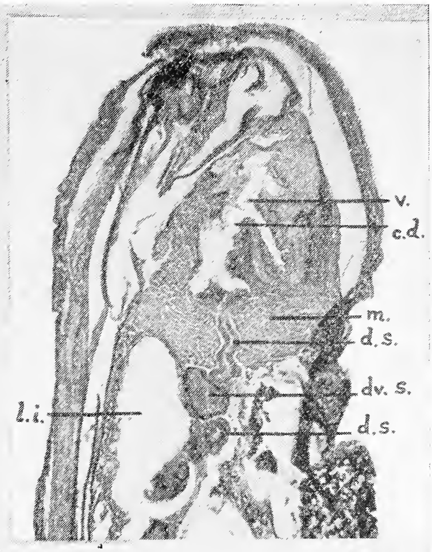

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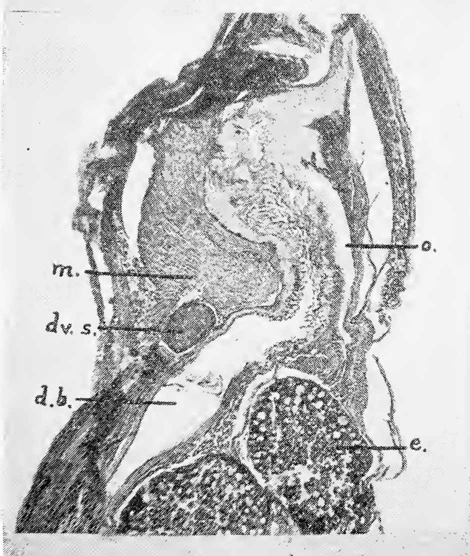

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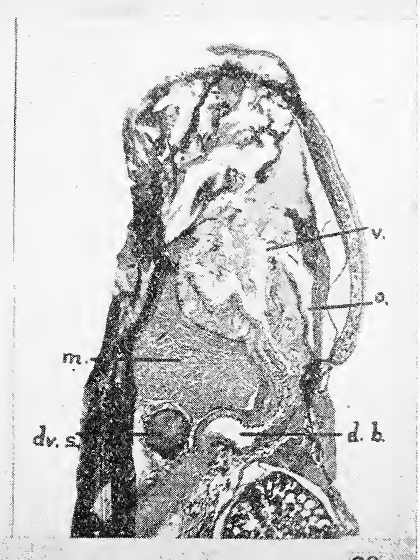

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INCURVARIA RUSSATELLA

STUDIES ON THE LEPTODIRIDÆ (CATOPIDÆ) WITH DESCRIPTIONS OF NEW SPECIES*

BY MELVILLE H. HATCH

The present report brings together the results of some more or less isolated studies the author has been led to make on certain of the Nearctic representatives of the family Leptodiridæ. He has recently compiled a bibliographical catalogue of most of the groups included in this study (Col. Cat. 95, 1928, p. 157–226), which may be consulted for an extended bibliography of the subject.

ACKNOWLEDGMENTS.—I am indebted to the following persons for the loan of material under their custodianship: Dr. Willard J. Fisher for material in the collection of the United States National Museum[a]; Mr. Andrew J. Mutchler for material in the collection of the American Museum of Natural History[b]; Mr. E. T. Cresson, Jr., for material from the Horn collection in the Academy of Natural Sciences of Philadelphia[c]; Dr. J. H. McDunnough for material in the Canadian National Collection[d]; Prof. J. Chester Bradley for material in the collection of Cornell University[e]; Mr. Warwick Benedict for material in the collection of the University of Kansas[f]; Prof. Clarence E. Mickel for material in the collection of the University of Minnesota[g].

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Finally, I am indebted to Mr. Herbert S. Barber and Mr. John Watson Angell for specimens and to Mr. Barber and Mr. John Wagener Green for valuable suggestions for the prosecution of the work.

* Contribution from the Zoölogical Laboratory of the University of Washington.

The letters following the institutions and collectors have been utilized in the body of the paper following the citation of localities to indicate the collection or collections containing the specimens under consideration.

THE FAMILY LEPTODIRIDÆ.—I have previously (Univ. Minn. Agr. Exp. Sta. Techn. Bull. 48, 1927, p. 8 et seq.) suggested that the Silphinæ are so inextricably bound up with the Staphylinidæ that it is best to separate them from the other components of the old family "Silphidæ" and to unite the Catopinæ, Camiarinæ, Coloninæ, and Leptodirinæ (= Bathysciinæ) as a single family, Leptodiridæ (= Catopidæ). The family Leptodiridæ, so conceived, dates at least from Thomson (Catopidæ Thomson, Skand. Col. IV, 1862, p. 56). Whether it is distinct from the Leiodidæ (= Anisotomidæ auct.) is uncertain.* The facies of each is characteristic: fragile with long appendages and thin integuments in the Leptodiridæ, stocky with shorter appendages and heavier integuments in the Leiodidæ. The various taxonomic categories are so subjective and arbitrary that I would never quarrel with any one who desired to give those here under consideration a ranking other than that I have given them.

In selecting the name** to apply to this family and its several subfamilies, the following supergeneric groups were found to have been based on included genera.

Stagobiinæ Schioedte (type *Stagobius* Schioedte 1849 = *Leptodirus* Schmidt 1832), Spec. Faun. subterr. 1849, p. 14.
Leptoderides Lacord. (type *Leptoderus* Schmidt 1852 = *Leptodirus* Schmidt 1832), Gen. Col. II, 1854, p. 95.
Catopidæ Thomson, Skand. Col. IV, 1862, p. 56.

* Bradley (Gen. Beetles Am. n. of Mex. 1930, p. 54) unites the two groups in a single family.

** Jeannel (Arch. Zool. exp. gén. LXI, 1922, p. 8) says, in arguing for the acceptance of the name *Catopinæ*, "le seule chose essentielle est que la tribu de Thomson ait exactement le même extension que la sous-famille actuelle." I am unable to accept such a proposition, but adhere to the principle laid down by Bradley (Sci. LXVIII, 1928, p. 103): "The type genus of a family or subfamily shall be the contained genus of which the stem of the name was first employed in combination with a termination in Latin plural form to designate a group higher than genus."

Mylœchina Thomson (type *Mylœchus* Latr. 1807, a subg. of *Colon* Herbst 1797), l. c. p. 68.
Leptodirites Abeille de Perrin, Bull. Soc. Hist. Nat. Toulouse XII, 1878, p. 144.
Cholevini Horn, Trans. Am. Ent. Soc. VIII, 1880, p. 255.
Bathysciæ Horn, l. c. p. 251.
Colones Horn, l. c. p. 266.
Camiarinæ Jeannel, Arch. Zool. exp. gén. (5) VII, 1911, p. 192.

Stagobiinæ is not available because it is founded on an unavailable genus. *Leptoderides* is founded on an improperly emended spelling of *Leptodirus* Schmidt and, in my opinion, is not thereby rendered unavailable as the name from which the name of the family must be formed. I have previously (Sci. LXVIII, 1928, p. 323) argued that when a family name is founded on a homonym or synonym the family should take the next available name—*Catopidæ* Thoms. in this instance. I do not believe, however, that such a ruling should apply in the cases of emended spelling where the opinion of later zoologists causes the emended spelling to be replaced by the original spelling.

Thus *Leptodiridæ* and *Leptodirinæ* become the names of the family and one of the subfamilies, *Catopinæ* (from *Catopidæ* Thoms. 1862) and *Camiarinæ* (Jeannel 1911) become the names of two of the other subfamilies. *Mylœchina* Thoms. is unavailable because it is founded on a group now recognized as a subgenus and must give way to *Colones* Horn 1880, giving *Coloninæ* as the name of the last subfamily of the group.

The subfamilies of Leptodiridæ have been defined by Jeannel (Arch. Zool. exp. gén. (5) VII, 1911, p. 192–193) and more briefly by myself (Hatch, Univ. Minn. Agr. Exp. Sta. Techn. Bull. 48, 1927, p. 11). In the same publication I have given (p. 13) a general account of the family and (p. 16) a selected bibliography of the same.

Subfamily Catopinæ.—Tribe Catopini

Jeannel (Arch. Zool. exp. gén. LXI, 1922, p. 12–52) has passed in review the phyletic series and genera of this subfamily and has outlined their phylogeny, and I (Hatch, l. c., p. 14–15) have abstracted the characteristics of most of the genera. Subsequent studies have, however, convinced me that the limits of some of the Nearctic genera should be altered, as indicated in the following key. For a more detailed characterization of these groups reference should be made to the works of Horn, Jeannel, and Hatch cited above.

KEY TO NEARCTIC GENERA AND SUBGENERA OF CATOPINI

A′ Elytra transversely striolate; mesosternum carinate

B′ Metatibia at apex with two long internal spurs and four shorter external spurs; pronotum not transversely strigose* subtribe Anemadina

C′ ♂ mesobasitarsomere feebly dilated and spongy pubescent beneath; mesosternal carina more elevated and extending nearly to the anterior margin of the mesosternum **Nemadus** Thoms.

C″ ♂ mesobasitarsomere not modified; mesosternal carina more feebly elevated, sometimes confined to the region between mesocoxæ .... **Dissochætus** Reitt.

B″ Metatibiæ at apex with two long internal spurs and an outer fringe of short equal spinules .... subtribe Ptomaphagina

C′ Eyes normal in size (.14 x .17 mm. or greater), separated from base of antenna by less than their own diameter; pronotum transversely strigose .... **Ptomaphagus** Ill.

C″ Eyes minute (.05 to .11 mm. in diameter), separated from base of antenna by their own diameter or more; pronotum with or without transverse strigæ .... **Adelops** Tellk.

A″ Elytra not transversely strigose; mesosternum not carinate subtribe Catopina

B′ Antennæ not serrate

C′ Tibial spurs not long, simple; ♂ mesobasitarsomere dilated **Catops** Payk.

D′ Pronotum with base arcuate, the hind angles obtuse or rounded, the sides arcuate, the surface finely densely roughly punctate, the width less than that of the elytra which are roughly densely punctate; antennæ with sixth segment transverse in frontal view; dorsal surface evidently more or less coarsely pubescent; type: *Catops alpinus* Gyll. (*Lasiocatops* Reitt.) subg. *Sciodrepa* Thoms.

* Certain Neotropical species now placed in *Dissochætus* (*monilis* and *spinipes* Murray, *spelœa* Bilimek, *ovalis* Kirsch, *semipicea* Matth.) are said to have the pronotum transversely strigose and may be incorrectly included in this genus.

D″ Pronotum with base sinuate on either side just within the rectangular posterior angles; antenna with sixth segment transverse; type: *Catops watsoni* Spence (*Sciodrepa* Ganglb., Jeann., nec Thoms.) subg. *Sciodrepoides* nov.

C″ Tibial spurs long, bipectinate; ♂ mesobasitarsomere not dilated .... **Prionochæta** Horn

B″ Antennæ serrate .... **Catoptrichus** Murr.

Echinocoleus setiger Horn (Trans. Amer. Ent. Soc. XII, 1885, p. 136) has not been included in the table. It may be closely related to *Dissochætus*. Its transversely strigose elytra would seem to preclude the position close to *Catops* suggested by Jeannel (l. c., p. 45) and myself (Hatch, l. c., p. 14; Col. Cat. 95, 1928, p. 202). The mesosternum is said to be without a carina and the eighth antennal segment to be as wide but a little shorter than either the seventh or ninth. The elytra are strongly attenuate behind, each with about eleven longitudinal series of semi-erect setæ. I have not seen a specimen.

The sexual dimorphism exhibited by the elytral apex of most of our species of Anemadina and Ptomaphagina has not previously been noted and has proved of some value in their separation. In describing the eighth antennal segment the body of the segment only, exclusive of the pedicel, is considered. In most of our species the eighth segment is considerably less than half the length of the ninth, in a few species it is nearly or quite one half as long as the ninth.

Nemadus Thoms.

This genus, not heretofore recognized from the American continent, is represented by three species in the Nearctic area. Three species are known from Europe and one from Japan. Of the three European species treated by Reitter (Verh. Nat. Ver. Brünn XXIII, 1884, p. 61) ours appear to be related to *colonoides* Kr. by the absence of any evidence of longitudinal striations on the elytra and by the more or less elongate spinules at the apex of the meso- and metatibiæ. They differ from this species by their unicolorous antennæ. In the male of our species the first three protarsomeres and the mesobasitarsomere are dilated and spongy pubescent beneath.

DIAGNOSIS OF THE NEARCTIC SPECIES OF NEMADUS THOMS.

Elytra without evidence of longitudinal striations; meso- and metatibiæ with more or less elongate unequal spinules at apex; antennæ unicolorous

A′ Eighth segment of antenna one-half the length of ninth and scarcely narrower; body more broadly oval; ♀ with and ♂ without three or four transverse microstriæ between the elytral striæ; elytral apex not or very feebly sexually dimorphic; length 1.7–2.25 mm.; Manitoba and Quebec to Virginia and Texas .... **parasitus** Lec.

A″ Eighth segment of antenna less than one-half the length of ninth; body less broadly oval.

B′ Head and pronotum more or less piceous, more or less broadly rounded in front; elytra brown, the striæ slightly oblique; ♀ with and ♂ without three or four transverse microstriæ between the striæ; elytral apex arcuate with the sutural angles narrowly rounded (♂) or subtruncate (♀); length 1.6–2.2 mm.; Iowa, Michigan and Massachusetts to North Carolina and Alabama .... **hornii** sp. nov.

B″ Head and pronotum brownish, nearly concolorous with elytra, more narrowly rounded in front; elytral striæ less oblique, nearly transverse; both sexes with three or four transverse microstriæ between the striæ; elytral apex of ♂ similar to *hornii,* in ♀ broadly arcuate with the sutural angle evidently more broadly rounded than in ♂; length 1.4–1.8 mm.; California, British Columbia .... **pusio** Lec.

Nemadus parasitus Lec.

Catops parasitus Lec. Proc. Acad. Nat. Sci. Phil. VI, 1853, p. 282.—Murray, Ann. Mag. Nat. Hist. (2) XVIII, 1856, p. 460 (separate p. 81), fig. 54.

Ptomaphagus parasitus Lec.—Horn, Trans. Am. Ent. Soc. VIII, 1880, p. 262, 264.—Blatchley, Col. Ind. 1910, p. 281, 282.

Catopomorphus parasitus Lec.—Wasmann, Krit. Verz. Myrmekoph. Termitoph. Anthrop. 1894, p. 127.

Adelops parasitus Lec.—Jeannel, Arch. Zool. exp. gén. LXI, 1922, p. 43.—Hatch, Col. Cat. 95, 1928, p. 169.

A certain amount of variation is exhibited by specimens of this species which at first glance might appear to be of taxonomic significance. In a series of over one hundred specimens from Massachusetts, which I owe to the kindness of Mr. Frost, these differences shade imperceptibly into one another. At one extreme are specimens with the sides of the pronotum broadly subevenly arcuate, the disc of the pronotum submuricately punctate, the base of the pronotum less than twice as long as the length, the elytra oval with the sides arcuate and the apices moderately attenuate. At the other extreme are specimens with the sides of the pronotum feebly obliquely arcuate, the base of the pronotum about twice as long as the length, the disc of the pronotum simply punctate, the elytra strongly attenuate behind with the sides oblique or feebly arcuate. Between these extremes are intermediates. I likewise find two specimens with the posterior angles of the pronotum somewhat acutely produced after the fashion of *Dissochætus brachyderus* Lec., but the base of the pronotum is here less than twice as long as the length. In the same lot with these,—presumably from the same ant nest,—is an identical specimen with the hind angles of the pronotum normally subrectangular.

This species closely resembles *Dissochætus brachyderus* Lec. from which it may be distinguished by the generic characters (the dilated ♂ mesobasitarsomere and the much more extensive mesosternal carina), its less wedge-shaped body, its more strongly dilated ♂ protarsi, and the sexually dimorphic microsculpture of the elytra. In *D. brachyderus* the elytra are transversely microstriate in both sexes and the base of the pronotum is twice its length or a trifle greater, but this is a characteristic that is approached by certain specimens of *parasitus*, as mentioned above.

Specimens examined: QUEBEC (Montreal[p]). NEW HAMPSHIRE (Rumney[q]). MASSACHUSETTS (Billrice[q], Framingham[l], Lexington[q], Natick[l], Sherborn[l], Southboro[l], Tyngsboro[ac]). CONNECTICUT (Cornwall[bq]). NEW YORK (Crystal L. (Albany Co.)[k], Ithaca[k], Katonah[e], New York[b], Olcott[k], Onondaga Co., West Point[a]). NEW JERSEY (Hopatcong[b]). PENNSYLVANIA (Allegheny[d], Frankford[a], Pocono L.[m]). MARYLAND (Blandensburg[a], Plummer's I.[a]). DISTRICT OF COLUMBIA[acdfg]. VIRGINIA (Fredericksburg[aq]). ONTARIO (Ottawa[d], Toronto[d]). WISCONSIN[g]. MANITOBA (Aweme[dq]). SOUTH DAKOTA (Hill City[a]). IOWA (Iowa City[d]). TEXAS[a].

Myrmecophilous with *Formica fusca* var. *subserica* Say, *F. integra* Nyl., *F. exsectoides* For., *F. schaufussi* Mayr., *Campono-*

tus marginatus Ltr., ?*C. pennsylvanicus* DeG. (Wasmann, *l.c.*, p. 127), *F. obscuriventris* (teste J. C. Bradley), *C. ferrugineus* F. and *C. pennsylvanicus* DeG. (Blatchley, *l.c.*, p. 282).

Nemadus hornii sp. n.

Ptomaphagus pusio pars Horn (nec Lec.), Trans. Am. Ent. Soc. VIII, 1880, p. 262, 264.—Blatchley, Col. Ind. 1910, p. 281, 182.

Dorsum pubescent; pronotum and elytra coarctate; body widest at about basal third of elytra, more broadly rounded cephalad than caudad. Head, pronotum, and ventral surface except abdomen piceous; elytra, abdomen, and legs fuscous. Antennæ with piceous five segmented club, fuscous basally; eighth antennal segment equal in width to seventh and ninth, four to five times as wide as long; ninth segment three to five times the length of the eighth. Pronotum submuricately punctate, widest at base, three-fifths as long as wide; the apex two-thirds the length of the base; the base just visibly sinuate within the hind angles which are subrectangular; sides arcuate; anterior angles broadly rounded. Elytra arcuate (♂) or subtruncate (♀) at apex; the sutural angle narrowly rounded; the transverse striæ just visibly oblique; sutural stria evidently impressed for its entire length; ♂ without, ♀ with three or four transverse microstriæ between the transverse striæ. The three basal protarsomeres and the mesobasitarsomere dilated and spongy pubescent beneath (♂) or unmodified (♀). Length 1.6–2.2 mm.

This is the form referred to by Horn (l.c., p. 264) as "provisionally placed with" *pusio* Lec. Eastern specimens differ constantly from Californian examples as indicated in the key. All eastern North American records of *pusio* should probably be ascribed to this species.

I name this species in honor of the memory of George H. Horn who has done more than any other one man to advance the knowledge of the Nearctic Leptodiridæ.

Type ♂ and allotype ♀: "Fram'ham," Mass. C. A. Frost. IV–16–1921 (in collection of author). About fifty paratypes: MASSACHUSETTS (Framingham[l]). NEW YORK (Olcott[k], West Point[a]). NEW JERSEY (Dundee[a], Phillipsburg[m]). PENNSYLVANIA (Easton[m], Frankford[a], Philadelphia[a]). DISTRICT OF COLUMBIA[ac]. NORTH CAROLINA (Black Mts.[ab]). MICHIGAN (Ann Arbor[a], Detroit[ac], Grand Ledge[a]). IOWA (Iowa City[f]). MISSOURI (St. Louis[a]). ALABAMA (Tumblin Gap[o]).

Myrmecophilous. Blatchley (l.c., p. 282) records a specimen from a deserted rabbit nest.

Nemadus pusio Lec.

Catops pusio Lec., Proc. Acad. Nat. Sci. Phila. 1859, p. 282.
Ptomaphagus pusio Horn, Trans. Am. Ent. Soc. VIII, 1880, p. 264 (pars).—Hatch, Col. Cat. 95, 1928, p. 168.

Specimens examined: CALIFORNIA (Los Gatos[a], Mendocino Co.[p], Oakland[p], Santa Cruz Mts.[a]). Horn records the species from Vancouver, B. C.

Dissochætus Reitt.

Jeannel (Arch. Zool. exp. gén. LXI, 1922, p. 41) was the first to suggest that this Neotropical genus occurred in the Nearctic region. Further investigation shows that not only does *Catops oblitus* Lec. belong here but likewise *C. brachyderus* Lec., *Choleva decipiens* Horn, and a new species to be described below.

While twenty-three Neotropical species are recognized, over half of them described by Portevin, the literature still consists entirely of isolated descriptions. Of the characters cited, the sculpture of the pronotum, the form of its posterior angles, the color of the pronotum and elytra, and, where mentioned, the length of the metatibial spur seem to be of most value. Too much reliability should not, I suspect, be placed on diverse author's descriptions of the posterior angles of the pronotum, as I feel that in some cases where it is described as rectangular, careful examination will show that it is appreciably acute or obtuse. In the absence of types, I have, however, been compelled to take each description at its face value in the notes that follow.

DIAGNOSIS OF NEARCTIC SPECIES OF DISSOCHÆTUS REITT.

Pronotum not transversely strigose; elytral microsculpture not sexually dimorphic.

A′ Hind angles of pronotum distinct.

B′ Hind angles of pronotum acute, the base of the pronotum evidently sinuate immediately within the hind angles; pronotum more than twice as wide as long; elytra strongly obliquely attenuate from base to apex; color brownish; eighth antennal segment one-half length of ninth; inner spur of metatibia less than half as long as the metabasitarsomere; elytral apices more oblique in ♀ than in ♂, with the sutural angle more narrowly rounded; length 2.5–3 mm.; Manitoba and South Dakota to New Hampshire and Nova Scotia .... **brachyderus** Lec.

B″ Hind angles of pronotum obtuse; the base of the pronotum very feebly sinuate immediately within the posterior angles; pronotum less transverse; elytra feebly narrowed, separately broadly arcuate behind; eighth antennal segment less than one-half length of ninth; inner spur of metatibia more than half as long as metabasitarsomere.

C′ Above piceous with the base of the elytra obscurely fuscous; inner spur of metatibia about two-thirds as long as metabasitarsomere; elytral apex narrowly, subevenly arcuate in ♂, more broadly arcuate with the sutural angle more narrowly arcuate in female; length 2.2–3 mm.; Arizona, New Mexico .... **arizonensis** sp. nov.

C″ Head piceous; pronotum and elytra fuscous; the apex of the elytra somewhat darker; inner spur of metatibia as long or longer than the metabasitarsomere; elytral apex narrowly subevenly arcuate in both sexes; length 1.75–2.1 mm.; Florida to Maryland, Illinois .... **oblitus** Lec.

A″ Hind angles of pronotum broadly rounded; base of pronotum arcuate, not sinuate; elytra feebly narrowed, conjointly broadly arcuate, the sutural angles narrowly rounded; head finely punctate; pronotum granulately punctate; elytral apex not sexually dimorphic; length 3.5–4 mm.; Washington .... **decipiens** Horn

Dissochætus brachyderus Lec.

Catops brachyderus Lec., Smiths. Misc. Coll. VI, 1863, p. 25.

Ptomaphagus brachyderus Lec.—Horn, Trans. Am. Ent. Soc. VIII, 1880, p. 264, pl. 5, fig. 16.

Catopomorphus brachyderus Lec.—Wasmann, Krit. Verz. Myrm. Term. Arth. 1894, p. 127.

Adelops brachyderus Lec.—Jeannel, Arch. Zool. exp. gén. LXI, 1922, p. 43.—Hatch, Col. Cat. 95, 1928, p. 169.

From other described species of *Dissochætus,* this species may be distinguished by its acute pronotal angles, its uniform brownish color, and the fact that its pronotum is twice as wide as long. For the differences between this species and *Nemadus parasitus* Lec. consult the remarks under that species.

Specimens examined: NEW HAMPSHIRE (Franconia[b]). ONTARIO (Ottawa[d], Toronto[e]). MICHIGAN ("Det."[c] = ? Detroit).

WISCONSIN (Bayfield[f]). MINNESOTA (Hennepin Co.[g], St. Anthony Park[g]). SOUTH DAKOTA (Hill City[a]). MANITOBA (Aweme[d]). Horn cites specimens from Nova Scotia and New York.

Myrmecophilous with *Camponotus pictus* For. and *C. herculeanus* L. (Wasmann l.c.).

Dissochaetus arizonensis sp. nov.

Dorsum coarsely pubescent. Piceous with the basal portions of the elytra and the legs except the meso- and metafemora obscurely fuscous. Antenna piceous apically, fuscous basally, with a five segmented club; the seventh segment subequal to ninth; the eighth narrower than the apical portions of the seventh and ninth, about equal in width to the basal portion of the ninth, about two-fifths as long as wide, about two-fifths the length of the ninth. Pronotum finely punctate, widest just behind middle, sides arcuate, anterior angles broadly rounded, posterior angles obtuse, two-fifths as long as wide, the apex about one half the length of the base, the base feebly sinuate just within the hind angles. Elytra widest in front of middle at which point they are wider than the pronotum at its widest, with transverse microstriæ between the transverse striæ; sutural stria evident, entire; apex narrowly subevenly arcuate in ♂, more broadly arcuate with sutural angle more narrowly arcuate in ♀. The three basal protarsomeres strongly and the mesobasitarsomere feebly dilated and strongly pubescent beneath in ♂, unmodified in ♀. Length 2.2–3 mm.

Type ♂ and allotype ♀ (No. 2999 and 2300, Mus. Calif. Acad. Sci.): Chiricahua Mts., Ariz. 8000 ft. June 29—1927. Cave Creek. Cochise Co. J. A. Kusche Collector. 15 paratypes same data as type. Three paratypes: Flys Pk. 9500 ft. Chiricahua Mts. Ariz. VII–9—1927. J. A. Kusche Collector. One paratype: Jemez Mts. N. M. VII–12. Jno. Woodgate Collector. N. M. specimen in J. W. Green collection. All other material in the collection of the California Academy of Science except five paratypes in collection of author.

Both this species and *oblitus* Lec. belong to that extensive section of the genus (*longispina* Port., *curtus* Port., *dubius* Pic, *sanguinicollis* Port., and possibly *philippi* Port.) possessing obtuse posterior pronotal angles and more or less indistinctly bicolored elytra. From *longispina* Port. they are distinguished by their shorter metatibial spur, from *curtus* Port. by their less transverse pronotum, from *dubius* Pic. and *philippi* Port. by their unicolorous pronotum. *Sanguinicollis* Port. from Peru and Ecuador resembles *oblitus* in color and I do not find anything definite in its description to separate it from Leconte's species.

Dissochætus oblitus Lec.

Catops oblitus Lec. Proc. Acad. Nat. Sci. Phil. VI, 1853, p. 282.—Murray, Ann. Mag. Nat. Hist. (2) XVIII, 1856, p. 459 (separate p. 80), fig. 53.

Ptomaphagus oblitus Lec.—Horn, Trans. Am. Ent. Soc. VIII, 1880, p. 262, 263.—Blatchley, Col. Ind. 1910, p. 261.

Dissochaetus oblitus Lec.—Jeannel, Arch. Zool. exp. gén. LXI, 1922, p. 41.—Hatch, Col. Cat. 95, 1928, p. 164.

Specimens examined: MARYLAND (Jackson's I.[a], Plummer's I.[a]). DISTRICT OF COLUMBIA[acg]. VIRGINIA (Black Pond[a], Fredericksburg[a], Pennington Gap[a], near Plummer's I., Md.[a]). NORTH CAROLINA (Black Mts.[b], Round Knob[a]). ILLINOIS (Monroe Co.[a]). Horn cites specimens from Georgia and Florida, and Blatchley records it from Indiana.

The specimens from Jackson's I., Md., were collected by Carnochan and Barber and by Shannon and Barber from a buzzard's nest. A specimen from Black Pond, Va., was taken by Shoemaker and Barber in a "syrup trap." Blatchley (l.c., p. 281) records specimens from carrion in Indiana.

Dissochætus decipiens Horn

Choleva decipiens Horn, Trans. Am. Ent. Soc. VIII, 1880, p. 257, 259.

Catops decipiens Horn.—Hatch, Col. Cat. 95, 1928, p. 201.

Horn was certainly in error in ascribing to this species a non-carinated mesosternum and a dilated ♂ mesobasitarsomere. The mesosternum is feebly but certainly carinate at its extreme posterior portion between the mesocoxæ. The ♂ mesobasitarsomere is unmodified.

From *fimbriatus* Matth., the only other species of the genus with rounded posterior pronotal angles, *decipiens* is apparently distinguished by its smaller size (length 4.25 mm. in *fimbriatus*), more finely punctate head, more granulately punctate pronotum, with the base of the pronotum arcuate, not at all sinuate, the apices of the elytra rounded, not obtuse.

Specimens examined: WASHINGTON (five paratypes labeled "W. T.,"but according to Horn's description, collected by Morrison at Olympia; a single specimen collected at Olympia by Trevor Kincaid).

Dissochaetus portoricensis sp. nov.

Length 2.6 mm. Piceous above and below; the basal portions of the elytra very evanescently paler; the anterior portion of the head, the basal segments and the apex of the apical segment of the antenna, and the legs more evidently paler. Pubescence fulvous. Head finely densely punctate, alutaceous. Antennæ attaining base of pronotum, with segments six to ten transverse; the eighth smaller than the seventh or ninth, about two fifths as long as wide; the eleventh segment acute at apex. Pronotum granulate, not transversely strigose, two thirds as long as wide, narrower than elytra, widest at about basal two fifths; apex nearly two thirds as long as base; sides broadly arcuate; anterior angles broadly rounded; posterior angles acute, feebly minutely prominent, the lateral and basal margins adjacent to the angle just visibly sinuate. Elytra transversely strigose, widest at about basal third, feebly narrowed behind; the sides broadly arcuate; apices separately arcuate; the sutural stria entire; disc without trace of striæ. Outer metatibial spur as long as metabasitarsomere.

Type ♀: El Yunque, P. R. Alt. 2950′, Feb., 1900. L. Stejneger collector. U. S. National Museum.

This species from Porto Rico seems to be characterized particularly by the form of the posterior angles of the pronotum. These at first appear to be obtuse, but in reality are minutely acute. From the other species with acute posterior pronotal angle it differs from *collaris* Port. apparently by its shorter metatibial spur, its darker ventral surface, and probably by its more obscurely paler elytral base. It differs from *brachyderus* Lec. by its less transverse pronotum and more minutely prominent posterior pronotal angles. From *exiguus* Kirsch., as originally described, it differs by the absence of a pale margin about the dorsal aspect; from *magnicornis* Port. (= *exiguus* Kirsch.) it differs by its piceous pronotum and more obscurely pale elytral base.

Ptomaphagus Illig.

The structure of the elytral apex in the female has proved to be the most useful character for the classification of the Nearctic species of this group. Figures (1–9) have been prepared to illustrate this in each of the species of which the female is known. The males all have the basal three protarsomeres broadly dilated and spongy pubescent beneath, the mesotarsi unmodified. A supplementary key to the males with oblique elytral striæ has been provided.

EXOTIC SPECIES OF PTOMAPHAGUS:—In the following notes on some of the exotic species of *Ptomaphagus* whose descriptions are available to me, the attempt has been made to differentiate them from the Nearctic species.

Of the Palæarctic species, *Pt. validus* Kr. and *fulvus* Reitt. are separated from the Nearctic species by the fact that in those species the third segment of the antenna is one and one-half to twice as long as the third. *Variicornis* Rosenh. is allied to *ulkei* Horn by the fact that the metabasitarsomere is equal to segments two to four. Judging from the descriptions, the ♂ metatibiæ in *ulkei* may be somewhat more strongly arcuate; descriptions of the apex of the female elytra of *variicornis* are wanting. With a similar metatarsus but straight meso- and metatibiæ and a yellow upper surface is *Pt. malyi* Obenberger. *Pt. sericatus* Chaud. and *ruthenus* Reitt. are close to *fisus* Horn but are separated by their piceous color and (at least in *sericatus*) their edentate ♂ metafemur. *Pt. subvillius* Goeze, with its arcuate ♂ meso- and metatibiæ, is related, perhaps, to *consorbinus* Lec.; the elytral apex of the female is not described, but since all European authors insist on the close affinity of this form and *sericatus,* the similarity with *consobrinus* may not be very far reaching.

Of the Oriental species, *Pt. angusticornis* Port. with truncate elytra (♀) would seem to be separated from *texanus* Melander and all other Nearctic species by its more or less bicolored head and elytra.

Of the Neotropical species, *Pt. ascutellaris* Murray is separated by its invisible scutellum, its small eyes, and its peculiar aedeagus. *Pt. rufficollis* Port. is likewise separated by its small eyes and *Pt. heterocera* Port. by its eyeless condition.* *Pt. forti-*

* The propriety of retaining these last three species in *Ptomaphagus* may well be questioned. *Adelopsis* Port. (type *A. heterocera* Port.), without

cornis Matthews, with elytral strigæ transverse, is allied to *Pt. schwarzi* sp. nov. by its rectangular posterior pronotal angles. The only characteristic I find mentioned that will definitely separate it from *schwarzi* is the transverse fifth antennal segment which in *schwarzi* is quadrate or slightly elongate.

DIAGNOSIS OF THE NEARCTIC SPECIES OF PTOMAPHAGUS ILL.

Third segment of antenna shorter than or equal to second in length; metabasitarsomere equal in length to segments two and three, except in *ulkei* Horn, where it is equal to segments two, three, and four.

A′ Elytra transversely strigose; ♂ metatibiæ straight

B′ ♂ metafemur edentate; fusco-piceous; eighth antennal segment less than half the length of ninth; posterior pronotal angles acute.

C′ Apex of elytra of ♀ obliquely sinuate; length 2.5–3 mm.; California to British Columbia (fig. 1) .... **californicus** Lec.

C″ Apex of elytra of ♀ transversely sinuate; length 2.6–3.25 mm.; Nevada, Colorado, Kansas (fig. 2) ...... **nevadicus** Horn

B″ ♂ metafemur obtusely dentate along lower edge at middle; flavo-fuscous; eighth antennal segment one half length of ninth; posterior pronotal angles subrectangular; fifth segment of antenna not transverse; length 3 mm.; Florida (♀ unknown) **schwarzi** sp. nov.

A″ Elytra obliquely strigose

B′ Elytral apices of ♀ subtruncate (cf. *uklei* Horn in B″); color brownish; ♂ metatibiæ straight

C′ Eighth antennal segment one half length of ninth; elytral apex very feebly sinuate, the sutural angle subacute (♀) or feebly subtruncately arcuate with narrowly rounded sutural angle (♂); ♂ metafemur not dentate; length 2.3–2.75 mm.; Texas, Colorado (fig. 3) .... **texanus** Melander

C″ Eighth antennal segment less than one half length of ninth; elytral apex subtruncate, not sinuate, sutural angle narrowly rounded (♀) or broadly arcuate with moderately rounded sutural angle (♂); ♂ metafemur dentate; length 2.25–2.75 mm.; Arizona, southeastern California (fig. 4) **fisus** Horn

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eyes, may be restored, and *ascutellaris* and *rufficollis*, with reduced eyes, may, as Jeannel himself suggests and rejects (Arch. Zool. exp. gén. LXI, 1922, p. 42), belong in *Adelops* Tellk. The discovery of *Adelops lödingi* sp. nov., to be described below, would seem to disprove Jeannel's hypothesis that *Adelops* is characterized by the absence of transverse strigæ from the pronotum.

B″ Elytral apices more or less oblique in ♀, arcuate in ♂; ♂ metafemur not dentate

C′ Elytral apex of female not sinuate

D′ Eighth antennal segment one half length of ninth; elytral apex strongly arcuately oblique with the sutural angle acutely narrowly rounded (♀) or narrowly arcuate with broadly rounded sutural angle (♂); ♂ metatibia straight; brownish; length 2.9–3.6 mm.; Missouri (cavernicolous) .... **cavernicola** Schwarz

D″ Eighth antennal segment less than one half as long as ninth; ♂ elytral apex more broadly arcuate with moderately rounded sutural angles

E′ ♂ metatibia straight; ♀ elytra more oblique at apex with the sutural angle more narrowly rounded; metabasitarsomere equal in length to segments two and three (as in all the other Nearctic species); brownish; length 2.5–2.8 mm.; California (fig. 6) **latior** sp. nov.

E″ ♂ metatibia evidently curved; ♀ elytra feebly oblique at apex, broadly arcuate with the sutural angle broadly rounded; metabasitarsomere equal in length to segments two, three, and four; piceous with the elytra varying to obscure fuscous in female; antennæ piceous with the apical segment somewhat paler; length 2.75–4.2 mm.; Maryland to North Carolina (fig. 7) .... **ulkei** Horn

C″ Elytral apex sinuate (♂) or broadly arcuate with moderately rounded sutural angles (♂); eighth antennal segment less than half as long as ninth

D′ Elytra brownish with head and pronotum piceous (rarely brownish); ♀ elytral apex more strongly sinuate; length 2.4–2.5 mm.; Washington, California (fig. 8) **piperi** sp. nov.

D″ Piceous; ♀ elytral apex less strongly sinuate; ♂ metatibiæ feebly curved; length 2.5–3 mm.; Florida and Texas to Massachusetts, Michigan, and Illinois (fig. 3) **consobrinus** Lec.

Supplementary Key to Males with Oblique Elytral Striæ

A′ Metafemur not dentate

B′ Eighth antennal segment one half as long as ninth; above uniform brown

C′ Elytral apex feebly subtruncately arcuate...... **texanus** Melander

C″ Elytral apex narrowly strongly arcuate... **cavernicolala** Schwarz

B″ Eighth antennal segment less than one half as long as ninth; elytral apex strongly arcuate

C′ Above uniform obscure brownish; metatibiæ straight **latior** sp. nov.
C″ Head and pronotum piceous; elytra brownish ...... **piperi** sp. nov.
C‴ Above piceous
D′ Metatibiæ evidently curved; elytral strigæ closer together; size larger; metabasitarsomere equal to segments two, three, and four .... **ulkei** Horn
D″ Metatibiæ feebly curved; elytral strigæ more distant; size smaller; metabasitarsomere equal to segments two and three .... **consobrinus** Lec.
A″ Metafemur dentate .... **fisus** Horn

Ptomaphagus californicus Lec. (fig. 1)

Catops californicus Lec. Proc. Acad. Nat. Sci. Phil. VI, 1853, p. 281.—Murray, Ann. Mag. Nat. Hist. (2) XVIII, 1856, p. 458 (separate p. 79), fig. 50.
Ptomaphagus californicus Lec.—Horn, Trans. Am. Ent. Soc. VIII, 1880, p. 263.—Hatch, Col. Cat. 95, 1928, p. 168.

Specimens examined: CALIFORNIA (Carmel[p], Fresno[a], Los Angeles[ab], San Francisco[ap], Victorville[b]).

Ptomaphagus nevadicus Horn. (fig. 2)

Ptomaphagus nevadicus Horn, Trans. Am. Ent. Soc. VIII, 1880, p. 263.—Hatch, Col. Cat. 95, 1928, p. 168.

Very close to *californicus* and distinguished principally by the form of the elytral apex in the female. The characters cited by Horn are evanescent.

Specimens examined: NEVADA (Goldfield[p]). COLORADO (Denver[ag]). KANSAS (Douglas Co.[p]).

Ptomaphagus schwarzi sp. nov.

Male: Flavo-fuscous; eye dark; finely pubescent. Head finely densely punctate. Head and pronotum coarctate, densely transversely striolate; the elytral striæ very feebly oblique, nearly transverse. Seventh antennal segment wider than eighth but slightly narrower than ninth; eighth segment two fifths as long as wide, about half as long as ninth; fifth segment quadrate or slightly elongate. Pronotum widest at base, nearly three fourths as long as wide; the apex 63% as long as the base; the sides arcuate, more strongly so from about apical third; anterior angles rounded; posterior angles produced, subrectangular; the base sinuate on either side just within the posterior angles. Elytra widest at about basal fifth where they are very slightly wider than the pronotum; apices conjointly arcuate; the sutural angles narrowly squarely rounded. Three basal protarsomeres dilated and spongy pubescent beneath; mesotarsus unmodified; metafemur obtusely dentate at middle; metatibia straight. Length 3 mm.

Type ♂: Crescent City, Fla. coll. Hubbard and Schwarz (in U. S. National Museum, Cat. No. 43481).

Ptomaphagus texanus Melander (fig. 3)

Ptomaphagus texanus Melander, Psyche IX, 1902, p. 329.—Hatch, Col. Cat. 95, 1928, p. 168.

Specimens examined: TEXAS (Austin[b], Belfrage[a], Dallas[g]). COLORADO[e].

Myrmecophilous with *Pogonomyrmex barbatus* var. *molefaciens* Buckley.

Ptomaphagus fisus Horn (fig. 4)

Ptomaphagus consobrinus (pars) Horn (nec Lec.), Trans. Am. Ent. Soc. VIII, 1880, p. 262, 263.

Ptomaphagus fisus Horn, l. c., XII, 1885, p. 137.—Hatch, Col. Cat. 95, p. 168.

Specimens examined: ARIZONA ("Ariz."[b]—three paratypes, Catal Springs[a], Galiuro Mts.[a], Pinal Mts.[f], Tuscon[a]). CALIFORNIA ("Cal. e"[b]—paratype, Palm Springs[a]).

Recorded by Hubbard (Proc. Ent. Soc. Wash. IV, 1901, p. 361–363) from burrows of kangaroo rats (*Dipodomys desertorum*) and spermophiles in Arizona.

Ptomaphagus cavernicola Schwarz (fig. 5)

Ptomaphagus cavernicola Schwarz, Proc. Ent. Soc. Wash. IV, 1898, p. 58.—Hatch, Col. Cat. 95, 1928, p. 168.

Specimens examined: MISSOURI (Marble Cave (Stone Co.)[a]—paratype, "Mo."[b], Onyx Caves (Washington Co.)[a]).

Cavernicolous.

Ptomaphagus latior sp. nov. (fig. 6)

Rufous; finely pubescent. Head finely transversely striolate. Antennæ rufous; ninth and tenth segments darker; eleventh segment flavous; second and third segments subequal in length; fourth and fifth segments shorter, elongate; sixth segment transverse; eighth one fifth as long as wide, one fifth as long as ninth. Pronotum and elytra coarctate. Pronotum two thirds as long as wide, two thirds as wide at apex as at base, widest at base; sides arcuate; anterior angles rounded; posterior angle produced, subacute; base sinuate just within posterior angles. Elytra with sides feebly arcuate, widest at about basal third; the strigæ oblique; the apices separately broadly arcuate with moderately rounded sutural angle (♂) or obliquely arcuate with narrowly rounded sutural angle (♀). The basal three protarsomeres dilated and spongy pubescent beneath (♂) or unmodified (♀). Mesotibia curved (♂) or straight (♀). Metatibia straight; metafemur edentate; metabasitarsomere equal to segments two and three. Length 2.5–2.8 mm.

Type ♂ and allotype ♀ (No. 2301 and 2302, Mus. Calif. Acad. Sci.): Northfork, Cal. 3–28–1920. H. Dietrich—in wood rat's nest (deposited by direction of Mr. Dietrich in California Academy of Science). Five paratypes same data in collection of Henry Dietrich. Four paratypes same data in Hatch collection. Two paratypes: Hills back of Oakland, Cal. V–8–1910—under small yellow cup fungus (in California Academy of Science). One paratype: Ls. Angls, Cal. Coquilett, and one paratype: Humboldt Co., Cal. 13–6. Bair's Rch. Redwd Crk. H. B. Barber collector (in U. S. National Museum).

Ptomaphagus ulkei Horn (fig. 7, 7a)

Ptomaphagus ulkei Horn, Trans. Am. Ent. Soc. XII, 1885, p. 137.—Hatch, Col. Cat. 95, 1928, p. 168.

Specimens examined: MARYLAND (Plummer's I.[a]). VIRGINIA (Dead Run (Fairfax Co.)[a]). NORTH CAROLINA (Round Knob[a], Black Mts.[p]).

Ptomaphagus piperi sp. nov. (fig. 8)

Rufous, head and pronotum piceous; finely pubescent. Head transversely strigose. Antenna rufous, apex somewhat darker; third segment three fourths as long as second; fourth and fifth elongate; sixth quadrate; seventh wider than eighth, subequal to ninth; eighth twice as wide as long, about two fifths as long as ninth. Pronotum and elytra coarctate. Pronotum widest at base, 63% as long as wide; apex 63% as wide as base; sides arcuate; anterior angles rounded; posterior angles produced, acute. Elytra with sides feebly arcuate, widest about basal fifth; the strigæ oblique. Elytral apex broadly arcuate with moderately rounded sutural angles (♂) or oblique and strongly sinuate, the sutural angles narrowly rounded (♀). Basal three protarsomeres dilated and spongy pubescent beneath (♂) or unmodified (♀). Tibiæ straight. Metabasitarsomere equal to second and third segments in length. Metafemur edentate. Length 2.4–2.5 mm.

Type ♀ (Cat. No. 43482 U. S. N. M.) and allotype ♂: Pullman, Wash. C. V. Piper collector (in U. S. National Museum). Paratype ♂ same date in Hatch collection. A female labeled "Cal." in the Horn collection at the Academy of Natural Sciences of Philadelphia seems to belong here; the head and pronotum are pale, concolorous with the elytra.

Ptomaphagus consobrinus Lec. (fig. 9)

Catops consobrinus Lec., Proc. Acad. Nat. Sci. Phila. VI, 1853, p. 281.—Murray, Ann. Mag. Nat. Hist. (2) XVIII, 1856, p. 458 (separate p. 79), fig. 51.
Catops strigosus Lec., l. c., p. 281.
Catops lecontei Murray, l. c., p. 459 (separate p. 80), fig. 52.
Ptomaphagus consobrinus (pars) Horn (nec Lec.), Trans. Am. Ent. Soc. VIII, 1880, p. 262, 263.
Ptomaphagus consobrinus Lec.—Horn, l. c., XII, 1885, p. 137.—Blatchley, Col. Ind. 1910, p. 261.

The castaneous specimens recorded under this name from Guatemala by Matthews (Biol. Centr.-Am. Col. II, 1, 1888, p. 100) can scarcely be correctly named. The piceous color of *consobrinus* is remarkably consistent and lighter colored specimens have almost without exception proved to be allied species (*fisus, texanus, piperi, latior*).

Specimens examined: MASSACHUSETTS (Sherborn[l]). NEW YORK (Ithaca[i], Mosholu[b], Olcott[k], West Point[a]). PENNSYLVANIA (Easton[m], Frankford[a]). MARYLAND (Plummer's I.[a]). DISTRICT OF COLUMBIA[g]. MICHIGAN (Detroit[ac]). ILLINOIS (Macon Co.). NORTH CAROLINA (Black Mts.[bp], Round Knob[a], Southern Pines). GEORGIA[cf]. FLORIDA (Dunedin[b], Gainesville[a], Jacksonville[a], Levy Co.[p]). ALABAMA (Mobile[ko], Selma[a]). MISSISSIPPI (Lucedale[k], Wiggins[k]). LOUISIANA (Baton Rouge[a], Bogalusa[k]). TEXAS (Columbus[a], Dallas[a], San Antonio[a]). ARKANSAS (Helena[a]). OKLAHOMA (Norman).

I collected specimens at carrion in Illinois.

Adelops Tellkampf

This genus was erected by a Dr. Theodor Tellkampf in 1844 for a new species (*hirtus* Tellk.) that he had discovered in Mammoth Cave, Kentucky. It was erroneously described as blind. In 1854 Lacordaire (Gen. Col. II, p. 195–198, 208) placed in the same genus *Bathyscia* Schiödte 1849, separating it from *Leptodirus* Schmidt 1832 by its contiguous metacoxæ. *Adelops* continued to be so considered until by 1880 more than eighty blind species of European cavernicolous, muscicolous, and lapidicolous beetles were held to be included therein. In that year Horn (Trans. Am. Ent. Soc. VIII, 1880, p. 251–254, 265) pointed out that the genotype of *Adelops* possessed colorless but minute eyes, and that its metacoxæ were contiguous, whereas the European species placed in the genus were truly blind with more or less evidently distant metacoxæ and belonged to a distinct section of his "Cholevini" which he termed the "Bathysciæ." Horn considered *Adelops* to be closely related to *Ptomaphagus,* separated from it by its antennæ being longer than the head and pronotum, its minute eyes, and its more prominent mesosternal carina. In 1922 Jeannel (Arch. Zool. exp. gén. LXI, 1922, p. 43) suggested that the two myrmecophilous species (*Catops parasitus* Lec. and *C. brachyderus* Lec.), placed by Horn in *Ptomaphagus,* were cogeneric with *Adelops hirtus.* Jeannel distinguished *Adelops* from *Ptomaphagus* by its non-strigose pronotal disc and rejected the characters cited by Horn as adaptive and of no more than specific value. An examination of the metatibæ of *parasitus* and *brachyderus,* however, showed that these species lack the apical fringe of equal spinules, so that they must be placed in the subtribe Anemadina.

The two new species described below appear to bridge the gap between *A. hirtus* and typical *Ptomaphagus* in two important respects. The result is that I am compelled to fall back on the abnormally minute eyes as the sole peculiarity of the genus. In addition to the small eyes, however, each species possesses one or more important additional features that separate it from *Ptomaphagus. A. lödingi* and *A. hirtus* have antennæ longer than the head and pronotum and unpigmented eyes; *A. mitchellensis* and *A. hirtus* have the pronotum devoid of transverse striæ, wider than the elytra, and fifty (*mitchellensis*) to sixty (*hirtus*) per cent. as long as the elytra.

As I have suggested above, it is possible that *Ptomaphagus ascutellaris* Murray and *Pt. rufficollis* Port. are members of this genus.

DIAGNOSIS OF NEARCTIC SPECIES OF *Adelops* TELLK.

A′ Antennæ shorter than head and pronotum; pronotum with hind angles acutely produced, not transversely strigose, wider than elytra and one half as long; color pale to piceous; eyes usually pigmented, larger (.06 to .11 mm. in diameter), separated from the base of the antenna by less than twice their own diameter; probably not cavernicolous; elytra feebly narrowed behind, with narrowly rounded sutural angles and subtruncately arcuate (♂) or obliquely subtruncate (♀); length 2.3–2.8 mm.; Black Mts., N. C. **mitchellensis** sp. nov.

A″ Antennæ longer than head and pronotum; pronotum with feebly produced subrectangular hind angles; color pale; eyes unpigmented, smaller, separated from base of antenna by more than twice their diameter; cavernicolous.

B′ Pronotum transversely strigose, not wider than and two fifths as long as elytra, which are feebly narrowed behind, the apices narrowly arcuate (♂) or obliquely arcuately produced to the minutely spinose sutural angles (♀); eye .06 × .09 mm. in size; length 2.9–3.2 mm.; northern Alabama........................**lödgingi** sp. nov.

B″ Pronotum not transversely strigose, wider than and three fifths as long as elytra, which are conjointly somewhat triangular, rapidly narrowed from base to apex; the elytral apices obliquely subtruncately arcuate with broadly rounded sutural angles (♂) or obliquely subsinuately produced to the acute sutural angles (♀); eye .03 × .04 mm.; length 2–2.5 mm.; south central Kentucky ....**hirtus** Tellk.

The probability is high that there are other species in this genus still to be discovered in the southern Appalachian upland.

Adelops mitchellensis sp. nov.

Pale yellowish brown to nearly piceous; pubescent. Head finely, the pronotum more coarsely roughly punctate without evidence of transverse strigæ. Eye more or less pigmented, diameter varying from about .06 mm. to .11 mm., separated from base of antenna by from its own diameter to twice that distance; antennal grooves shorter. Antennæ not attaining base of pronotum; third segment shorter than second, all segments elongate except the eighth, which is twice as wide as long and about one half the length of the eighth. Pronotum wider than elytra, widest about basal fourth, one half as long as the elytra, nearly two thirds as long as wide; the apex nearly three fifths as wide as the base; the sides arcuate; the posterior angles produced, acute; the base sinuate within either posterior angle. Elytra obliquely strigose, widest about basal fourth, feebly narrowed behind; sides feebly arcuate; the apices with narrowly rounded sutural angles and subtruncately arcuate (♂) or obliquely subtruncate (♀). Basal three protarsomeres dilated and pubescent beneath (♂) or unmodified (♀). ♂ mesotibiæ feebly arcuate. Length 2.3 mm.

Type ♂: Black Mt., N. C. IX–27; allotype ♀: Black Mt., N. C. VIII–8–11; three paratypes: Black Mt., N. C. IX–16–01, IX–27 (in collection of American Museum of Natural History). Two paratypes: Mt. Mitchell, N. C., and one paratype: Black Mountain, N. C. (U. S. National Museum). Three paratypes in collection of author.

Adelops lödingi sp. nov.

Pale brown, pubescent. Head finely punctate; the antennal grooves elongate; the eyes small (.06–.09 mm. in diameter), separated from the base of the antenna by more than twice their diameter. Antenna longer than the head and pronotum; the eighth segment at about the level of the base of the pronotum, smaller than the seventh and ninth and very feebly transverse. Pronotum widest at base, slightly narrower than and two fifths as long as the elytra, finely transversely strigose, about three fourths as long as wide; the apex about three fifths as wide as the base; sides feebly arcuate for about basal two fifths, thence more strongly arcuate to the rounded anterior angles; posterior angles very feebly produced, rectangular; base feebly sinuate on either side just within the posterior angles. Elytra obliquely strigose, subparallel to behind middle, whence the sides are obliquely arcuate to the apices, which are narrowly arcuate (♂) or obliquely arcuately produced to the minutely spinose sutural angles (♀). Three basal protarsomeres dilated and pubescent beneath (♂) or unmodified (♀). Metabasitarsomere somewhat shorter than the second and third segments combined. Length 2.9–3.2 mm.

Type ♂, allotype ♀ and ten paratypes: Shelta Cave, Madison Co., Ala. V–21–'30. H. P. Löding (type No. 43763 and allotype in U. S. National Museum; ten paratypes in collection of H. P. Löding). Three paratypes in collection of author. Mr. Henry Dietrich writes me that the beetles occur in bat dung and that the caves serve as the headquarters of "bootleggers," so that they cannot be entered except by parties of considerable size!

Adelops hirtus Tellk.

Hatch, Col. Cat. 95, 1928, p. 169.

Specimens examined: KENTUCKY (Dixon's Cave (Edmonson Co.)[h], Indian Cave[d], Lyon Cave[a], Mammoth Cave[a], Ronald's Cave[a], Saltpeter Cave (Barren Co.)[a], White's Cave[a]).

Catops Payk

Subgenus **Sciodrepa** Thoms. (*Lasiocatops* Reitt.)

Reitter (Deutsche Ent. Zeit. 1901, p. 47–48) selected *Catops alpinus* Gyll. as the type of a subgenus that is rather evanescently characterized by its somewhat more evident and uniformly pale dorsal pubescence. Since the Nearctic species as a whole appear to be somewhat more closely related to *alpinus* than to any other European species, I have elected to utilize this rather vaguely delimited subgenus to receive them.* With *alpinus* Reitter associated three other Palæarctic species.** Since Thomson (Skand. Col. I, 1859, p. 60) had previously selected *C. alpinus* Gyll. as the type of his *Sciodrepa,* it is impossible to retain Reitter's name.***

This subgenus has always presented difficulty. It was in an attempt to clear up some of the problems in connection with its study that Horn was led to write his monograph on the Silphidæ, and the present paper may be said to have had a similar origin.

Say (1823 and 1825) recognized two species which he separated on the color of the elytra. Leconte (1853), thirty years later, was still able to recognize but two species—one of these held to be different from either of Say's—which he separated on antennal characters. Horn (1880) recognized five species

* Jeannel (Arch. Zool. exp. gén. LXI, 1922, p. 44) anticipates me in this suggestion.

** The diagnoses of these species are entirely too vague to enable them to be intercalated with the Nearctic species. *C. hybridus* Reitt. would seem to be distinguished by its quadrate sixth antennal segment and *œrtzeni* Reitt. and *alpinoides* Reitt. by their rectangular posterior pronotal angles, but such characteristics, unless carefully checked, are likely to be evanescent. *C. alpinus* Gyll. is very close to *basilaris* Say. *C. bicolor* Port. has the pronotum rufous.

*** This fact was, unfortunately, not discovered until the specimens upon which this study is based had been returned to their owners, so that specimens labeled *Lasiocatops* by the author belong to the *Sciodrepa* of this study and those labeled *Sciodrepa* belong to *Sciodrepoides.*

which he separated primarily on the basis of the general shape, the shape of the pronotum, and the ♂ profemur, but he noted important differences in the degree of impression of the abdominal segments in the female and other sexual characters. Horn added a sixth species in 1885, without, however, discovering new characters of importance. The publication posthumously by Charles Liebeck of a letter by Frederick Blanchard (1915) added two species and pointed out important antennal characters, the dentation of the male metatrochanter in one of the species, and the emargination of the posterior margin of the fifth abdominal segment in the female of another. In the present study I have been able to recognize only five of Horn's six species as well as both of Blanchard's, a total of seven species. I have separated the species primarily on antennal and sexual characters.

Most of the extant descriptions of the members of this group contain so much persiflage that I have attempted in the following description to enumerate the points that all the Nearctic species of the group have in common. These points will not be repeated in the descriptions that follow.

Dorsum more or less coarsely pubescent. Head black, densely punctate; antennæ with two basal segments pale; sixth segment transverse in frontal view; the eighth transverse and smaller than the seventh or ninth. Pronotum black, three fifths to two thirds as long as wide, narrower than elytra, finely densely roughly punctate, widest between the base and the middle; the base arcuate, wider than apex; sides arcuate; anterior angles rounded; posterior angles broadly to somewhat obtusely rounded. Scutellum black. Elytra densely roughly punctate, widest at between the basal one third and two fifths, feebly narrowed behind; sides arcuate to the conjointly rounded apex, the sutural angles narrowly rounded. Mesotibiæ arcuate. Basal three protarsomeres and the mesobasitarsomere dilated and pubescent beneath (♂) or unmodified (♀).

DIAGNOSIS OF NEARCTIC SPECIES OF CATOPS SUBG. SCIODREPA THOMS.

A′ Third antennal segment longer than second; eighth more than half as long as ninth*; ♂ profemur not tuberculate; ♂ metatrochanter

* No one should attempt to carry on precise studies in this genus who is not equipped with a binocular microscope or its equivalent that gives a

edentate; ♀ abdomen unmodified; pronotum widest at about basal two fifths, sides broadly arcuate; sixth antennal segment feebly transverse in frontal view; eighth antennal segment wider at apex than ninth at base

B′ Eighth antennal segment subequal to sixth in length, less than twice as wide as long; ♂ mesobasitarsomere less than twice as wide as the second mesotarsomere; elytra brown or black; length 3.75–4.75 mm.; Maine and Virginia to Kentucky, Indiana and Ontario; Washington .... **gratiosus** Blanch.

B″ Eighth antennal segment only slighly more than half as long as sixth, twice as wide as long; ♂ mesobasitarsomere more than twice as wide as second mesostarsomere; elytra black; length 3.2–4 mm.; Alaska, Alberta, Montana, New York, Massachusetts, Nova Scotia .... **alsiosus** Horn

A″ Third antennal segment equal to or slightly shorter than second; eighth segment at least twice as wide as long and half as long as ninth or less

B′ Sixth antennal segment only slightly transverse in frontal view; ♀ fifth abdominal not emarginate behind; ♂ profemur or metatrochanter modified; ♂ mesobasitarsomere twice as wide as second mesotarsomere; elytra brown, not or feebly darker behind; eighth antennal segment from two fifths to one half as long as wide, about half as long as ninth

C′ ♂ profemur tuberculate below; ♂ metatrochanter edentate; ♀ abdomen with third to sixth segments more or less impressed; eighth antennal segment one half as long as wide; pronotum widest at about basal two fifths; length 3–4.5 mm.; Alaska and California to Illinois, Louisiana, Florida and Labrador .... **simplex** Say

C″ ♂ profemur not tuberculate; ♂ metatrochanter dentate at about apical fourth; ♀ abdomen with segments five and six impressed or unimpressed; eighth antennal segment two fifths as long as wide; pronotum usually widest at about basal fifth; length 2.15–3.25 mm.; Manitoba and New Brunswick to North Carolina and Kansas; ? Tex., ? N. M. **americanus** Hatch

B″ Sixth antennal segment strongly transverse, nearly twice as wide as long in frontal view; ♀ fifth abdominal emarginate behind; elytra usually bicolored, darker behind; eighth antennal segment from one fourth to one third as long as wide, less than half as long as ninth; ♂ profemur not tuberculate; ♂ metatrochanter edentate

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magnification of approximately eighty diameters. One of the oculars should be provided with a micrometer disc as the eye cannot be trusted to make comparisons with the requisite precision. The disc that I have employed in the present study involves a square centimeter ruled in millimeter squares, one of the center squares ruled in one tenth millimeter squares.

C′ Pronotum with sides moderately arcuate, widest at about basal two fifths; ♀ abdomen with segments five and six impressed; eighth antennal segment as wide at apex as ninth is at base; ♂ mesobasitarsomere less than twice as wide as second mesotarsomere; length 3–4 mm.; Alaska, Yukon Territory, and Newfoundland to California, Nevada, New Mexico, Wyoming, Michigan and North Carolina **basilaris** Say

C″ Pronotum with sides very feebly arcuate, nearly parallel behind, especially in female, feebly narrowed in front; ♀ abdomen unimpressed; eighth antennal segment as wide at apex as ninth is at base; ♂ mesobasitarsomere less than twice as wide as second mesotarsomere; length 3.2–4 mm.; Alaska to California .... **egenus** Horn

C‴ Pronotum with sides more obliquely arcuate, strongly narrowed at apex, widest at about basal fifth; ♀ abdomen unimpressed; eighth antennal segment wider at apex than ninth is at base; ♂ mesobasitarsomere twice as wide as second mesotarsomere; length 2.3–3.2 mm.; British Columbia, Quebec, and Maine to Colorado, Missouri, Mississippi, and North Carolina .... **hornianus** Blanch.

Catops (Sciodrepa) gratiosus Blanch.

Choleva alsiosa Blatchley (nec Horn), Col. Ind. 1910, p. 279.
Choleva gratiosa Blanch. Ent. News XXVI, 1915, p. 294.
Catops gratiosus Blanch.—Hatch, Col. Cat. 95, 1928, p. 201.

Antennæ longer than head and pronotum; apex of apical segment pale; third segment longer than second; sixth subequal to eighth, slightly transverse in frontal view, somewhat elongate in side view; eighth segment five sevenths as long as wide, five sevenths as long as ninth, seven eighths as wide as the ninth, wider at its apex than is the ninth at its base. Pronotum widest from between middle and basal two fifths, seven tenths as long as wide; apex about two thirds as wide as base; hind angles rounded. Elytra black, black streaked with brown, brownish, or brownish feebly darker behind, widest at about basal two fifths. ♂ second mesotarsomere three fourths as wide as the mesobasitarsomere. Profemur below shining, punctate, pubescent, rounded, not tuberculate; the groove for the reception of the tibia about one fifth the total length of its ventral surface, smooth. ♂ metatrochanter edentate. ♀ abdomen unimpressed. ♂ protibia sinuate within.

Specimens examined: MAINE (Rangeley L.[c]). NEW HAMPSHIRE (Crawford's[b], Franconia[b]). MASSACHUSETTS (Natick[l]). NEW YORK (Ithaca[ai], Mosholu[b], Olcott[k], Upper Saranac[m], White Plains[l]). NEW JERSEY. ONTARIO (Ottawa[d], Toronto[e]). MICHIGAN (Washtenaw Co.). INDIANA (Saltpeter Cave (Crawford Co.)[a]). KENTUCKY (Lexington Caves[ac], Lyon Caves[a]). MARYLAND (Crystal Cave (Boonsboro)[a]). VIRGINIA (Madden Cave (New Market)[a]), Mushroom Caves (Murray Cavern)[a], Pennington Gap[a]). WASHINGTON (Olympia).

This species appears to be both free living and cavernicolous, nor can I detect any difference between the two except that nearly all the specimens with black elytra appear to be from caves. Intermediate and brownish cavernicolous specimens are likewise present, however. My single Michigan specimen was taken at carrion.

Catops (Sciodrepa) alsiosus Horn

Choleva alsiosa Horn, Trans. Am. Ent. Soc. XII, 1885, p. 136.—Blanchard, Ent. News XXVI, 1915, p. 294.
Catops aliosus Hatch, Col. Cat. 95, 1928, p. 201.

Antennæ attaining level of base of pronotum; apex of apical segment pale; third segment longer than second; sixth twice length of eighth, slightly transverse in frontal view, somewhat elongate in side view; eighth segment one half as long as wide, two thirds as long as ninth, nearly as wide as ninth, wider at its apex than is the ninth at its base. Pronotum widest at about basal two fifths, nearly two thirds as long as wide, apex about two thirds as wide as base; posterior angles broadly rounded. Elytra black, widest at about basal two fifths. ♂ second mesotarsomere less than half as wide as the mesobasitarsomere. Profemur below shining, punctate, pubescent, rounded, not tuberculate; the groove for the reception of the tibia about one tenth the total length of its ventral surface, smooth. ♂ metatrochanter edentate. ♀ abdomen unimpressed. Metatibia feebly arcuate. ♂ protibia sinuate within. Length 3.2–4 mm.

Specimens examined: ALASKA (Cape Zion[p], Koyukuk R. (Lat. 67°–69° N., Long. 151° W.)[a], Rampart House[a]). ALBERTA (Edmonton[j]). MONTANA (Assiniboine Mts.[a]). MANITOBA (Onah[q], Mile 214 (Hudson Bay R. R.)[q]). NEW YORK (Ithaca[e]). MASSACHUSETTS (Framingham[l], Sherborn[l]). NOVA SCOTIA (Truro[e]).

Frost took specimens at carrion and sifting in Massachusetts; Wallis took specimens in a weasel's nest in Manitoba.

Catops (Sciodrepa) simplex Say

Catops simplex Say, Jour. Acad. Nat. Sci. Phila. V, 1825, p. 184; Complete Writings II, 1859, p. 289.—Lec. Proc. Acad. Nat. Sci. Phila. VI, 1853, p. 281.—Murray, Ann. Mag. Nat. Hist. (2) XVIII, 1856, p. 306 (separate p. 53).—Hatch, Col. Cat. 95, 1928, p. 201.

Catops luridipennis Mann., Bull. Soc. Nat. Mosc. XXVI, 1853, p. 176.—Murray, Ann. Mag. Nat. Hist. (2) XVIII, 1856, p. 305 (separate p. 52).—Hatch, Col. Cat. 95, 1928, p. 200.

Choleva luridipennis Mann.—Horn. Trans. Am. Ent. Soc. VIII, 1880, p. 256, 257, pl. 5, fig. 17.

Choleva simplex Say.—Horn, l. c., p. 257, 258.—Blatchley, Col. Ind. 1910, p. 279.

Catops (*Lasiocatops*) *luridipennis* Mann.—Jeannel, Arch. Zool. exp. gén. LXI, 1922, p. 44.

Antennæ barely attaining base of pronotum; second and third segments subequal; sixth twice length of eighth, slightly transverse in frontal view, somewhat elongate in side view; eighth segment one half as long as wide, one half as long as ninth, six sevenths as wide as ninth, wider at its apex than is ninth at base. Pronotum widest at about basal two fifths, nearly two thirds as long as wide; apex not quite three fifths as long as base; hind angles broadly rounded. Elytra brownish, sometimes faintly darker at apex, widest at about basal two fifths. ♂ second mesotarsomere one half as wide as the mesobasitarsomere. Profemur below in ♂ tuberculate, flattened, impunctate, glabrous, shining, somewhat microstrigose; in the ♀ rounded, punctate, pubescent, the groove for the reception of the tibiæ about one third the total length of its ventral surface, smooth. ♂ metatrochanter edentate. ♀ abdomen with segments three to six impressed, the third and fourth vaguely so, the fifth and sixth more strongly. As a result of their impression, the posterior margin of the impressed segments (♀) are more or less sinuate, but never sharply emarginate as in the *basilaris* section. Mesotibiæ arcuate. ♂ protibia sinuate within. Length 3–4.5 mm.

Specimens examined: MASSACHUSETTS (Framingham[l], Natick[l], Sherborn[l]). NEW YORK (Ithaca[k], Upper Saranac[m]). NEW JERSEY (Boonton[a]). PENNSYLVANIA (Easton[m]). MARYLAND (Plummer's I.[a]). DISTRICT OF COLUMBIA[ac]. VIRGINIA (Dead Run (Fairfax Co.)[a], Fredericksburg[ap]). NORTH CAROLINA (Chapel Hill[e], Round Knob[a]). GEORGIA[c]. MISSISSIPPI (Lucedale[k]). ALABAMA (Mobile[o]). LOUISIANA (Bogalura[k]). KENTUCKY (Henderson[k]). OHIO[cf]. MICHIGAN (Ann Arbor, Berrien Co., Huron Mts.[a], St. Clair Co.[h]). ILLINOIS (Macon Co.). BRITISH COLUMBIA (Duncan (Genoa Bay)[n], Glenora[f], Goldstream[d], Lorna[n], Peachland[q], Trinity Val.[n]). WASHINGTON (Coupeville, Seattle). OREGON (Portland[a]). CALIFORNIA (Berkeley[k], Fairfax[p], Los Gatos[a], Mendocino Co.[p], Taylorville (Marin Co.)[k], Tulare Co.[h]). Horn records *luridipennis* from Alaska and Sherman (JR. N. Y. ENT. SOC. XVIII, 1910, p. 188) records it from West St. Modest, Labrador.

I have taken this species at carrion in Michigan, Illinois, and Washington, and I have seen specimens so recorded from British Columbia. Frost took it in a trap made of "skunk cabbage" leaves in Massachusetts.

It is my conclusion that the *luridipennis* and *simplex* of Horn's Synopsis refer to the same species—at least in their typical form. On the other hand, there is evidence that both Horn's species are composite. Horn separated *simplex* from *luridipennis* on its more *clavicornis*-like pronotum, its narrower ♂ mesobasitarsomere, and its unimpressed ♀ abdomen. Among the specimens (♂) with tuberculate profemora I find no evidence of the two species that Horn describes; there is no variation in the mesobasitarsomere and such variation as there is in the pronotum is without significance. In the Horn collection the specimens labeled *simplex* consist of one male with a broadly dilated mesobasitarsomere and three females with definitely impressed abdominal segments. The attention of future students of this group should, however, be directed to the fact that, if Horn's two species are eventually proved to be distinct, the species here recognized should be regarded as *luridipennis*.

I suspect that as females of *simplex* Horn selected females of the as yet undescribed *alsiosus* or *gratiosus* or females of *americanus* (=*clavicornis* Lec.) with unimpressed abdomens; I shall mention some evidence below that *americanus* is, in the female, dimorphic as regards this character. Finally, I find no evidence of males of *luridipennis* without the profemoral tubercle, and I suggest that those specimens in which Horn could not observe the tubercle were males of *alsiosus* or *gratiosus.*

It is, of course, impossible to fix precisely the species to which Say's name should be affixed. Say distinguished *simplex* from *basilaris* on the basis of its unicolorous brownish elytra, and, as such, Say's name is applicable alike to the *gratiosus, simplex* or *americanus* of this study. LeConte separated *clavicornis* (=*americanus*) from *simplex* on antennal characters and Horn designated it as a species with tuberculate ♂ profemora, which is the sense in which I use it in the present paper.

Catops (Sciodrepa) americanus Hatch

Catops clavicornis Lec. (nec Steph. 1830), Proc. Acad. Nat. Sci. Phila. VI, 1853, p. 281.—Murray, Ann. Mag. Nat. Hist. (2) XVIII, 1856, p. 307 (separate p. 53), fig. 28.

Choleva clavicornis Lec.—Horn, Trans. Am. Ent. Soc. VIII, 1880, p. 257, 259.—Blatchley, Col. Ind. 1910, p. 279, 280.—Blanchard, Ent. News XXVI, 1915, p. 294.

Catops americanus Hatch, Col. Cat. 95, 1928, p. 201.

Antennæ barely attaining base of pronotum; second and third segments subequal; sixth twice length of eighth, slightly transverse in frontal view, somewhat elongate in side view; eighth segment two fifths as long as wide, about half as long as ninth, five sixths as wide as ninth, slightly wider at its apex than is the ninth at its base. Pronotum widest from basal fifth to basal two fifths, about three fifths as long as wide; apex three fifths as long as base; hind angles feebly obtusely rounded. Elytra brownish, obscurely darker at apex, widest at about basal two fifths. ♂ second mesotarsomere about one third as wide as the mesobasitarsomere. Profemur below rounded, punctate, pubescent; the groove for the reception of the tibia about one sixth the total length of its ventral surface, not smoother than rest of ventral surface (♂) or with the groove somewhat more extensive and smoother (♀). ♂ metatrochanter dentate at about apical fourth. ♀ abdomen with fifth and sixth segments strongly impressed and the fifth not emarginate behind, or with the fifth segment only feebly impressed, or with the abdominal segments unimpressed. Mesotibiæ arcuate. ♂ protibia strongly and somewhat sinuately narrowed towards base. Length 2.15–3.25 mm.

As regards their abdominal characters the females are dimorphic. I get such a perfect intergradation that I have no hesitancy in pronouncing the extremes a single species.

Specimens examined: NEW BRUNSWICK (Fredericton[d]). NEW HAMPSHIRE (Franconia[b]). MASSACHUSETTS (Framingham[l], Hopkinton[l], Sherborn[l], Tyngsboro[c]). NEW YORK (Altamont[l], Cranberry L., Upper Saranac[m], West Point[a]). NEW JERSEY (Boonton[a]). PENNSYLVANIA (Castle Rock[a], Easton[m], Frankford[a], Montrose[m]). MARYLAND (Plummer's I.[a]). DISTRICT OF COLUMBIA[ag]. NORTH CAROLINA (Black Mts.[bp], Retreat[a], Round Knob[a]). ONTARIO (Rousseau[a], Toronto[e]). ILLINOIS (Macon Co., "n. ILL."[g]). KANSAS (Riley Co.[a]). WISCONSIN[c]. MINNESOTA (Itasca St. Park[a]). MANITOBA (Aweme[dq], Onah[q]). Wickham (Davenport Acad. Nat. Sci. VI, 1896, p. 140) records this species from Texas and Fall and Cockerell (Trans. Am. Ent. Soc. VIII, 1907, p. 165) record it from New Mexico, but the determinations should be checked.

I have taken specimens at carrion in Illinois and from decaying fungi in New York. Mr. Frost records it from traps of "skunk cabbage" leaves in Massachusetts.

Catops (Sciodrepa) basilaris Say

Catops basilaris Say, Journ. Acad. Nat. Sci. Phila. III, 1823, p. 194; Complete Writings II, 1859, p. 124.—Murray, Ann. Mag. Nat. Hist. (2) XVIII, 1856, p. 394 (separate p. 68).

Choleva spenciana Kirby, Fauna Bor.-Am. 1837, p. 108.—Horn, Trans. Am. Ent. Soc. VIII, 1880, p. 259.

Catops cadaverinus Mann. Bull. Soc. Nat. Mosc. XVI, 1843, p. 82.—Murray, l. c. p. 304 (separate p. 50).

Catops basillaris Lec. Proc. Acad. Nat. Sci. Phila. VI, 1853, p. 282.—Hatch, Col. Cat. 95, 1928, p. 201.

Catops brunnipennis Mann. Bull. Soc. Nat. Mosc. XXVI, 1853, p. 176.—Murray, l. c. p. 306 (separate p. 52), fig. 25.—Horn, l. c., p. 259.
Catops spencianus Kby.—Murray, l. c. p. 304 (separate p. 50), fig. 24.
Choleva basillaris Lec.—Horn, l. c. p. 257, 258.—Blatchley, Col. Ind. 1910, p. 279, 280, fig. 140.
Ptomaphagus basilaris Say.—Portevin, Bull. Mus. Hist. Nat. Paris 1903, p. 329.
Catops (*Lasiocatops*) *spencianus* Kby.—Jeannel, Arch. Zool. exp. gén. LXI, 1922, p. 44.
Catops (*Lasiocatops*) *cadaverinus* Mann.—Jeannel, l. c.

Antennæ barely attaining base of pronotum; second and third segments subequal; sixth segment nearly twice the length of the eighth, nearly twice as wide as long in frontal view, somewhat less transverse in side view; eighth segment nearly four times as wide as long, about one fourth the length of the ninth, about five eighths the width of ninth and little if any wider at its apex than is the ninth at its base. Pronotum widest at about basal two fifths, nearly two thirds as long as wide, the apex from three fifths to two thirds as long as base; hind angles rounded. Elytra brownish with the apex usually evidently darker. ♂ second mesotarsomere about two thirds as wide as the mesobasitarsomere. Profemur below rounded and smooth, impunctate, glabrous, not tuberculate (♂) or punctate, pubescent, with groove for the reception of the tibia about one third of the total length of its ventral surface smooth (♀). ♂ metatrochanter edentate. ♀ abdomen with the fifth and sixth segments impressed, the fifth with a sharp emargination behind. Protibia (♂) feebly arcuate, strongly sinuate at middle within. Length 3–4 mm.

For the discussion of the variability of this species see the notes under *egenus* Horn.

Specimens examined: MAINE (Cumberland Co.[b], Wales[l]). NEW HAMPSHIRE (Franconia[b], Mt. Washington[b]). MASSACHUSETTS (Framingham[l]). NEW YORK (Ithaca[i], L. Pleasant[b], New York[b], Upper Saranac[m]). PENNSYLVANIA (Frankford[a]). MARYLAND (Plummer's I.[a]). DISTRICT OF COLUMBIA[ag]. VIRGINIA

(Dead Run (Fairfax Co.)[a], Fredericksburg[a], Pennington Gap[a]). NORTH CAROLINA (Chapel Hill[e], Black Mts.[b]). ONTARIO (Batchewan Bay[c], Michipicoten I.[acf], Toronto[e]). MICHIGAN (Charlevoix Co., Floodwood (Schoolcraft Co.)[h], Huron Mts.[a], Oakland Co.[h]). MANITOBA (Mile 214 (Hudson Bay R. R.)[q]). ALBERTA (Edmonton[jl], Saskatchewan R.[l]). WYOMING (Nat. Park[a]). NEVADA[c]. NEW MEXICO[f]. CALIFORNIA (Berkeley[ek], Carmel[p], Los Gatos[a], Mendocino Co.[p], Napa Co.[h], Pasadena[l], San Francisco[ap], Taylorville (Marin Co.)[k], Tulare Co.[h]). OREGON (Astoria[a], Cannon Beach[p]). WASHINGTON (Paradise Valley (Mt. Rainier)[e], Seattle, Stillaguamish R., Union). BRITISH COLUMBIA (Duncan (Genoa Bay)[n], Inverness[d], Kelso[a], Lorna[n], Massett[d], Metlakatla[d], Oliver[d], Peachland[q], Trinity Val.[n]). YUKON TERRITORY (Stewart R.[d], Whitehorse[a]). ALASKA (Ft. Wrangle[c], Ft. Yukon[a], Idsterod[a], Katmai[p], Kussiloff[a], New Rampart House[a], Popoff I.[a], Rampart House[a], 100 mi. n. Rampart H.[a], 20–30 mi. n. Rampart H.[a], between Rampart H. and Rapid R.[a], Sitka[a], 141 meridian). Portevin records *basilaris* from St. Pierre and Miquelon islands near Newfoundland.

I have taken this species at carrion in Michigan and Washington, and Mr. Carr so records it from Alberta. Mr. Frost records it from "skunk cabbage," and Blatchley from the nest of a shrew.

Catops (Sciodrepa) egenus Horn

Choleva egena Horn, Trans. Am. Ent. Soc. VIII, 1880, p. 256, 257.

Catops (*Lasiocatops*) *egenus* Horn.—Jeannel, Arch. Zool. exp. gén. LXI, 1922, p. 44.

Catops egenus Horn.—Hatch, Col. Cat. 95, 1928, p. 200.

Antenna with second and third segments subequal; sixth segment about one and one half times as long as the eighth, twice as wide as long in frontal view; eighth segment three to four times as wide as long, about one third as long as the ninth and three fourths as wide, its width at apex subequal to that of the ninth segment at base. Pronotum widest at about basal two fifths, two thirds as long as wide, feebly narrowed in front; the sides feebly arcuate, almost parallel behind, especially in the ♀;

the apex two thirds as long as base; hind angles rounded. Elytra widest at basal two fifths, brownish, piceous towards apex. Profemora below rounded, punctate, pubescent, except for the groove for the reception of the tibia at the apical fifth which is somewhat smoother. ♂ second mesotarsomere three fifths as wide as mesobasitarsomere. ♂ protibia feebly arcuate, strongly sinuate at middle within. ♂ metatrochanter edentate. ♀ abdomen unimpressed, fifth segment minutely but sharply emarginate behind.

Specimens examined: ALASKA (Ft. Wrangle[f], Pribilof I.[a], Sitka[c], Wrangel[f]). YUKON TERRITORY (Whitehorse[a]). BRITISH COLUMBIA (Duncan (Genoa Bay)[n], Lorna[n], Massett[d], Merritt (Midday Val.)[n]). WASHINGTON (Seattle, Union). CALIFORNIA ("Cal."[c]).

Egenus is characterized in the female by its unimpressed fifth ventral abdominal segment. This is correlated with a notable narrowing and straightening of the sides of the pronotum which, in the two paratypes (♀) I have seen and in a certain number of other specimens, are nearly parallel. Other females, however, exhibit a notable arcuation of the pronotal side margin. I have seen no males in which the sides of the pronotum are as feebly arcuate as in the typical females just cited, so that this character would seem to be more or less sexually dimorphic.

Egenus is, in reality, a rather feebly defined species, which I retain largely on the basis of the female abdominal character already cited. The male genitalia do not exhibit important points of difference with those of *basilaris* (fig. 21, 22), and in many instances the placing of male specimens is more or less arbitrary, determined best by the females with which they were associated. Thus, in a series in the Canadian National Collection taken by J. H. Keen at Massett in the Queen Charlotte Islands in which the females are preponderantly *egenus,* I do not hesitate to place most of the males in the same species, even though the majority of them exhibit a considerable arcuation of the side margin of the pronotum. In a series of several females taken by Mr. Hopping at Lorna, B. C., in which the sides of the pronotum are feebly but evidently arcuate some of the specimens have the fifth abdominal segment impressed, *i.e.,* are *basilaris,* and some have it unimpressed (*egenus*). Future investigators may conclude that this is simply a case of dimorphic females, as in *americanus.* Against such a contention may be cited the fact that all females with unimpressed abdomens have a more or less narrowed pronotum and are confined to the Pacific coast from Alaska to California. On the other hand, most of the *basilaris* females with narrowed pronotum come likewise from the Pacific coast, though I have at least one such specimen from New York.

A reading of pages 304 to 306 (separate p. 50–52) of Murray's Monograph suggests that the name *spencianus* Kby. (= *cadaverinus* Mann.) might be resurrected to apply as a varietal name to those specimens of *basilaris* with a less transverse pronotum. But the vagueness of this character as well as the number of intermediate specimens present in the material before me renders such a course of dubious validity.

A note or two further on *basilaris* is in order. It is impossible to determine exactly which species Say had before him. The elytra of his species was bicolored, which would limit it to the *basilaris, egenus,* and *hornianus* of the present study. Its habitat was Missouri and the side margin of the pronotum was "regularly arcuated," which would exclude *egenus.* I hold it to be entirely proper that the form so designated by Horn shall retain Say's name.

Basilaris is very close to *alpinus* Gyll. of Europe; the abdominal characters of the female are the same, but the pronotum of *alpinus* seems to be somewhat more transverse (scarcely three fifths as long as wide).

Finally, I have seen two or three females otherwise resembling typical *basilaris* in which the middle of the posterior margin of the fifth ventral abdominal segment is produced to form a point, instead of being emarginate. Since the emargination is typically limited on either side by a variably prominent angle, I interpret the condition just noted to be an abnormality resulting from the coalescence of the angulation on either side of the emargination with the consequent elimination of the emargination itself. The possibility that this is a feature of taxonomic significance should not, however, be completely overlooked.

Catops (Sciodrepa) hornianus Blanch.

Choleva horniana Blanch., Ent. News XXVI, 1915, p. 294.
Catops hornianus Blanch.—Hatch, Col. Cat. 95, 1928, p. 201.

Antennæ barely attaining base of pronotum; third segment five sixths as long as second; sixth segment more than twice as wide as long in frontal view, nearly as short as the eighth; eighth segment between three and four times as wide as long, less than half as long as ninth, about five sixths as wide as ninth and somewhat wider at its apex than the ninth at its base. Pronotum widest at about basal fifth, three fifths as long as wide, the apex somewhat less than three fifths as wide as base; hind angles obtusely rounded. Elytra brownish with the apex usually evidently darker, widest at about basal third. Profemur below not tuberculate, rounded, punctate, and pubescent at apical half, flattened, impunctate, and glabrous at basal half. ♂ metatrochanter edentate. ♂ second basitarsomere nearly one half as wide as the mesobasitarsomere. ♀ abdomen unimpressed, the fifth segment sharply emarginate behind. ♂ protibia straight, somewhat narrowed at base, not appreciably sinuate. Length 2.3–3.25 mm.

Specimens examined: QUEBEC (Knowlton[d]). MAINE (Paris[l], Rangeley L.[c], Wales[l]). MASSACHUSETTS (Framingham[l], Natick[l], Sherborn[l], Tyngsboro[o]). CONNECTICUT (Litchfield[b]). NEW YORK (Altamont[l], Enfield[k], Ithaca[i], Mosholu[b], New York[b], Olcott[k], Piseco L.[l], Upper Saranac[m], West Point[a]). NEW JERSEY (Dundee[a], Hopatcong[b]). PENNSYLVANIA (Allegheny[d], Delaware Water Gap[b], Easton[m], Frankford[a]). MARYLAND (Baltimore[a], Plummer's I.[a]). DISTRICT OF COLUMBIA[a]. VIRGINIA (Pennington Gap[a]). NORTH CAROLINA (Black Mts.[ab], Retreat[a]). ONTARIO (Belleville[f], Sudbury[d], Trenton[df]). MICHIGAN (Berrien Co., Charlevoix Co., Detroit[ah], Huron Mts.[a], Oakland Co.[h], St. Clair Co.[h], Washtenaw Co.). OHIO (Cincinnati[l]). ILLINOIS (Macon Co., "n. Ill."[g]). MISSISSIPPI (Meridian[a]). MISSOURI (St. Louis[a]). IOWA (Iowa City). MINNESOTA (St. Paul). KANSAS (Onaga[f], Riley Co.[a]). NEBRASKA (Lincoln[a], Malcolm[l]). COLORADO (Denver[l], Littleton[l]). MANITOBA (Aweme[dq], Onah[q], Winnipeg[q]). ALBERTA (Edmonton[j]). BRITISH COLUMBIA (Kalso[a], Mara[d], Peachland[q]).

I have taken this species at carrion in Michigan, Illinois, and Minnesota, as has Mr. Frost in Colorado and Massachusetts. Likewise Mr. Frost records it from a trap of cheese and "skunk cabbage" leaves in Massachusetts.

Subgenus **Sciodrepoides** nov. (*Sciodrepa* Ganglb. nec Thoms.)

I am compelled to replace the term *Sciodrepa* as applied by Ganglbauer (Käf. Mitteleur. III, 1899, p. 127) to *Catops fumatus* Spence, *C. watsoni* Spence, and *C. umbrinus* Er. by a new name. While Thomson (Skand. Col. IV, 1862, p. 66) did include *C. fumatus* Spence in *Sciodrepa,* he had previously (l. c., I, 1859, p. 60) designated *C. alpinus* Gyll. as the type of *Sciodrepa.*

Jeannel (Arch. Zool. exp. gén. LXI, 1922, p. 45) indicated *C. umbrinus* Er. as the type of *Dreposcia* on the basis of its feebler antennal club and quadrate sixth antennal segment, and left *C. fumatus* Sp. and *C. watsoni* Sp. in Sciodrepa. Portevin (Hist. Nat. Col. Fr. I, 1929, p. 521) transferred *fumatus* to *Dreposcia.* The sixth antennal segment is certainly far less transverse in *fumatus* than in *watsoni,* so that, while I have followed Jeannel in placing *fumatus* and *watsoni* together, I have made *watsoni* rather than *fumatus* the type of the subgenus *Sciodrepoides* nov.

Catops (Sciodrepoides) terminans Lec.

Catops terminans Lec. in Agassiz, Lake Superior IV, 1850, p. 218; Proc. Acad. Nat. Sci. Phila. VI, 1853, p. 282.—Murray, Ann. Mag. Nat. Hist. (2) XVIII, 1856, p. 395 (separate p. 69), fig. 43.

Choleva terminans Lec.—Horn, Trans. Am. Ent. Soc. VIII, 1880, p. 257, 260.—Blatchley, Col. Ind. 1910, p. 280.

Sciodrepa fumata Hatch (nec Spence), Univ. Minn. Agr. Exp. Sta. Techn. Bull. 48, 1927, p. 15; Col. Cat. 95, 1928, p. 202.

The margins of the pronotum and elytra are not coarctate, as maintained by Horn. The pronotum is widest at about the basal two fifths. The hind angles are rectangular or subacute, feebly produced.

This species closely resembles the Palæarctic *Catops* (*Sciodrepoides*) *fumatus* Spence. They may be distinguished, however, by the structure of the apex of the median lobe of the male genitalia. In *terminans* (fig. 27) the apex of the median lobe curves abruptly upwards at the tip. In *fumatus* (Jeannel, Arch. Zool. exp. gén. LXI, 1922, p. 26, fig. 26) the tip of the median lobe has another structure.

British Columbia and New Brunswick to Illinois and North Carolina.

Specimens examined: British Columbia (Kalso[a], Mara[n], Trinity Val.[n], Peachland[q]). Alberta (Edmonton[j]). Manitoba (Aweme[q], Mile 214 (Hudson Bay R. R.)[q]). Illinois (Macon Co.). Michigan (Berrien Co., Grand Ledge[a], Huron Mts.[a], Livingston Co., Oakland Co.[h], St. Clair Co.[h]). Ontario (Ottawa[d], Prince Edward Co.[d], Toronto[k], Ventnor[d]). New Brunswick (Boiestown[d]). Maine (Cumberland Co.[b], Monmouth[l], Wales[l]). New Hampshire (Franconia[b]). Massachusetts (Framingham[l], Hopkinton[l], Monterey[l], Natick[l], Sherborn[l]). New York (Cranberry L., Etna Logs[e], Ithaca[k], L. Pleasant[bp], New York[b], Olcott[k], Upper Saranac[m], West Point[a], White Plains). New Jersey (Anglesea[a], Boonton[a], Phillipsburg[jm], Sandy Hook[b]). Pennsylvania (Allegheny[d], Easton[m], Frankford[a]). Maryland (Jackson's I.[a], Plummer's I.[a], Teavilah[f]). District of Columbia[cg]. Virginia (Pennington Gap[a]). North Carolina (Black Mts.[bcp], Round Knob[a]).

I have taken this species at carrion in New York, Illinois, and Michigan, and others have so recorded it from Massachusetts (Frost) and Indiana (Blatchley). I have found it in decaying fungi in Michigan and Blatchley so records it from Indiana. Shannon and Barber record specimens from a buzzard's nest in Maryland and Blatchley took specimens in deserted mouse nests in Indiana.

Prionochæta Horn

On the basis of characters cited by Portevin (Ann. Soc. Ent. France LXXII, 1903, p. 159) the three species of this genus may be distinguished as follows:

A′ Antennæ black with two basal segments and the apex of the apical segment pale; legs black, the anterior tarsi pale, the middle and hind tarsi fuscous; base of pronotum feebly sinuate on either side just within the hind angles; elytra with discal striæ feebly impressed

B′ Pubescence of pronotum yellow; hind angles of pronotum acute, feebly produced; base of pronotum finely margined with rufous; metatibial spurs longer than metabasitarsomere; more parallel and depressed; length 4–4.5 mm.; Japan........................*harmandi* Port.

B″ Pubescence of dorsum uniform gray; hind angles of pronotum obtusely rounded; base of pronotum black, not margined with rufous; metatibial spurs shorter than metabasitarsomere; less parallel; less depressed; length 5 mm.; Quebec and North Carolina to Arkansas, Kansas, Minnesota, and Ontario...........*opaca* Say

A″ Antennæ pale with segments seven to nine dark; legs pale; broadly oval; Sikhota Alin........................*sibirica* Reitt.

Prionochæta opaca Say

Catops opacus Say, Journ. Acad. Nat. Sci. Phila. V, 1825, p. 184; Complete Writings II, 1859, p. 289.—Lec. Proc. Acad. Nat. Sci. Phila. VI, 1853, p. 280.—Murray, Ann. Mag. Nat. Hist. (2) XVIII, 1856, p. 395 (separate p. 68), fig. 42.—Provancher, Pet. Faune Ent. Can. Col. 1877, p. 230.

Prionochæta opaca Say.—Horn, Trans. Am. Ent. Soc. VIII, 1880, p. 261, pl. 5, fig. 14.—Port. Ann. Soc. Ent. Fr. LXXII, 1903, p. 159.—Blatchley, Col. Ind. 1910, p. 280, fig. 139b.—Hatch, Col. Cat. 95, 1928, p. 306.

Specimens examined: QUEBEC (Kazubazua[d], Knowlton[d], Montreal[l]). NEW HAMPSHIRE (Franconia[b]). MASSACHUSETTS (Framingham[al], Sherborn[l]). NEW YORK (Buffalo[f], Cranberry L., Ithaca[ek], Mosholu[b], Upper Saranac[m], West Point[a], White Plains). NEW JERSEY (Boonton[abm]). PENNSYLVANIA (Allegheny[a], Arcola[a], Chestnut Hill[a], Delaware Water Gap[b], Easton[jm], Frankford[a], Philadelphia[a]). MARYLAND (Jackson's I.[a], Plummer's I.[a]). DISTRICT OF COLUMBIA[g]. VIRGINIA (Fredericksburg[a], Pennington Gap[a]). NORTH CAROLINA (Black Mts.[b], Round Knob[a]). OHIO (Cincinnati[l]). ONTARIO (Gravenhurst[a], Ottawa[d], Sudbury[d], Toronto[ek]). MICHIGAN (Ann Arbor[a], Detroit[ah], Grand Ledge[a], Livingston Co., Oakland Co.[h]). MINNESOTA (Chisago Co.[g]). IOWA (Guttenberg[a]). KANSAS (Lawrence[df], Topeka[a]). ARKANSAS ("south west Ark."[b]).

I have taken this species at carrion in New York and Michigan and Mr. Frost so records it from Massachusetts. I have taken it likewise in decaying fungi in Michigan and Frost and Blatchley so record it from Massachusetts and Indiana respectively.

Blatchley, moreover, records specimens from rabbit nests in Indiana, Shannon and Barber from a buzzard's nest in Maryland, and Shoemaker and Barber from a syrup trap in Virginia.

Catoptrichus Murr.

Catoptrichus frankenhæuseri Mann.

Hatch, Col. Cat. 95, 1928, p. 205 (*Frankenhauseri*).

Described from Sitka, Alaska, in a human cadaver, and listed from Masset (Queen Charlotte I.), B. C., under carrion by Keen (Can. Ent. XXVII, 1895, p. 168). I have seen specimens from "Q. C. I."[d] and the "mainland" of British Columbia[d], and Olympia and Seattle, Wash.

Subfamily Coloninæ

Colon Herbst

Judging from the number of apparently new species that have been revealed by the rather limited number of specimens of this genus that I have had before me for study, the Nearctic forms of *Colon* must be very incompletely understood. I hope that the new species and new characters here described will induce a more critical study of our fauna. I have studied my material under a magnification of from forty to eighty diameters. Under such magnification certain inadequacies in the older descriptions become apparent. The sculpture of the pronotum must be more adequately described. I find several types. First is a type in which the surface is set with well impressed discrete punctures, the spaces between the punctures, which are less than the area of the punctures, being nearly smooth. A second type is exhibited by *C. pribilof* sp. nov., in which the punctures are feebly impressed and the center of the puncture about the base of the hair is more or less ocellate. Thirdly there is the type which may be variously described as "roughly" or "granulately" punctate, which may be the result of the complete obsolescence of the periphery of the puncture itself and the more or less conspicuous elevation of the central ocellate portion of the puncture.

The form of the hind angles must be noted precisely. I consider the hind angles "rounded" if they are so revealed under a magnification of eighty diameters. If the margins are arcuate for a considerable distance from the angle, the angle is "broadly rounded," if for an inconsiderable distance, the angle is "narrowly rounded." If the angle is "narrowly rounded" it may be either "obtusely," "rectangularly," or "acutely narrowly rounded," depending upon the sort of angle that would have been formed had the angle been "distinct" rather than "rounded."

In the notes on described species I have attempted to supplement the description of the distribution given in the Coleopterorum Catalogus (Hatch, 95, 1928, p. 214, 225–226) with such other distribution as I have encountered in the literature, but, in view of our incomplete knowledge of the species, such records may well be taken *cum grano salis.*

Colon (Curvimanon) bidentatum Sahlb.

Specimens examined: BRITISH COLUMBIA[d]. ALBERTA (Edmonton[j]). It is recorded from New Jersey by Smith (Ins. N. J. 1909, p. 230).

Subgenus **Mylœchus** Latr.

All the American species of *Colon* belong to this subgenus except *bidentatum* mentioned above and *paradoxum* Horn, which belongs to *Colon* s. str.

The four species of the *hubbardi*-group possess the following characteristics in common in the male (females unknown).

Basal three protarsomeres dilated; metafemur with an elongate parallel sided tooth along inner margin towards apex; metatibiæ arcuate. Length 2.5 mm. Rufous, the head somewhat darker. Pubescence flavous. Head coarsely, discretely punctate. Antenna with a five segmented club, the sixth and seventh segments transverse. Pronotum and elytra subequally granulately punctate. Pronotum narrower than elytra, not wider at base than elytra at base, about seven tenths as long as wide (three fourths in *hubbardi*), about one half as wide at apex as at base, widest just behind middle; sides feebly arcuate behind, more strongly arcuate towards the broadly rounded anterior angles; base feebly sinuate either side of middle. Elytra widest at about basal two fifths, sides feebly arcuate basally, feebly narrowed behind to the more or less separately rounded hind angles; sutural stria entire; disc devoid of striæ. Pro- and mesotibiæ straight; apex of all tibiæ widened.

The species may be differentiated as follows:

A′ Metafemur three times as wide at apex as at base; pro-, meso-, and metatibiæ twice as wide at apex as at base; metafemoral tooth with inner angle produced.

B′ Hind angles of pronotum broadly rounded; D. C. ...**hubbardi** Horn

B″ Hind angles of pronotum feebly produced, obtusely rounded, the base sinuate just within the angle; type ♂: Detroit, Mich. (in coll. U. S. National Museum Cat. No. 43483)..... **productum** sp. nov.

B‴ Hind angles of pronotum retracted, the angle itself an obtusely rounded lobe mesad of which the base is evidently sinuate; type ♂: Black Mts., N. C. (VI–22) (in coll. Amer. Museum); paratype ♂ same data (VI–02) (Van Dyke collection). **excisum** sp. nov.

A″ Metafemur four times as wide at apex as at base, the apex on the outer side more broadly rounded; meso- and metatibiæ three times as wide at apex as at base, as a result being somewhat more strongly sinuate within; metafemoral tooth notched at apex; pronotum with hind angles subrectangularly produced, the base somewhat sinuate just within the hind angles; type ♂: Seattle, Wash. 7–10–12 (in author's collection) ....**kincaidi** sp. nov.

By the form of the ♂ metafemoral tooth and the posterior pronotal angles these species are closely related to *appendiculatum* Sahlb. and *calcaratum* Er. of Europe. *Appendiculatum* may be distinguished by the evident discal striæ of the elytra.

Colon (Myloechus) hubbardi Horn

Horn records cotypes from Michigan and Tennessee and Dury (Jour. Cincinnati Soc. Nat. Hist. XX, 1902, p. 119) records it from Ohio.

Colon (Myloechus) dentatum Lec.

Listed from New Jersey (Smith, l.c.), Quebec (Chagnon, Suppl. Rep. Que. Soc. Protec. Plants, 1917, p. 184), and Ohio (Dury, l.c., XXI, 1910, p. 66).

Colon (Myloechus) putum Horn

Hatch, Col. Cat. 95, 1928, p. 225 (*putatum*).

Listed by Leonard (Cornell U. Agr. Exp. Sta. Mem. 101, 1928, p. 273) from New York.

The five new species described below are all members of the *dentatum-celatum-putum-liebecki* group. In each case I have isolated what appear to be the diagnostic characters in an introductory paragraph.

Colon (Myloechus) rufum sp. nov.

Male: basal three protarsomeres dilated; metafemur acutely minutely dentate at middle along anterior margin below; protibia straight, with outer margin just visibly sinuate, with outer anterior angle somewhat acute, apex three times as wide as base, with inner margin somewhat sinuate towards base; metatibiæ straight, not enlarged at apex. Pronotum equal in width to elytra, wider than elytra at base; surface moderately but rather finely granulately punctate, much more finely so than the elytra; hind angles rounded; base arcuate, feebly sinuate on either side of middle; sides arcuate.

Length 1.6–1.8 mm. Rufous, pubescent. Head coarsely densely, discretely punctate. Antenna with four segmented club. Pronotum two-thirds as long as wide, widest in front of base; base nearly twice as wide as apex; sides arcuate, strongly incurved towards base. Elytra widest at base, sub-parallel for about basal third, thence feebly narrowed to the separately rounded elytral apices; sutural stria entire; discal striæ absent. Mesotibia straight, wider at apex.

Type ♂: Macon Co., Ill., V–8–1925. M. H. Hatch (in author's collection). Paratype ♂: Ft. Pendltn., W. Va., 8–7. Coll. Hubbard and Schwarz (in U. S. National Museum).

Distinguished from *celatum* by its straight protibia, from *putum* by its rounded posterior pronotal angles, and from *dentatum* by its finely punctate pronotum.

Colon (Myloechus) discretum sp. nov.

Male: basal three protarsomeres dilated; metafemur with an acute moderately large tooth at middle along anterior margin below; protibia arcuate, with outer margin sinuate towards apex, with outer anterior angle bluntly acute, with apex about twice as wide as base, with inner margin sinuate near middle. Metatibiæ nearly straight. Pronotum subequal in width to elytra; surface densely discretely strongly punctate; sides arcuate; hind angles broadly rounded; base feebly arcuate. Elytral sculpture nearly as coarse as that of the pronotum, granulate.

Length 3 mm. Pubescent. Head black, pronotum piceous, elytra and venter somewhat, the legs and basal portions of the antennæ evidently paler. Head coarsely densely discretely punctate. Antennæ with four segmented club. Pronotum nearly seven tenths as long as wide, widest about basal fourth, apex nearly half as wide as base. Elytra widest about basal fifth, feebly narrowed to the separately rounded apices; sutural stria entire; discal striæ absent. Mesotibiæ straight, feebly wider at apex.

Type ♂: Lorna, B. C., VIII–27–1926. H. Richmond. *Picea engelmanni.* 17165 Lot 68 (in coll. Ralph Hopping).

Distinguished from *dentatum*, *putum*, and *liebecki* by the form of its protibia, from *celatum* by its densely punctate pronotum.

Colon (Myloechus) rectum sp. nov.

Male: basal three protarsomeres dilated; metafemur acutely dentate at middle along anterior margin below; protibia straight along outer margin with outer anterior angle rectangular, apex three times as wide as base, with inner margin somewhat sinuate towards base; metatibiæ just visibly arcuate, not enlarged at apex. Pronotum narrower than elytra, equal in width to elytra at base; surface densely granulately punctate but less distinctly so than the elytra; hind angles broadly rounded; base arcuate, feebly sinuate on either side of middle; sides arcuate.

Length 2.75 mm. Piceous, pubescent, the head except the anterior margin black, the mouthparts, venter, legs, and basal segments of antennæ rufopiceous. Head coarsely, densely, discretely punctate. Antennæ with four segmented club. Pronotum three fourths as long as wide, widest in front of base; base twice as wide as apex; sides feebly arcuate basally, more strongly arcuate beyond basal third. Elytra widest at about basal third, feebly narrowed to the separately rounded elytral apices; sutural stria entire; discal striæ absent. Mesotibiæ feebly arcuate, somewhat wider at apex.

Type ♂: Ft. Pendltn., W. Va., 8–7. Coll. Hubbard and Schwarz (in U. S. National Museum, Cat. No. 43484).

Distinguished from other species of the group by its straight outer protibial margin.

Colon (Myloechus) pribilof sp. nov.

Male: basal three protarsomeres dilated; metafemur acutely minutely dentate at middle along anterior margin below; protibia angulately bent at middle, outer margin arcuate, inner margin with an obtuse angulate sinuation at middle, outer apical angle obtuse; metatibia straight, feebly widened at apex. Pronotum nearly as wide as elytra, wider than elytra at base; surface densely, somewhat shallowly and subgranulately punctate; hind angles feebly produced, narrowly obtusely rounded; the sides obliquely sinuate in front of the hind angles and behind an obtuse angulation at basal fourth, thence arcuate to apex; base evidently sinuate on either side just within the hind angles and just visibly sinuate on either side of the middle. Elytral sculpture coarser than that of pronotum, granulate.

Length 2.4 mm. Piceous, the legs and basal portions of antennæ always evidently paler, the venter and pronotum sometimes feebly so. Pubescent. Antennæ with four segmented club. Head coarsely densely discretely punctate. Pronotum nearly three fourths as long as wide, widest at basal fourth; apex nearly three fifths as wide as base. Elytra widest about basal third, gradually narrowed to the conjointly rounded apex, the sutural angles narrowly rounded; sutural stria entire; discal striæ absent. Mesotibia straight, feebly widened at apex.

Female with protarsi, protibiæ, and metafemora unmodified; the margin of the pronotum in front of the posterior angles obliquely truncate, not sinuate.

Type ♂, allotype ♀, and three paratype ♂: St. Paul I., Alaska. Aug. 1897. T. Kincaid (in coll. U. S. National Museum, Cat. No. 43485). 1 paratype ♂ same data in collection of author.

Distinguished from all other species of the group by the side margins of the pronotum being obliquely sinuate in front of the posterior angles. The form of the protibia relates it to *liebecki* Wickham.

Colon (Myloechus) schwarzi sp. nov.

Male: basal three protarsomeres dilated; metafemur with an elongate blunt tooth at middle along anterior margin below; protibia arcuate, with outer margin sinuate towards apex, with outer anterior angle rectangular, with apex two or three times as wide as base, with inner margin almost subangulately sinuate near middle; metatibiæ feebly curved at base, feebly widened at apex. Pronotum equal in width to elytra, wider than elytra at base; surface densely discretely strongly punctate; posterior angles broadly rounded; base arcuate, just visibly sinuate either side of middle; sides arcuate. Elytral sculpture nearly as coarse as that of the pronotum, granulate.

Length 2.9 mm.; brownish, the antennæ except the basal segments darker; pubescent. Head coarsely discretely punctate. Antenna with four segmented club. Pronotum seven tenths as long as wide, widest at or just in front of the broadly rounded posterior angles; the sides arcuate; apex less than half as wide as base. Elytra feebly arcuate at basal half, feebly narrowed to the separately rounded elytral apices; sutural stria entire; discal striæ very feebly indicated. Mesotibiæ straight, feebly widened at apex.

Type ♂: Rnd. Knob, N. C. 26–6 (in U. S. National Museum, Cat. No. 43486), Paratype ♂: Detroit, 15 Sep. (in author's collection).

Distinguished from other species of the group by its elongate blunt metafemoral tooth.

Colon (Myloechus) magnicolle Mann.

Recorded from Ohio (Dury, l.c. XX, 1902, p. 119), Wisconsin (Wickham, Proc. Davenport Acad. Nat. Sci. VI, 1896, p. 140), Colorado (Wickham, Bull. Lab. Nat. Hist. St. U. Iowa V, 1902, p. 247) and New York (Leonard l.c.).

Colon (Myloechus) pusillum Horn

Recorded from Quebec (Chagnon, l.c.), New York (Leonard, l.c.), District of Columbia (Ulke, Proc. U. S. Nat. Mus. XXV (1275), 1902, p. 10), and Yukon Territory (Fall, Pan-P. Ent. II, 1926, p. 143).

Colon (Myloechus) thoracicum Horn

Specimen examined: VIRGINIA (Fredericksburg[a]).

Colon (Myloechus) asperatum Horn

I have seen specimens ranging from California to Maine that appear to belong to this species as conceived by Horn. The specimens vary greatly in size (1.4 to 3 mm. in length), color (piceous to rufous) and to some extent as regards the shape and sculpture of the pronotum. I am almost certain that several species are involved, but am unable at present to define any of them.

Subfamily **Leptodirinæ** (Bathysciinæ)

Platycholeus Horn

(Genotype **Ptomaphagus leptinoides** Crotch)

Horn, Trans. Amer. Ent. Soc. VIII, 1880, p. 251, 254.—Jeannel, Arch. Zool. exp. gén. LXI, 1922, p. 9–12; LXIII, 1924, p. 30, 35. —Bradley, Gen. Beetles Am. n. of Mex. 1930, p. 54.

leptinoides Crotch, Trans. Amer. Ent. Soc. V, 1874, p. 77 (*Ptomaphagus*).—Horn, l.c. VIII, 1880, p. 254, pl. VI, fig. 2.—Wasmann, Krit. Verzeichn. myrm. term. Arthrop. 1894, p. 129.—Fall, Psyche XVI, 1909, p. 133.—Snyder, Bull. U. S. Nat'l Mus. 108, 1920, p. 119.—Jeannel, Arch. Zool. exp. gén. LXI, 1922, p. 9–12, fig. 1–2; LXIII, 1924, p. 35–36, fig. 41–

42. California, Nevada, Oregon. Termitophilous with *Termopsis nevadensis* Hagen.

Specimens examined: CALIFORNIA (L. Tahoe[a], Sisson[a], Placerville[a]).

opacellus Fall, Psyche XVI, 1909, p. 133. California.

Platycholeus is the only Nearctic genus of Leptodirinæ, the only genus of the subfamily to occur outside the Palaearctic area. Jeannel affirms that it is most closely related to the eastern Siberian *Sciaphyes* and that it and that genus are relicts of a fauna that once extended from Siberia to America across a Bering Strait land bridge. Fall (l.c.) distinguishes the two species of the genus: *leptinoides* with the dorsum shining; *opacellus* with the pronotum feebly shining, the elytra opaque. Jeannel states that the beetle is termitophilous, but Fall indicates that the possibility of it being myrmecophilous has not entirely been excluded.

MALE GENITALIA OF LEPTODIRIDÆ

Adelops hirtus Tellk. is the only American leptodirid to have had its male genitalia figured (Jeannel, Arch. Zool. exp. gén. LXI, 1922, p. 21, fig. 32). In connection with the present study I have figured (fig. 16–28) the male genitalia of as many of our species as were represented by a sufficient series of specimens. The data so derived confirm to a remarkable degree the conclusions attained through a study of the more available portions of the animal, so that I have confined them to the present appendix.

Following the terminology of Sharp and Muir, the male genitalia of the species studied consists of a *median lobe* and right and left *lateral lobes* which are united baso-ventrally by a transverse plate. In specimens which exhibited it in an extroverted condition (fig. 10, 11, 15, 22, 25a), the *internal sac,* extruding from the apex of the median lobe, has been figured. Its absence from the other figures is, however, of no significance.

The differential characteristics exhibited by the male genitalia of the species dissected are noted briefly in the following key, which makes no pretense of validity beyond the species actually studied. A general agreement, however, may be noted with those forms studied by Jeannel (l.c., p. 15–27).

KEY TO MALE GENITALIA OF CERTAIN NEARCTIC LEPTODIRIDÆ

A′ Lateral lobes longer than median lobe, which is bilaterally symmetrical at apex .... subtribe *Anemadina*
  B′ Lateral lobes foliaceous at apex .... *Nemadus*
    C′ Median lobe nearly straight in lateral view (fig. 10). *N. pusio* Lec.
    C″ Median lobe moderately arcuate (fig. 11, 11a). *N. parasitus* Lec.
    C‴ Median lobe rectangularly bent at about middle (fig. 12). *N. horni* Hatch
  B″ Lateral lobes only moderately dilated at apex .... *Dissochaetus*
    C′ Lateral lobes more strongly dilated at apex, shorter, feebly sinuate nearly straight; median lobe less attenuate (fig. 15) .... *D. brachyderus* Lec.
    C″ Lateral lobes less strongly dilated at apex.
      D′ Lateral lobes shorter, nearly straight; median lobe less attenuate (fig. 13) .... *D. arizonensis* Hatch
      D″ Lateral lobes longer, sinuate within towards apex; median lobe more attenuate (fig. 14) ...... *D. oblitus* Lec.
A″ Lateral lobes not longer than median lobe.
  B′ Median lobe asymmetrical, "notched" somewhat before apex on left side; lateral lobes attenuate, shorter than median lobe. subtribe *Ptomaphagina*
    C′ Notch small, obscure .... *Ptomaphagus*
      D′ Median lobe arcuate at apex in lateral view. *Pt. consobrinus* Lec. (fig. 16, 16a) and *fisus* Horn
      D″ Median lobe feebly knobbed at apex in lateral view.
        E′ Apical knob smaller (fig. 17, 17a). *Pt. cavernicola* Schz.
        E″ Apical knob larger (fig. 18, 18a). *Pt. californicus* Lec.
    C″ Notch more evident .... *Adelops*
      D′ Apex of median lobe beyond notch larger (fig. 19). *A. lödingi* Hatch
      D″ Apex of median lobe smaller .... *A. hirtus* Tellk.
  B″ Median lobe bilaterally symmetrical at apex .... subtribe *Catopina*
    C′ Median lobe strongly arcuate; lateral lobes shorter than median lobe; basal piece not bilobed below .... *Catops*
      D′ Median lobe not turned up abruptly at apex. subg. *Sciodrepa*
        E′ Ventral surface of median lobe bilobed.
          F′ Lateral lobes very slender.
            G′ Apex of median lobe not sinuate above in side view.

H′ Processes formed as a result of the bilobing of the ventral surface of the median lobe not strongly pigmented; apex of median lobe not suddenly depressed in lateral view.

I′ Apex of median lobe more attenuate in lateral view (fig. 20, 20a).
C. gratiosus Blanch.

I″ Apex of median lobe less attenuate in lateral view; internal sac with prominent scleroticized apex (fig. 21, 21a).
C. americanus Hatch

H″ Processes formed as a result of the bilobing of the ventral surface of the median lobe strongly pigmented: apex of median lobe suddenly depressed in lateral view; apex of internal sac feebly scleroticized (fig. 22, 22a)......*C. simplex* Say

G″ Apex of median lobe sinuate above and somewhat lobed in side view (fig. 23, 23a)................................*C. hornanus* Blanch.

F″ Lateral lobes stout, sinuate towards apex (fig. 24, 24a).............................*C. alsiosus* Horn

E″ Ventral surface of median lobe not bilobed, the ventral margins strongly lobed in lateral view; lateral lobes very slender.

F′ Median lobe in side view not sinuate above, less attenuate; internal sac with numerous long barbs (fig. 25, 25a)......*C. basilaris* Say

F″ Median lobe in side view feebly sinuate; more attenuate (fig. 26, 26a).
C. egenus Horn

D″ Median lobe turned up abruptly at apex; lateral lobes attenuate; ventral surface of median lobe bilobed; internal sac with about four chitinous teeth (fig. 27, 27a).............................(subg. *Sciodrepoides*) *terminans* Lec.

C″ Median lobe nearly straight; lateral lobes as long as median lobe, slender at base, ovally dilated at apex; basal piece bilobed below (fig. 28, 28a)..................*Prionochaeta opaca* Say

PLATE XV

Figures 1–9. Apices of left elytron of *Ptomaphagus* ♀: (1) *californicus* Lec., (2) *nevadicus* Horn, (3) *texanus* Melander, (4) *fisus* Horn, (5) *cavernicola* Schwarz, (6) *latior* Hatch, (7, 7a) *ulkei* Horn, (8) *piperi* Hatch, (9) *consobrinus* Lec.

Figures 10–28. ♂ genitalia of Leptodiridæ.

Figure 10. *Nemadus pusio* Lec., lateral view with internal sac evaginated.

Figures 11, 11a. *N. parasitus* Lec., with internal sac evaginated: (11) lateral view, (11a) ventral view of apical portions.

Figure 12. *N. hornii* Hatch, lateral view.

Figure 13. *Dissochaetus arizonensis* Hatch, ventral view.

Figure 14. *D. oblitus* Lec., ventral view with internal sac evaginated.

Figure 15. *D. brachyderus* Lec., ventral view with internal sac evaginated.

Figure 16, 16a. *Ptomaphagus consobrinus* Lec.: (16) lateral view, (16a) dorsal view of apex of median lobe.

Figures 17, 17a. *Pt. cavernicola* Schwarz: (17) lateral view, (17a) dorsal view of apex of median lobe.

Figures 18, 18a. *Pt. californicus* Lec.; (18) lateral view, (18a) dorsal view of apex of median lobe.

Figure 19. *Adelops lödingi* Hatch, dorsal view.

Figures 20, 20a. *Catops* (*Sciodrepa*) *gratiosus* Blanch.: (20) lateral view, (20a) ventral view of apical portions.

Figures 21, 21a. *C. americanus* Hatch: (21) lateral view, (21a) ventral view of apical portions.

Figures 22, 22a. *C. simplex* Say: (22) lateral view, (22a) ventral view of apical portions.

Figure 23, 23a. *C. hornianus* Blanch.: (23) lateral view, (23a) ventral view of apex of median lobe.

Figures 24, 24a. *C. alsiosus* Horn: (24) lateral view, (24a) lateroventral view.

Figures 25, 25a. *C. basilaris* Say: (25) lateral view, (25a) same with spinose internal sac partially evaginated.

Figures 26, 26a. *C. egenus* Horn: (26) lateral view, (26a) ventral view.

Figures 27, 27a. *C.* (*sciodrepoides*) *terminans* Lec.: (27) lateral view, (27a) ventral view of apex of median lobe.

Figures 28, 28a. *Prionochaeta apaca* Say: (28) lateral view, (28a) ventral view.

LEPTODIRIDAE

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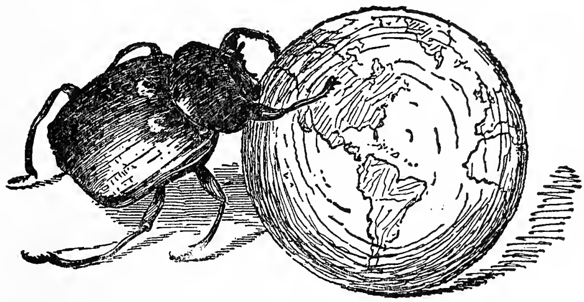

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CONTENTS

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THE SHIELDING EFFECTS OF VARIOUS MATERIALS WHEN INSECTS ARE EXPOSED TO THE LINES OF FORCE IN A HIGH FREQUENCY ELECTRO-STATIC FIELD[1]

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Rutgers University, New Brunswick, New Jersey

Introduction

It has been shown that electromagnetic waves can destroy certain insects when they are exposed in a high frequency electrostatic field: crickets (Lutz 1926); *Apis mellifera*, Glypta, *Musca domestica, Diabrotica 12-punctata, Pieris rapae,* and *Periplaneta germanica,* (Headlee and Burdette 1929). It appears that this destruction is due to the generation of internal heat of lethal degree (Headlee and Burdette 1929). It has also been found that there is a differential effect on plants and on insects: wheat seeds, seedlings, and *Apis mellifera* (Headlee 1931); bean seeds, and bean weevils (Hadjinicolaou 1931).

Insects live within and are surrounded by various common substances which the lines of force must penetrate if they are to

[1] Contribution from Department of Entomology.

Paper of the Journal Series, New Jersey Agricultural Experiment Station, Department of Entomology.

Acknowledgment. I wish to acknowledge my indebtedness to Dr. Thomas J. Headlee for his encouragement and guidance throughout these investigations.

kill the insects. For this reason a study of the shielding effects of these common substances was undertaken. The common substances within which insects work and by which they might be protected are: liquids, solutions, oils, chemical elements, soil minerals, soils, carbohydrates and proteins.

The Apparatus

The machine used was a vacuum tube oscillator. The active field was formed by two 6″ x 6″ aluminum plates facing each other. When an alternating E.M.F. is set up across the plates the dielectric is strained first in one direction and then in the other. These stresses that are set up are equivalent to displacement currents in the dielectric. The experimental subjects were placed between the plates so that they were in the direct path of the lines of force.

A constant frequency of 3,000,000 cycles per second and a constant field strength of 2,620 volts per linear inch were maintained except where otherwise specified.

Experimental Procedure and Results

In the investigations two pyrex glass tubes were used: one, 100 mm. long and 13 mm. in diameter; the other 150 mm. long and 25 mm. in diameter. The smaller tube containing three adult worker honey bees, which were the insects used in the investigations, were placed in the larger one and the material to be tested was then placed in the larger tube around the smaller tube. This left a wall of 6 mm. of substance all around the bees. In this way the penetrating effect of the lines of force could be studied, and at the same time the heating effects on the substances were also investigated.

The lethal effect of the lines of force to the worker honey bee was first determined when the bees were shielded by the air between the inner and the outer tubes. The time to kill the bees under this condition was used as the standard of comparison with the time to kill them when other substances were used. This time was found to be, as an average of 20 trials, 4 minutes and 13 seconds and was given the unit value of one. All other time observations were divided by this time to kill so that a series of time index numbers were obtained with the lethal effect through

TABLE 1

PENETRATING AND HEATING OF LIQUIDS

Liquid	Condition	No. of Runs	Temperature Rise °F.		Time Index Air = 1	Dielectric Constant	Condition of Bees
			Inner Tube	Substance			
Water	Distilled	7	3°	3.3°	2.37	81	Normal
Water	Triple Distilled	3	5.2°	2°	2.37	81	Slightly excited
Glycerine	U. S. P.	3	4°	.5°	2.37	45	" "
Methyl Alcohol	Crude	3	40.6°	44.6°	2.37	40	Dead (from outer heat)
Ethyl Alcohol	95%	3	10°	5°	2.37	30	Weakened
Amyl Alcohol	U. S. P.	3	40.6°	46°	.99	15	Dead (from outer heat)
Analine	Pure	3	15°	6.6°	2.37	7.2	Very weak
Chloroform	U. S. P. Ak. 1%	7		1°	1.42	5	Dead
Petrolatum	Extra Heavy	5		3°	1.04	2.2	"
Petroleum Oil	Light	5		2.2°	.97	2	"

air as a standard of comparison. The time index is never over 2.37, since the lines of force produced no lethal effect on the honey bees, if they did not kill them in ten minutes.

Penetration Through Liquids. A series of liquids were taken (table 1) whose dielectric constants, according to the International Critical Tables, ranged from 81 to 2. An examination of the table shows that there is a definite relation between the dielectric constant of the liquids and the lethal effect of the lines

TABLE 2

PENETRATION AND HEATING OF AQUEOUS SOLUTIONS

Solution	Condition	No. of Runs	Temperature Rise °F. Inner Tube	Temperature Rise °F. Substance	Time Index Air = 1	Condition of Bees
Non-Electrolytes						
Dextrose	$\frac{M}{10}$	3	4°	3°	2.37	Excited
Sucrose	$\frac{M}{10}$	3	4°	4°	2.37	"
"	$\frac{M}{2}$	4	4°	3°	2.37	"
Wheat starch	$\frac{1\text{ gm.}}{100\text{ cc.}}$ Colloidal	3	6.3°	6°	2.37	"
Blood Albumin	$\frac{1\text{ gm.}}{100\text{ cc.}}$ Soluble	2	3°	1°	2.37	"
Egg Albumin	$\frac{1\text{ gm.}}{100\text{ cc.}}$ Soluble	2	3°	2°	2.37	"
Electrolytes						
KCl	$\frac{M}{10}$ Highly ionized	7	1.3°	1.3°	2.37	Normal
NaCl	$\frac{M}{10}$ Highly ionized	7	1.6°	1.6°	2.37	"
$MgSo_4$	$\frac{M}{10}$	6	2°	2°	2.37	"
KH_2Po_4	$\frac{M}{10}$	5	1.6°	1.6°	2.37	"
Sodium silicate	$\frac{M}{10}$	5	1.8°	1.8°	2.37	"
$Fe(OH)_3$	$\frac{M}{10}$ Colloidal	5	10.2°	10.2°	2.37	Slightly excited (from outer heat).

of force: namely that the lethal effects of the lines of force increase with decreasing dielectric constants.

Penetration Through Aqueous Solutions. An investigation of table 2 brings out the fact that there is apparently no penetration of the lines of force through electrolytic solutions while through non-electrolytic solutions there is apparently enough to excite the bees. Evidently the conducting solutions deflect the lines of force. The table also shows a tendency for heating to be less in electrolytic solutions. The two colloidal substances used caused higher heating of the solutions. Marshall (1930) states that the rapid heating of a carbon disulfide emulsion is due to its colloidal structure, but gives no further explanation for the cause of rapid heating.

The Penetration Through Oils. A study of the lethal effect of the lines of force through oils (table 3) shows that there is greater lethal effect through mineral oils than through either animal or plant oils. Of the animal oils, the lethal effect through cod-liver oil was the quickest; and of the plant oils, the lethal effect through pine oil was the quickest. None of the oils showed any marked heating effects.

TABLE 3

PENETRATION THROUGH AND THE HEATING OF OILS

Oil	Condition	No. of Runs	Temperature Rise °F. Inner Tube	Temperature Rise °F. Substance	Time Index Air = 1	Condition of Bees
Petroleum	Light	5		2.2°	.97	Dead
"	Heavy	5		1.4°	1.06	"
Petralatum	Extra heavy	5		3°	1.04	"
"	Light	5			1.18	"
Cod-Liver	Pure	5		2.4°	1.27	Dead
Whale		6		5°	2.37	Very weak and dead
Pine	Light	5		4°	1.27	Dead
Cedarwood		5		8.4°	1.90	"
Bergamot		2	14°	9°	2.37	Weakened
Linseed	Raw	5	12°	7.5°	2.37	"
Cinnamon		3	8.3°	4.3°	2.37	"
Citronella	Java	3	6°	4.3°	2.37	"

The Penetration Through Chemical Elements. An examination of certain elements (table 4) shows that lead foil from cigarette packages, copper wire screening; tin sheeting; iron wire screening; silver, precipitated on inside of large test-tube; and mercury are all perfect shields to the insects. The size of the mesh in the screening did not appear to affect the deflection of the lines of force. On the other hand, metals in the form of aluminum dust, zinc dust, granular manganese, and granular nickel allowed the penetration of the lines of force to a varying degree. Evidently the surfaces of the particles had become oxidized, causing the metals to act as dielectrics. Of the two non-metallic elements carbon, a conductor, was a shield and sulfur, a non-conductor, facilitated the passage of the lines of force into the inner tube. Very little heating was observed in the metals with the exception of granular nickel which showed rapid treating under the effect of the stresses.

TABLE 4

THE PENETRATION THROUGH AND THE HEATING OF METALLIC AND NON-METALLIC ELEMENTS

Substance	Condition	No. of Runs	Temperature Rise °F.		Index Time Air = 1	Condition of Bees
			Inner Tube	Substance		
Silver	Pure sheet	5			2.37	Normal
Copper	Wire screening	5			2.37	"
Iron	Wire screening	5			2.37	"
Tin	Sheeting	5			2.37	"
Lead	Foil	5			2.37	"
Mercury	Liquid	3			2.37	"
Aluminum	Dust	3	10.3°	3.3°	2.37	Excited
Nickel	Granular	4		30.5°	2.30	Dead
Manganese	"	12		2°	1.47	"
Zinc	Dust	8		5°	1.04	"
Carbon	Conductor Dust	5	7.4°	7.6°	2.37	Normal
Sulfur	Non-Conductor Dust	5		3.6°	.84	Dead

Penetration Through Soil Minerals. The small time indexes indicate a rapid lethal effect through all of the soil minerals examined (table 5). In none of the soil minerals was there a lethal heat accumulated to cause the death of the bees, except in the case of tri-calcium phosphate where the temperature rose 38.5 degrees F. in one minute and 22 seconds in the dry material.

TABLE 5

THE PENETRATION THROUGH AND THE HEATING OF SOIL MINERALS

Substance	Condition	No. of Runs	Temperature Rise °F. Inner Tube	Temperature Rise °F. Substance	Time Index Air = 1	Condition of Bees
Silica	Ground	5		5=	.77	Dead
Iron Hydroxide	Colloidal	5		21.4°	.80	"
Gypsum	$CaSO_4 \cdot 2H_2O$	5		5.4°	.71	"
Calcite	$CaCO_3$	5		9.3°	.63	"
Kaolin	$H_2Al_2(SiO_4)_2 \cdot H_2O$	5		19°	.53	"
Magnesium Oxide	MgO	5		20°	.53	"
Calcium Phosphate	$Ca_3(PO_4)_2$	6		38.5°	.35	"

Penetration Through Soils. Examination of table 6 shows that soils greatly facilitate the penetration of the lines of force and that moisture content of the soils is of great importance in the lethal effect of these lines of force. It appears that clay even in the dry condition heats rather rapidly. Small amounts of moisture which are insufficient to raise the temperature of the soils high enough to kill the bees appear to hasten the lethal effect of the stresses. The speed of kill and also the heating increases with the amount of water added to a certain point, and then diminishes with the addition of more water. The table also brings out the abnormal heating of water when it is in a dispersed state. According to Hosmer (1928) rate of heating is directly proportional to the length of the conducting path measured perpendicular to the plates and inversely proportional to its cross-section. Since dispersing the water increases the length of the conducting path in proportion to its cross-section, dispersed water is heated rapidly. To investigate the effect of dispersed liquids on heating, water and oil were exposed to the lines of force in mass, and then a foam emulsion, made of a very small quantity of albumin solution mixed and shaken with oil, was exposed to the lines of force. The latter form heated more than ten times as fast, rising 80 degrees F. in ten minutes. Another test was run wherein the water was dispersed by means of glass beads. The distilled water without the beads was heated 5° F. in 10 minutes, while the same volume of water dispersed by the glass beads was heated 18° F. in the same length of time. It is apparent that dispersed water in soils and similar substances is a major factor in the speed of heating of these substances.

Of the soils used and with the water content employed humus appears to have the ability to hold the greatest per cent. of moisture by weight with the least heating effect. A mixture of equal parts by weight of sand, clay, and humus may hold 10 per cent. moisture by weight or even more, without approaching a lethal temperature before the bees are killed by the lines of force.

TABLE 6

A STUDY OF THE SHIELDING AND HEATING EFFECTS OF SOIL

Substance	Condition	No. of Runs	Temperature Rise °F. Inner Tube	Temperature Rise °F. Substance	Time Index Air = 1	Condition of Bees
Clay	Oven Dry Ground	5		20°	.66	Dead
"	5% H_2O by wt.	5		35°	.64	"
"	20% H_2O by wt.	5	18.4°	12.8°	2.37	Weakened
Humus (Peat)	Oven Dry Ground	5		6°	.70	Dead
"	5% H_2O by wt.	6		6.6°	.63	"
"	20% H_2O by wt.	5		34.6°	.43	"
Sand	Oven Dry Fine	5		2°	.72	"
"	5% H_2O by wt.	5		43°	.48	"
Clay, Sand, Humus	Oven Dry Ground	5		2.4°	.54	"
Clay, Sand, Humus	5% H_2O by wt.	5		12.6°	.52	"
Clay, Sand, Humus	20% H_2O by wt.	5		39.8°	.38	"

Penetration Through Carbohydrates. Examination of table 7 shows that compared to air the lethal effect of the lines of force is on the whole greater through carbohydrates in the solid form. Different types of woody materials are easily penetrated by the lines of force. Addition of moisture to the wood frass accelerated the speed of kill of the bees as in the case of soils.

The pipe tobacco and the breakfast foods heat somewhat, but the lines of force proved lethal to the bees before the outer heat was great enough to kill the bees. An external temperature of about 118° F. is necessary to kill the bees. Hard wax has a time index very near that of air; and both dry raisins and green leaves protect the bees from the lines of force. They also heat readily because of moisture in them.

TABLE 7

A STUDY OF THE SHIELDING AND HEATING OF CARBOHYDRATE COMPOUNDS

Substance	Condition	No. of Runs	Temperature Rise °F.		Time Index Air = 1	Condition of Bees
			Inner Tube	Substance		
Paper	Corrugated	10			.58	Dead
"	Manila	10			.80	"
Cloth	Cheese	10			.81	"
Cellophane		10			.86	"
Paper	Waxed	10			.95	"
Cedar wood	Dry Frass	6			.96	"
" "	5% H_2O by wt.	5		8°	.92	"
" "	10% " " "	3		29°	.50	"
" "	Bark	10			.96	"
Excelsoir	Cut up	5			.96	"
Soft wood	Xylem	5			.98	"
Tobacco	Pipe	3		13°	.62	"
Wheat	Grain	10			.72	"
Quaker Oats	Ground	3		9°	.80	"
Rice Krispies	Ground	3		7°	.76	"
Sucrose	Dry granulated	5		2°	.90	"
Starch (Wheat)	Dry colloidal	5		6°	.93	"
Dextrose	Dry powder	5		4°	1.30	"
Raisins	Dry	1		36°	2.37	Dead (outer outer heat)
Green leaf		1		31°	2.37	Excited (by outer heat)
Paraffin	Wax solid	6		1°	1.02	Dead

Penetration Through Protein Materials. Examination of table 8 also shows accelerated lethal effects with protein substances. Chitin and the albumins show some heat accumulation, but not rapid enough to cause the death of the bees.

Penetration Through Vacua. Since the atmosphere is the basic dielectric involved in the lethal effects of the lines of force, a study was made of their lethal effect to the honey bees through

TABLE 8

A STUDY OF THE SHIELDING AND HEATING EFFECTS OF PROTEINACEOUS SUBSTANCES

Substances	Condition	No. of Runs	Temperature Rise °F. Inner Tube	Temperature Rise °F. Sub-stance	Time Index Air = 1	Condition of Bees
Leather	Chamois	5			.77	Dead
Albumin	Crystalline Dry Blood	3		16°	.72	"
"	Powder Dry Egg	3		13°	.78	"
Chitin	Flakes	3		12°	.80	"
Wool	Cloth	5			.84	"

different degrees of vacuum (table 9). In every case there is an abnormal rise in the time to kill from normal conditions to the first 5 inches of vacuum; after that there appears to be a gradual increase in time to kill to the highest degree of vacuum. It was observed that it took more time to kill the bees the first one or

TABLE 9

THE LETHAL EFFECT OF LINE OF FORCE THROUGH DIFFERENT DEGREES OF VACUUM

Degree of Vacuum	Field Strength	No. of Runs	Time in Minutes and Seconds	Condition of Bees
Normal	2,620	5	3′: 57″	Dead
5″	"	3	10′: 00″	Normal
10″	"	1	10′: 00″	"
25″	"	1	10′: 00″	"
5″	3,275	3	5′: 30″	Dead
10″	"	3	5′: 47″	"
15″	"	3	6′: 5″	"
20″	"	5	6′: 39″	"
25″	"	4	7′: 30″	"
30″	"	5	7′: 39″	"
Normal	3,930	5	0′: 26″	"
5″	"	5	2′: 7″	"
10″	"	5	2′: 17″	"
15″	"	5	2′: 18″	"
20″	"	5	2′: 17″	"
25″	"	4	2′: 46″	"
30″	"	5	2′: 58″	"

two trials with each new tube than in the following trials. No lethal effect whatsoever could be obtained at the field strength used in the preceding investigations with the vacuum tubes, therefore, it was found necessary to increase the field strength to 3,275 volts per inch until lethal effects were observed.

General Discussion. From these investigations it appears that the dielectric constant of liquids plays a major part in the lethal effect of the lines of force, which grows smaller as the dielectric constant increases. It does not influence the lethal effect in solid dielectrics, since the dielectric constant is small in most of them. Water containing ionized solutes and solid conductors appears to have a complete shielding effect on the honey bees, but there is some penetration of the lines of force through conductors in granular or dust state with oxidized surfaces. The lethal effect of the lines of force is greatly increased through soil minerals, soils, carbohydrates, and proteins. When moisture is added the lethal effect through soils and heat production in soils and similar materials increases with a rise in moisture content to a certain point and decreases with greater amounts beyond that point. The lethal effect of lines of force through vacua decreases with increasing evacuation to near 30 inches of mercury.

The investigations also show that colloidal solutions were heated more than ionic or molecular solutions; that tricalcium phosphate has an abnormal rate of heating; that heating is negligible in most dry solid dielectrics; and that the heating of soils and similar substances depends upon the degree of dispersion of the water and the quantity of water in them.

Conclusions. The lethal effect of lines of force in a high frequency electro-static field is limited in solid dielectrics mostly by moisture content; and in pure liquids by the dielectric constant.

Electrical conducting substances whether liquid or solid act as shields to insects when they are exposed to the lines of force between the plates.

As a result of these investigations it is considered possible to destroy insects in many substances without injuring them with excessive heat. These substances are mainly: soils with a limited amount of moisture, woody materials, tobacco, grains or seeds, breakfast foods, clothes, flours, paper, cellulose compounds, and nuts.

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REVISION OF THE LIST OF SIPHONAPTERA FROM NEW YORK STATE

By M. A. Stewart

The Rice Institute, Houston, Texas

Since the writer compiled the original list of Siphonaptera from New York State[1] a sufficient number of changes, in the way of additions, synonymy, and the clearing up of the family status in the order (Ewing 1929), have occurred to warrant revision of the list.

All specimens included in the records of this revised list have been determined, or checked, by the author unless a name and date, within parentheses, immediately follow the record.

Acknowledgements are due the officials of the New York State Museum and the Zoological Division of the Bureau of Animal Industry. Especial thanks are due Dr. H. E. Ewing of the U. S. National Museum for his never-failing, generous, cooperation in connection with the study of specimens under his supervision in the U. S. National Museum.

Family HECTOPSYLLIDÆ

Echidnophaga Olliff.

E. gallinacea Westw.—This species has been reported from New York City by Fox (1925) as occurring on rats, presumably *Rattus norvegicus* Erxleben.

Family PULICIDÆ

Cediopsylla Jordan

This genus was referred to in the original list as *Spilopsyllus* Bak. but Jordan (1925) has pointed out that the species formerly referred to under this genus differ from the *genotype, S. cuniculi,* in having a labial palpus of four segments rather than one of two.

[1] Published in "A List of the Insects of New York" Memoir 101 Cornell University—Aug., 1928, pp. 868–869.

C. simplex Baker.—In the previously published list this flea was reported as having been taken in Ithaca on the cotton-tail rabbit (*Sylvilagus floridanus mearnsi* Allen). Additional collections are as follows: Ithaca, from skunk (*Mephitis nigra* Peale and Beauvois); and Duanesburg from the gray fox (*Urocyon cinereoargentatus cinereoargentatus* Schreber).

Ctenocephalides Stiles & Collins

This genus was formerly referred to as *Ctenocephalus* Kolenati but Stiles and Collins (1930) have pointed out that this name is preoccupied by *Ctenocephalus* Hawle and Corda, a trilobite, and incidentally, also by *Ctenocephalus* Linstow, a nematode. These two authors have proposed the new name *Ctenocephalides* to replace *Ctenocephalus.*

C. canis Curtis.—No new records have been added for this species. It is reported from New York City by Fox (1925) as occurring on rats, presumably *Rattus norvegicus* Erxleben, and from Schenectady from an unrecorded host by Felt. The determination of the latter specimen has been checked by the author.

C. felis Bouché was previously recorded on the cat (*Felis domestica* L.) from Ithaca and from an unknown host on Long Island. More recent records indicate, as would be supposed, a statewide distribution of this flea. The additional records of this species are as follow: New York City, on rats, presumably *Rattus norvegicus* Erxleben (Fox 1925); Ithaca, on red squirrel (*Sciurus hudsonicus* subsp.) and dog (*Canis familiaris* L.); Rochester, on dog; Oakfield, in house; Clinton, on man; Cleron, in cellar of house; Schenectady, in house; and Hornell, from an unrecorded host.

Pulex Linnæus

P. irritans Linn.—No new records for this species have been reported. It has been taken in a house in Springfield, from an unrecorded host in Schenectady, and from a man in Brooklyn.

Xenopsylla Glinkiewicz

X. cheopis Roths.—This species, rare in the northern United States, has not been reported from New York State since the previous list was published. Fox (1925) recorded this flea from rats, presumably *Rattus norvegicus* Erxleben, in New York City.

Family DOLICHOPSYLLIDÆ

Catallagia Rothschild

No member of this genus was reported in the original list.

C. onaga Jord.—Jordan (1929) collected two males of this flea from the short-tailed shrew (*Blarina brevicauda* subsp.) at Lake Placid and described them as belonging to this new species. This collection is especially interesting since the other four species belonging to the genus are from Queen Charlotte Island, British Columbia, Alberta, and California.

Ceratophyllus Curtis

C. acerbus Jord.—This species did not appear in the original list but Jordan (1929) reports it from Lake Placid on the chipmunk (*Tamias striatus* subsp.). In the U. S. National Museum there are specimens, also from *Tamias striatus* subsp., collected at Chapel Pond.

C. asio Baker—Jordan (1929) reports this flea from Ithaca on "field mice."

C. fasciatus Bosc has been reported from Ithaca on rat, presumably *Rattus norvegicus* Erxleben, and on weasel (*Mustela* [*Putorius*] *noveboracensis noveboracensis* Emmons). Fox (1925) reports it from New York City, also on rat (*R. norvegicus* [?]). The latter record in some way was omitted from the original list.

C. gallinæ Schrank—In the list of 1928 this flea was reported only from an unrecorded host at Perry. Additional records are as follows: Barker, from hen house; Blauvelp, on man; Ithaca, from nest of English sparrow (*Passer domesticus domesticus* L.); Lake Placid (Jordan 1929) on chipmunk (*Tamias striatus* subsp.); and Mt. Kisco (Jordan 1928) in nest of *Passer domesticus domesticus*. *Tamias striatus* subsp. is obviously an accidental host.

C. niger niger Fox.—This species was recorded simply as *C. niger* Fox from Ithaca, on bluebird (*Sialia sialis* L.), in the original list. Jordan (1929) writes of this record, in view of the fact that this is a western species, as follows: "doubtless included in the list by error in consequence either of wrong locality labels or erroneous identification." This specimen has been very carefully checked and certainly belongs to the species in question. It is, of course, possible that in some way or other a wrong label was placed upon this slide by the individual who made the mount. However, the data as preserved are those given above.

C. pseudarctomys Baker was recorded in the original list from Ithaca on the northern flying squirrel (*Glaucomys* [*Sciuropterus*] *volans volans* L.). Young's collection of the type in Newport from the woodchuck (*Marmota monax* subsp.) was recorded in the manuscript of the above mentioned list but was apparently overlooked by the printer.

C. quirini Roths. was reported from Lake Placid on the jumping mouse (*Napæozapus* [*Zapus*] *insignis* subsp.) by Jordan (1929). This species has previously been collected only in British Columbia and Alberta.

C. riparius J. & R.—No new records of this flea have been reported from New York State. As stated in the earlier list, it has been taken from the nest of the bank swallow (*Riparia* [*Clivicola*] *riparia* L.) and the belted kingfisher (*Ceryle alcyon* L.) in Ithaca and from nests of the bank swallow in Olcott.

C. vison Baker.—In the list of 1928 this flea was reported only from the weasel (*Mustela* [*Putorius*] *noveboracensis noveboracensis* Emmons) in Ithaca. Through some mistake the record of the type, collected on the mink (*Mustela vison* subsp.) in Peterboro, was omitted. Further records are as follows: Ithaca, on red squirrel (*Sciurus hudsonicus* subsp.); Lake Placid, on red squirrel (*Sciurus hudsonicus loquax* Bangs) and chipmunk (*Tamias striatus* subsp.) Jordan (1929); Heart Lake, on *Sciurus hudsonicus* subsp.; Peterboro, on *Mustela noveboracensis noveboracensis;* Long Lake, on *Sciurus hudsonicus* subsp.; and Clear Lake, on *Sciurus hudsonicus gymnicus* Bangs.

C. wickhami wickhami Baker.—This flea was originally recorded as *C. wickhami,* from Ithaca on red squirrel (*Sciurus hudsonicus* subsp.), white-footed mouse (*Peromyscus leucopus* subsp.), and northern flying squirrel (*Glaucomys* [*Sciuropterus*] *volans volans* L.); and from Halsey Valley on gray squirrel

(*Sciurus carolinensis leucotis* Gapper). Additional records are as follows: Ithaca, on chipmunk (*Tamias striatus* subsp.), short-tailed shrew (*Blarina brevicauda* subsp.), mink (*Mustela vison* subsp.), in rodent's fur in owl's nest, in siftings of decayed stump, on star-nosed mole (*Condylura cristata* L.), cotton-tail rabbit (*Sylvilagus* sp.), and on *Sciurus carolinensis leucotis;* Newport, on woodchuck (*Marmota monax* subsp.) and *Glaucomys volans volans;* Hunter, in old house; New York City, on weasel (*Mustela noveboracensis noveboracensis* Emmons); Lansingburg, from an unrecorded host; Lake Placid, on white-footed mouse (*Peromyscus maniculatus gracilis* Le Conte); Long Lake, on *Sciurus hudsonicus* subsp.; and Mt. McIntyre, on *Peromyscus maniculatus gracilis.*

C. cædens cædens Jordan is a new addition to the list of New York fleas. It has been collected on the red squirrel (*Sciurus hudsonicus* subsp.) at Valcous Island (Lake Champlain), Long Lake, and Lake Placid.

C. cædens durus Jordan.—Jordan (1929) reports this flea from Lake Placid on the red squirrel (*Sciurus hudsonicus loquax* Bangs).

C. leucopus Baker.—In the original list this species was recorded as *Ceratophyllus leucopus* and was reported only from Peterboro, on the white-footed mouse (*Peromyscus leucopus* subsp.), by Baker (1904) as a new species. Jordan (1929) recorded it from Lake Placid and Mt. Kisco on *Peromyscus leucopus* subsp.

C. sexdentatus pennsylvanicus Jordan, an addition to the state list, has been collected on the wood-rat (*Neotoma pennsylvanica* Stone) at Schunemunk Mt., Orange County.

Conorhinopsylla Stewart

The only species known belonging to this genus has been found in New York.

C. stanfordi Stewart.—This species, only five specimens of which are known, has been collected and described since the publishing of the original list. All the specimens were taken in Ithaca from the red squirrel (*Sciurus hudsonicus* subsp.).

Ctenophthalmus Kolenati

C. pseudagyrtes Baker.—The distribution of this flea was published in the list of 1928 as from Selkirk on the hairy-tailed mole (*Parascalops breweri* Bachman); from Alpine in a mouse nest; and from Ithaca on the white-footed mouse (*Peromyscus leucopus* subsp.), the field mouse (*Microtus* [*Arvicola*] *pennsylvanicus* subsp.) and the muskrat (*Ondatra* [*Fiber zibethicus zibethicus*] *zibethica zibethica* L.). Later records show the following geographical and host distribution: Mt. Kisco, on *Microtus pennsylvanicus* subsp., and the short-tailed shrew (*Blarina brevicauda* subsp.) (Jordan 1928); Ithaca, on red squirrel (*Sciurus hudsonicus* subsp.), northern flying squirrel (*Glaucomys volans volans* L.), *Blarina brevicauda* subsp., in grass siftings, on star-nosed mole (*Condylura cristata* L.), and *Peromyscus leucopus noveboracensis* Fischer; Lake Placid, on *Parascalops breweri, Condylura cristata, Blarina brevicauda* subsp., the house-rat (*Rattus norvegicus* Erxleben) (Jordan 1929), and the chipmunk (*Tamias striatus lysteri* Richardson); Bronxville, from unrecorded host; Longville, from unrecorded host; and from Long Lake, on *Sciurus hudsonicus* subsp.

Oropsylla Wagner & Ioff

This genus was erected by Wagner and Ioff (1926) to include some species formerly referred to as *Ceratophylli.*

O. arctomys Baker.—The type of this species was collected on the woodchuck (*Marmota* [*Arctomys*] *monax* subsp.) at Peterboro by Miller and described by Baker in 1904. The list of 1928 gave the following records for this flea: McLean and Keeseville, on *Marmota monax* subsp., and Stamford, on red squirrel (*Sciurus hudsonicus loquax* Bangs). Additional records are as follows: Ithaca, on skunk (*Mephitis nigra* Peale & Beauvois); Hamilton, on deer (*Odocoileus virginianus borealis* Miller); Duanesburg, on gray fox (*Urocyon cinereoargenteus* subsp.); North Alba, on the woodchuck (*Marmota monax preblorum* Howell); and Macedon, on *Marmota monax* subsp.

Trichopsylla Kolenati

T. lotoris Stewart.—This flea was reported in the original list from Olcott, on the raccoon (*Procyon lotor lotor* L.). No additional collections have been reported from New York State.

Family ISCHNOPSYLLIDÆ

Myodopsylla Jordan & Rothschild

M. insignis Roths.—This species was reported in the original list as occurring on the little brown bat (*Myotis lucifugus lucifugus* Le Conte) at Homer and on the bat (*M. subulatus subulatus* Say) from Ithaca. No additional records have been reported.

Family HYSTRICHOPSYLLIDÆ

Ctenopsyllus Kolenati

In the original list of fleas from New York State this genus was referred to as *Leptopsylla* Jord. & Roths. Wagner (1927b) pointed out that Oudemans (1906) did not understand a previous paper of his in which he pointed out that Kolenati would have shown better judgment had he called his genus "*Ctenopsyllus*" rather than "*Ceratopsyllus.*" Oudemans thought from Wagner's paper that *Ctenopsyllus* had been used for *Ceratopsyllus* and consequently sunk Kolenati's *Ctenopsyllus.* Jordan and Rothschild (1911), following Oudeman's statement, without rechecking, proposed *Leptopsylla* for *Ctenopsyllus* which actually was valid. The present writer, following Jordan and Rothschild, used the name *Leptopsylla* in the above mentioned list.

C. catatina Jordan was not recorded in the original list. Jordan (1929) records this species from Lake Placid on the hairy-tailed mole (*Parascalops breweri* Bachman), the short-tailed shrew (*Blarina brevicauda* subsp.) and the meadow-mouse (*Microtus pennsylvanicus* subsp.).

C. hesperomys Baker.—This flea was reported in the list of 1928 as follows: Ithaca, from vacated king-fisher's nest and on the white-footed mouse (*Peromyscus leucopus* subsp.); and Alpine, in mouse nest. No additional distribution records have been reported.

C. segnis Schön. (=*L. musculi* Dugés).—No additional collections of this flea in New York State have been reported. The record previously reported is from New York City on rat (Fox 1925), presumably *Rattus norvegicus* Erxleben.

C. selenis Roths. has been collected at Mt. Marcy on the white-footed mouse (*Peromyscus maniculatus gracilis* Le Conte). This record is of especial interest since all other collections of this insect have been made in British Columbia, Alberta and Manitoba.

Doratopsylla Jordan & Rothschild

No representative of this genus was recorded in the original list.

D. blarinæ Fox.—This flea has been taken at Ithaca on the short-tailed shrew (*Blarina brevicauda* subsp.), and at Mt. Kisco (Jordan 1929) on the same host.

D. curvata Roths.—Jordan (1929) reports this species from Lake Placid on the short-tailed shrew (*Blarina brevicauda* subsp.). This flea was formerly considered to be a western species, having been collected only in Alberta, Minnesota, and Iowa.

Hystrichopsylla Taschenberg

This genus was not represented in the list of 1928.

H. gigas tahavuana Jordan.—Jordan (1929) collected, and described as new, this flea at Lake Placid on the short-tailed shrew (*Blarina brevicauda* subsp.) and the meadow-mouse (*Microtus pennsylvanicus* subsp.). He points out that *Pulex gigas* Kirby (1837) is an *Hystrichopsylla* and further states that it is highly probable that "*Pulex gigas* is the same flea as *Hystrichopsylla dippiei* Roths. from Calgary Alberta." However, in accordance with Jordan (1929) it is advisable to secure more material from Northern Alberta before definitely stating that *H. gigas* is a synonym of *H. dippiei.*

Neopsylla Wagner

N. grandis Roths. was not reported as such in the original New York State list. However, it was reported as *Ctenophthalmus gigas* Kirby from Ithaca on the red squirrel (*Sciurus hudsonicus loquax* Bangs) and as *Neopsylla striata* Stewart from Ithaca in the nest of a chipmunk (*Tamias striatus lysteri* Richardson). The first synonym arose from what probably was an erroneous identification by Baker (1895). The second synonym also arose from a misidentification, due largely to the rarity of the species in collections and consequent unfamiliarity with it. Jordan

(1929) states he has seen only five specimens of this flea. Additional records of distribution are as follows: Ithaca, on *Tamias striatus lysteri* and from Lake Placid (Jordan 1929) on the same host.

N. wenmanni Roths. was previously reported as *Ctenophthalmus wenmanni* Roths. from Ithaca on the white-footed mouse (*Peromyscus leucopus* subsp.) and as *Neopsylla similis* Chapin from Ithaca in grass siftings. Both of these forms are now known to be *Neopsylli* belonging to the species *wenmanni*. Records subsequent to the list of 1928 are as follows: Ithaca, on short-tailed shrew (*Blarina brevicauda* subsp.); Lake Placid, on the hairy-tailed mole (*Parascalops breweri* Bachman) and *Peromyscus leucopus* subsp. (Jordan 1929); and Elma, on the weasel (*Mustela cicognanii cicognanii* Bonaparte).

N. testor Roths.—This flea was reported in the original list from Lansingburg in a nest which might have belonged to a mouse. One specimen was collected by Felt and determined as a new species by Rothschild. No additional collections have been made in New York State.

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Materialen zum Studium der Ektoparasitenfauna im S.–O. Russlands. Publication of the Institute of Epidemiology and Microbiology at Saratov U.S.S.R. p. 113 (In Russian).

It will be of interest to all workers in biology and to nature students everywhere to learn that the Council of the Biological Society of Washington just recently has reissued all the various parts of its Proceedings formerly out of print, and can now supply a limited number of complete sets of its Proceedings, volumes 1 to 46, 1881 to 1933, inclusive, or can also supply whatever parts may be needed to complete partial sets now in the libraries of individuals or institutions. Among the items again available is the formerly very rare Volume 3, July 1, 1884, to February 6, 1886, now lacking from a considerable number of otherwise complete sets. This volume contains, pages 35 to 105, inclusive, the well-known work by Dr. G. Brown Goode entitled "The Beginnings of Natural History in America," the continuous demand for which contributed to the speedy exhaustion of the original edition. Lists of desiderata or requests for information should be sent to the Society's Corresponding Secretary, J. S. Wade, U. S. Bureau of Entomology, Washington, D. C.

NOTES ON COCCINELLIDÆ WITH A DESCRIPTION OF A NEW SUBSPECIES, (COLEOPTERA)

BY J. C. GAINES

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This paper contains the description of a new subspecies of Coccinellidæ and notes on a species described by Crotch from Mexico collected at College Station, Texas.

Hyperaspis fimbriolata Melsh. **marginatus** new subspecies

Broadly oblong-oval; head usually black often tinged with yellow anteriorly in female, reddish-yellow in male; thorax black margined with reddish-yellow in female, reddish-yellow in male narrowly darker at base, sparsely punctate; elytra entirely black with a yellow marginal vitta extending from the base to near the suture, curving slightly inward shortly before the apex, leaving the elytral margin narrowly black on about the apical fifth, more closely and coarsely punctate than thorax; underside blackish, abdomen tinged with red along the side margins and apex, legs wholly pale yellow.

Length, male 2.5 mm.; female 2.5 to 3 mm.

Type.—United States National Museum.

Described from 40 specimens in my collection collected from weed sweepings at College Station, Texas, during May, 1932.

The thorax of *marginatus* is black margined with reddish-yellow in female and almost wholly reddish-yellow in male while the thorax of *fimbriolata* is wholly black in female and black margined with yellow in male. The elytral marginal vitta is slightly narrower in *marginatus* than in *fimbriolata.* The legs are wholly pale in *marginatus* while the legs are only partially pale in *fimbriolata.* Dr. E. A. Chapin and Dr. Th. Dobzhansky report that this subspecies represents the southeastern race of *H. fimbriolata.*

From March 19 to April 27, 1931, I collected 34 specimens of a species of Coccinellidæ on arborvitæ plants that were heavily infested with *Dilachnus sp.* at College Station, Texas. Dr. Chapin reports that there is no species in the Casey collection or otherwise known to him that corresponds to this species, but that it is possibly *Cleis concolor* Cr., described from Mexico.

Cleis concolor Crotch, 1874, p. 142.

"Orange yellow, pectus black, head with two black dots on the vertex, thorax paler with a discoidal Y (of which the branches do not join the stem) and a basal triangle on either side black; elytra uniformly orange, punctuation evident. L. $1\frac{1}{2}$ lin. Mexico (Deyrolle)."

The species collected at College Station, Texas, is broadly oval, convex. The head is yellow with two interrupted black vittæ. The spots on the thorax differ from *C. concolor* in that they are generally united forming the characteristic, irregular design with a large M-shaped central figure. The elytra are sparsely, uniformly punctate, and pale orange yellow in color. The underside is black, epipleura yellow, prosternum yellow, mesosternum and side pieces yellow; metasternum black, bordered with yellow medially along the anterior margin, meta-episternum largely black, epimeron yellow, legs black, tarsi and apex of tibæ yellow.

Length, male 5 to 5.5 mm.; female 5 to 6 mm.

The description of *C. concolor* Cr. does not fit the species collected at College Station in all details, but it is expedient to list the species as *C. concolor* until a study of the type can be made.

STUDIES IN THE PYRRHOPYGINÆ, WITH DESCRIPTIONS OF NEW SPECIES (LEPIDOPTERA, RHOPALOCERA, HESPERIIDÆ)

BY E. L. BELL

This paper contains the results of the study of several more genera in this subfamily of the *Hesperiidæ*, and is a continuation of that published in the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY, vol. xxxix, (3), pages 417 to 491, 1931.

A radical departure is made in the treatment of the genera *Mysoria* Watson and *Amenis* Watson, from that of Mabille and Boullet in their paper and Draudt in Seitz Macrolepidoptera of the World. Godman and Salvin, Biologia Centrali-Americana, Rhop. vol. 2, pp. 253, 254, 1893, are followed in the characters they use for the separation of the two genera: in *Mysoria* the absence of a dorsal row of hairs on the hind tibiæ, the second median branch of the secondaries rising at or about the end of the cell; in *Amenis* the hind tibiæ having a dorsal row of hairs, the second median branch of the secondaries rising at the end of the cell. As stated in the first part of this paper, Godman and Salvin are followed in placing *galgala* Hewitson in the genus *Mysoria* where it seems better allied than in the genus *Pyrrhopyge*. In the *pallens* Mabille (*acastus* Cramer) group the discocellulars of the hind wings are sometimes rather indistinct and vary in appearance, seeming in some cases to be nearly straight and in others to be curved in varying degrees, occasionally varying in appearance in the two wings of the same insect. This variation produces the effect of making the second median branch seem to arise from beyond the cell in some cases and at the end of the cell in others. In this group these differences in appearance in the rise of the second median branch are unaccompanied by any other character of maculation, other than normal individual variation, or in the form of the genitalia and it can only be concluded that they have no value whatever for the separation of some of the forms into distinct species.

In the genus *Yanguna* we have left *parima* Plotz where it is placed by both Mabille and Boullet and Draudt, in Seitz Macrolepidoptera of the World, although it does not appear to be congeneric with the type, differing considerably in superficial appearance and form of the genitalia. Although no specimens of *assaricus* Cramer have been available for examination, we believe that this species is more nearly allied to *Myscelus* than to this genus. Mabille and Boullet also place *crida* Hewitson in the genus *Mahotis,* probably following the action of Watson, in this paper we follow Godman and Salvin in including it in *Yanguna,* where it very closely agrees with several of the other species in superficial appearance; however, in the form of the genitalia *crida* is more closely allied to the typical group of the genus *Pyrrhopyge* (Group A of the previous paper) than to this genus.

The study of the genus *Jemadia* presents considerable difficulty in satisfactorily determining some of the species from the published descriptions, the pattern of the maculation being so extremely similar in some species that they cannot be accurately separated when the actual specimens are before one, to try to separate them according to the printed descriptions is hopeless. The writer has in certain cases followed the determination of other authors and an examination of the genitalia of the type specimen may later prove that the identifications so based in this paper may be incorrect. The fact that some of the species are based on female types, sometimes from an unknown locality, further increases the difficulty of the study of the genus. As Draudt, in Seitz Macrolepidoptera of the World, has figured many of the species and as the figures are for the most part quite good, a detailed description of the bands and spots of the various species is not given in this paper, except in certain cases, as to do so would probably be of no aid in identification. Any one seriously concerned with the proper identification of doubtful material will find it quite necessary to examine the genitalia, which exhibit excellent characters for accurate separation of the species. The division of the genus into two parts, the "*punctati*" and the "*lineati,*" is used in this paper, following Mabille and Boullet, the former including those species which have white dots and the latter those which have a white line on the shoulder-covers (usually referred to as the "collar"). The writer, however, is unable to take the view of Mabille and Boullet that the under side of the secondaries is blue with black bands, when the reverse condition is obvious, but in any event the similarity of the bands in many species and the variation among individuals of the same species, renders their value for conclusive specific separation extremely doubtful, whether one considers them blue or black.

Erycides licinus Moschler, Verh. k.-k. zool.-bot. Ges. Wien, vol. xxviii, p. 209, 1878, and *Pyrrhopyga dysoni* Plotz, Stett. Ent. Zeit., vol. xl, p. 521, 1879, described from specimens combining the body and wings of a *Phocides* and the head of a *Jemadia* are synonyms of *Phocides distans* Herrich-Schaffer, *Jemadia licinus* Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, p. 265, 1893; p. 731, (Supplement), 1901, is a synonym of *Phocides pigmalion* Cramer.

In *Jemadia* vein 5 of the secondaries is either absent or very weakly indicated, but in this paper the references to the veins of these wings are made as though vein 5 were normal, that is, veins 6, 7, and 8 are referred to exactly the same as though vein 5 was present.

In this paper, and any others published by the author, the same terms will be used in referring to the anterior parts of the thorax and to the genitalia, as were used, and illustrated, in the previous paper on the *Pyrrhopyginæ.*

Again the writer must express his thanks to his various friends for their very valuable assistance. Capt. Riley, of the British Museum, and Professor Hering, of the Zoologisches Museum, Berlin, have both been exceedingly kind in furnishing important details of types.

Despite careful efforts to prevent them, certain typographical errors occurred in the first part of this paper, JOURNAL N. Y. ENT. SOC., vol. xxxix, (3), 1931, the correction of which is given below:

page 444, read "*P. phœax,*" not "*pheax.*"
page 445, read "*P. rubricor,*" not "*rubricolor.*"
page 459, under *P. semidentata,* fifth line, read "*intersected fringes,*" not "*interested fringes.*"

page 461, under *P. hygieia,* the Draudt reference mentioned is Draudt, Seitz Macrolepidoptera of the World, vol. 5, p. 839, pl. 162 f, 1921.''

page 461, under *P. phœbus,* third line, read ''*hygieia,*'' not ''*hyfieia.*''

Mysoria

Watson, Proc. Zool. Soc. London, (1), p. 12, 1893.

Orthotype, *Papilio acastus* Cramer, (*pallens* Mabille). Genitalia. The uncus is rather stout at the base, diminishing rapidly to the apex, which is bifid, terminating in two short arms which have a small tooth-like projection on their inner edge, (absent in *galgala* and *thasus,* which also have a longer and more slender termination). The girdle and saccus are of moderate length. The claspers are rather short and stout, the termination variable as illustrated in the accompanying figures. The ædœagus is short and a little bent toward the base. On each side of the uncus at the base rises a slender flange, variable in shape among the species.

M. pallens (Fig. 1).

Mabille, Ann. Soc. Ent. Belg., vol. xxxv, (C. R., ser. iv), p. cix, 1891.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th ser., pp. 185, 186, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 841, 1921.

acastus Cramer, Pap. Exot., vol. 1, p. 65, pl. 41, figs. C, D, 1779, (not vol. 3, pp. 12, 13, pl. 199, fig. E, 1782).

Godman and Salvin, Biol. Cent.-Amer., Rhop., vol. 2, p. 254, 1893, (under *venezuelæ* and the notes).

It is unfortunate that Cramer's *Papilio acastus* is a homonym of the much earlier *Papilio acastus* of Linnæus (Systema Naturæ, 10th ed., (1), p. 487, 1758). As *pallens* Mabille seems to be conspecific with *acastus* that name may be substituted.

According to Cramer's description and figure *acastus* is apparently the insect with a yellow outer marginal band and complete absence of a red costal marginal stripe on the secondaries beneath. The insect having a red outer marginal band and a red costal marginal stripe on the secondaries beneath, which Cramer later described as a variety of *acastus,* is *barcastus* Sepp.

Mabille apparently considered the red banded insect to represent *acastus* and redescribed the yellow banded form lacking the red costal marginal stripe as *pallens,* as there are no characters in his description to separate *pallens* from *acastus.*

Pallens appears to be a variable species, in size of individuals, in the extent and depth of the metallic sheen of the upper side and in the extent and shade of the outer marginal band and costal marginal stripe of the under side of the secondaries. The name must be restricted to those individuals lacking the red costal marginal stripe.

The flanges from the base of the uncus are very long and slender, from their base they extend forward then curve upward above the uncus and then curve forward again, they are somewhat flattened toward their apex. The claspers terminate in an upturned, sharp pointed hook, with serrations before and after it, back of this hook is another very strong tooth-like projection pointing somewhat backward. The serrations on both sides of the terminal hook vary in size and number and the hook itself varies in length.

Distribution. Type locality: Brazil. *Acastus,* "les Berbices" and "a Surinam."

M. pallens form **venezuelæ.**

Scudder, Rept. Peabody Academy of Sciences for 1871, p. 67, 1872.

Godman and Salvin, Biol. Cent.-Amer., Rhop., vol. 2, pp. 254, 255; vol. 3, pl. 73, fig. 17, (genitalia), 1893.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 185, 186, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 841, pl. 162 h, 1921.

ambigua Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 183, 184, 1908. (*Amenis*).

Draudt, Seitz Macrolep. of the World, vol. 5, p. 841, (*Amenis*), 1921.

Venezuelæ differs from *pallens* only in having a red costal marginal stripe on the secondaries beneath, which may be complete or reduced. The form of the male genitalia does not differ in the two. There is considerable variation in the width of the outer marginal yellow band on the under side of the secondaries, a fact which has been noted by Godman and Salvin. Mabille and Boullet distinguish *ambigua* from *venezuelæ* by the rise of the second median vein being at the cell end, all of the other characters being the same, yet at the same time they find this same apparent difference in individuals of the insect they describe as *proxima* and consider it only as combining the characters of the two genera *Mysoria* and *Amenis*. As stated previously in this paper the seeming difference in the rise of the second median branch is more apparent than real and there is no other difference in maculation or form of the genitalia.

Distribution. Type locality: Venezuela (for *venezuelæ*). Not given for *ambigua*. Northern Mexico to south Brazil and Paraguay.

According to strict priority *venezuelæ* should take the name of the species, and *pallens* that of the form.

M. proxima.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 183, 184, 1908. (*Amenis*).

Draudt, Seitz Macrolep. of the World, vol. 5, p. 841, 1921. (*Amenis*).

The description does not seem to give any character that will serve to separate *proxima* from *venezuelæ* other than the outer marginal yellow band of the under side of the secondaries narrows to a point "as far as nervure 2." In all of the large number of specimens of *venezuelæ* examined this yellow band goes beyond nervure 2, sometimes very little and sometimes narrowly along the margin of the wing to the anal angle. *Proxima* may be a form of *pallens*, but as there are no specimens at hand which agree with the description the question cannot be decided here.

Distribution. Type locality: Mabille and Boullet mention Mexico, Costa Rica, Colombia, Paraguay.

M. decolor.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 185, 186, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 841, 1921.

The description states that the red costal marginal stripe of the under side of the secondaries is incomplete, ending in the middle of the border, and that the marginal band is sordid-white strewn with small black scales.

Distribution. Type locality: "Costa Rica, Panama."

M. caucana.

Rober, Ent. Mitteil., vol. 14, p. 162, 1925.

The description states that *caucana* is very similar to *venezuelæ,* somewhat larger, little metallic sheen on the wing base, fringes of the fore wings at the anal angle and of the hind wings from the upper radial down, yellowish, prominently so beneath, the anal tuft brownish-red, the yellow marginal band of the secondaries beneath broader and longer, the red costal stripe narrower and of equal breadth.

Distribution. Type locality: West Colombia, Cauca Valley.

M. barcastus.

Sepp, Surinam Vlind, vol. 3, pl. 138, 1855.

Plotz, Stett. Ent. Zeit., vol. xl, p. 535, 1879.

Godman and Salvin, Biol. Cent.-Amer., Rhop., vol. 2, p. 254 (notes), 1893.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 185 (as *verbena* Butler), 186 (as synonym of *acastus* Cramer), 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 841, 1921.

acastus Cramer (female), Pap. Exot., vol. 3, pp. 12, 13, pl. 199, fig. E, 1782.

phidias Fabricius, Mant. Ins., p. 90, 1787.

verbena Butler, Ent. Mon. Mag., vol. 5, p. 272, 1869.

In *barcastus* the outer marginal band of the under side of the secondaries is red instead of yellow, and the red costal marginal stripe is present. The fringes of the primaries are white or partly so from the anal angle to vein 2 or 3, from there to the apex brownish; of the secondaries white. *Barcastus* has a slightly different appearance from *pallens,* but as the form of the genitalia is identically the same in both they are probably not really specifically distinct.

Distribution. Type locality: Surinam. Surinam; French Guiana. (B).

M. barcastus form **cayenne.**

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 185, 186, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 841, 1921.

According to the description *cayenne* differs from *barcastus* (*verbena* Butler) in having the outer marginal band of the under side of the secondaries bright yellow instead of red. The specimens at hand are from the island of Trinidad, B. W. I., and they differ slightly from the description in that the red costal marginal stripe of the under side of the secondaries is reduced, consisting of a short basal streak and when continued to the outer angle composed only of scattered red scales. The fringes of the primaries are entirely black or with a few white scales between veins 1 and 3; of the secondaries white only in the anal half of the wing.

The form of the male genitalia does not differ from that of *barcastus* and therefore not from that of *pallens.*

Distribution. Type locality: "Honduras, Amazone, Guayane Franc." Trinidad. (A.M.), (B).

M. affinis (Fig. 2).

Herrich-Schaffer, Corresp.-blatt., Regensb., vol. xxiii, p. 165, 1869. (Prodr. Syst. Lep., part 3, p. 57, 1869).

Godman and Salvin, Biol. Cent.-Amer., Rhop., vol. 2, p. 255; vol. 3, pl. 73, figs. 19, 20, 21, 1893.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, p. 184, 1908. (*Amenis*).

Draudt, Seitz Macrolep. of the World, vol. 5, p. 841, pl. 162 h, 1921. (*Amenis*).

On the upper side of this species the wings are black with a greenish sheen to the primaries and according to the light, greenish or bluish to the secondaries. Beneath, the apical half of the primaries as well as the costal area is greenish, the rest bluish; the secondaries are bluish along the abdominal fold, the rest greenish, with a narrow yellow marginal stripe extending from near the base on the costal margin around the margin of the wing almost to the anal angle. The primaries beneath sometimes have a small accumulation of yellow scales on the costal margin at the base. The fringes are entirely white. Head black with a bluish sheen. Collar red. Shoulder-covers and tegulæ blue-black. Palpi red with the tip bluish. Red below and around the eyes. Pectus black. Anal tuft red. A yellow lateral line extending the entire length of the body on both sides.

The claspers terminate in a short upturned arm with a rather broad, slanting, serrated tip. The projecting flanges from the base of the uncus are slender, extending a little forward at the base, then curving upward to a little above the uncus and are somewhat broadened at the tip.

Distribution. Type locality: not given. Mexico (G. & S.); (A. M.); (B).

M. amra (Fig. 3).

Hewitson, Exot. Butt., vol. 4, Pyrrh. pl. 3, figs. 16, 17, 1871.

Godman and Salvin, Biol. Cent.-Amer., Rhop., vol. 2, pp. 255, 256; vol. 3, pl. 73, fig. 18 (genitalia), 1893.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, p. 184, 1908. (*Amenis*).

Draudt, Seitz Macrolep. of the World, vol. 5, p. 841, pl. 166 c, 1921. (*Amenis*).

brasiliensis Mabille, Genera Insect., Hesp., p. 10, 1903.

Amra differs from *affinis* in having the collar black with a blue sheen, instead of red, in the lateral stripe of the body being red instead of yellow and in the broader outer marginal band of the under side of the secondaries. In the specimens at hand there appears to be less sheen to the wings than in *affinis*.

Mabille and Boullet place *brasiliensis* as a synonym, of *amra*, with which Mabille's description appears to agree, however, it seems rather strange that a large and conspicuous insect like this one has not turned up in the intervening country between Hewitson's type locality, Mexico, and Mabille's type locality, Brazil, except in Guatemala, which is the neighboring country to Mexico, it may be possible that the type locality given for *brasiliensis* is incorrect, or it may be more or less rare in its southern range.

The flanges from the base of the uncus are short, extending forward from the base and then curving upward. The claspers terminate in a short, narrow, slightly upturned arm, serrate at the tip, behind which is a serrate undulation.

Distribution. Type locality: Mexico. Mexico, Guatemala (G. & S.). Mexico (A. M.); (B).

M. thasus (Fig. 4).

Cramer, Pap. Exot., vol. 4, pp. 179, 180, pl. 380, figs. M, N, 1782.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 185, 186, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 841, pl. 162 h, 1921.

Upper side black with a green or greenish-blue reflection or dark olive-brown, the veins showing somewhat darker. Beneath, the primaries have the basal and inner-marginal areas brownish to bluish-black, the apical half and the secondaries are of variable shades of brown, the veins showing a little darker than above. Head black, with a red dot (which may be absent) in the center behind the antennæ, another larger red spot in the center of the black collar. Shoulder-covers black. Tegulæ black with a small yellow dot at the base. Palpi black. A red spot below and a yellow spot behind the eyes. Anal tuft red. On each side of the body a prominent yellow spot at the base of the primaries, one at the base of the secondaries and one at the base of the abdomen. The ventral surface of the abdomen has from five to six red spots on each side, and in some individuals there is a second parallel line of smaller red spots just above them, which may be of an equal number or less. Pectus black. Fringe of primaries white, in variable extent, from anal angle up, sprinkled with black scales towards the apex, which is entirely black; of the secondaries white, sometimes sprinkled with dark scales especially toward the outer angle.

The claspers terminate in a short, upcurved arm, serrate at the tip, back of which is a stout, tooth-like, serrate projection. The flanges at the base of the uncus are long, extending upward and a little forward from their rise, then curving forward and reaching nearly to the apex of the uncus.

Distribution. Type locality: Surinam. Bogota, Colombia; Ecuador; Santa Cruz, Bolivia; Obidos, Brazil. (B).

M. thasus form sejanus.

Hopffer, Stett. Ent. Zeit., vol. 35, p. 369, 1874.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 185, 186, 1908.

Draudt, Seitz, Macrolep. of the World, vol. 5, p. 841, pl. 162 g, 1921.

Sejanus differs from *thasus* in the lack of the red spots of the collar, the head and below the eyes. The form of the male genitalia is identically the same in both forms.

Distribution. Type locality: The exact locality is not mentioned, but the description is in a paper entitled "New Lepidoptera from Peru and Bolivia." Ecuador. (B).

M. erythrostigma.

Rober, Ent. Mitteil., vol. 14, p. 87, 1925.

The description states that this insect differs from *thasus* in the somewhat larger size, in the lack of the red spot of the collar, paler in color of the upper side with more prominent veins, beneath yellowish-grey.

As *thasus* appears to be variable in color, and in the tendency for the red spots to disappear, it may be possible that *erythrostigma* is merely one of the forms of that species.

Distribution. Type locality: "Bolivia (Rio Songo, 750 m, A. H. Fassl.)."

M. galgala (Fig. 5).

Hewitson, Trans. Ent. Soc. London, 3rd series, vol. 2, p. 483, 1866.

Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, pp. 253, 256, 257; vol. 3, pl. 73, fig. 22 (genitalia), 1893.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 175, 181, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 838, pl. 162 d, 1921.

strigifera Felder, Reise Nov., Lep., vol. 2, p. 505; pl. 70, figs. 7, 8, 1867.

Plotz, Stett. Ent. Zeit., vol. xl, p. 531, 1879.

Wings blackish with a green reflection, primaries with a narrow, irregular, orange, transverse band from about the center of the costa to the outer three-fourths of vein 1. Beneath the color is about the same as above, the orange band of the primaries much heavier at the costal margin, rapidly diminishing and ending indistinctly on vein 2; the secondaries also with a narrow, slightly bent, orange band from the costal margin almost to vein 1. Fringes white. Shoulder-covers and tegulæ blackish. Head blackish with a red spot below each antenna. Collar reddish. Palpi bluish-black at the tip, beneath intermixed with reddish. Pectus blackish. Abdomen with six red spots on each side of the ventral surface and four red spots in the center of the dorsal surface. Anal tuft red. Godman and Salvin say that the transverse band of the primaries is variable in width without reference to the locality from which specimens come.

The claspers terminate in a short, rounded, deeply serrate arm, in the center of the disc there is a strong projection which is notched at the tip. The termination of the uncus, and the flanges arising from the base, are long and slender.

Distribution. Type locality: Venezuela. Panama; Colombia; Venezuela. (G&S).

Amenis

Watson, Proc. Zool. Soc., London, (1), p. 12, 1893.

Orthotype, *Pyrrhopyga pionia* Hewitson.

Genitalia. In the one species available for examination the form of the male genitalia differs from that of *Mysoria,* as noted by Godman and Salvin, in the Biologia, resembling that of some of the species of *Pyrrhopyge* in the shape of the flanges arising from the base of the uncus, the termination of the claspers and the long upward projection from their dorsal edge at the base of the terminal arm. The uncus terminates in two bluntly pointed arms. The saccus is rather long. The ædœagus is slender, tapering gradually from the base to the apex.

A. pionia (Fig. 6).

Hewitson, Exot. Butt., vol. 2, Pyrrh. pl. 2, fig. 9, 1857.
Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 3, pl. 73, fig. 25, (genitalia), 1893.
Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 183, 184, 1908.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 841, pl. 162 h, 1921.

There is some variation in the extent of the green overscaling of the primaries, and in the bluish spot of the under side of the primaries in the angle of the rise of vein 2, this is prominently shown in some individuals, in others but faintly indicated or entirely lacking. As noted by Hewitson the lower one of the two crimson spots of the upper side of the primaries is represented on the under side by a whitish spot which is sometimes absent. The fringes of both wings are white.

There is some asymmetry in the termination of the claspers, which also vary individually in the extent of the development of the termination.

Distribution. Type locality: ''New Granada.'' Caracas, Venezuela; Viota, Colombia. (A.M.). Colombia. (B).

A. baroni.

Godman and Salvin, Ann. and Mag. Nat. Hist., series 6, vol. xv, p. 372, 1895.
Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, p. 203, 1908 (as ''*Mimoniades baroni* Salvin'').

Draudt, Seitz Macrolep. of the World, vol. 5, p. 847, 1921 (as *Mimoniades baroni* Mabille and Boullet).

The description states that the costa of the primaries is slightly curved; the outer margin convex. Anal angle of secondaries slightly produced. Primaries golden-olive, outer and inner margins broadly black, a transverse series of three black-bordered red spots, the largest in the cell, the others below toward the inner margin; four orange-red spots beyond the cell, in a black border, two more in the disc. Secondaries black with two irregular olive bands, one submarginal, the other through the cell, the two meeting near the anal angle. Fringes of both wings buff. Under side of primaries as above, the lowest spot of the transverse band orange-buff, a large black patch inside the band. Secondaries greenish-buff, outer and inner margins, two narrow, irregular lines across the disc, a wider one through the cell and one near the base, black. Head above black, with two longitudinal light bands on either side. Abdomen black above banded with olive, the extremity buff. Palpi beneath, thorax, abdominal bands, hind surface of coxæ and dorsal fringe of hind tibiæ, orange-buff; the rest of the legs, and antennæ, black. The form of the male genitalia is similar to that of *pionia* Hewitson but differs in several details of structure.

Female similar to the male, with larger and more rounded wings.

Distribution. Type locality: Cajamarca, Peru.

A. similis.

Rober, Ent. Mitteil, vol. 14, pp. 86, 87, 1925.

The description states that this species differs from *pionia* Hewitson in the wings being shorter, the fringes narrower, those of the forewings darker, the red spots of the upper side of the primaries larger, the lower one semi-circular, the upper one circular, on the under side the lower spot is yellow; the submarginal bluish band of the secondaries narrower and longer, the bluish-green scaling of the upper side reduced, beneath extended; shoulder-covers inwardly red, outwardly yellowish bordered. The rest similar to *pionia*.

Distribution: Type locality: Venezuela.

A. ponina.

Herrich-Schaffer, Corresp.-blat. Regensb., vol. xxiii, p. 165, 1869; (Prodr. Syst. Lep., part 3, p. 57, 1869).

Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, pp. 257, 258; vol. 3, pl. 73, figs. 23, 24, 1893.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 183, 184, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 841, 1921.

The only specimen at hand is a female and it differs from specimens of *pionia* Hewitson before the writer in the fringes of both primaries and secondaries being entirely orange-yellow, and in having a very fine orange-yellow line on each side of the center of the thorax on the upper side, and in lacking the green submarginal spots near the anal angle of the secondaries. The original description of *ponina* states that the fringes are golden-yellow, white toward the apex of the primaries, but as mentioned above in this female specimen they are entirely orange-yellow.

Distribution. Type locality: not given. Panama; Venezuela (G. & S.). Panama (B.).

Yanguna

Watson, Proc. Zool. Soc. London, (1), pp. 12, 13, 1893.
Orthotype, *Pyrrhopyga spatiosa* Hewitson.

Genitalia. The apex of the uncus is cleft and rather blunt. A flange varying in shape arises at the base of the uncus on each side, in most of the species (absent in *rubricollis* and *parima*). The girdle and saccus are moderately long. The ædœagus is swelled and bent at the base and tapers toward the apex. The scaphium is more or less developed in some species. The claspers are stout and usually long, more or less serrate on the outer and dorsal edges, usually with one or two stout upward projections from the dorsal edge. In some species the right and left claspers are asymmetrical. The inner plate of the disc is often serrate on its dorsal edge and sometimes carries serrated projections. The genitalia of *parima* Plotz differs considerably from the other members of the genus and that species probably does not belong here.

I. Head black with white spots and lines.

a. Pectus black, narrowly edged with white.

Y. spatiosa (Fig. 7).

Hewitson, Equat. Lep., p. 69, 1870. Exot. Butt., vol. 4, Pyrrh. pl. 2, fig. 15, 1871.

Staudinger, Exot. Schmett., vol. I, pl. 99, 1888.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 186, 187, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 843, pl. 164 b, (as *speciosa*), 1921.

Hewitson's description states that there are three minute white spots near the subapical series, and the figure shows another one on the costal margin and two between the subapical spots and the spots between veins 3 and 5; in the specimens at hand the last two mentioned, between those of veins 3 and 5 and the subapical spots, are absent. This probably represents a variable character.

The claspers are symmetrical and terminate in a triangular lobe, serrate on the outer and inner edges, back of this arising from the dorsal edge is a stout smooth projection; the inner plate of the disc is irregular and serrate on the dorsal edge.

Distribution. Type locality: Ecuador. Ecuador (A.M.), (B.).

Y. mabillei.

Druce, Ann. and Mag. Nat. Hist., vol. 3, p. 438, 1909.

The description states that the primaries are blue-black with a pure white transverse band, beginning broadly just below the subcostal nervure and extending to the submedian nervure, where it terminates pointedly. Base of wings broadly bright red. Fringes reddish-brown. Secondaries with basal and discal areas bright red, the rest blue-black, extreme basal area thickly clothed with deep black hair. Fringes reddish-brown. Beneath, primaries blue-black, the white band repeated, a slight reddish irroration at the base; secondaries blue-black, a clearly defined bright red fascia from costal margin near the base to the middle of the wing. Fringes of both wings as above. Head black with two white spots between the eyes. Collar grey. Thorax bright red interspersed with black hairs. Abdomen black annulated with bluish-grey. Anal tuft reddish-brown. Palpi black with some grey scales. Legs black, fringed with grey. Antennæ black.

In his remarks on this species, Druce states that it is somewhat like *cometes* Cramer but seems to be allied to *aspilos* Mabille and Boullet from which it differs in the broad white transverse band of the primaries and the more extensive red on the hindwing beneath. He described the species from two specimens, one of which has the fringe of the hindwings more nearly concolorous with the border of the wing and which may be the usual coloring.

Distribution. Type locality: Huancabamba, East Peru, 6,000 to 10,000 feet.

b. Pectus white or narrowly edged with black.

Y. cosyra (Fig. 8).

Druce, Cist. Ent., p. 363, 1875.

Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, p. 258; vol. 3, pl. 74, figs. 1, 2, 1893.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 186, 187, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, pl. 164, b, 1921.

This species somewhat resembles *spatiosa* but differs in the more orange-red color of the basal area of the wings and body, which are deeper red in *spatiosa*; in the whiter palpi and the more metallic sheen to the wings. The two species also seem to have a different habitat.

The claspers terminate in an irregular, subtriangular lobe, serrate on the outer and inner edges; back of this, in the right clasper, there rises a stout upward projection from the dorsal edge, in the left clasper there are two of these projections, with some serrations. The inner plate of the disc is irregular and somewhat serrate on the dorsal edge.

The remarks in the Biologia on page 258 in regard to the genitalia of *cosyra* are transposed and in reality apply to *Yanguna crida* Hewitson, while the remarks under *crida*, on the following page, refer to *cosyra*.

Distribution. Type locality: "Bugaba, Veragua," Chiriqui, Panama; Colombia. (B).

Y. aspitha.

Hewitson, Trans. Ent. Soc. London, 3rd series, vol. 2, p. 481, 1866. Exot. Butt., vol. 4, Pyrrh. pl. I, fig. 5, 1869.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, p. 187, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, pl. 164 c, 1921.

The description states that the male is dark brown above. The body and a transverse band near the base of the primaries, a broader one on the secondaries, are rufous-yellow. A trifid, triangular band of white hyaline spots in the center of the primaries. Outer margin of the secondaries dentate, fringes white. Abdomen banded with white.

The female differs in the darker rufous color and in having a minute white spot or two on the costal margin near the apex.

The figure in Exotic Butterflies shows a distinct tooth or lobe at the anal angle of the secondaries.

Distribution. Type locality: "Amazon, Para and St. Paulo."

Y. rufescens.

Riley, The Entomologist, vol. 52, p. 201, 1919.

The description states that the head is brown with a narrow white collar. Palpi white. Patagia, probably whole of thorax and part of the abdomen with long brick-red hairs. Tip of abdomen brown, internally white. Front coxæ densely clothed with long creamy hairs.

Wings above and below dark brown with a greenish-blue reflection. A narrow transverse band near the base of the forewing and a large sub-basal area on the hind wing the same color as the patagia. Fore wings with a broad white semi-transparent central band of three spots, the upper two oblong, the lowest triangular, situated in the cell and interspaces 2 and 1. On the under side this band is continued into interspaces 11 and 12 and in the latter is considerably extended basally and distally. Fringes of the fore wing apically brown, becoming white towards tornus. Hindwing below with a sub-basal red-brown area. Fringes white, brick-red at the anal angle, then brown towards inner margin. Differs from *aspitha* in the brick-red thorax, the color of the fringes and the duller appearance.

Distribution. Type locality: Abuna, Upper Madeira.

Y. aspilos.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, p. 186, pl. 13, fig. 2, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, pl. 164 b, 1921.

The description states that the wings are dark blue with a bright blue reflection. No hyaline spots. At the base of the primaries two long fulvous-red spots; at the base of the secondaries two spots of the same color, the upper one the longer, passing the cell and bent at its anterior border. Secondaries strongly concave between veins 2 and 3.

Distribution. Type locality: none given.

Y. staudingeri (Fig. 9).

Plotz, Stett. Ent. Zeit., vol. xl, p. 530, 1879.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 186, 187, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, pl. 164 b, 1921.

The specimens at hand have a brilliant sheen. The primaries have a transverse band of three white hyaline spots, from the upper edge of the cell to midway between veins 1 and 2, the lowest spot ending in a point a little beyond the center of the interspace; three subapical spots, very small in one specimen. Base of primaries and base of secondaries from the cell to the abdominal fold, red, sometimes very much reduced. Basal area of both wings beneath spotted with red, varying in extent. Thorax, base of abdomen, shoulder-covers and tegulæ red. Abdomen ringed with white. Head and collar black spotted and lined with white. Palpi and pectus white, the pectus edged with black interiorly. Legs striped with white. Fringes of primaries black, of secondaries white.

Capt. Riley has sent to the writer for determination, a rather small specimen which bears the label "Guyane;" this individual has the red basal area of the wings on both sides, reduced to a very few scattered scales, the shoulder-covers are worn but still contain a few red scales, as do the tegulæ at the base. The three subapical spots are present but very small. The genitalia of this specimen does not differ in form from that of typical individuals.

The uncus terminates in two rather blunt arms; the flanges arising from the base extend slightly beyond the apex of the uncus and broaden just before the pointed tip. The girdle is rather long. The ædœagus is bulbous at the base, then very slender. The terminal arm of the claspers ends in a broad irregular lobe, followed by a stout projection at the base and with numerous serrations on the dorsal edge. The inner plate of the disc has a broad upward projection at about the center and a number of serrations on the dorsal edge.

Distribution. Type locality: not given. Ecuador, Bolivia (B). Pebas, East Peru (B.M.).

Y. staudingeri form **cometides.**

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 186, 187, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, pl. 164 b, 1921.

The description states that this form differs from *staudingeri* in the absence of the subapical spots.

A specimen loaned the writer by the Academy of Natural Sciences, Philadelphia, Pa., is somewhat smaller than typical individuals, the subapical spots are entirely lacking and the red basal area of the wings both above and beneath is very much reduced. The form of the genitalia is identically the same as in typical specimens.

Distribution. Type locality: Bolivia. Rio Songo, Bolivia (A.S.).

Y. thelersa (Fig. 10).

Hewitson, Trans. Ent. Soc. London, 3rd series, vol. 2, p. 481, 1866.

Watson, Proc. Zool. Soc. London, (1), p. 13, 1893 (as synonym of *cometes* Cramer).

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, p. 187, 1908 (as synonym of *cometes* Cramer).
Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, 1921 (as synonym of *cometes* Cramer).
blossomiae Williams, Trans. Amer. Ent. Soc., vol. lvii, pp. 288, 290, pl. xxv, fig. 4, 1931.

Although the description does not give the color of the fringes of the secondaries it does state that they are not white. Capt. Riley informs the writer that Hewitson's type in the British Museum Collection has black fringes and that they have other similarly colored specimens of both sexes. There are two specimens in the writer's collection, a male and a female, the male having a very minute dot in interspace 7, and the female small spots in interspaces 6, 7, 8 and 9 not mentioned in the original description, but as the subapical spots in this group show considerable variation, their presence in the two specimens mentioned does not seem to be of importance.

The superficial appearance of *thelersa* is very much like that of *staudingeri,* differing in the black fringes of the secondaries and the outer margin of those wings being a little more excavate in the males. The female has broader and more rounded wings. The form of the male genitalia, though similar to that of *staudingeri,* differs in detail.

Blossomiæ Williams, from Ecuador, appears to be the same as *thelersa.*

Distribution. Type locality: "Amazon (St. Paulo). Montes Aurcos, Maranhao, North Brazil; Amazons, Brazil; Rio Colorado, 2,000 feet, Peru; French Guiana; Rio Napo, Ecuador; St. Paulo (probably Sao Paulo de Olivenca, Upper Amazon), Brazil (B.M.). Iquitos, Peru (B).

Y. timæus (Fig. 11).

Bell, The Entomologist, vol. lxiv, p. 236, 1931.

Wings black with a blue sheen. Primaries with a transverse band of three white hyaline spots and two minute subapical spots of the same color. Base of both wings above red haired, not extending above the cell of the secondaries; beneath, the red hairing is much reduced. A slight projection in the outer margin of the secondaries from vein 1 b to 2. Fringes of primaries black; of secondaries white. Thorax above and beneath covered with red hairs. Abdomen above and beneath red haired at the base, each ring banded with white. Fore and middle legs striped with white, the middle legs fringed with red hairs. Hind legs missing. Head black with white spots and lines. Palpi white, with a black tip. Pectus white, narrowly edged with black in the center. Collar black with a white line. Shoulder-covers and tegulæ red. Anal tuft blackish.

The uncus is bifid, the basal flanges are narrow at their base and widen into a broad blade which ends in a point. The girdle is long and the saccus rather short. The right clasper terminates in a short arm with an upturned, rounded, serrate apex, back of which rises a stout projection with a few serrations. The inner plate of the disc is extended forward in a long, narrow projection which nearly reaches the outer edge of the apex of the terminal arm, the dorsal edge carries some strong serrations near its center and there are numerous fine ones at and near the tip of the long projection. The left clasper terminates in a similar manner, but from the side of the long projecting part of the inner plate of the disc there arises two stout, smooth projections which extend well above the dorsal edge of the terminal arm.

This species resembles *cometes* Cramer and *staudingeri* Plotz, differing from the first in the color of the head, and from the second in the extensive red hairing of the thorax beneath and the red fringe of the middle legs.

Distribution. Type locality: Pebas, East Peru. (B.M.), (B).

Y. rubricollis (Fig. 12).

Sepp, Surinam Vlind, vol. I, pl. 36, 1848. (Text on unnumbered page).

Watson, Proc. Zool. Soc. London, (I), p. 13, 1893.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, p. 187, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, pl. 164 c, 1921.

hadora Hewitson, Trans. Ent. Soc. London, 3rd series, vol. 2, p. 482, 1866. Exot. Butt., vol. 4, Pyrrh. pl. 3, fig. 23, 1871.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, p. 187, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, pl. 164 c, 1921.

Sepp's figure shows a black head, with lines of white; red shoulder-covers and collar; white fringes of the secondaries; white palpi and pectus; blackish anal tuft. Hewitson's figure of *hadora* differs in having the head red with a black line from eye to eye; however, Capt. Riley has informed the writer that the Hewitson type of *hadora* in the British Museum Collection has a black head with white markings and is unquestionably the same species as *rubricollis.* It seems apparent that Hewitson did not figure his type of *hadora* but selected for the figure a specimen of another species. The figure of Draudt does not represent the true *hadora* as it shows a red head.

The uncus terminates in two well separated, rounded arms, the basal flanges absent. The scaphium well developed and shagreened. The girdle slender. The ædœagus short and slender. The claspers are short, broad and asymmetrical, the right one terminating in a broad upward flange, blunt and serrate at the tip, back of which is a stout upward projection; the left one terminates in a broad upward flange rounded at the apex, with numerous fine serrations, from the inner side of the terminal arm is another rounded, serrate flange directed obliquely outward, from the base of which arises a strong upward projection, extending well above the dorsal edge of the clasper. The disc of the claspers carries a long narrow plate on the inner side, which extends backward beyond the base and forward beyond the apex of the terminal arm; on the right clasper this plate carries a number of serrations at the apex; on the left clasper there are but two strong teeth at the apex.

Distribution. Type locality: Surinam. Of *hadora*, "Amazon (Para and Ega)." S. Paulo, Upper Amazon. (B.M.).

Y. parima (Fig. 13).

Plotz, Stett. Ent. Zeit., vol. xlvii, p. 116, 1886.

Godman, Ann. and Mag. Nat. History, series 7, vol. xx, p. 155, 1907.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 187, 188, pl. 13, fig. 3, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, pl. 164 d, 1921.

The single male specimen at hand has black wings with a little metallic sheen. The primaries are crossed diagonally near the base by an orange band, broader at the inner margin than at the costal, and a transverse series of three white hyaline spots, the lower one narrow and tapering to a sharp point on vein 1; four subapical spots slightly curved inward toward the costal margin; a spot in each of interspaces 3 and 4. The secondaries have an elongate orange spot in the basal half, not reaching the base of the wing, extending from above the costal vein to the abdominal fold. The secondaries have a well developed tooth at the anal angle and another one above it. Beneath, the orange band of the primaries is much paler in color; the secondaries have a narrow, oblique orange band near the base. Fringes of the primaries black; of the secondaries white between the teeth, the rest black. Head brown, lined and spotted with white. Collar brown lined with white. Shoulder-covers orange. Tegulæ orange narrowly edged with brown below. Palpi white narrowly edged with brown internally. Pectus white. The upper side of the thorax is too badly rubbed to be sure of the color but there are still some orange scales near the base of the wings, beneath it is brown with tufts of white hair at the base of the legs. Abdomen brown above, the segments edged with white beneath. Anal tuft brown.

Distribution. Type locality: Surinam.

As previously stated it seems doubtful that *parima* belongs in this genus, the superficial appearance is different from the type and the form of the genitalia is very much like that of the *Myscelus* species.

Y. leander.

Boullet, Bull. Soc. Ent. France, p. 92, 1912.

The description states that this species resembles *parima* Plotz, being a little larger, primaries with two white hyaline fascia and reddish-yellow at the base. Secondaries scarlet at the base, and a similarly colored geminate spot between veins 1 and 2.

Fringes, palpi and fore legs white. The abdomen ventrally, feebly annulated with white. Differing from *parima* in the apical band, which is composed of very small spots, and the basal band of the secondaries, which, while narrow, is broader than in *parima*. The description does not give the color of the head but it is assumed that it is the same as in *parima*.

Distribution. Type locality: Muzo, Colombia, 800 meters (A. H. Fassl).

This species from its apparent affiliation with *parima* probably does not belong in the genus *Yunguna*.

c. Pectus red.

Y. tetricus (Fig. 14).

Bell, The Entomologist, vol. lxiv, pp. 235, 236, 1931.

Wings black with a green sheen. Primaries with a transverse band of three white hyaline spots, slightly sinuous; a small, elongate, white hyaline spot in the cell-end, slanting obliquely inward; four small, white hyaline subapical spots. Secondaries somewhat concave between veins 1 b and 6. Fringes nearly worn off but appear to have been black on the primaries and white on the secondaries. Thorax beneath with some red hairs in the center. Abdomen blackish above, the rings edged with greenish-grey, beneath grey. Head black with white lines and spots. Collar black. Shoulder-covers black with a few red hairs at the tip. Tegulæ greenish-black, with a few red hairs on the lower part of the base and which extend under the base of the primaries. Palpi white. Pectus red. Anal tuft blackish.

The uncus is somewhat sinuous and but little cleft at the apex. The basal flanges narrow and bent downward. The scaphium well developed and shagreened. The claspers terminate in a short, broad arm, somewhat rounded at the apex, the right one with a triangular, serrate, dorsal flange, back of which is a broad flange obliquely directed inward, on the outer side below the triangular flange are numerous short teeth, the dorsal edge is serrate from the flange to the apex. The inner plate of the disc carries a small triangular flap with a few teeth. The left clasper has the dorsal, triangular flange somewhat more developed, and the serrations on it and the dorsal edge are heavier; from the side of terminal arm, under the dorsal flange, arises another narrow flange. The inner plate of the disc is irregular on the dorsal edge and with numerous serrations, it also carries a number of teeth on the inner side, and at the base of the clasper extends considerably backward. The ædœagus is long, bulbous at the base, with a slight projection near the center.

This species is allied to *cometes* Cramer and *staudingeri* Plotz, from the first it differs in the color of the head, from the second in the red pectus, and from both of them in the lack of the red hairing at the base of the wings and in the cell-spot of the primaries.

Distribution. Type locality: "Roraima." (B.M.).

2. Head red.

a. Pectus red.

Y. arinas.

Cramer, Pap. Exot., vol. 2, pp. 6, 7, pl. 100, fig. D, 1779.
Fabricius, Spec. Ins., vol. 2, p. 134, 1781. (as *arinus*).
Watson, Proc. Zool. Soc. London, (I), p. 13, 1893.
Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 187, 188, 1908.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, pl. 164 c, 1921. (as *arinos*).
pedaia Hewitson, Trans. Ent. Soc. London, 3rd series, vol. 2, pp. 481, 482, 1866. Exot. Butt., vol. 4, Pyrrh. pl. 3, fig. 22, 1871.
Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, p. 187, 1908.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, pl. 164 c, 1921.

Front head, palpi, pectus and anal tuft red. Primaries with a transverse band of three white hyaline spots. Fringes of the secondaries white. There is nothing in the figure or the description of *pedaia* to separate it from *arinas* and Watson is followed here in placing it as a synonym. There is a form or race of *arinas* occurring in Peru which has a black pectus, and it was described by the writer as *temenos*, reference to this form will be found on subsequent pages of the present paper. The form of the male genitalia is identically the same in both forms.

Distribution. Type locality: Surinam. Of *pedaia,* "Amazon, Ega." French Guiana (B.M.).

Y. mopsus (Fig. 15).
Bell, The Entomologist, vol. lxiv, p. 233, 1931.

Wings blue-black, veins somewhat greenish. Primaries with a transverse band of four white hyaline spots, the upper one being a mere streak above the cell. Fringes of primaries black, of secondaries white from anal angle to vein 7. Head red with a black line at the rear. Collar, palpi, pectus and anal tuft red. Shoulder-covers and tegulæ blue-black.

The uncus terminates in a broad, curved, bifid apex; the basal flanges are broad at their origin and extend in a long arm beyond the apex of the uncus, and are serrate on their dorsal edge. The girdle is long, the saccus moderately so. The claspers terminate in a narrow arm with an upturned sharp pointed tip. On the dorsal side of the arm, near its base, there arises a stout upward projection, broad at its base and ending in a sharp apex, a little erose on the inner edge near the base. On the inner side of the disc is a long, broad plate extending backward a little beyond the base of the clasper, serrate on the dorsal edge and carrying numerous short teeth on the inner side. The ædœagus is rather short and has a small serrate flange near the apex.

Distribution. Type locality: Chanchamayo, Peru. (B.M.).

b. Pectus black.

Y. cometes.
Cramer, Pap. Exot., vol. 3, p. 60, pl. 227, fig. F, 1782.
Watson, Proc. Zool. Soc. London, (I), p. 13, 1893.
Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 186, 187, 1908.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, 1921.

Cramer's figure shows an insect with a red head and he confirms this in the text of the description; the rest of the figure resembles *staudingeri* Plotz, which has a black head spotted with white. Cramer states in his description that the "head, corslet and part of the wings near the joints" are dark orange and that the wings beneath are as above. Cramer figures only the upper side of *cometes* (Fig. F), and Mabille and Boullet have evidently mistaken Figure E on the same plate to represent the under side of *cometes,* whereas it really represents the under side of Cramer's *amycus* and does not in any way refer to *cometes.* Draudt, in Seitz, has continued this error.

Thelersa Hewitson is usually placed as a synonym of *cometes,* but as the fringes of *cometes* are white on the secondaries, according to Cramer's figure, and in *thelersa* they are black, according to the type in the British Museum, and the fact that *cometes* has a red head and *thelersa* a black one, the synonymy does not seem justified and they are kept separate in this paper.

Distribution. Type locality: Surinam.

The writer has not seen a specimen of *cometes* and it may possibly not belong in this division having a black pectus, but Cramer's remark "Beneath the body and feet are blue-black" seems to indicate that such may be the case.

Y. **arinas** form **temenos** (Fig. 16).
Bell, The Entomologist, vol. lxiv, pp. 234, 235, 1931.

Wings greenish-black. Primaries with a transverse band of three white hyaline spots. Fringes of primaries above, black, intermixed with white from anal angle to vein 3, beneath the white scaling is more prominent and there is a fine white terminal line almost to the apex of the wing. Fringes of the secondaries white from the anal angle to vein 7. Head red, narrowly black at the rear. Collar, palpi and anal tuft red. Shoulder-covers and tegulæ greenish-black. Pectus bluish-black.

This insect resembles *mopsus* in the shape of the hyaline band of the primaries. From typical *arinas* it differs in the bluish-black pectus and the partly white fringes of the primaries. It may be merely a form of *arinas* or a geographical race, the exact relationship being impossible to determine from a single specimen. The form of the genitalia is the same as that of *arinas.*

The apex of the uncus is bifid, the basal flanges are narrow, serrate on the dorsal edge and apex. The girdle moderately long. The claspers terminate in an obliquely upturned lobe, rounded and serrate at the apex, at the base of the terminal arm rises an irregular serrate projection, and another shorter, rounded one. The ædœagus carries a serrate flange near the apex.

Distribution. Type locality: La Merced, Chanchamayo, Peru. (B.M.).

Y. crida.

Hewitson, Trans. Ent. Soc. London, p. 167, 1871. Exot. Butt. vol. 4, Pyrrh. pl. 2, fig. 14, 1871.

Watson, Proc. Zool. Soc., London, (I), p. 13, 1893.

Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, p. 259; vol. 3, pl. 74, fig. 3, 1893.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 188, 189, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, pl. 164 e, 1921.

Wings bluish-black. Primaries with a transverse band of three white hyaline spots, this band is long, narrow and obliquely crosses the wing from the upper edge of the cell almost to vein I above the anal angle. The fringes of the primaries are blackish and of the secondaries white. Head, collar, palpi and anal tuft red. Shoulder-covers, pectus and tegulæ blue-black. The female is similar, with more rounded wings and a little wider hyaline band of the primaries.

As previously noted, the remarks in the Biologia in regard to the genitalia of this species are transposed with those referring to *cosyra* Druce.

The genitalia, as figured by Godman and Salvin in the Biologia, resemble the form found in typical *Pyrrhopyge*. The uncus is bifid, terminating in two bluntly rounded arms, the basal flanges broad, roughly triangular and serrate on the outer edge. The terminal arm of the claspers is obliquely directed upward, terminating in a triangular apex, serrate on the outer edge; from the dorsal edge at the base of the arm rises a stout serrate projection with a broad base.

Distribution. Type locality: Nicaragua (Chontales). Santa Fe de Bogota; Nouvelle Grenada. (B.M.).

Y. creusæ (Fig. 17).
Bell, The Entomologist, vol. lxiv, pp. 233, 234, 1931.

Wings greenish-black. Primaries with a transverse band of three white hyaline spots, shorter and less oblique than in *crida.* Fringes of primaries black, of secondaries white between anal angle and vein 6 and a fine white marginal line between veins 6 and 7. Head red, narrowly black at the rear. Palpi and anal tuft red. Collar black. Shoulder-covers, tegulæ and pectus greenish-black.

This species resembles *arinas* Cramer but differs in having a black pectus; it also resembles the form *temenos* from which it differs in having entirely black fringes on the primaries and a slightly different shaped hyaline band of those wings.

The form of the male genitalia is similar to that of *crida* Hewitson, as figured by Godman and Salvin in the Biologia, and as in that species more nearly coincides with the typical group of *Pyrrhopyge* than with the type of *Yanguna.* Superficially *creusae* is readily separated from *crida* by the shorter and steeper hyaline band of the primaries.

The female is similar to the male, the wings more rounded and the hyaline band of the primaries a little broader.

Distribution. Type locality: Cayenne, French Guiana. (B.M.). St. Laurent, French Guiana. (B).

Y. sarpedon (Fig. 18).
Bell, The Entomologist, vol. lxiv, p. 234, 1931.

Wings greenish-black. Primaries with a transverse band of three white hyaline spots. On the secondaries the outer half of the veins from 2 to 8 are paler greenish. The outer margin of the secondaries is slightly concave between veins 1 b and 6. Fringes of primaries blackish, of secondaries white from anal angle to a little above vein 6. Head red, narrowly black at the rear. Collar, palpi and anal tuft red. Shoulder-covers and tegulæ greenish-black. Pectus blue-black.

The uncus is bifid, the basal flanges very broad and partly shagreened. The claspers terminate in a short, broad arm with a stout upward projection on the dorsal side near the apex, curved outward, and serrate on the inner edge; at the base of the arm are two projections from the dorsal edge, one long and serrate at the tip, the other short and irregularly rounded. The inner plate of the disc is serrate on part of the dorsal edge. The ædœagus has a serrate flange near the apex.

This species resembles *arinas* Cramer and *creusæ* Bell in the shape of the hyaline band of the primaries, differing from the first in the blue-black pectus, from the second in the red collar and less excavate outer margin of the secondaries.

Distribution: Type locality: "Pebas, Amazones." (B.M.).

Mahotis

Watson, Proc. Zool. Soc. London, (I), p. 13, 1893.
Orthotype, *Tamyris nurscia* Swainson.

Genitalia. In *nurscia* the uncus is slightly curved downward and cleft, terminating in two sharp pointed arms. A short, smooth flange projects forward from the base on each side. The girdle is of moderate length and the saccus rather long. The ædœagus is short, bulbous toward the base and tapering to the apex. The claspers show some asymmetry in the termination, the right one terminating in a short, slightly upturned arm with quite heavy serrations on the dorsal edge; the left one in a broad, upturned, double pointed arm, with serrations between the points. At the base of the terminal arm of each clasper there rises a stout upward projection.

M. nurscia (Fig. 19).
Swainson, Zool. Illustr., vol. I, pl. 61, 1821.
Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 188, 189, 1908.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, pl. 164 d, 1921.

There is quite a little variation among individuals of this species, in some the bluish overscaling of the under side extends over the entire area between the discal band and the apex of the primaries, and the outer margin of the secondaries, obliterating the usual black border of the wings.

Distribution. Type locality not given. Peru (A.M.). Ecuador (B).

(To be continued)

BOOK REVIEW

Jungle Bees and Wasps of Barro Colorado Island, Panama, by Phil Rau. 338 pp., 120 illus., octavo, cloth. Kirkwood, Mo. Published by author, 1933. $2.75.

This review is not intended to be a critical examination by a professional Hymenopterist of technical subject matter. Instead, it is hoped that it may be accepted merely as an appreciation, from one who enjoys travel books, of an exceedingly interesting and charmingly written narrative of entomological exploration. While the volume primarily is an account of the ecology and biology of social and solitary wasps and stingless bees of a jungle island in Panama, yet, it also contains many data on their attributes and adaptations and comparison of their habits and instincts with those of their near relatives in the temperate region. Consideration is given to the Stingless bees, the Polybia wasps, the Solitary wasps, the Great Carpenter bee, two species of Polistes wasps, and also various paper making Social wasps. There are likewise ecological and behavior notes on the other principal orders of insects and on spiders and myriapods, as well as a discussion of mind as a forerunner in evolution. Probably of greatest popular interest is the non-entomological chapter reporting in detail on the events of an exploration of New Limon. The book is trenchant and vigorous, sincere and illuminating. Although packed with information it is presented in a form which makes it arresting and readable even to those who might have only a casual interest in the subject. The series of word pictures descriptive of various phases of the natural history of the Island are presented with a real sensitiveness to beauty and atmosphere. Under these fortunate conditions, with the author's heart and imagination deeply stirred, a journey like this becomes to him an epoch of exploration.—J. S. WADE.

SHORT STUDIES IN THE CHRYSOMELIDÆ (COLEOPTERA)

By CHAS. SCHAEFFER
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Most of the following notes, descriptions, etc., and others, published elsewhere, have been written at various times in the past years while devoting some of my little spare time to the study and investigation of Chrysomelidæ.

With the transfer of the museum's collections to Washington some of the type specimens from which the descriptions were drawn are now in the National Museum collection and are so mentioned under the descriptions; otherwise the types are in my own collection.

Aulacoscelis ventralis new species.
Aulacoscelis femorata Schaeffer not Jacoby.

MALE: Rather elongate testaceous, elytra paler, antennæ, except the first joint, fuscous; first and second ventral segment black; tibiæ at apex more or less blackish.

Head not constricted behind the eyes, which latter are small and entire as usual; surface irregularly not closely punctate, punctures moderate; inter-antennal space with a well defined elevated ridge on each side, separated from each other by a moderately deep and broad impression. Antennal joints compressed basally, longer than wide, joints six to eleven, more slender than the preceding joints. Pronotum slightly wider than long, oblique behind; anterior angles slightly prominent; transverse groove near base very feeble, the usual longitudinal plica on each side of the groove absent; surface irregularly punctate with moderately large punctures, laterally more or less distinctly pubescent. Scutellum transverse, pubescent. Elytra at base slightly wider than the pronotum at base, about twice as long as wide; sides nearly parallel but slightly narrowing towards apex, surface not costate, near the umbo feebly impressed, rather finely, irregularly punctate and moderately closely pubescent. Ventral segments rather sparsely punctate and sparsely pubescent, first and last segments slightly longer than each of the intermediate segments. Last segment triangularly emarginate. Length 8.25 mm.

FEMALE: Differs from the male in having the head and pronotum narrower, the antennal joints shorter and relatively a little stouter, the ventral segments unicolorous pale, the first ventral segment as long as the three following, the last with a slight moderately broad projection at middle of apical margin and the legs slightly less shorter. Length 7.25 mm.

Huachuca Mts., Arizona. Type, male, and female allotype and three paratypes in the Nat. Museum collection, also paratypes in my collection.

This is the species identified and recorded by me as *femorata,* but a renewed examination and study of the specimens and description forces me to the conclusion that it is not *femorata* nor any other of the described Mexican species. The description of *femorata* fairly agrees with our insect except that the antennal joints of the males are not "rather short and robust" and the femora in the male are not "much more strongly developed" than in the female but only slightly so in the former. Also the difference in size and coloration of the first ventral segment of male and female, if present in *femorata,* would not have been overlooked by its author.

The measurements are taken from the apical margin of prothorax to the apex of elytra.

Syneta carinata Mann.

This species is recorded from Alaska, Idaho and Utah and I have also a male from Dilley, Oregon, which agrees in every respect with Lacordaire's description. The latter had a male and female collected by Eschscholz from which Mannerheim also had received the types of his species.

Lacordaire says that it is the largest of the species then known to him but I have some eastern specimens which are smaller, about 5–6 mm., which do not seem to differ otherwise, except in coloration and prominence of the elytral costæ both of which are possibly variable. These eastern specimens are from Mt. Mansfield, Vermont, June (Engelhardt); Maplecrest, Catsk. Mts., N. Y. June (Schott); Slide Mt. and Whiteface Mt. trail, N. Y., July (Shoemaker); Mt. Mitchell, N. C., June (Nicolay); also a specimen from Scott Glacier, Alberta, June, and one from Waldport, Oregon, July (Davis) which do not seem to differ from the eastern specimens.

The sculpture of pronotum in all these is variable, some more densely punctate than others and the coloration is also very variable.

As far as my material shows, the size does not seem to differ so much in the species of this genus and these smaller specimens are perhaps entitled to a varietal name but on account of the limited material of typical *carinata* I leave this for future investigation.

Syneta hamata Horn

Specimens of this species were taken at Lake Josephine and Iceberg Lake, Glacier Park, Montana, by Mr. Howard Notman and at Edmonton, Alberta, by Mr. F. S. Carr.

Zeugophora scutellaris Suffr.

This European species has a wider distribution than is given in the Leng catalogue. It has been taken at Arlington, N. J., June, by Mr. H. B. Weiss; at Williston, Wilms Co., N. D., June, by Mr. Howard Notman, and at Trinity Val., B. C. (J. R. L. Howell), the latter in the collection of Mr. Ralph Hopping.

Crioceris duodecimpuncta dodecastigma Suffr.

This is listed as var. in the European catalogue and occurs also in North America. It differs from typical *duodecimpunctata* in having the underside and legs entirely black. I have taken both, the typical form and the variety, on the same plant.

Lema margineimpressa new species.

Form nearly as in *collaris* but a little stouter, color above and below more or less dark blue, except tarsi and antennæ, which are black. Head scarcely constricted behind the eyes; antennal joints moderately stout. Pronotum rather moderately constricted laterally; sub-basal impression deep; surface smooth except the usual geminate row of punctures medially and a few well separated punctures near each anterior angle. Each elytron with ten entire rows of moderate punctures; intervals flat, smooth, not costate at apex; sub-basal transverse impression deep, also a deep impression laterally a little below the humerus. Abdomen smooth with scarcely any punctures; posterior femora not stouter than the intermediate femora and scarcely longer. Length 4.5 mm.

Arizona.

This species differs from *concolor* Lec., the only other uniformly colored blue North American *Lema,* by slightly more robust form, ventral segments almost without punctures and the presence of a rather deep lateral post humeral and discal impression of each elytron. The Mexican *cœrulea,* which is also a uniformly blue species with lateral post-humeral elytral impression, has the ninth row of punctures on each elytron interrupted at middle and the elytral intervals at apex are elevated.

Lema simulans, new species.

Form, size and coloration as in *cornuta* but base of tibiæ and entire femora red, frontal tubercles of head less prominent and smaller, ocullar orbits between the tubercles and eyes wider. Length 5 mm.

Medicine Lodge, Kansas.

Except for the differences given above this species is otherwise much like *cornuta* and is possibly only a western race of the latter.

Lema palustris floridana new variety.

Like typical *palustris* in form and size but antennal joints narrower and more elongate and the elytra bright green.

Enterprise, Florida (O. Dietz).

Lema longipennis Linell.

This species is recorded only from Colorado, but has been taken by Mr. E. L. Bell at Dewey Lake, Cherry Co., Nebraska, and I have also a specimen from Riverside, Illinois.

Lema conjuncta Lac. var. **circumvittata** Clark.

L. circumvittata is listed as a distinct species but is only a variation of *conjuncta* in which the yellow basal spot on each elytron is absent. This spot is variable. In some specimens it is very large; in others exceedingly small. Both the spotted and unspotted forms occur together.

Lema nigrovittata Guer.

L. notativentris Schffr.

Looking over the species of Lema in the Biologia, shortly after I described *L. notativentris* my attention was arrested by Mr. Jacoby's remarks on *Lema nigrovittata* which seemed to apply very well also to my recently described *notativentris* and after carefully reading Guerin's and Lacordaire's descriptions I became convinced that my species is synonymous with *nigrovittata* and the California specimens received from the late Ricksecker and other sources under that name were not that species but on closer examination appeared to me to be only a western form of the common *trilineata.* Since then I had seen specimens of the true *nigrovittata* from other sources and have named them correctly for some of my correspondents and have also returned California specimens with the manuscript name *trilineata californica* which was later described by Mr. Fall as var. *nigriventris.*

Besides the slightly different form *L. nigrovittata* differs from the western variety of *trilineata* with narrow lateral elytral vittæ—*trivirgata* Lec.—in having the head always entirely black, the black pronotal spots never on the disk as in *trilineata* and varieties but in the lateral excavation and the narrow lateral black vittæ of elytra are never close to the lateral margin but separated from it by two or three intervals and are occasionally interrupted medially. The ventral segments may be entirely pale, or more or less marked with black; the legs also are marked more or less with black.

It occurs in this country in Arizona and New Mexico. Mr. Fall* reports it as very common in Southern California, but this has to be verified; they are very likely what almost everybody used to call erroneously *nigrovittata* and which he later described as var. *nigriventris.*

Lema trivittata californica n.n.

L. trivittata nigriventris Fall not Gerst.
L. nigrovittata auct, not Guer.

As stated above this is what used to be called *nigrovittata* and for which Mr. Fall proposed more recently the name *nigriventris.* The name *nigriventris,* however, is preoccupied in the genus by an African species described by Gerstäcker and I propose therefore to use my manuscript name *californica* for this form under which it possibly stands in some collections.

This race is apparently found only in California and differs from specimens from Texas, Arizona, Utah, Colorado, etc., by the usually darker coloration of head; underside and legs and

* Occas. Papers, Cal. Acad. Sc. VIII. P. 152.

having the lateral elytral vittæ broad, as in typical *trilineata.* The head is often entirely black; the black pronotal spots generally larger, more or less quadrate, sometimes transversely confluent and occasionally the thorax is almost entirely black. The black lateral vittæ of the elytra extend in some specimens to the fourth or fifth interval; the underside and legs are usually more or less black.

Lema trilineata trivittata Say.

L. immaculicollis Chev.
L. trivirgata Lec.
L. nigrovittata Schaef. not Guer.

This western race has the lateral elytral vittæ narrower than typical *trilineata* and the California form, occupying the last or the last two elytral intervals. It is very variable. Some have the head, underside and legs colored as in typical *trilineata,* that is, reddish, except tibiæ near apex and frequently side pieces of metasternum; in others they are marked more or less with black and the first three or four joints of antennæ are occasionally reddish; the interocular triangle is more or less pubescent. The black spots of pronotum are often very small or absent; these latter are *immaculicollis* of Chevrolat.

As Say described his *trivittata* from specimens taken at the base of the Rocky Mountains and as typical *trilineata,* to my knowledge, do not occur so far west, they are apparently the same as Leconte's *trivirgata* and therefore Say's name is accepted for this variety, otherwise the rather misleading name *immaculicollis* would have to be used.

In this form as in the new race *medionota* the lateral elytral vittæ are occasionally interrupted before middle.

The specimens taken in the Brooklyn Botanic Garden by Mr. Engelhardt and recorded by me as *nigrovittata* rather belong here as all have the lateral elytral vittæ narrow, though the head, underside and legs are marked more with black, than in most of the western specimens.

While this is apparently a common western form, I have seen one or two specimens from Mobile, Alabama (Loding), one from Washington, D. C. (Shoemaker) and one from Evergreen

Cemetery, Long Island (Siepmann) which have to be placed here on account of the narrow elytral vittæ. The last two may be accidental introductions but those from Alabama are possibly not. In Alabama typical *trilineata* and race *trivittata* apparently meet and occur together with a new southeastern race. They undoubtedly interbreed the offspring belonging either to one or the other of the three forms or combining characters or markings of two.

Certain southeastern specimens with narrow elytral vittæ, however, differ from the western specimens and appear to be a distinct race. They have the head pale, but have a spot of variable size on the interocular triangle and the occular orbits black. In some specimens the interocular spot is united with the black orbits forming a transverse black fascia between the eyes, a maculation I haven't seen in any of the numerous western specimens examined. In the latter the interocular triangle is always pale even then when the head is more or less marked with black. In the race *californica* the interocular triangle is apparently also the last part of the head to become black. In consideration of all this I think that these are entitled to a name and are described below.

Lema trilineata medionata new variety.

Like var. *trivittata* with narrow elytral vittæ and sutural interval only black. Head with a spot on interocular triangle and ocular orbits black; interocular triangle apparently more distinctly pubescent than in any of the other forms; antennæ black, except first joint which is reddish below. Length 7 mm.

Florida, Daytona (Bather), Alabama, Dauphin Isld., (Loding); North Carolina; Virginia (O. Dietz).

The black interocular spot is variable in size and in some specimens extends to the black ocular orbits forming one broad transverse fascia but the head behind and the anterior part of the neck is pale, the posterior part of the latter black. One specimen from North Carolina with a black, transverse interocular fascia has the ventral segments largely black and anterior and intermediate femora spotted with black.

Lema trilineata Oliv.

Typical *trilineata* have the lateral black elytral vittæ wide, occupying more or less the last three or four elytral intervals, the underside red, metasternal side pieces occasionally more or less black; head, including ocular orbits red, first joint of antennæ red, the rest black; femora red, tibiæ red but apical half or less and tarsi black.

It is the common form of eastern North America and is less variable than its western races. Specimens are found occasionally without the two black spots on the pronotum and rarely a few may have the apex of femora more or less narrowly black.

Two specimens, one from North Carolina and one from Mobile, Alabama, the latter in the collection of Mr. H. P. Loding, are marked and colored as in typical *trilineata,* with wide black elytral vittæ and underside pale, etc., but the head in both specimens has a large, median interocular spot and the ocular orbits black. These, as suggested above under var. *trivittata,* are possibly the offsprings of a union between typical *trilineata* and race *medionota.* I place these provisionally as an aberration of typical *trilineata* but they could equally well be placed as such with race *medionota.*

I also place here as individual variation two specimens, which have the elytral vittæ narrow as in the western variety *trivittata.* One of these is from Ithaca, N. Y., and the other from Minnesota. In these specimens the lateral vittæ occupy the entire last interval from base to near apex, while in all the specimens of var. *trivittata* and also var. *medionota* I have seen the black lateral vittæ are removed from the lateral margin basally for a short distance.

Lema melanocephala Say.

It is strange that this apparently distinct species has never been found again since its description. It could not be an accidental aberration as Say had more than one specimen, some of which he had received from Dr. T. W. Harris. Say compares it in form with *trilineata* but with unicolored rufo-testaceous pronotum and elytra, both without any black markings, and head, underside and legs black. An easy recognizable species when found.

Lacordaire in his remarks following the description of *nigrovittata* suggests that Say's *melanocephala* might possibly be a variety of the former but no specimens of that species are recorded to have the underside and legs entirely black, moreover the former is known only from Mexico and the Southwest while Say's species came from the Northwest.

Since Crotch's table of Lema has been published a number of species and varieties have been added and to assist in the identification of these the following table, which I had made for my own use, may also prove useful to others.

KEY TO THE NORTH AMERICAN SPECIES OF LEMA FAB.

1. Elytra unicolorous blue or black, including the lateral margins, surface without markings 2
   Elytra maculate, fasciate, vittate or entirely pale, when blue without markings, lateral margins pale 16
2. Pronotum entirely blue or black 3
   Pronotum red, occasionally marked more or less with black 5
3. Pronotum black .... (L. Cal.) *peninsulae* Cr.
   Pronotum blue 4
4. Elytra with a short, deep, lateral impression below the humeral umbone, ventral segments sparsely punctate. (Ariz.) *margineimpressa* n. sp.
   Elytra without lateral impression, ventral segments closely punctate. (N. Mex.) *concolor* Lec.
5. Head red 6
   Head entirely or in great part black 13
6. Head not bituberculate 7
   Head strongly bituberculate 9
7. Legs more less red .... (Tex.) *texana* Cr.
   Legs entirely black 8
8. Ninth elytral stria not interrupted at middle, prothorax clear red. (Ariz.) *orizonae* Schffr.
   Ninth elytral stria interrupted at middle, prothorax red with or without a black spot at middle .... (S. E. U. S.) *sayi* Cr.
9. Ventral segments of abdomen red 10
   Ventral segments of abdomen black 11
10. Femora at apex and tibiæ black .... (S. E. U. S.) *cornuta* F.
    Femora and base of tibiæ red .... (Kans.) *simulans* n. sp.
11. Legs entirely red, antennal joints one to four red, the following black. (Col.) *coloradensis* Linell
    Legs and antennae black 12
12. Antennal joints rather short and robust, elytra dark blue. (E. U. S.) *palustris* Blatch.
    Antennal joints narrower and more elongate, elytra bright green and more shining .... (Fla.) *palustris floridana* n. var.

13. Head strongly bituberculate, pronotum scarcely constricted laterally and anteriorly more or less black .... (Fla.) *brunnicollis* Lac.
Head not bituberculate or only feebly so 14
14. Pronotum alutaceous, marked more or less with black. (S. E. U. S.) *maculicollis* Lac.
Pronotum shining, clear red 15
15. Small species, length about 4 mm. .... (Kans.-Ind., Fla.) *collaris* Say
Larger and more elongate species, length about 5.5 mm. (Col., Neb., Ill.) *longipennis* Linell
16. Elytra black or blue without or with lateral margins yellow and marked with transverse reddish-yellow fasciæ, spots or without any markings on the disk but then with lateral margins yellow 17
Elytra yellow or red, either vittate, ornate with black or without markings 24
17. Elytral margin yellow 18
Elytral margin black or blue 21
18. Pronotum red 19
Pronotum black 20
19. Elytra with a reddish spot at middle of base .... (Fla.) *conjuncta* Lac.
Elytra, except the yellow lateral margin, entirely blue without markings .... (Fla.) *conjuncta circum-vittata* Clark
Elytra with a transverse reddish-yellow median fascia, connected laterally with the pale marginal vittæ .... (S. E. U. S.) *solani* Fab.
20. Each elytron with a large, yellow basal spot connected laterally with the pale marginal vitta, near apex a narrow arcuate fascia also connected laterally with the pale marginal vitta, this fascia occasionally reduced to one or two yellow spots. (S. Fla., Ariz.) *confusa trabeata* Lac.
21. Pronotum black 22
Pronotum red 23
22. Elytra with large yellow basal spot extending narrowly along base to the lateral margin .... (L. Cal.) *confusa omogera* Horn
Elytra with a transverse, yellow or reddish fascia at middle, occasionally with a narrow, arcuate subapical fascia on each side, reduced sometime to one or two spots .... (Ariz.) *balteata* Lec.
23. Elytra with a transverse median fascia and a narrow, slightly arcuate subapical fascia yellow or reddish .... (Ariz.) *balteata equestris* Lac.
24. Ninth elytral striæ interrupted at middle 33
Ninth elytral striæ not interrupted at middle 25
25. Pronotum entirely black, elytra pale with sutural and lateral vittæ black .... (S. Fla.) *confusa* Chev.
Pronotum pale, either with or without black spots or markings; elytra entirely pale or with black vittæ 26
26. Elytra with an entire sutural vitta 28
Elytra without or with at most a short, wide sub-scutellar vitta 27

27. Elytra without sutural and lateral vittæ, head, underside and legs black .... (N. W. U. S.) *melanocephala* Say
Elytra with a short sub-scutellar vitta, lateral vittæ towards its apex much dilated and occasionally reaching the suture apically; head and prothorax pale or marked more or less distinctly with black. (Tex.) *opulenta* G. & H.
28. Lateral elytral vittae absent, entirely yellow except antennae, tarsi, sutural interval and met-episterna black .... (L. Cal.) *flavida* Horn
Lateral elytral vittæ present, head, pronotum, legs and underside variable in coloration and markings 29
29. Lateral elytral vittæ removed from the margin, occupying the sixth or seventh elytral intervals; head black, black pronotal spots in the lateral impressions .... (N. Mex., Ariz.) *nigrovittata* Cuer.
Lateral elytral vittæ close to the lateral margin, occupying the last two or more elytral intervals; coloration of head, underside and legs variable; black pronotal spots, when present, always on the disk 30
30. Lateral elytral vittæ wide, occupying the last three or more elytral intervals 31
Lateral elytral vittæ narrow, occupying at most the last two intervals 32
31. Head, body below and legs reddish, except apex of tibiæ, tarsi and usually the met-episterna black .... (E. U. S.) *trilineata* Oliv.
Head, body below and legs more or less marked with black. (Cal.) *trilineata californica* n. n.
32. Head with a black spot on interocular triangle and ocular orbits black, or by extension of the black median spot the latter becomes connected with the black ocular orbits forming a broad, transverse interocular fascia .... (S. E. U. S.) *trilineata medionota* n. var.
Head variable, either without or with black markings or almost entirely black, but interocular triangle always more or less pale and never with a black median spot only .... W. U. S. *trilineata trivittata* Say
33. Legs entirely red, or red with tarsi only black 34
Legs more or less black 35
34. Antennæ and legs entirely reddish, elytra either immaculate, with three black spots on each side and a short, common sutural vitta near base or with a broad piceous sutural vitta of irregular outline. (L. Cal.) *aemula* Horn
Antennæ black, except first four joints, which are reddish, legs reddish, tarsi black; elytra with a subapical spot on each side and suture black .... (Tex.) *jacobina* Linne
35. Elytra with six black spots, the two anterior subsutural spots occasionally united at suture .... (S. E. U. S.) *sexpunctata* Oliv.
Elytra with a common, more or less triangular or subcordate, sutural spot below scutellum and on each side a humeral spot and one below middle black .... (S. E. U. S.) *sexpuctata albini* Lac.
Elytra with a wide, common sutural vitta of irregular outline black. (S. E. U. S.) *sexpunctata ephippium* Lac.

Anomœa Lac.

Anomœa is not a synonym of *Antipus* as given in the Leng catalogue. In his ''Monographie des Phytophagides'' Lacordaire recognized only one genus—*Clytra*—in his tribe Clytrini but with thirty-nine subgenera. Chapuis in ''Genera des Coléoptères'' elevated some of the subgenera to generic rank and one of these was *Titubœa* with *Anomœa, Antipus* and a few others as subgenera. This course was later more or less followed by those treating the species of the tribe Clytrini. However, Crotch in 1873 and Leconte and Horn in ''Classification of Coleoptera of North America'' accepted *Anomœa* for the North American species while Jacoby in the Biologia uses *Titubœa* for the Mexican species with *Anomœa* as synonym. Both names were proposed by Lacordaire in the same publication but *Anomœa* has page precedence. Of the three, *Antipus* is the older name but the typical species of the latter, which occur only in Africa, are said to have smaller and more rounded eyes, which are not obliquely placed and the epistoma is not emarginate as in *Anomœa* but broadly lobed in front. These differences and the different habitat ought to be sufficient to retain *Anomœa* for the American species, at least for the present, till the troublesome tribe Clytrini has been thoroughly revised.

There is apparently very little to separate *Titubœa* from *Anomœa.* Besides the differences in markings the males of the former have the elytra not pubescent and the epistoma is not quadridentate, however, this latter character is in some males of *Anomœa* scarcely noticeable.

The species of *Anomœa* are more or less troublesome. They are separated by scarcely any good structural character, but mostly on coloration and markings. These are more or less variable and differ also, in some species at least, a good deal in the two sexes, which makes it rather difficult to correctly associate the males and females of certain species if they are not taken together in the same locality. This is well illustrated by *rufifrons* and *mutabilis,* of which the females, which Lacordaire refers to these two species, scarcely differ from each other and therefore *mutabilis* was regarded by him a dubious species. However, *mutabilis* is apparently a good species and the females Lacordaire associated with the males of *rufifrons* are in my opinion all females of *mutabilis* and that the females of *rufifrons* are not positively known so far. There is also a possibility that Lacordaire's varieties A and C of the males of *rufifrons* do not belong there. At least it seems that the later described *högei* is his var. C, which he describes as having the elytra immaculate "sans aucune trace de raie suturale et de lineoles marginales noires" which are the essential characters of *högei*. Var. A is apparently very close to the males of *nitidicollis* described below and a single male, I place provisionally with the males of *crassicornis*,* a new species described further on, agrees fairly with the description of typical *rufifrons*. The males of these species—*rufifrons*, *crassicornis*, *nitidicollis* and *högei*—differ very little from each other and may easily be considered varieties of one species but the females are quite distinct and differ a good deal.

In the following short revision I have attempted to straighten out our North American species of *Anomœa;* however, a thorough and critical study of the North and Central American species with large series of specimens of each is desirable to place the species of this genus on a sound base. The male and female often differ very much from each other in form and in some species in coloration and markings of elytra also. The males have the anterior legs much longer, the anterior tibiæ arcuately curved near apex, the head usually much larger, the pronotum more or less so and the elytra pubescent, narrower and more parallel than the females. The front and middle tibiæ of the females of all our species are not straight but slightly arcuate and elytra usually not pubescent.

KEY TO THE SPECIES OF ANOMŒA LAC.

Females

1. Pronotum flavous 2
   Pronotum black, elytra reddish with suture, lateral margins more or less and a transverse, post-median fascia black, the latter occasionally interrupted medially .... *mutabilis*

* Since the above remarks were written I have seen another male of this form from Coral Gables, Fla., in Nat. Museum collection, placed on the same pin with a typical female of *crassicornis*, both possibly taken in copulation. These two males are very close to the males of *nitidicollis* from which they seem to differ only in coloration of femora and stouter antennal joints.

2. Elytra reddish with a common, large, black, submedian sutural spot, extending frequently to the lateral margin, the latter in great part and legs black, pronotum very shining .... *nitidicollis*
   Elytra flavous with a common, large, black submedian sutural spot, lateral margins entirely pale, all the femora and middle and hind tibiae pale, pronotum rather dull .... *högei* var.
   Elytra flavous with a common black sutural vitta, which is often laterally more or less dilated, in *laticlavia* the elytra are occasionally black, with flavous humeral and apical spots 3
3. Elytra with suture and lateral margins black 4
   Elytra entirely pale 8
4. Fourth antennal joint subtriangular, about as long as wide at apex, following joints rather stout and usually wider than long. *crassicornis*
   Fourth antennal joint not subtriangular, usually longer than wide at apex, following joints less stout and about as long as wide at apex...... 5
5. Elytra with common black sutural vitta more or less arcuate externally, or dilated from before middle but narrowing near apex, occasionally by extension of black coloration the elytra are black with large humeral and apical spots pale 6
   Elytra with suture narrowly black as in males of *laticlavia* straight, not arcuate externally 7
6. First three or four antennal joints pale, the following black; femora and some of the tibiae pale .... *laticlavia*
   All the antennal joints and legs black, pronotum wider .... var. *floridana*
7. The first three or four antennal joints pale, the following black; legs pale, except anterior tibiæ and tarsi black........ var. *kansana*
8. Sutural and lateral margins pale, antennal joints five to eleven, anterior tibiæ, all tarsi and underside more or less black........ *högei*

Males

1. Pronotum and elytra flavous, the latter without distinct transverse postmedian fascia* 2
   Pronotum black or very nearly so, elytra more or less reddish with a wide, post-median, transverse fascia black, which is occasionally interrupted at middle on each elytron .... *mutabilis*
2. Elytra with suture and lateral margins black 3
   Elytra with suture and lateral margins pale .... *högei*
3. Elytra with suture narrowly black 5
   Elytra usually with a common wide sutural vitta black, which is variable in width and of more or less irregular outline 4
4. Small species, about 6 mm. in length, prothorax shining, scarcely rounded at sides and in form more like that of the females of *crassicornis*. *angustata*

* Occasionally in a specimen of *nitidicollis* faint indications of a postmedian fascia are seen.

Larger species, about 8 mm. in length, prothorax dull, broadly rounded at sides .... *crassicornis*

5. Fourth antennal joint longer than wide at apex, following joints about as long as wide 6

Fourth antennal joint subtriangular, about as wide as long, following joints transverse, wider than long 7

6. Elytral suture narrowly black, faintly so in var. *kansana;* femora pale. *laticlavia*

Elytral black, sutural vitta wider, slightly arcuately dilated as in some females of *laticlavia,* head and pronotum distinctly smaller and more like those of the females .... var. *floridana*

7. All the femora pale, knees blackish .... *crassicornis* var.

Middle and hind femora more or less black .... *nitidicollis*

Anomœa mutabilis Lac.

This is readily recognized from the other North American species by its black prothorax and black elytral fascia both present in male and female. It varies a good deal but more so in the male than in the female.

The head is more or less distinctly rugose in both sexes, either entirely red, marked more or less with black or entirely black; antennæ black, or the outer joints black, the preceding pale, joints five to eleven transverse, serrate, especially in the males; pronotum either entirely black, or black with apical and lateral margins pale in both sexes, in some males the median part is reddish or yellowish, widening abruptly apically, and at sides largely black or the pronotum black with an antebasal reddish spot, in one small male the entire pronotum is flavous, except a narrow obscure cloud in basal half near lateral margin. Elytra reddish or yellowish with a large submedian fascia, suture, apical and lateral margins behind the submedian fascia black, the latter reduced occasionally to a common sutural spot of variable size and very rarely the spot may be entirely absent; body beneath black, often, especially in the males, last ventral segment and part of the metasternum pale, pubescence moderately long, dense and white, legs black or more or less pale. Length 7–9 mm.

Texas, Mexico.

I rather would place the *ruficauda* of Foersberg with this species than with *laticlavia* on account of its black pronotum, which never occurs in *laticlavia* nor any other of our species, except *mutabilis.*

Anomœa nitidicollis Schffr.

I described this species from a single female in the Dietz collection but both sexes were afterwards collected at Alpine, Texas, by Mr. G. P. Engelhardt and the late O. C. Poling; also in Brewster Co., Tex., by Mitchel and Cushman. The males differ a good deal from the females and more than in any other species known to me.

Male allotype: General form and coloration of *laticlavia* but larger. Posterior part of head behind the eyes smooth and shining, front more or less closely rugose; antennæ rather strongly serrate, first four joints pale, the following black; pronotum flavous, more or less dull; elytra slightly paler than pronotum, pubescent as usual, suture and the greatest part of lateral margin medially narrowly black; body beneath except prothorax black, covered with dense, white pubescence; femora flavous, apex only or entire femora marked more or less with black, or entirely black, especially the hind femora; tibiæ and tarsi black. Length: 9 mm.

Type and paratypes in Nat. Museum collection, paratypes in my collection.

While the coloration varies very little except that of the legs, I have one specimen with a lateral black median spot which extends inwardly to about middle and another one with a short, obscure line at middle of each elytron but in both the pronotum remains unicolorous flavous.

The female as usual is more robust, the head and pronotum very shining, the former not or very feebly wrinkled between and below the eyes; color reddish above, scutellum, elytral suture, apical and lateral margins, the latter in about apical third, narrowly black and at about middle a large transverse black fascia of irregular outline; this fascia is variable and sometimes reduced to a large, common, black sutural spot; body beneath, except prothorax, and legs black, clothed densely with white pubescens.

While all the females seen agree with the above description I have one small specimen (7 mm.) from Round Mount, Texas, which has an elongate dark mark between the eyes and on each side of pronotum, occupying about basal half, a large, reddish-brown spot, but otherwise agrees with the larger typical specimens. On account of the coloration of head and pronotum it could have been taken for a variety of *mutabilis,* but the very smooth, shining, scarcely wrinkled head removes it at once from that species, which have the head, between and below the eyes, more or less distinctly rugose.

Anomœa crassicornis new species.

FEMALE: Similar to *laticlavia* but larger, with heavier and more strongly serrate antennal joints.

Head unicolorous flavous, shining, almost smooth and scarcely wrinkled between and below the eyes; antennæ black but first joint pale; second and third joints very small, third narrower than second, fourth longer than the two preceding joints, wide and subtriangular, following joints rather strongly serrate. Pronotum flavous, more or less evenly rounded at sides; surface shining, impunctate. Elytra flavous with a wide, common sutural vitta of variable size and lateral margin narrowly but not reaching base nor apex, black; surface distinctly, irregularly punctate, punctures at apex obsolete, near suture two or three, more or less complete impressed striæ. Body beneath black, densely clothed with cinereous hairs, except prothorax which is flavous and shining; femora, middle and posterior tibiæ flavous, anterior tibiæ and all tarsi black. Length 8.25 mm.

Florida: Biscayne Bay (Hubbard and Schwarz); Pleasant Lake, near St. Petersburg, May (Doll); Miami (O. Dietz, P. Laurent); Homestead, May (Mozier); Coral Gables, March.

Male, allotype: Differs from the female as usual in form, larger head and longer anterior legs. Head flavous, posterior part smooth, shining, anteriorly rugose; antennæ as in the female, but first, second and third joints pale. Pronotum dull, impunctate, except for a few, vague punctures seen laterally. Elytra flavous, with a rather wide, common sutural vitta of irregular outline and lateral margins black, the black coloration of the latter not reaching base nor apex. Body beneath black and densely pubescent, except prothorax and last ventral segment at apex pale; femora pale, at apex more or less and tibiæ and tarsi black. Length: 8 mm.

Florida: Homestead, May (Mozier).

Type, allotype and paratypes in National Museum collection, also paratypes in my collection.

Two males are colored like the males of *laticlavia,* that is the sutural vitta is very narrow, they are larger and are very near the males of *nitidicollis,* but besides the differences given in the table the antennal joints are a little stouter in this species.

The common black sutural vitta of elytra of both sexes is variable, in some specimens it is very wide of more or less regular outline, in others it is narrower anteriorly but more or less dilated apically and in a few specimens the suture is narrowly black as in some *laticlavia.*

Anomœa laticlavia Forst.

Typical specimens of this common and well known species differ as usual in form in both sexes and also in elytral coloration. The antennæ are rather feebly serrate with the fourth joint usually longer than wide at apex or nearly so and more feebly dilated. In the female the punctuation of elytra is variable from feebly to distinctly punctate; occasionally two or three, more or less complete, longitudinal stria-like impressions are present near suture, which are in some specimens only faintly indicated; the color varies from flavous with a black sutural vitta of variable size to black with humeral and apical spot on each elytron pale, but in all the black marginal vitta usually reaches the basal margin which also is generally narrowly black; the legs are pale, anterior tibiæ either entirely or partly and tarsi black, specimens occur with middle tibiæ more or less to all the tibiæ and hind femora also black; the underside is generally black, occasionally the last ventral segment and pygidium more or less pale, densely pubescent.

The males differ from the females as usual in having the head and prothorax larger, the elytra sparsely pubescent more slender and parallel, the anterior legs elongated with tibiæ curved near apex; the upper surface is flavous, elytra slightly paler with suture more or less narrowly black but apparently never as widely black as in the more feebly marked females. Length: 5.75–8 mm.

It occurs in the entire Atlantic Region, except possibly Florida, to Ohio, Wisconsin, Minnesota, Nebraska and South Dakota.

Anomœa laticlavia kansana new variety.

The females differ from typical *laticlavia* in having the elytra with a more or less straight, narrow black sutural line as in the males of typical *laticlavia.* The single male of this form I have seen has only the sutural bead of elytra blackish and the lateral margin narrowly black from about middle to base, but basal margin pale; all the femora and tibiæ pale, tarsi black; the fourth antennal joint is nearly as wide at apex as the fifth, the following joints as in typical *laticlavia.* Length: 7–8 mm.

Kansas: Medora (Knaus) type, Benedict (Knaus).

Paratypes in Mr. Knaus' collection.

Two female specimens from the Dietz collection labelled "Kansas" have the elytra very sparsely pubescent as generally seen in males but do not differ otherwise. It is an unusual character in the females and the only species in which the elytra in both sexes are pubescent is the Mexican *villosa,* which, however, is colored like *mutabilis.*

From the description it seems to be trivial to separate this variety from the typical form but in a series of specimens of both placed together, the differences are very obvious.

Anomœa laticlavia floridana new variety.

MALE: Differs from the males of typical *laticlavia* in having the head and pronotum smaller than usual, more like the females of the typical form; antennæ black, first joint pale and more or less so the second and third; the black sutural vitta of elytra narrow, not straight, but somewhat arcuate externally as in some females of *laticlavia;* the black marginal vittæ at sides moderately wide but narrower towards base, the latter also narrowly black; underside and about basal third of pronotum black, the latter anteriorly pale, the former densely pubescent; femora pale, apex and tibiæ and tarsi black.

FEMALE: Less slender and more robust than the male, pronotum and elytral vitta wider, all the antennal joints and legs black. Length: 7 mm.

Florida: Rockbluff, April (Leonhard).

A paratype in the collection of Mr. H. Dietrich.

The basal margin of the pronotum is narrowly black, the prothorax below is pale anteriorly and black posteriorly in the few specimens seen; this, however, occurs also occasionally in both sexes of typical *laticlavia.*

A peculiar and aberrant form which possibly is a distinct species, though the female scarcely differs from those of typical *laticlavia.* The head of male and female is alike but the eyes in the former are slightly larger, the prothorax is narrower in the male and less broadly rounded laterally than in the female, the narrow, black sutural vitta of the males is not straight as in the males of *laticlavia* but laterally more or less arcuately dilated as in some more feebly marked females of the latter. To any one more intimately acquainted with these insects the males look at first sight more like very slender females, but the elongated front legs, pubescent elytra and last ventral segment without the usual fovea of the females show that they are males. There is another species so far recorded in which both sexes are nearly alike in form and that is the Mexican *sphacelata*, but that species is differently colored and the prothorax is apparently narrower in the female than in the male.

Anomœa angustata new species.

MALE: Narrow, slender, above flavous except antennal joints four to eleven, antescutellar lobe of pronotum, scutellum, a moderately wide vitta at lateral margins of elytra, not reaching base nor apex and a very wide common sutural vitta, rather suddenly narrower around scutellum but more gradually narrowing apically, black, the common sutural vitta laterally nearly straight in outline and slightly more than twice as wide as the lateral pale space. Body beneath black, densely pubescent, except prothorax entirely and a narrow, longitudinal space on last ventral smooth and flavous; femora and hind tibiæ pale, anterior and middle tibiæ and tarsi black.

Head and pronotum more like those of the females, small, the sides of the latter feebly rounded and surface smooth and shining; elytra elongate parallel, not pubescent, irregularly punctate, punctures near suture forming more or less regular rows; anterior legs elongate with tibiæ slightly curved near apex. Length: 6 mm.

Florida; Enterprise (O. Dietz).

This is another aberrant species related to *floridana* and the Mexican *sphacelata* of which I unfortunately have only one male. The antennæ are formed as in *floridana*, also the head and prothorax very nearly as in the latter with which I had placed it for a time as an aberration. But the elytra apparently not pubescent, the very wide sutural vitta, the base of elytra and prothorax above and below pale, not margined with black and the hind tibiæ pale decided me to give it a name. The elytra of the male without pubescence in itself is an unusual character in this genus and the pubescence being usually sparse, abrasion by handling, etc., might have caused it, but even in old worn specimens of several species, at least some of the hairs on the surface and sides are present. Additional specimens of both sexes will possibly give a better idea of the relationship of this peculiar insect.

Anomœa högei Jacoby.

This species is easily recognized by its entirely pale upper surface without black fasciæ or black sutural and lateral vittæ of elytra. It is described from Mexico from a single male and three females. The male type is entirely pale above including the scutellum, the underside pale, except metasternum which is black, tarsi black, lgs pale and the antennæ black except the first four joints which are pale. The females colored as the males but the underside black. I have several specimens of each sex from Texas which show that this species is also variable. In the male the anterior tibiæ are either pale, or partly so and the rest black or entirely black, also in the female, the scutellum in the latter is apparently always pale, in the male from entirely pale to entirely black; the metasternum and ventral segments are more frequently black with the last ventral segment only pale. One of my females has the suture of elytra below middle for a short distance a little darker, also the lateral margin; in another female the suture from above middle to nearly to apex is brownish and on each elytron are two short, dark lines, one on the disk far beyond middle and one near the lateral margins. Another female on the same pin with a typical male from Victoria, Texas, in the National Museum, taken on *Cassia sp.,* has behind middle of elytra a distinct, large, blackish common sutural spot as occasionally found in certain females of *nitidicollis,* the scutellum is blackish but the lateral margin of elytra is pale, the pronotum and elytra are flavous and duller than in the latter.

This species is generally larger than *laticlavia* with more strongly serrate antennal joints especially in the males, the anterior tibiæ of *högei* are more strongly curved near apex and the elytra in both sexes are more finely punctate than in the former. Length: 7–8 mm.

Texas: New Braunfels, Gainesville, Victoria, Dallas, Frt. Worth.

Gynandrophthalma Lac.

Anomœa militaris and *arizonica* belong in this genus, which differs from *Anomœa* in both sexes being alike in form; the anterior tibiæ are straight, not elongated nor arcuate apically in the male and are the same in both sexes. The eyes are also relatively smaller, more evenly rounded and scarcely emarginate, the epistoma is arcuately emarginate and in the male not quadriangulate, at least not in the two North American and the European species known to me, and the elytra in the males are never pubescent. There is also very little doubt that the Mexican *Anomœa humerigera* Lac. belongs here. It was described from a single female and is closely allied to my *arizonica*. Mr. Jacoby in the Biologia recorded only a single female of *humerigera* from La Parada, Mexico; this has an additional, small, red spot near apex of each elytron, which would bring it close to *militaris*. More Mexican material may show that the three are variations of one species.

In the table of genera of the subfamily Clythrinæ in Genera Insectorum, the authors separated the genus *Gynandrophthalma* from *Titubœa* (including in the latter the subgenera *Anomœa, Antipus,* etc.) by having the base of the pronotum truncate but in the description the base is said to be "subsinueuse." In all the species of this genus known to me the base of pronotum is more or less sinuate.

Two species occur in the United States.

Gynandrophthalma militaris Lac.

This species is known so far only from Texas. It is black, elytra bluish with a large humeral and smaller apical spot red. Length about 4 mm.

Gynandrophthalma arizonica Schffr.

Same coloration and size as in the preceding species, but without the red apical spot on each elytron. The anterior tibiæ are occasionally more or less pale, the pronotum in the majority of specimens is more or less faintly clouded with red, the red humeral spot on each elytron is variable and at its apex extends occasionally to the suture as in *Cryptocephalus binominis* Newn.

Coscinoptera dominicana franciscana Lec.
Coscinoptera dorsalis Lec.

This is not a plain synonym of *dominicana* but a good western race, distinguished by the elytra being distinctly pubescent and generally less coarsely punctate. It is known to me from Texas, Arizona, Colorado and Kansas.

Saxinis sonorenss Jac.

I have a specimen from Albuquerque, N. Mexico, of this species which is so far only recorded from Mexico and Arizona.

Babia Lac.

Crotch was wrong in placing *tetraspilota* as a variety of *quadriguttata.* It is a good species. In the latter and its varieties the lateral margins of pronotum are rather wide, subexplanate, scarcely reflexed and irregularly, somewhat coarsely punctate. In *tetraspilota* as in *humeralis* and *oregona,* a new species, the lateral margins are not explanate but narrowly reflexed with a single row of punctures within the reflexed margin.

KEY TO THE SPECIES AND VARIETIES OF BABIA LAC.

1. Lateral margins of pronotum more or less explanate or flattened, the flattened portion confusedly punctate with relatively coarse punctures 2
   Lateral margins of pronotum not explanate but narrowly reflexed, within the reflexed margin a single row of punctures 4
2. Size large, $3\frac{1}{2}$–5 mm.; elytral striæ on the disk more or less confused and pronotal punctuation generally distinct and rather coarse, especially near the sides .... *quadriguttata*
   Size smaller 3–$3\frac{1}{2}$ mm.; elytral striæ not confused; pronotal punctuation relatively finer 3
3. Form as in *quadriguttata,* sides of pronotum broadly rounded. var. *pulla*
   Form narrower and more slender, sides of pronotum feebly rounded. var. *tenuis*
4. Elytra black with one or two red spots on each elytron 5
   Elytra entirely red 7
5. Each elytron with humeral and apical red spot, form narrower and more elongate than *quadriguttata* 6
   Each elytron with a red humeral spot only, form of *quadriguttata.* *humeralis*

6. Humeral red spot small, generally extending from the lateral margin to the fourth stria and not extending along the lateral margin to the middle of elytra, size smaller .... *tetraspilota*
   Humeral red spot larger, extending from the lateral margin to about the second stria and often along the lateral margin to or beyond middle of elytra, size larger .... var. *texana*
7. Punctuation of pronotum and elytra very fine, almost obsolete .... *oregona*

B. quadriguttata Oliv.

This well known species has generally the serial punctures of elytra irregular and more or less confused with those of the intervals, though specimens occur with the rows of punctures nearly regular. It is our largest species and a common insect in the eastern States but occurs as far west as Texas and Nebraska. Length: 3.5–4.5 mm.

B. quadriguttata pulla Lac.

I refer specimens taken in the Huachuca and Pinal Mts., Arizona, and Yemez Springs, New Mexico, to this variety. They are usually smaller, with finer punctuation and the serial punctures of elytra generally regular. Length: 3–3.5 mm.

B. quadriguttata tenuis new variety.

Narrower and rather more parallel than *quadriguttata* var. *pulla*, punctuation of prothorax fine, the serial punctures clearly defined and the intervals not or feebly punctate. Length: 3.25 mm.

Cheyenne, Wyoming. Type in U. S. Nat. Museum, paratypes in my collection.

B. tetraspilota Lec.

These are the small specimens (2.25–3 mm.) which apparently inhabit the arid region. The pronotum is very finely punctate, the lateral margin narrowly reflexed and the serial punctures of elytra are fine and generally clearly defined, intervals scarcely punctate. The reddish humeral spot of elytra usually extends inwardly to the third or fourth series of punctures. It occurs in Arizona and New Mexico.

B. tetraspilota texana new variety.

Larger than typical *tetraspilota* with humeral and apical reddish spots much larger, the former generally reaching inwardly to the first row of punctures and along the lateral margin to or below middle. Length: 3–.5–4 mm.

Brownsville, Texas. Type and paratypes in U. S. Nat. Museum, paratypes in my collection.

This form was commonly taken by sweeping low vegetation and looks quite distinct from typical *tetraspilota* by the larger size and much larger elytral spots. One specimen has the elytra reddish-yellow with suture narrow and a narrow, interrupted subapical fascia black.

B. humeralis F.

This species is at once known by the absence of the reddish apical spot of elytra. It has the narrowly reflexed lateral margin of pronotum as in *tetraspilota* and var. *texana* and the same pronotal and elytral sculpture but the form is slightly more robust and more like typical *quadriguttata*. Length: 2.5–3.25 mm.

It occurs in Lower California and Mexico.

B. oregona new species.

Slightly larger than typical *tetraspilota*, black, elytra reddish; pronotum nearly impunctate, except a few scattered punctures near apical and basal angles; lateral margins as in *tetraspilotus* narrowly reflexed; elytral series of punctures feebly impressed, very faint and scarcely visible at sides, intervals nearly smooth, punctures feebly visible. Length: 3.25 mm.

Waldport, Oregon, July 4. (Engelhardt). Type in U. S. Nat. Museum.

It differs from the var. *texana* in coloration of elytra and finer, almost obsolete punctuation of upper surface.

Monachulus opacicollis new species.

Coloration like *guerini* but pronotum very dull, almost impunctate, with two short, broad black median vittæ, closely placed, which do not reach the apical nor basal margin; elytra feebly shining, the red median fascia laterally narrower than on the disc and interrupted by the very deeply impressed darker ninth stria. Body below and legs black with very faint metallic-blue tint, except prothorax below, mesosternum, anterior legs and base of intermediate femora red. The head and the first five joints of antennæ red, the following black. Length: 2.25 mm.

S. Bernardino Rch., Cochise Co., Arizona, August (Snow).

With the above described male I associate a single female labelled only Arizona, on account of the very dull prothorax but which has two black spots and the punctuation more evident; the red elytral fascia is broader not narrowing laterally and the underside and legs black with metallic-blue tint except the prothorax beneath which is red.

Besides the characters given above *opacicollis* differs from *guerini* in being more narrowed anteriorly and posteriorly and the eyes are less widely separated. The pronotum of *guerini* is more or less shining and distinctly punctate. *M. opacicollis* is apparently related to the Mexican *scaphidioides* by its very dull pronotum and judging from the description the form of both is alike. The Mexican species has the pronotum black, however, in one of the two teneral specimens, mentioned by Suffrian, the sides of the pronotum are reddish. More material and comparison with Mexican specimens may show that *opacicollis* is a color variety of *scaphidioides*.

Cryptocephalus notatus sellatus new variety.

Like var. *quadrimaculatus* in form, size, sculpture and color, but with the humeral and red apical markings broadly connected laterally.

New Braunfels, Texas (O. Dietz).

This color phase is intermediate, connecting *quadrimaculatus* with *fulvipennis;* it apparently does not occur further north. These Texas specimens are also rather more bluish and the serial punctures of elytra are smaller.

Cryptocephalus pubiventris Schffr.

The three specimens in my collection represent three different forms. One, the typical form, is marked like var. *quadrimaculatus,* the second specimen marked like the above described var. *sellatus,* that is, the red humeral and apical markings are connected laterally, the other specimen has the elytra red with a rather faint, obscure, dark cloud behind middle; a specimen from Fort Grant (Hubbard and Schwarz) in the Nat. Museum has a distinct black mark slightly behind middle of the red elytra and is somewhat intermediate in coloration between the two last mentioned forms.

Cryptocephalus binominis rufibasis new variety.

In this form the elytra, in about basal half, are entirely red, except the basal margin and suture, both very narrowly black; the red apical spot on each elytron is slightly larger than in the typical form. Length: 4–4.25 mm.

Punta Gorda, Florida, November (W. T. Davis).

Cryptocephalus multisignatus new species.

Narrower and more slender than *quadruplex* or its var. *quadriguttulus*, black, except apical margin of prothorax narrowly, lateral margins in about apical half and on each elytron a small spot near scutellum, a large humeral spot extending at its apex to the suture as in *binominis*, a transverse subapical fascia narrowing exteriorly and not reaching suture nor lateral margin, a small apical spot also pygidium with two small apical spots and joints one to five of antennæ reddish.

Head moderately coarsely and distantly punctate; pronotum with sides feebly arcuate, surface finely and distantly punctate, punctures almost obsolete laterally; elytra with rows of rather coarse punctures, the fifth and sixth row more or less confused; prosternum, seen laterally, with a large tooth anteriorly, ventral segments of abdomen feebly pubescent and rather sparsely punctate. Length: 3.5 mm.

Arizona.

The specimen described is a male and will be easily recognized not alone by its markings but also by its more slender form and less arcuate sides of pronotum than in *quadruplex* and its variety.

Cryptocephalus trizonatus Suffr.

In the Leng catalogue the localities given for this Mexican species are Mexico and Arizona. It was first recorded here from Brownsville, Texas, where it is by no means a rare species. I am not aware that it has ever been taken in Arizona.

Cryptocephalus texanus new species.

Very much like the Floridian *bivius* in coloration, markings, pronotal and elytral sculpture but the black pronotal spot near the lateral margins of the latter is always absent in *texanus*, the postscutellar markings on the second interval are obliquely prolonged for a short distance forming the handle of a hatchet-like mark produced by the inward extension and confluence with the subbasal spot on the third interval; the inner one of the two submedian spots on each elytron is situated on the third elytral interval—in *bivius* on the first and occasionally extending more or less to the sutural interval; the inner one of the two submedian spots on each elytron is situated scarcely lower than the outer one while the latter in *bivius* is decidedly so. Length: 5.25 mm.

New Braunfels, Texas. (O. Dietz).

I have seen a small number of this species which superficially resembles *bivius* a good deal and are probably mixed with that species in collections. In one specimen the postscutellar markings unite at apex forming a somewhat heavy letter W, in *bivius*, when united these markings represent a rather arcuate postscutellar fascia. The pronotum is also more distinctly punctate than in *bivius*.

Cryptocephalus cupressi new species.

Form, size and coloration of *leucomelas* with similar markings on pronotum and elytra, except that on each elytron are two submedian spots which do not form a transverse fascia, the inner spot is always separated from the suture by one or two intervals. The umbonal spot on each elytron is generally very large and apparently rarely connected with the juxta-scutellar markings, the latter decidedly more oblique than in *leucomelas* and more or less pipe-like in design; the pronotal vittæ are more removed anteriorly from the apical margin than in the latter species, the outer vittæ are relatively strongly dilated externally and the two discal vittæ more or less so apically. Length: 4–5 mm.

New Orleans, Louisiana (G. P. Engelhardt).

Several pupal cases were collected by Mr. Engelhardt on branches of cypress December 29th and January 2d from which four imagoes emerged April 6th.

The elytral markings are the same as in *texanus* described above, but the latter is a larger and more robust species with more shining smoother pronotum and finer elytral punctures, the pronotum in *cupressi* is rather coarsely and closely punctate.

The submedian transverse elytral fascia in *leucomelas* is more or less variable, but apparently there remains always a common, more or less transverse sutural spot in the specimens in which this fascia is much reduced.

The markings in *cupressi* are more or less longitudinally linear, in *leucomelas* usually transverse; in the latter species are generally one or two small spots near the lateral margin between the subbasal and submedian bands or spots, which are absent in *cupressi*.

Cryptocephalus duryi Schffr.

A specimen in the National Museum collection from Yuma, Arizona, (McLachlan coll.) agrees in form, sculpture of prothorax and elytra with the Brownsville specimens, except in slightly smaller size, absence of the two dark central vittæ of prothorax and the lateral vitta on each side represented by only a dark, short subbasal stripe, the median and lateral vittæ, however, are very faintly indicated at apex. In the Brownsville specimens a few of the dark punctures of the elytra are connected transversely and longitudinally but in the Arizona specimen all the punctures are clear. These differences may be more or less constant but more material of both is necessary to decide on the correct standing of this Arizona form.

(To be continued)

BOOK REVIEW

Medical Entomology, A Survey of Insects and Allied Forms which Affect the Health of Man and Animals, by William A. Riley and O. A. Johannsen. 476 pp. 8 vo. Cloth. Illus. N. Y. McGraw-Hill Book Co. 1932. $4.50.

The present work is a review of the ''Handbook of Medical Entomology'' issued by the authors a decade and a half ago. In the former work the insects and allied forms were considered under the general headings of poisonous forms, parasitic species and species that serve to transmit and disseminate disease. Keys to the various forms of medical importance were grouped together at the end of the text. As the work of revision progressed it seemed more suitable to recast the material and to consider the various hominoxious forms in their systematic order. The text, therefore, has been entirely revised and is not only entirely new work but is presented under its new name. Particular attention has been devoted to pioneer work on the subject as well as to current literature. Extended as the bibliography is, it is hardly necessary to state that it cites only a small fraction of the voluminous literature on the subject. Something of the scope of the work may be gained by the names of its various subject subdivisions: Early suggestions regarding transmission of disease by insects; ways in which Arthropods may affect health of man and animals; crustacea of medical importance; venomous spiders, whip-scorpions and true scorpions; mites, chigger mites, itch mites, and others; Ixodoidea or ticks; Myriapoda or centipedes and millipedes; structure and development of insects; Anoplura or lice; bedbug, assassin bug, and other Hemiptera; Coleoptera; Lepidoptera; Diptera, Culicidæ or mosquitoes and disease; other blood-sucking Diptera; botflies, house flies, stable flies, tsetse flies; myiasis or infestation of man and animals by Diptera; and Siphonoptera or fleas.

The present generation has witnessed a remarkable and practically world-wide change in the view-points of both scientists and laymen regarding the relation of insects and their allies to man. Until the beginning of the 20th Century they were considered merely as an annoyance or menace to man and his flocks or herds and to his crops. Now it is known that in another and much more insidious manner many of them may be enemies in that they maintain and disseminate some of the most important diseases of mankind. The recognition of this fact has completely revolutionized our methods of control of certain diseases of man and animals and has become an important weapon in the fight for the conservation of health. In view of the exceeding value of this work it is certain to attain a world-wide usefulness.—J. S. W.

THE PHYLOGENY OF SOME MAYFLY GENERA

BY HERMAN T. SPIETH

(Continued from Vol. XLI, page 86)

PHYLOGENETIC RELATIONS OF GENERA

Super Family SIPHLONUROIDEA

Family *Siphlonuridæ*

Siphlonurus

This genus possesses the most primitive wing to be found within the order. In the fore wing (Fig. 3), R_3 is truly attached to R_2, and the R_3 triad has not been greatly modified. MP_1 is attached to MP_2 and this triad likewise has not been greatly changed from its primitive condition. CuA still shows distinctly a triadic method of forking on its distal end, and basally CuA and CuP meet as in the hypothetical primitive insect wing. Three anal veins are present. The interpolated veins are vigorous and attached basally.

The hind wing (Fig. 4) is large and Sc is only moderately arched; consequently the radial area is small. The radius and medians do not fuse but run into the base. The anterior median is triadically forked. There are no interpolated veins in the Cu area and three anals are found within the large anal area.

In contrast to the wings, the genitalia are specialized. In mature nymphs the forceps (Fig. 58) are 3-jointed, the styliger plate is flatly cone shaped and the penes can be distinguished as rod shaped organs. In the adult the styliger plate (Fig. 61) is extremely elongated and is longer than wide. The forceps which arise from the postero-lateral corners of the styliger plate are four-jointed, consisting of a short, heavy, trunk-like basal joint, a slender, slightly arced, long second segment, and two comparatively short, slender terminal members. The penes are distinctly divided into two separate organs which are accompanied by parameres and spurs. The penes, as well as the accessory organs, vary in shape among the different species.

The mouth parts are decidedly primitive in structure. The mandibles (Fig. 95) are of the generalized type. Both laciniae mobiles (Fig. 166) are similar. The maxillary palp (Fig. 118) is 3-jointed. The lacinia-galea (Fig. 118) is sturdy and has not been modified. It is straight, with a faint trace of the suture between the galea and the lacinia. The lacinial dentes are strong. The lacinial spurs are distributed along the inner surface. Setae are to be found on the terminal part of the galea and along the inner lacinial portion.

The labium (Fig. 143) likewise is primitive, having palps that are 3-jointed, while the mentum, submentum, and internal lobe are all small and match very closely the hypothetical, primitive type. Both glossae and paraglossae are distinct, not only in size and shape but also in method of attachment.

Gills are found on the first seven abdominal segments. The posterior five (Fig. 204) are large, foliaceous, single structures. They possess no filaments or other modifications, and merely represent an expanded, primitive gill. The tracheal method of ramification is distinctive. The two anterior pairs of gills (Figs. 198, 199) are similar to the others except that they are double instead of single. Each component of the double gills is much like one of the five posterior, single gills. According to Needham (1905) and McDunnough (1930), the nymph of *S. alternatus* is an exception in having all seven gills double.

To summarize, the wings strongly suggest that *Siphlonurus* is primitive. With the exception of the reduced secondaries and the accompanying changed shape of the primaries in the anal region the wings in this genus might be mistaken for those of the Permian Protereismidae. The data from the mouth parts (with the unmodified mandibles, lacinia-galea, and labium, the 3-jointed palps of both the labium and maxillae, and also the similar laciniae mobiles) parallel the wing findings. The 4-jointed forceps and the complicated penes indicate specialization. In regard to the shape of the joints and the styliger plate of the genitalia, *Siphlonurus* stands distinct from the remainder of the family.

The gills similarly show *Siphlonurus* to be distinct. The arrangement of double and single gills, and the shape and distribution of the trachea are peculiar to this genus.

Siphlonurus probably arose directly from the Protereismidae stock or from a stock that was closely related to the Protereismidae. While it has some peculiar specializations, it shows in the more conservative characters, especially the wings, a decided primitiveness, and occupies the lowest position in the phylogenetic scheme of the extant forms.

Family HEPTAGENIIDAE

Isonychia (*Chirotonetes*)

The wings of this genus are much like those of *Siphlonurus,* but display some specialization. In the fore wing (Fig. 10) the R_3 has broken away from R_2 and is now connected by a cross vein. The connection of MP_2 and MP_1 is greatly weakened and the CuA triad has been almost completely obscured. The anal area is smaller than in *Siphlonurus* and the interpolated veins are unattached basally. The hind wings (Fig. 11) are like those of *Siphlonurus* in so far as phylogenetic significance is concerned.

During the last nymphal instar the genital forceps (Fig. 57) are 2-jointed and are borne on an elongated, cone shaped styliger plate. Between the forceps two sharply pointed, posteriorly directed processes of the styliger plate are to be found. Between these processes the styliger plate is excavated.

In the adult state (Fig. 59) the forceps are 4-jointed. The styliger plate (Fig. 59) in *I. bicolor* wlk., and other closely related species is divided and consists of two narrow rectangular structures, from the terminal end of which arise the forceps. Basally, between these two structures, a posteriorly directed protuberance arises. In the case of *I. arida* Say and its close relatives the styliger plate is only slightly excavated. Doubtless this splitting of the styliger plate into two parts in the case of the bicolor complex represents a specialized condition. The penes (Fig. 59) in the case of the bicolor complex are simple, consisting of two posteriorly directed processes. In the arida complex, however, they are more complex having spines developed on a recurved protuberance that arises near the outer distal edge of the penes. (See McDunnough, Can. Ent. 63: 158.)

The mandibles (Fig. 91) are distinct, especially as to shape. The dentation is much like that of other generalized mandibles;

the outer right canine has three teeth, the inner right two teeth; and at the base on the posterior side a flange of the caine covers the lacinia mobilis. The two laciniae mobiles (Figs. 170, 171) are dissimilar. The maxillae (Fig. 119) show a distinct relationship to the remainder of the Heptageniidae. The palp is 2-jointed, with the terminal joint longer than the proximal joint. The lacinia-galea is expanded and, while not expanded so greatly as in the other Heptageniidae, the shape is the same. The lacinial dentes, and the arrangement of the hairs on the lacinia-galea and on the palps exhibit a primitive form which is probably close to the type from which the other more specialized Heptageniidae were derived.

The labium (Fig. 147) has 2-jointed palps. The paraglossae, the glossae, and the internal lobe are all distinctive in this genus.

Gills are to be found on the first seven abdominal segments. They are all alike except in size. They are compound, each gill consisting of an anterior, sub-oval, foliaceous lamella (Fig. 205) on the fore side of which runs an oblique ridge. The lamellae contain pinnately branching tracheae. The posterior part (Fig. 200) consists of a flattened fascicle of filaments. This type of gill (*i.e.,* one anterior lamella and a posterior flattened fascicle) is characteristic not only of *Isonychia* but also of its relatives the other Heptageniidae.

Isonychia, to sum up, has a venation and other wing characteristics such as shape, size of hind wings, etc., that indicate a fair amount of primitiveness. On the basis of the shape and number of the segments of the genital forceps, of the maxillae, and of the gills, *Isonychia* has been placed in the Heptageniidae. The shape of the penes, the condition of the styliger plate, the shape of the mandibles, and the labium, all indicate modifications that are peculiar to the genus itself and distinctly set it apart from all other existing forms.

Heptagenia, Ecdyonurus, Rhithrogena,* and *Epeorus.*

The remainder of the Heptageniidae, considered here, consist of a closely knit group of which there are six genera commonly

* Since this has been written, Traver has published two papers (Jour. Elisha Mitchell Sci. Soc., 48: 141–207; N. Y. Ent. Soc., 41: 105–125) in which he has designated the new genus *Stenonema,* which I find identical with the genus Ecdyonurus as defined here.

conceded to be present in North America, *i.e., Heptagenia, Ecdyonurus, Iron, Rhithrogena, Epeorus,* and *Cinygma.* All of these with the exception of *Heptagenia* were erected by Eaton who employed American material for *Iron,* but European material for the other four. *Heptagenia* was described by Walsh who used his *Heptagenia flavescens* as the genotype.

Eaton employed, as the primary means of identifying the various genera, the tarsal joints of the hind legs. Later Needham (1905) used the tarsal joints of the male fore tarsus, especially the first joint; McDunnough (1924) followed Needham. Eaton realized that the use of tarsal joints was beset with difficulties due to the shrinkage of the members and due to the fact that regenerated nymphal legs did not mature into normal organs. The use of the fore leg is encumbered with more difficulties because, in addition to the above mentioned ones, these members are very delicate and are usually the first part of the body to be lost. Furthermore, this system leaves no method for identifying females.

This group can never be thoroughly understood and a natural classification—one that will express the evolution of the group—can never be constructed, until the nymphal and adult stages have been connected for a large number of species, and until large series over wide-spread areas have been collected. Then by utilizing all nymphal and adult characters, a true and natural classification may be designed. At this time I do not have enough material, especially in the genera *Epeorus* and *Rhithrogena,* for a thorough and detailed discussion of the group. Consequently this discussion is restricted to pointing out a few of the evolutionary changes that the group has undergone. This discussion is based mainly upon nymphal material. *Iron* and *Cingyma,* of which the nymphs of the latter are unknown, are omitted.

The wings (Figs. 5, 6, 12, 13, 14) of all of these genera are uniform in so far as the primary venation is concerned. In the fore wings the R_3 has become detached from R_2 and is now connected to R_2 by cross veins. The R_3 triad has been modified so that R_{3b} appears as the direct prolongation of R_3 and thus R_{3a} is a distinct vein. MP_2 is distinctly attached to MP_1 well out on the wing so that the M triad is as primitive as that found in *Siphlonurus.*

The Cu_1 triad, which was found in the Protereismidae and *Siphlonurus,* has become completely obliterated. Two pairs of interpolated veins are to be found within the Cu area, these constituting the distinguishing marks of these genera. At their bases CuA and CuP bend forward so as to lie very close to M within the wing root. Three anals and two interpolated veins are present.

In the hind wings (Figs. 7, 14, 16) Sc is more strongly arched than in *Siphlonurus*; MA and R are fused out to the level of the costal projection; and MA gives rise to a triad. There is a pair of interpolated veins between CuA and CuP, except in the *Heptagenia maculipennis* complex where they are lacking. The anal area is greatly reduced with A_1 and IA_1 distinct and A_2 a short unattached vein.

Concerning the cross veins and the pigmentation of the veins there is a great amount of variability, as was indicated in the section on cross veins. This cross-venation apparently is not a valid criterion for the recognition of genera, although it may indicate the lines of evolution within each genus. This is shown by the genus *Ecdyonurus* which has three distinct modifications of cross venation. Thus the *E. tripunctata* complex has one group in which the cross veins are aggregated in the region of the bulla as far back as the costa (Fig. 6), and another (Fig. 12) in which there is no indication of aggregation. In the *E. interpunctata* complex there is an aggregation extending back to the R_2, and also a long, longitudinal black streak between the R_1 and R_2 in the region of the bulla (Fig. 5). In the *maculipennis* complex of the genus *Heptagenia* there are two types of cross venation, one with aggregation and one without it.

In the mature nymphs the genitalia (Figs. 50, 51, 52, 66, 67) are similar to that of *Isonychia* with the exception that the part of the styliger plate lying between the bases of the forceps consists of a hump shaped structure and is usually not deeply excavated as in *Isonychia.* In the adults, the forceps (Figs. 49, 53, 60, 62) which are much like those found in *Isonychia,* consist of a short somewhat conical joint, a long slender second joint, and two short slender terminal joints. These are constant throughout the group. The styliger plate (Figs. 49, 53, 60, 62) likewise is uniform throughout the group. The penes, however, are highly variable. In the genus *Ecdyonurus* two distinct types are to be found: one with L shaped penes (the *tripunctata* complex, Fig. 53), and the other with penes which are stub-like and slightly expanded at the tip (*interpunctata* complex, Fig. 60). In the genus *Heptagenia* the species of the *maculipennis* complex have peculiar penes which differ considerably from those of the other *Heptagenia* species. The reader is referred to the sketches of McDunnough for further information on the variability of the penes of the species of Heptageniidae.

The mandibles are quite constant in shape (Figs. 97, 98, 100, 101, 102) and the molar area is not highly variable. The incisors and laciniae mobiles, on the other hand, are quite variable. The lacinia mobili is present in some of the *Heptagenia* as a group of large setae (Fig. 185), and in *Ecdyonurus interpunctata* (Fig. 174) as a single hair; and it is lacking in all the rest. The inner incisors are reduced in *Ecdyonurus* and *Heptagenia* (Figs. 99, 101, 102), having one prong terminating in a sharp point, while the other retains its normal shape. In *Epeorus* they are greatly reduced but not sharply pointed (Fig. 100), while in *Rhithrogena* (Fig. 98) the inner incisors are almost lacking. With this reduction there has been an enlargement of the outer incisors. Generally speaking they are scoop-shaped and vary in size inversely to the inner members, being moderate in size in *Heptagenia* and very large in *Rhithrogena.*

The maxillae have 2-jointed palps. The terminal segment is long, expanded, and hairy, thus forming an efficient sweeping organ to brush food into the mouth (Figs. 120, 121, 124, 125, 128, 130). The maxillae of *Heptagenia* (Fig. 124) and *Ecdyonurus* (Figs. 125, 128, 130) are similar in size and shape, while those of *Rhithrogena* (Fig. 120), and *Epeorus* (Fig. 121) approach each other in appearance. In *Rhithrogena* the hairs of the terminal segment have become enormously enlarged with secondary, lateral processes which form a unilateral, comb-like organ (Fig. 120).

The lacinia-galea in *Heptagenia* and *Ecdyonurus* is a large, broadly expanded organ with a characteristic shape (Figs. 124, 125). The lacinial dentes are greatly reduced, and the lacinial spurs are fine. Along the straight edge of the lacinia, a closely set row of slender setae extend. Another row of widely spread setae is located more nearly on the median axis of the lacinia. On the end of the lacinia-galea there are a number of setae. In *Heptagenia* these have become enormously enlarged and secondarily branched at their inner, distal margins so as to form comb-like structures (Fig. 124). In *Ecdyonurus,* especially in the *tripunctata* complex (Fig. 130), this modification of the seta is only slightly indicated. In *Epeorus* (Fig. 121) and *Rhithrogena* (Fig. 120), the lacinia-galea is much stouter and terminally much narrower than in *Heptagenia.* Those of *Epeorus* are armed terminally with three massive teeth (Fig. 121), while the setae on the galea portion are reduced to a minimum. *Rhithrogena* (Fig. 120), with a lacinia-galea that compares with that of *Epeorus,* lacks the heavy tooth-like structure. It has galeal setae and lacinial dentes as in *Heptagenia.*

The labium (Figs. 142, 145, 146, 148, 149) is a rather uniform structure throughout the group and consists of a broadly expanded internal lobe with large flat paraglossae and finger-like glossae. The 2-jointed palps are enormous and flattened. The basal joint is pear-shaped and attached on one side to the internal lobe. The short, heavy, second joint bears on its inner surface an area that is densely covered with setae.

The gills are all of the same type as described for *Isonychia,* each gill consisting of an anterior foliaceous lamella that serves for both protection and respiration, and a posterior fasciculated member which is wholly respiratory in function. The shape of the anterior lamellae varies greatly. In *Epeorus* (Figs. 209, 210), whose species live in swift currents, the anterior lamellae are beset with an area of spines on their outer edge so that the gills can serve as grasping organs. Thus the nymphs are enabled to climb the face of a vertical stone wall or to maintain themselves in swift currents. When the anterior lamellae are being employed in this manner, the fasciculated posterior lamellae are so constructed that they extend out between the body of the animal and the inner basal part of the shield portion and thus are exposed to the wash of the water. In such nymphs, the posterior gill portions are small. *Rhithrogena* has the anterior parts of the first pair of gills greatly elongated so that the front edges of these come in contact with each other under the abdomen, but the outer edges of the anterior lamellae are not as greatly modified for prehensile organs as in *Epeorus*.

Ecdyonurus and *Heptagenia* both live in still or only moderately swift water, and the gills are not adapted for grasping and suction as in the above mentioned genera. Further, the posterior, fasciculated lamellae can retain their normal position behind the leaf-like anterior members and still be exposed for aeration. The posterior lamellae are large (Figs. 202, 207, 216) providing a large aerating organ for use in the quieter water in which they dwell. In the *Heptagenia* the seventh gill usually consists of both an anterior and posterior portion, but the posterior part may be lacking as in the *H. maculipennis* complex (Fig. 215). The genus *Ecdyonurus* has the posterior part of the seventh gill completely lacking and the anterior part has been reduced to a small structure shaped like an arrow-head (Figs. 203, 208). In the first six gills of the *E. tripunctata* complex, the anterior lamellae are elongate, quadrilateral structures (Fig. 201), while in the *E. interpunctata* complex the corresponding members are broadly obovate and terminate distally in a sharp point (Fig. 206).

From the above evidence, incomplete as it is, two distinct major lines of evolution can be distinguished. One is represented by *Heptagenia* and *Ecdyonurus* and the other by *Epeorus* and *Rhithrogena.*

Ecdyonurus, on the basis of wings, genitalia, gills, and maxillae, displays two lines of development. One is represented by the *tripunctata* and the other by the *interpunctata* complex. The latter appears to be more closely related to *Heptagenia* than is the former. The genus *Heptagenia* (when sufficient amounts of material have been studied) will doubtless show as divergent lines of development as *Ecdyonurus* does. The *maculipennis* complex will probably represent one of these lines.

On the basis of nymphal characters, *Epeorus* and *Rhithrogena* are all closely related. The maxillae, however, show *Epeorus* to be distinct, while *Rhithrogena* (although displaying distinct affinities) also shows a similarity to the more primitive species of *Heptagenia*. This group can not be profitably discussed until further data are available.

Family Baëtidae

The genera *Callibaëtis, Baëtis, Centroptilium, Cloëon,* and *Pseudocloëon* all have been derived from a common stock and still form a closely compact group. The most striking characteristic of these genera is the excessive reduction that the metathoracic wings have undergone. This reduction reaches its extreme development in *Cloëon* and *Pseudocloëon* where the hind wings are completely lacking. In the fore wing the cross venation has been greatly reduced and the basal attachments of MA_2 and MP_2 with their respective triads have been obliterated. R_3 is always detached and is shortened so that it is about as long as IR_2 Along the margin of the fore wing, between each of the principal veins, there are short intercalary veins. The number of these veins in each wing space is either one or two, depending upon the genus under consideration.

After noting the distinctive morphology of each of the genera of this group, we will discuss their phylogenetic relations in the sections concerned with *Cloëon* and *Pseudocloëon.*

Callibaëtis. The hind wing of this genus (Fig. 24) is fair sized and has a number of cross veins present. The fore wing (Fig. 23) also has a goodly number of cross veins. The intercalaries vary in number with the various parts of the wing. In this genus, as in all of the other genera of the family, the genitalia during the nymphal state are almost, if not wholly, lacking as visible external organs. In mature nymphs the genital organs can sometimes be seen through the thin chitin of the ninth sternite. In the case of *Callibaëtis,* however, mature nymphs have tiny cone shaped forceps (Fig. 56).

In the adult state, the genitalia (Fig. 48), as in all the rest of the relatives of this genus, exhibit a peculiar condition in having the styliger plate divided into separate parts. From the posterior ends of these structures arise the 2-jointed forceps, consisting of a long, slender, basal segment and a short, small, terminal segment. The penes are internal (uncertainly extrusible), all evidence of external organs being completely absent.

The mandibles (Fig. 96) are heavy and sturdy with short incisors and large molar areas, the grinding ridges of which are narrow and numerous. The laciniae mobiles are dissimilar (Figs. 179, 180).

The maxillae (Fig. 123) are like the mandibles, *i.e.,* heavy, thick, and sturdy, with strong lacinial dentes and lacinial spurs. The palps are 2-jointed with the segments about the same length.

The labium (Fig. 157) has 3-jointed palps with the first joint longer than the distal two combined. The paraglossae and glossae are finger-like structures arising from the nearly straight anterior edge of the inner lobe. They are about the same size.

The gills in *Callibaëtis* are peculiar structures, differing among different species. In one species (undetermined) the first two (Fig. 218) are triple; the third, fourth, fifth, and sixth (Fig. 217) are double, and the last one (Fig. 218) is single. This type of gill appears to have originated from a lateral extension of a single gill. This extension is supplied with a single branch of the main trachea. In the course of the evolution, this flap became folded at its junction with the main part of the gill giving rise to a double gill. Still later this secondary part in turn gave rise to an extension and thus the triple gill originated. In another species of *Callibaëtis* the triple portion of the first and second gills is very small, while Eaton states that the gills of a species which he had are all double, and Needham describes the nymph of *C. skokiana* as having all of the gills double, the inferior portions becoming progressively smaller on the posterior gills. These double gills would appear to be more primitive than the triple gills.

Baëtis. The cross venation in the fore wings of *Baëtis* (Fig. 17) is greatly reduced. The hind wings (Figs. 19, 20, 27) have been extremely reduced and the costal projection now consists of a small, obtuse, sharply pointed structure, or it is in some instances absent. The hind wing varies greatly in different species of the genus. Thus *B. parvus* Dodds has a large hind wing for a *Baëtis* (Fig. 19). The costal projection is present and, in addition to the usual veins in a baëtid hind wing, MA is to be found as a simple vein attached to the radius. In *Baëtis intercalaris* McDunnough (Fig. 20), the costal projection is present, but MA is lacking. In other species (Fig. 27), the costal projection and the median is lacking.

The genitalia are invisible during the nymphal state (Fig. 73). The adult genitalia (Fig. 65) like that of *Callibaëtis* consist of a divided styliger plate, a 2-jointed forceps, and internal penes. The forceps segments, especially the long basal joints, vary greatly in shape. Usually they are expanded proximally and show incipient segmentation where they contract. In *Baëtis spinosus* McDonnough this basal enlargement is long, and at the point of contraction a distinct shoulder evidences itself on the inner side of the segment. The terminal joint is slender and moderately long.

The mandibles (Fig. 107) are heavy and strong with the enormous canines directed slightly outward and fused to form a single structure. The laciniae mobiles terminate with heavy, rounded teeth.

The maxillae (Fig. 127) like the mandibles are strong and thick, with heavy lacinial dentes and lacinial spurs. The palps are 2-jointed.

The labial palps (Fig. 162) are 3-jointed, the terminal joint being short and terminating roundly. The second joint may be broadly distended distally (*B. pygmaeus,* Fig. 162), or may be of an even size throughout. The paraglossae and glossae arise from the straight anterior edge of the internal lobe. The former are finger-like structures, while the latter are slender, sharply pointed, and somewhat shorter than the paraglossae.

The gills (Fig. 220) which are to be found on abdominal segments one to seven are single, sub-oval, foliaceous structures, each with a pinnately branched trachea. In the case of *B. pygmaeus,* the terminal gill is broadly lanceolate.

Pseudocloëon. The genus *Pseudocloëon* (Figs. 18, 70) is like *Baëtis* in every item of nymphal and adult structure considered here, except that the adult lacks hind wings and the nymph has only two caudal setae. McDunnough has established a genus *Hetercloëon* (of which the nymphs are also unknown), for those species in which the hind wings are present but are reduced to a mere thread. What the nymphs of these two genera are like can only be hypothesized. Considering wing characters alone, a graded series can be found which extends from the condition found in *Baëtis parvus* to that found in *Pseudocloëon.* Bengtsson (1912) established the genus *Acentrella* for those species in which the hind wing lacks the costal projection and possesses only two longitudinal veins, *i.e.,* the Sc and R. In the present paper neither *Acentrella* nor *Hetercloëon* are accepted as good genera, but are treated as elements of true *Baëtis.* It is possible that even *Pseudocloëon* should be considered part of the genus *Baëtis,* comparable with the short winged forms known among *Drosophila,* leaf hoppers, beetles, parasitic hymenoptera, gall wasps, etc. (See Kinsey, 1930.) Each of the types of reduced wings in these mayfly groups may have arisen by direct and independent mutation from a form such as *B. parvus.* It is not necessary that there has been a gradual decrease in the size of the hind wings. The *Pseudocloëon* species *may* be more closely related to a species of *Baëtis* than are two species which are now unquestionably regarded as members of that genus.

A thorough and careful working of the whole group with large series from wide localities, plus the correct association of the nymphs with the adults, may throw some light upon the question of relationships and the relative positions of the various species in the evolutionary scheme. Until that time it is necessary to admit that our classification may be and probably is an artificial one, and that it can not be said with certainty that it represents a picture of the phylogenetic history of the group.

Centroptilium. The fore wing of *Centroptilium* (Fig. 25) is similar to that of *Baëtis* except that only one intercalary is to be found in each marginal wing space. The hind wing (Fig. 28) is long, slender, and very narrow with an acuminate costal projection.

The genitalia (Fig. 69), while basically like those of *Baëtis* and *Callibaëtis* during both the nymphal and adult stages, show distinctive differences in the adult in having the terminal segment small and droplet shaped, while the first or proximal segment is expanded at its termination. The styliger plate is divided. The penes are external, being represented by small, hump-like structures. They show no indication of being double. In only a few species of this genus have the nymphs and adults been associated. Eaton has figured *C. lutelolum* which he connected to the proper adult by field observation and possibly by rearing. McDunnough has connected the nymph of his *C. album* with its adult, and Ide has identified the nymphs of *C. convexum* Ide and *C. bellum* McDunnough.

There is goodly variation between these nymphs in regard to mouth parts and gills. Only by extensive rearing of many species will the problem be completely cleared up.

The mandibles (Fig. 99) and also those described for *C. lutelolum* are more like generalized mandibles than are those to be found in *Baëtis*. The canines are not fused, and the laciniae mobiles are distinct. In one species of *Centroptilium,* however, the mandibles are similar to those of *Baëtis.*

The maxillae (Fig. 122) are also more generalized in shape and ornamentation than those of *Baëtis.* In *C. album* and *C. lutelolum* the palps are 3-jointed, but in *C. convexum, C. bellum,* and *C. sp.* they are only 2-jointed with the terminal joint long and slender.

The labium (Fig. 150) has the glossae and paraglossae about equal in size, with the glossae terminating sharply and the paraglossae slightly curved. They arise from the slightly bulging internal lobe. The palps are always 3-jointed with the terminal joint expanded, short, and truncate. This truncate, last segment of the labial palp is one of the primary means of identifying *Centroptilium* nymphs. In *C. bellum,* however, the terminal margin of this segment is slightly oblique.

The gills, like the mouth parts, are variable. Eaton has figured the gills of *C. lutelolum* as being similar to those of *Baëtis* except that they terminate acutely. This, along with the characteristic labial palp, has been employed as a primary means of identification. On the other hand, in *C. album* and *C. convexum* they are broadly rounded, and in other species (Fig. 213) they become broadly expanded distally so that the gills are somewhat triangular in shape. In *C. bellum* and an undetermined species (Fig. 221) all seven gills possess a slender lateral flap that has been folded back so as to create a double gill. It is impossible to say at present whether this heterogeneous group of nymphs really represents a single, phylogenetic unit. It is perfectly plausible that the nymphs have undergone mutations while the adults have remained the same, and this seems a reasonable explanation for the variations cited above.

The gills in this group of genera, as was apparent in *Callibaëtis* and *Baëtis,* and as will hold true for *Cloëon,* are highly variable structures.

Cloëon. Concerning the wings and genitalia of the adults, this genus (Figs. 26, 64) is an exact duplicate of *Centroptilium* except that it completely lacks a hind wing.

The mandibles (Fig. 103) are much like those of *Baëtis.* The maxillae (Fig. 126) have 2-jointed palps with segments like those in *Centroptilium.*

The labium (Fig. 154) shows distinct relationship to *Centroptilium* except that the terminal palp segment is obliquely truncate.

The gills are roughly oval (*Cloëon simile* Fig. 212) or sub-oval (Fig. 214), and have a lateral flap on gills one to six which has been folded parallel to the main body of the gill so as to form a compound gill. McDunnough states that this lateral flap is present on the seventh gill of *C. igens,* but it is lacking on *C. mendax* according to Ide and also according to my own observations.

Thus, within this compact group of genera, it is possible to distinguish three distinct lines of evolution. *Callibaëtis* represents one line, which is the most primitive of the three; the other two branches are highly specialized and about equal in position. *Baëtis* and *Pseudocloëon* make up one line and *Centroptilium* and *Cloëon* the other. If some of the related, monotypic genera are to be considered as valid, then *Hetercloëon* and *Acentrella* must be added to the *Baëtris* branch and *Procloëon* and *Centroptiloides* to the *Centroptilium* branch.

Bengtsson (1914) has discussed the phylogeny of this group, but while he recognized the distinct line of evolution represented by *Callibaëtis,* he derived *Callibaëtis* from *Baëtis,* and failed to recognize two distinct lines of evolution and has placed all of the remaining genera in a linear arrangement.

Super Family EPHEMEROIDEA

Family *Leptophlebidae*

Blasturus, Leptophlebia, Choroterpes, and *Thraulus**

These four genera show decided relationships, and may be discussed together. They stand comparatively low on one of the main branches of the evolutionary tree of the mayflies.

Blasturus, which is probably the most primitive genus of the group, shows distinctive characters in the venation (Fig. 31). The R_3 has become completely detached at the base from R_2. The connection of MP_2 to MP_1 is weak. All traces of the CuA triad have been lost, and between CuA and CuP a pair of interpolated veins is to be found. CuP pursues a fairly straight course in the Heptageniidæ, Baëtidæ, and *Siphlonurus,* but is strongly arched in *Blasturus.* At its base it lies midway between CuA and A_1 but within the wing root it swings sharply forward and joins CuA_1. The anal area is small and only A_1, and A_2 with the interpolated vein IA_1 are present; A_1, however, is attached basally. In the hind wing (Fig. 32) the Sc displays the primitive condition of being moderately arched; R_1 and MA, however, are fused for some distance; MA is unbranched, and a pair of interpolated veins lie in the CuA area. The hind wing is moderately large in comparison with the front wing.

Thraulus has greatly reduced hind wings (Fig. 30) and consequent with this reduction there has been a shifting of some veins and a complete suppression of others. The differences between the fore wing of *Thraulus* (Fig. 29) and *Blasturus* are restricted to the cubital and anal regions, and can be accounted for by the reduction of the hind wing and the consequent moving of the anal angle nearer the wing base. This has in turn been

* Upon further study, I have become convinced that the adult specimens utilized for this paper as representatives of *Choroterpes* belong to the genus *Thraulus* rather than to *Chroroterpes.* In reading the first section of this paper (N. Y. ENT. SOC., 41: 55–86), the reader should bear this correction in mind In the following discussion, the reader will note that I lack nymphal material for *Thraulus* and adult material for *Choroterpes.* The two genera seem to be so closely related, however, that I feel certain my phylogenetic placement of them is correct.

accompanied by an enlargement of the cubital area and a reduction of the anal area.

The wing of *Leptophlebia* (Fig. 21) displays a venation and shape intermediate between that of *Thraulus* and *Blasturus,* but is closer to *Blasturus* than to *Thraulus.*

The genitalia of *Blasturus, Leptophlebia,* and *Thraulus* are much alike. During the mature nymphal stages, the styliger plate (Figs. 74, 78, 80) is a cone shaped structure which bears unjointed forceps on its sloping sides. The nymphal penes, which are hidden by the styliger plate, consist of two small finger-like structures which lie side by side. In the adult state, the styliger plate of *Thraulus* (Fig. 63) is narrow (antero-posteriorly, not laterally), with only a slight prominence along the posterior edge. This prominence is slightly indented at the middle. In *Blasturus* the styliger plate has been greatly extended postero-medially (Fig. 72) and is deeply incised along the middle, though it is not completely divided into two elements. The species of the genus *Leptophlebia* (Fig. 68) exhibit a variable condition intermediate between that found in *Blasturus* and *Thraulus* not only in reference to the styliger plate but also in reference to the penes. Some species are like *Blasturus,* while others approach the condition found in *Thraulus.* The penes in *Blasturus* (Fig. 72) consist of two straight, posteriorly directed, rod-like processes which lie side by side. From the postero-dorsal surfaces of each of these bodies there arises a strongly arched, inwardly concave, slender, tail-like process which is directed anteriorly. The penes of *Thraulus* (Fig. 63) are similar except that the tail-like processes are lacking. *Leptophlebia* (Fig. 68), as mentioned above, exhibits an intermediate condition.

The forceps of *Blasturus, Leptophlebia,* and *Thraulus* in the adult condition are 3-jointed with long, tapering basal joints and two short terminal segments of which the penultimate is the heavier and longer (Figs. 63, 68, 72). Thus these genera lack the basal articulation so characteristic of the Heptageniidae and *Siphlonurus.* Another peculiarity of the forceps is that they arise from the dorsal surface of the styliger plate and that the latter extends under them for a short distance posteriorly.

Usually in most genera the forceps arise from the posterior edge of the styliger plate.

The maxillary (Figs. 129, 131, 132) and labial palps (Figs. 151, 155, 160) of these genera are all 3-jointed, with the first joint always the longest and sturdiest. They are all slender, cylindrical and unexpanded. The lacinia-galea is expanded (Figs. 129, 131, 132), and on its terminal edge the lacinial portion bears a dense patch of setae. The lacinial dentes are small and the spines on the inner surfaces are restricted to the vicinity of the dentes.

As regards dentation and form, the mandibles in *Leptophlebia* and *Blasturus* are similar (Figs. 112, 115), while those of *Choroterpes* (Fig. 111) show some but not as close relationship.

The laciniae mobiles (Figs. 175, 176, 177, 178, 181, 182(also show distinct relationships between the three genera.

The paraglossae (Figs. 151, 155, 160) are expanded, especially in *Choroterpes,* so that they roughly resemble a quadrant of a circle. In *Choroterpes* the extreme development of the paraglossae has resulted in small, reduced glossae (which are short, finger-like bodies located between the paraglossae), while in *Blasturus* and *Leptophlebia* the paraglossae are not so decidedly expanded and the glossae are larger and more expanded, especially posteriorly, and slightly ventral in position in relation to the paraglossae.

The gills of *Leptophlebia* (Fig. 228) are double organs which consist of two blade-like lamellae which join basally forming a Y-like structure. Into the gills runs a single trachea which gives off a limb to each lamella. All seven pairs of gills are similar in construction. In *Blasturus* the first gill (Fig. 227) is identical with the gills of *Leptophlebia.* The remaining gills, however, have had the basal two-thirds of both lamellae broadly dilated (Figs. 225, 226), while the distal third has the same appearance as the distal part of the *Leptophlebia* gills, *i.e.,* a slender, blade-like lamella. The basal parts of the last six gills of *Choroterpes* (Figs. 222, 223) are also broadly expanded, while the distal third is expanded but not as greatly as the proximal parts Between the distal and proximal parts the gill contracts strongly, and the distal part has become twisted so that this part of the gill lamellae stands at right angles to the basal section. The first gill of *Choroterpes* (Fig. 224) consists of a single blade-like lamella.

From the above discussion it is evident that *Leptophlebia* and *Blasturus* present a closer affinity to each other than they do to *Thraulus* and *Choroterpes* although all four genera form a closely knit group. Indications that they all represent primitive branches of a major division of the Ephemerida are: (1) the fairly primitive condition of the wings, especially those of *Blasturus;* (2) the simple form of double gill consisting of two foliaceous lamellae without such special modifications as are found in the Heptageniidae and *Baëtidae* branches; and (3) the 3-jointed forceps, lacking any indications of the basal articulation commonly found elsewhee in the order.

Ephemeridæ

Potamanthus. This genus clearly stands intermediate between the genera *Blasturus, Choroterpes,* and *Leptophlebia* and the rest of the Ephemeridæ. Many of its characteristics connect it definitely with the Ephemeridæ while others undoubtedly indicate a derivation from the same stock from which *Blasturus* and its relatives arose.

The wing venation (Fig. 34), definitely places it as a close relative to *Hexagenia* (Fig. 41), *Ephemera* (Fig. 39), *Polymitarcys* (Fig. 43), *Pentagenia* (Fig. 37), and *Campsurus* (Fig. 38). In the fore wing there seems to be a tendency toward the elimination of R_3 and IR_2 not only in *Potamanthus* but also in the other Ephemeridæ. The R_3 (Fig. 34) has lost its true basal attachment to R_2 and is now connected by a cross vein. The point of attachment, via the cross vein, is now much further from the base of the wing than it is in the primitive condition. Accompanying this there has been a reduction in the length of IR_2 and the branches of the R_3 triad. The posterior median and cubital veins have undergone distinctive specialization. MP_2 has lost its true basal attachment and this rôle has been assumed by a cross vein, thus creating an obtuse angle between MP_2 and MP_1 (Fig. 34). This peculiar behavior of the posterior median is the chief character which is used to define the family Ephemeridæ. CuA and CuP have migrated anteriorly and immediately after their union they join MA_1. Distally CuA is arched as in *Blasturus* and this, plus the decided anterior migration of the proximal part, has caused CuA_1 to pursue a sigmoid course. CuP is also sigmoid but to a lesser degree. Between the cubital veins a number of posteriorly directed pectinates are to be found. A_1 is distinctly present and has been carried forward, but IA_1 and A_2 have not been prolonged anteriorly. The anal region is smaller than in *Blasturus*.

In the hind wing (Fig. 35), as in *Blasturus* and in the other Ephemeridæ, R_1 and M are fused for a short distance and the MA is unbranched. The callus, however, apparently has migrated outwardly from its usual position which it occupies in the more primitive genera and forced the cubital veins apart.

While the wings of *Potamanthus* display a close relationship to the remainder of the Ephemeridæ, the genitalia (Fig. 77) show an equally distinct relationship to the Leptophlebiidæ. The condition of the genitalia (Fig. 79) in mature nymphs clearly indicates an intermediate condition between that found in the remainder of the Ephemeridæ and the Leptophlebiidæ. The forceps are 2-jointed, the styliger plate is roughly cone shaped, and the penes show a certain amount of fusion on their inner sides.

In the adult state (Fig. 77), the forceps are only 3-jointed, there being no basal articulation present which, as shall be shown later, is possessed by all the rest of the Ephemeridæ. The proportions and shapes of the various segments of the forceps are the same as those in *Blasturus* (Figs. 63, 68, 72) and its relatives. The penes are somewhat like those of *Blasturus* except that they lack the recurvant, finger-like process, and are expanded terminally, but assuredly they are more like the type found in *Blasturus* than any that are found in the remaining Ephemeridæ.

Concerning the mouth parts, the mandibles (Figs. 104, 108) are tusked as in the rest of the Ephemeridæ, but the dentation of *Potamanthus* has not undergone the shifting of position to which the incisors and molars of the other Ephemeridæ have been subjected.

The laciniae-mobiles (Figs. 186, 187) are distinctly similar to those in *Blasturus* (Figs. 175, 176) ; it should be noted that there is variability in the laciniae of the various genera. The left lacinia mobilis in *Potamanthus* represents a type intermediate between that found in *Blasturus* (Fig. 176) and *Hexagenia* (Fig. 190).

The maxillary palps (Fig. 133) are 3-jointed and the segments compare in shape to those of *Blasturus* (Fig. 129) except that the terminal segment has become elongated and the second segment is reduced. The shape and ornamentation of the lacinia-galea approximate those of *Blasturus* except that the whole organ is more slender than it is in *Blasturus.*

The labial palps (Fig. 159) of *Potamanthus* are similar to the maxillary palps. The glossae and paraglossae (Fig. 159) are more expanded laterally than those of *Blasturus.*

The gills of *Potamanthus* (Fig. 229) display the basic plan that is exhibited by the Leptophlebiidæ but, instead of the gill lamellae expanding as in *Blasturus* (Figs. 225, 226) and *Choroterpes* (Figs. 222, 223), *they have developed a number of laterally directed filaments.*

From the above discussion it is evident that *Potamanthus* (by virtue of the wings, the tusks of the mandible, and the gills) is related to the burrowing Ephemeridæ on one hand; while the genitalia, mouth parts, and the gills connect the genus with *Blasturus* and its relatives. The habitats of the various genera also lead to the same interpretation of relationships. *Blasturus, Leptophlebia,* and *Choroterpes* live on the bottom and crawl around in the debris, while *Potamanthus* is a semi-burrower and lives under stones and shells and other objects of like character on the bottoms of the streams. The remainder of the Ephemeridæ are true burrowers.

Hexagenia, Ephemera, Polymitarcys, Pentagenia, and *Campsurus.* The Ephemeridae or burrowers in North America consist of five genera besides *Potamanthus, i.e., Hexagenia, Ephemera, Polymitarcys, Pentagenia,* and the extraordinary stump-legged genus *Campsurus.* I do not possess nymphs of *Campsurus* so its relative position has been based upon the two adult characters, wings and genitalia. The stump-legged condition, however, is sufficient to show that, while its nearest relatives are undoubtedly the other burrowers, it stands distinct.

The wings of these genera (Figs. 37, 38, 39, 41, 43) are similar to those described above for *Potamanthus* except in a few features. In the fore wing the CuA always joins the MP before it joins CuP. *Pentagenia* has the R_3 and its triad more reduced (Fig. 37). The genus *Polymitarcys* is distinct by virtue of the copious cross venation of its wing (Fig. 43) and the enlarged CuA area which lacks the posteriorly directed pectinates that are to be found in the other genera, but which does have two pairs of interpolated veins in the CuA area. From the fourth of these veins arises a series of pectinates, and the MP_2 always fuses with CuA before it joins MP_1. In the secondaries of this genus, the callus has retained the primitive position, while the radius and anterior median are unfused. In *Campsurus* (Fig. 43) the R_3 is unbranched in the male, due probably to the complete disappearance of R_{3a}, while in the female both R_3 and IR_2 are absent. The forking of the MA_1 has receded to the wing base, and the basal part of MP_2 has been lost so that the vein is now attached by a cross vein to IMP a goodly distance out from the wing base. The costal area has been greatly reduced and only a single pectinate vein runs posteriorly from CuA, while a sturdy cross vein is found between A_1 and CuP. A_1 is the only anal vein present. In the hind wing of the male (Fig. 44) R_3 is unbranched just as it is in the hind wing of the female.

The genitalia of each of the above mentioned genera are distinctive. Within each genus the various species exhibit structures much alike, but between genera (even though they are closely related) there is an enormous amount of difference. During the mature nymphal state *Ephemera* (Fig. 81), *Hexagenia* (Fig. 85), and *Polymitarcys* (Fig. 86) agree, however, in having (1) a 3-jointed forceps, which consists of a short basal joint, a long second joint, and a short terminal joint; (2) small, ribbon-like styliger plates; and (3) externally visible forceps due to the reduction of styliger plates. I do not have enough material of *Pentagenia* to draw conclusions. In the adult state all of these genera agree in one point, *i.e.*, the forceps possess a basal articulation, and thus are 4-jointed in *Ephemera* (Fig. 71), *Hexagenia* (Fig. 76), *Polymitarcys* (Fig. 83), and *Pentagenia* (Fig. 82). These forceps consist of a short, sturdy basal joint and a long, slender second joint. Finally, segments three and four are relatively short and small. This definitely distinguishes these genera from *Potamanthus* which lacks all indications of a basal articulation. In *Campsurus* (Fig. 84), however, while the basal articulation is present, the terminal segments have been lost so that the forceps now consist of a short basal segment and a slender second joint which has become expanded on the terminal end. The styliger plate (Figs. 71, 76, 82, 83, 84) and penes proper present great differences between the various genera and do not serve as indicators of relationships.

The mandibles in these genera (Figs. 105, 106, 109, 110) are all tusked. This acquisition of tusks has been accompanied by the shifting and twisting of the molars and incisors. Thus the molars and incisors retain the same position as in primitive genera, even though the long axis of the mandibles has shifted from a perpendicular to a horizontal position.

The laciniæ mobiles bespeak an affinity between *Ephemera* (Figs. 193, 194) and *Hexagenia* (Figs. 189, 190) on one hand and *Polymitarcys* (Fig. 191) and *Pentagenia* (Fig. 195) on the other, with the former two closer than the latter.

As in *Potamanthus* the maxillary palps are 3-jointed, except in *Polymitarcys* (Fig. 134) where they are 2-jointed. The maxillæ, by virtue of their long slender palps and the slender, curved, sharply pointed lacinia-galea, indicate close relationships between *Hexagenia* (Fig. 138) and *Ephemera* (Fig. 139), while on the basis of this criterion *Polymitarcys* (Fig. 134) and *Pentagenia* (Fig. 140) are rather distinct.

The glossæ, the paraglossæ, and the internal lobes of the labium in *Pentagenia* (Fig. 156), *Ephemera* (Fig. 153), and *Polymitarcys* (Fig. 152) are similar to those found in *Potamanthus* (Fig. 159) as described above. In *Hexagenia* (Fig. 161), however, the postero-lateral area of the paraglossae has been produced until the point of attachment of the internal lobe lies on a midpoint on the inner surface of the paraglossae. Anteriorly the tips of the paraglossae almost touch since the glossae have been greatly reduced. The palps of the labium are 3-

jointed in *Polymitarcys* (Fig. 152) and *Ephemera* (Fig. 153), while in *Hexagenia* (Fig. 161) and *Pentagenia* (Fig. 156) they are 2-jointed.

The gills of these genera, like those of *Potamanthus,* are double, consisting of two blade-like lamellæ with filaments around the periphery. The first gill, however, is always very small, simply consisting of two blade-like lamellæ in *Ephemera, Hexagenia* (Fig. 230), and *Polymitarcys,* becoming a single leaf-like structure in *Pentagenia* (Fig. 239). The shape of the gills and the arrangement of the lamellæ indicate close affinities between *Hexagenia* (Figs. 231, 232) and *Ephemera* (Fig. 238) on one hand and *Pentagenia* (Figs. 233, 234) and *Polymitarcys* (Fig. 243) on the other.

Thus, to sum up, *Hexagenia* and *Ephemera* are closely related, constituting one of the evolutionary branches which has divided recently into these two genera. *Campsurus* represents another stock. *Pentagenia* and *Polymitarcys* are close relatives and represent still another stock, although they are more distinct from each other than *Ephemera* and *Hexagenia* are from one another.

Potamanthus stands as an intermediate between the other Ephemeridæ and the Leptophlebiidæ. The latter family represents an off-shoot from a primitive stock, the genera of which have been considerably modified since its origin. This primitive stock apparently had the genital forceps 3-jointed, while the penes were rod-like structures, lacking both spurs and parameres. The wings were somewhat primitive but showed certain specializations, such as the reduction of the anal area, the bending posteriorly of the Cu_2 and the detachment of R_3. The nymphs were bottom dwellers and crawled around on the bottoms of streams. The mouth parts in all probability were like those found in the Leptophlebiidæ genera today. The gills probably resembled those of the present day *Leptophlebia.* Thus, they did not possess any special protection for their gills, nor were the gills capable of a great amount of movement so as to be able to keep up a circulation of water around them. The nymphs, which were probably poor swimmers, should have lived in fairly clear, well aerated water, and were probably excluded from swift-flowing streams which carried a large amount of heavy material that would have injured the delicate gills. They could not have lived in the muck bottoms inhabited by the present day *Tricorythus.* After the origin of the Leptophlebiidae, the main stock underwent three morphological changes that were of great importance and one ecological change. The mandibles developed tusks; the wings developed the peculiar characteristics of the M, Cu, and anal veins of the Ephemeridæ, while the gills changed from the simply compounded type to something like that found in *Potamanthus* at the present time. At the same time the nymphs began a semi-burrowing existence. An individual of this primitive stock possibly looked like the present day *Potamanthus,* except that the primitive nymph was cylindrical in shape.

With the development of the tusks and the change in position of the incisors and molars, the nymphs became true burrowers. In the adult a basal articulation of the forceps of the genitalia was developed, so that these organs became 4-jointed.

Family Ephemerellidæ

Ephemerella

Ephemerella, along with *Tricorythus,* occupies a distinct and separate place in the phylogenetic story. The wings (Figs. 55, 47) show a relationship to *Blasturus,* but the position of the Cu veins basally and the strong arching of the CuA and A_1 indicates a different type of specialization of the fore wing. The anal vein, especially, differs from that of *Blasturus.* The hind wing of *Ephemerella* (Fig. 55) is somewhat specialized in having the Sc strongly arched, the cross venation reduced, and the sinus on the anterior margin indicating an incipient reduction of the wing.

The adult forceps (Fig. 88) are distinct, for while they are 3-jointed, as they are in *Blasturus,* in *Ephemerella* the three segments consist of a short, heavy basal part, a long, slightly concave second segment, and a heavy and oval terminal member. It is possible that this type of forceps arose from the type found in *Blasturus* (Fig. 72) and its relatives, by the long basal joint of the latter developing an articulation near the base, and by the loss of the terminal joint. The condition of the genitalia of *Ephemerella* during the nymphal state also substantiates this explanation. The genitalia of mature *Ephemerella* nymphs (Figs. 92, 93) show such close resemblance to those of *Blasturus* (Fig. 74) as to warrant this belief. In both instances the styliger plate is cone shaped with small, finger-like, unsegmented forceps arising from its sloping sides. We have seen that in *Campsurus* a parallel development has taken place, except that in *Campsurus* both terminal joints have been lost.

The penes (Fig. 88) is a simple, tubular affair which is incised at the tip. This penes obviously originated by the fusion of the two penes of the primitive stock. This is substantiated by the fact that the nymphal penes consist of two separate structures. The styliger plate is deep and the posterior edge may be arched or almost straight.

The mandibles (Fig. 113) are distinctly like those of *Blasturus*. The outer edges are more nearly straight and the body of each mandible is more slender, but in fundamental shape and dentation they are much like those of *Blasturus*. The laciniae mobiles (Figs. 188, 192) are much alike in the two genera.

The maxillae are peculiar. The maxillary palps are generally 3-jointed (Fig. 135), but the palps are small and weak and in the bicolor group (Fig. 136) completely lacking. The lacinia-galea (Figs. 135, 136) is massive and thick. The lacinial dentes and lacinial spurs are heavy and strong; the setae on the lacinial and galeal surfaces and the lacinial spurs are restricted to the terminal area of the lacinia-galea.

The labium (Figs. 164, 165) is likewise distinctive. The submentum is greatly expanded, and the internal lobe has been enlarged at the expense of the glossæ and paraglossæ which are small. The labial palps are 3-jointed, with the first segment heavy and large, the second smaller, and the third very small.

The gills of *Ephemerella,* along with those of *Tricorythus,* are the most complex and distinctive within the family. Each gill consists fundamentally of a double gill of which the anterior member (Fig. 242), a heavy, foliaceous structure, serves principally as a protecting shield, although it also receives a tracheal branch and doubtless carries on some respiration. The posterior gill member (Figs. 237, 240) consists of a foliaceous structure that has acquired a double row of finger-like processes, one row on each side of the gill lamellæ. These large, postero-laterally directed processes have greatly increased the area of the lamella. This member may be secondarily divided again at right angles to the plane of division between the principal gill lamellæ (Fig. 237). This secondary division is not as well developed in the posterior as in the anterior gills. The most posterior gill (Fig. 240) lacks all indication of cleavage. If there is a gill on the first segment, it is simply a slender, elongate member (Fig. 244). The gill on the second abdominal segment is invariably absent and there are some species in which even the third segment may lack a gill. The absence of gills on segments two and three, as in the *bicolor-lutulenta* complex, in *Ephemerella,* and in *E. margarita,* represents specialization greater than that found in species that lack gills only on the second abdominal segment (as in *E. inermis, E. aronii,* and *E. cornuata*). Nymphs of the latter species have gills which are closely imbricated on the dorsum of the abdomen. In the *bicolor-lutulenta* complex, they are more or less stratified, and the protective portion of the first gill almost completely covers all the remaining gills.

Various attempts have been made to split up the genus *Ephemerelle.* Bengtsson (1909) erected the genus *Chitonophora;* Needham (1905) created *Drunella,* and in 1928 segregated the two subgenera *Eatonella* and *Timpanoga.*

All these divisions are open to serious criticisms, due primarily to the fact that they are based upon nymphal material. Not until the adults of the various species have been correctly connected to their nymphs is it going to be possible to determine the relationships and the phylogenetic story within the group. Consequently, in this paper the genus *Ephemerella* has been considered in the sense of including all of the above mentioned divisions.

Tricorythus

The genus *Tricorythus,* while clearly distinct from *Ephemerella,* is more closely related to it than to any other genus of the family.

This genus is greatly specialized. It possesses only one pair of wings, the hind wings having been completely lost. Along with this loss, the anal area (Fig. 46) has been so enlarged that the anal angle has completely disappeared. There seems to be a tendency for each vein to attach to the next posterior vein. With the loss of the anal angle and the expansion of the anal area, the placement of the major veins has been shifted. CuP now joins A_1 at the base, and MP_2, which had a very weak attachment in *Ephemerella,* has become completely detached. The cross venation has been restricted to the inner part of the wing disk.

As in *Ephemerella,* the genitalia in *Tricorythus* have 3-jointed forceps in the adult state (Fig. 87), consisting of a short basal joint; a long second segment which has a spherical protuberance on its inner proximal surface; and a short, rotund terminal segment. The styliger plate is moderately long, but is deeply excavated medianly while the penes consist of a tubular organ (Fig. 87) that apparently has risen from the fusion of the two penes just as in *Ephemerella.* In mature nymphs the genitalia (Fig. 94) also show a distinct relationship to *Ephemerella.*

The mandibles (Fig. 114) are much like those of *Ephemerella* in regard to the shape, the dentation, and the lacinia mobilis. The maxillæ (Fig. 137) and the labium (Fig. 158) likewise exhibit unmistakable affinities to *Ephemerella.* The glossæ and paraglossæ have been reduced to an even greater extent than in *Ephemerella.*

The gills which are located on abdominal segments two to six are complex, just as in *Ephemerella,* with an anterior lamella (Figs. 245, 249) of each gill modified so as to form a protective shield, and the posterior lamella adapted primarily for respiration. The posterior lamella (Fig. 241) consists of two foliaceous parts which overlap each other. The gills assume a stratified position, *i.e.,* the first gill (Fig. 249) entirely covers the remaining gills. The ancestors of *Tricorythus* probably had imbricated gills, judging from the structure of the anterior member of each gill. Now, however, the gills are stratified, the foremost gill serving as a shield for all the other gills, and the inferior part

(Fig. 248) of the first gill is so modified that it, in connection with the shield portion, forms a sort of gill box.

Formerly this genus has been considered as a relative of *Cænis,* based upon the fact that both genera lack hind wings, and nymphs of the two genera show a striking, although superficial, resemblance. As will be shown in the discussion on *Cænis,* these similarities have arisen independently of each other.

Some will doubtless advance the argument that the great similarities between the mouth parts of *Ephemerella* and *Tricorythus* are parallel adaptations of the nymphs to somewhat similar habitats. This is possible, but there are similarities in other structures in these insects which seem certain evidence of actual relationships. The genitalia of the two groups are similar and very distinct from the genitalia of other members of the family. Nevertheless, the differences between the gills and the wings of these genera are enough to suggest that the two have been distinct for some time.

The *Ephemerella* and *Tricorythus* branch probably arose from the stock which later broke up into the genera *Blasturus, Leptophlebia,* and *Choroterpes,* and the family Ephemeridæ. The wings of *Ephemerella* show a closer resemblance to those of *Blasturus* than to any other extant genus. The genitalia of the adults of these two genera, it is true, are quite different, but the similarities of the nymphal genitalia between *Blasturus, Leptophlebia,* and *Choroterpes* on one hand and *Ephemerella* and *Tricorythus* on the other hand can not be disregarded. The mandibles of *Ephemerella* also show a distinct likeness to those of *Blasturus.* Superficially the gills of the *Ephemerella-Tricorythus* stock are very different from the type found in the *Blasturus, Leptophlebia,* and *Choroterpes.* Fundamentally, however, the differences are not great. The *Ephemerella* gill is a double structure of which the inferior lamella of the anterior gills has become secondarily split. The seventh abdominal gills, however, lack this secondary splitting, and each gill consists of a double structure whose lamellæ are greatly expanded and thus basically does not differ from the gill of *Blasturus.*

Ephemerella-Tricorythus represent a branch of generalized stock described at the end of the section dealing with the Ephemeridæ, which probably originated earlier than the stock represented by *Blasturus* and its relatives. Instead of becoming burrowers as the Ephemeridæ have done, or still living in a habitat very similar to that of their ancestors as *Blasturus* has done, the *Ephemerella-Tricorythus* stock became dwellers in and amongst the vegetation and gravels of swiftly flowing waters. Accompanying this the gills became reduced and the superior gill lamellæ developed protective features. The lacinia-galea became heavy and sturdy; the maxillary palps were reduced in size; and the paraglossæ and glossæ decreased in size, while the internal lobe became large. Since the origin of this stock, the forceps of the adult genitalia have developed the basal segmentation, and the penes have become more or less fused together.

Super Family Cænoidea

Family Cænidæ

Cænis

As mentioned before, *Cænis* has been considered a close relative of *Tricorythus,* because of the superficial external similarities of the nymphs and adults of the two genera; but *Tricorythus* appears to have been derived from the same stock as the Leptophlebidæ-Ephemeridæ stock; and although we are not certain of the ancestors of *Cænis,* the distinctive character of the latter genus shows this type of classification to be absurd. The distinctive characters of *Cænis* indicate that it has been removed from the rest of the order for a very long time. *Cænis* (Fig. 45) differs from *Tricorythus* in that MA_2 is broken away from M, and MP_2 and IMP are distinct veins that originate in the wing base. The CuP is attached to A at the base, which is the only anal vein present. The cross venation has become reduced to a uniserial condition.

The genitalia (Fig. 89) of *Caenis* are the most peculiar in the order. During the nymphal stage the genitalia are internal. In mature nymphs (Fig. 90) the forceps and penes can be discerned through the thin chitin of the ninth sternite. The penes appear as a rectangular organ located near the anterior end of the sternite. The forceps seem to be unsegmented and arise lateral to the penes. Posteriorly they extend past the main body of the ninth sternite and are enclosed in the lateral margins of a mound shaped, posterior extension of the sternite. In the adult the styliger plate is small and narrow, and it is produced laterally into slender, arm-like structures. From the end of these arms arise slender, unsegmented, rod-like forceps. The penes (Fig. 89) consist of a single roughly rectangular organ.

The mandibles (Fig. 117) are quite generalized, but they are heavier than the mandibles in most of our genera. The maxillary palps (Fig. 141) are 3-jointed, with the segments strong and large. The lacinia-galea is slender, roughly cylindrical with the lacinial spurs restricted to the terminal end.

The labium (Fig. 196) is of the generalized type, with three segments to the palpus, and the glossae and paraglossae are distinct and unexpanded. The internal lobe is small and unmodified. Thus the labium simulates the labium of *Siphlonurus* (Fig. 143).

Gills are to be found on the first six abdominal segments. The first gill (Fig. 251) is rudimentary, consisting of a seta-like organ. The second is a simple, foliaceous, elytroid-like gill (Fig. 250). It covers all the remaining gills and serves as a protective shield. The other gills (Fig. 246) are foliaceous structures, fringed with unilaterally branched filaments.

Briefly, *Caenis* differs from *Tricorythus* in the venation, in the structure of the mouth parts (especially the labium), in the genitalia, and in the gills. The gills, it is to be remembered, are complex in *Tricorythus*, lack all filamentation, and are not single and filamented as in *Caenis*. Apparently the ancestoral stock from which *Caenis* arose differentiated long ago, and it has since then become highly specialized. In doing so it has reached, both in the nymphal and adult stage, a condition superficially—but only superficially—like that in *Tricorythus*.

Super Family Bætiscoidea

Family Bætiscidæ

Bœtisca

The wings (Fig. 54) of this genus are peculiar. The R_2 and R_3 veins form a perfect triad. The branching of the posterior median into its two component parts does not take place as usual, but all three veins (MP_1, IMP, and MP_2) are separate and distinct veins which originate in the wing base. CuA is an unbranched vein, and both CuA and CuP terminate on the outer wing margin, just as in the primitive *Triblosoba.* In all other present-day forms which have two pairs of wings and possess an anal angle, the CuP terminates behind the anal angle. The anal area in *Bœtisca* is consequently large. Even though A_1 terminates on the outer margin, there are only two anal veins present.

The hind wing is large and greatly expanded. The subcostal arc is moderate and the radius is weak, extending inward from the margin only about half way to the wing base, thus becoming completely detached. The R_3 gives rise to the usual triad, but the anterior limb has become detached. MA_1 is an unbranched vein, while the anal area exhibits three anals which are all unattached basally.

I lack sufficient nymphal material to draw conclusions as to the nymphal condition of the genitalia. In the adult state (Fig. 75), the styliger plate of the genitalia is rectangular, while the forceps are 2-jointed, with a long, arched, proximal joint which is very broad at the base and contracted sharply about two-fifths of the distance from the base. The terminal segment is short and oval. The penes (Fig. 75) consist of a cone shaped organ which is divided terminally.

The mandibles (Fig. 116) represent a somewhat unspecialized form. The two laciniae mobiles (Fig. 167) are similar—a peculiarity displayed by only one other genus of the order; and in both cases this probably represents a primitive condition. The dentation and shape of the mandible exhibit no extraordinary characteristics. The maxillary palps (Fig. 144) are 3-jointed with an indication of incipient segmentation on the terminal segment. The lacinia-galea (Fig. 144) is heavy but unspecialized as to shape, possessing massive lacinial dentes and lacinial spurs. The latter are restricted closely to the terminal end of the lacinia.

The labium (Fig. 163) has an enormously expanded submentum; the palp is 3-jointed, and the glossae and paraglossae are distinct and well developed.

All the gills are concealed under a massive shield which consists of a backward prolongation of the mesothorax. The mesothoracic wing pad of the nymph has been included in this structure. This shield fits closely against the abdomen so as to form a special, highly developed gill chamber. The metathoracic wing pad is also concealed in this chamber. The gills are found on the first five abdominal segments, of which the first is a large foliaceous structure. The posterior four (Fig. 247) are also foliaceous but smaller and more elongated. On the inner margins of these, a number of dichotomously branched filaments arise.

Bœtisca seems a distinct entity in the phylogenetic arrangement of the mayflies. Its ancestral stock must have separated early from the remainder of the order. During its history certain parts have developed astonishing specializations, *e.g.*, the gill chamber, the anal area of the fore wing, the enormously expanded submentum, the distribution of the radius and of the anterior members of the Rs triad of the hind wing, and the peculiar penes. On the other hand, the behavior of the Cu veins of the fore wing, the forceps of the genitalia, the similar laciniae mobiles, and the highly modified but *single* gills are all primitive characters in the group.

SUMMARY

1. The mayfly venation is probably the most primitive in existence today and supports Lameere's wing vein hypothesis admirably.

2. The major veins that are to be found in the Ephemerida wings can be homologized vein for vein with those found in the primitive Dictyoneuridæ. None of the major veins have been lost as Lameere and Martynov have hypothesized.

3. The wings are of great importance in the study of the phylogeny of the group. The most primitive genus has a fore wing that tallies even to details with those of the fossil Protereismidæ. Those genera which have only one pair of wings, but that pair somewhat possessing the primitive ancestral shape, have arrived at that shape secondarily and not primarily.

4. The genitalia are of value as generic criteria in the nymphal state as well as in the adult state. Especially valuable are the forceps and the styliger plate. The primitive mayflies, during the adult period, probably had an undivided styliger plate and a 2-jointed forceps. The latter consisted of a long basal segment and a short terminal segment. The penes, while excellent as specific characters, are not good indices of generic relationship.

5. The maxillæ, mandibles, and labium can all be employed to advantage as phylogenetic indicators. The mandibles are more conservative than the other two. Usually the conditions found in the maxillæ are parallel to those of the labia.

6. The gills are highly diverse and are excellent indices of generic relationships. The ancestral mayfly nymphs had gills that consisted of simple tubular out-pushings. These have undergone many types of modification to arrive at the present day types.

7. *Siphlonurus* is the most primitive extant genus.

8. *Bœtisca* and *Cœnis* rose from the ancestral stock before *Siphlonurus*, but each has become highly specialized in its own peculiar manner.

9. The Baëtidae form one distinct phylogenetic stock, the origin of which can not be determined. It exhibits three separate paths of development within itself.

10. The Heptageniidae represent another branch of the phylogenetic tree. *Isonychia* occupies an inferior position, while the more highly specialized genera of the Heptageniidae can be divided into two sections.

11. *Ephemerella, Tricorythus, Blasturus, Choroterpes, Thraulus, Leptophlebia,* and the Ephemeridae constitute another great phylogenetic branch.

12. *Ephemerella* and *Tricorythus,* while very distinct now, arose together near the base of the last mentioned stock. Both *Ephemerella* and *Tricorythus* are highly specialized now, especially the latter. *Tricorythus* has no close relationship to *Caenis.*

13. *Blasturus, Choroterpes, Thraulus* and *Leptophlebia* are closely related and have retained many of the original characteristics of the stock from which they were derived.

14. *Potamanthus* stands intermediate between the remainder of the Ephemeridae and the Leptophlebiidae.

15. The remainder of the Ephemeridæ can, at this time, be divided into two main stocks: the first a closely knit one represented by *Hexagenia* and *Ephemera;* the second by *Polymitarcys* and *Pentagenia.* *Campsurus* can not be placed at present.

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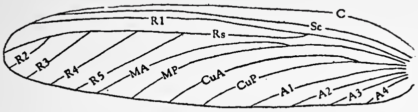
PLATE XVI

Figure 1. *Stenodictya Gaudryi* Brong. (After Handlirsch).
Figure 2. Hind wing of *Proteresma* sp? (After Tillyard.)
Figure 3. Fore wing of *Siphlonurus* sp?
Figure 4. Hind wing of *Siphlonurus* sp?
Figure 5. Fore wing of *Ecdyonurus* sp?—interpunctata complex.
Figure 6. Fore wing of *Ecdyonurus* sp?—tripunctata complex.
Figure 7. Hind wing of *Ecdyonurus* sp?—tripunctata complex.
Figure 8. Diagram of triadic system of branching of veins.
Figure 9. Hind wing of *Triblosoba.*
Figure 10. Fore wing of *Isonychia* sp?
Figure 11. Hind wing of *Isonychia* sp?
Figure 12. Fore wing of *Ecdyonurus* sp?
Figure 13. Fore wing of *Heptagenia* sp?—maculipennis complex.
Figure 14. Hind wing of *Heptagenia* sp?—maculipennis complex.



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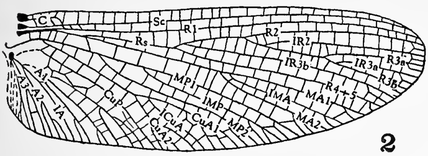

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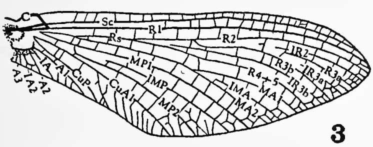

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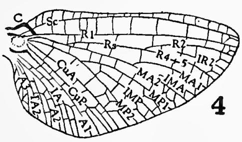

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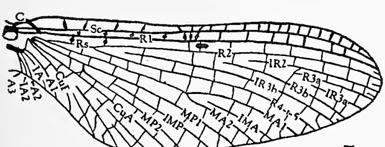

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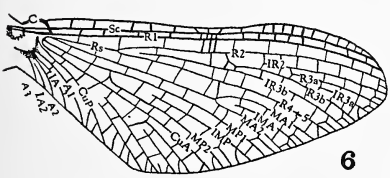

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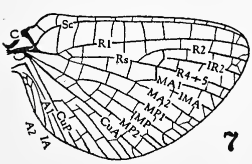

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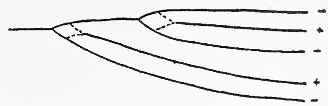

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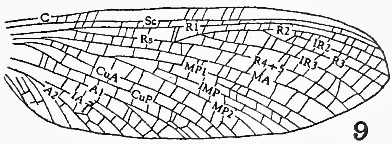

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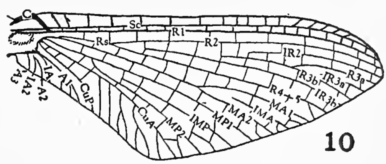

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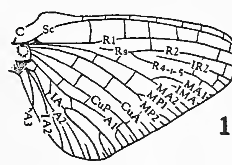

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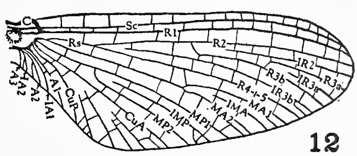

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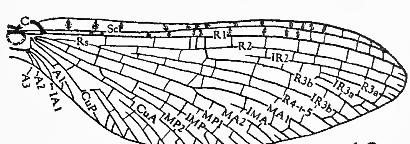

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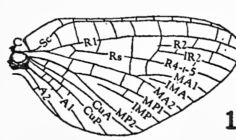

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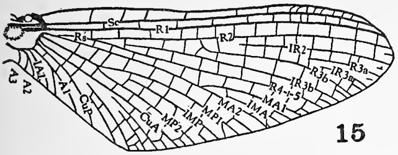
PLATE XVII

Figure 15. Fore wing of *Epeorus* sp?
Figure 16. Hind wing of *Epeorus* sp?
Figure 17. Fore wing of *Baëtis* sp.
Figure 18. Fore wing of *Pseudocloëon* sp?
Figure 19. Hind wing of *Baëtis* sp?
Figure 20. Hind wing of *Baëtis* sp?
Figure 21. Fore wing of *Leptophlebia* sp?
Figure 22. Hind wing of *Leptophlebia* sp?
Figure 23. Fore wing of *Callibaëtis* sp?
Figure 24. Hind wing of *Callibaëtis* sp?
Figure 25. Fore wing of *Centroptilium* sp?
Figure 26. Fore wing of *Cloëon* sp?
Figure 27. Hind wing of *Baëtis* sp?
Figure 28. Hind wing of *Centroptilium* sp?
Figure 29. Fore wing of *Thraulus* sp?
Figure 30. Hind wing of *Thraulus* sp?



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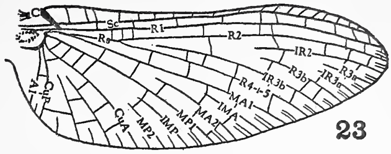

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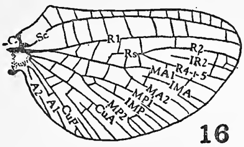

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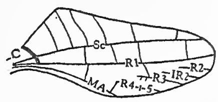

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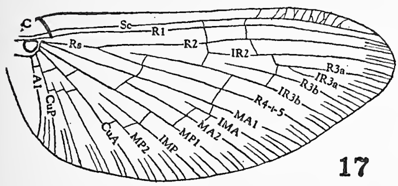

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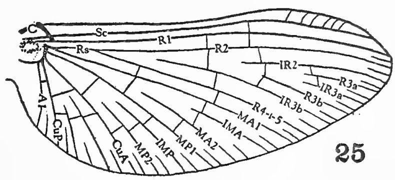

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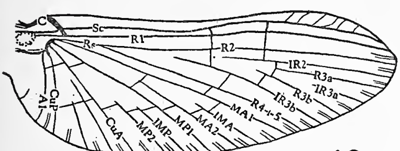

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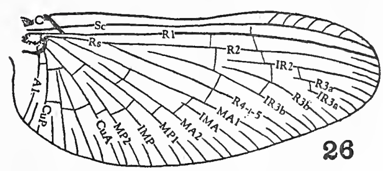

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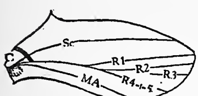

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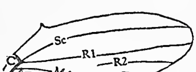

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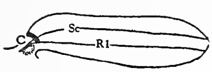

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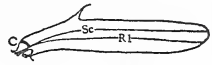

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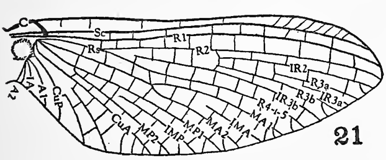

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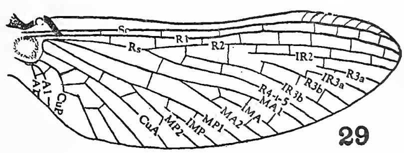

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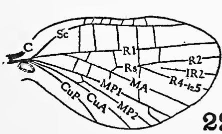

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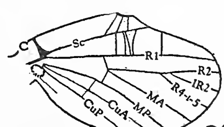

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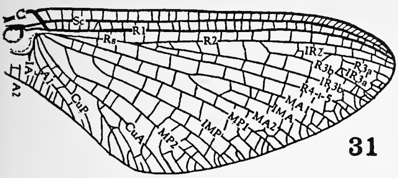
PLATE XVIII

Figure 31. Fore wing of *Blasturus* sp?
Figure 32. Hind wing of *Blasturus* sp?
Figure 33. Hind wing of *Ephemera* sp?
Figure 34. Fore wing of *Potamanthus* sp?
Figure 35. Hind wing of *Potamanthus* sp?
Figure 36. Hind wing of *Pentagenia* sp?
Figure 37. Fore wing of *Pentagenia* sp?
Figure 38. Fore wing of *Campsurus* sp?
Figure 39. Fore wing of *Ephemera* sp?
Figure 40. Hind wing of *Hexagenia* sp?
Figure 41. Fore wing of *Hexagenia* sp?
Figure 42. Hind wing of *Polymitarcys* sp?
Figure 43. Fore wing of *Polymitarcys* sp?
Figure 44. Hind wing of *Campsurus* sp?



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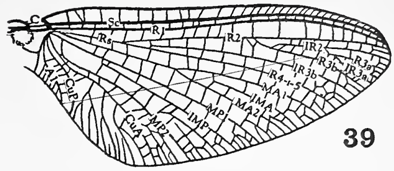

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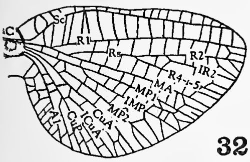

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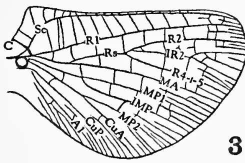

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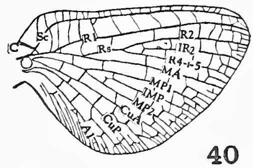

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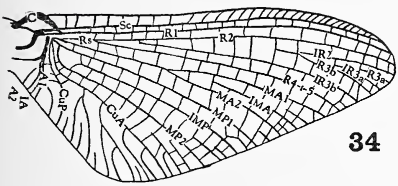

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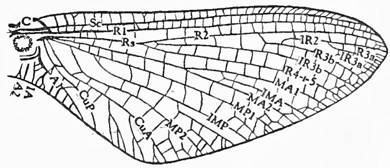

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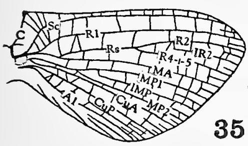

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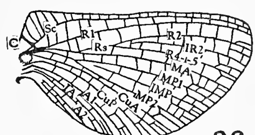

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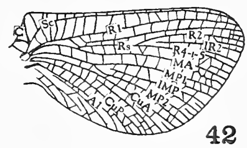

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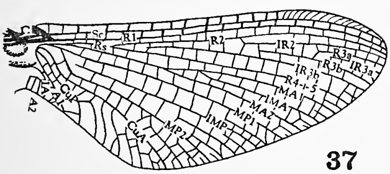

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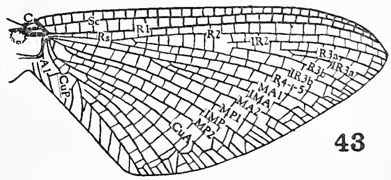

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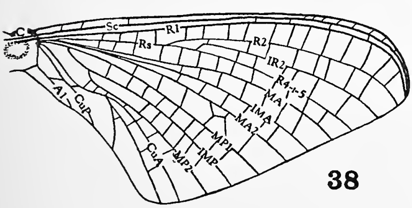

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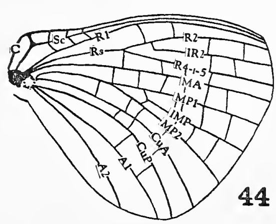
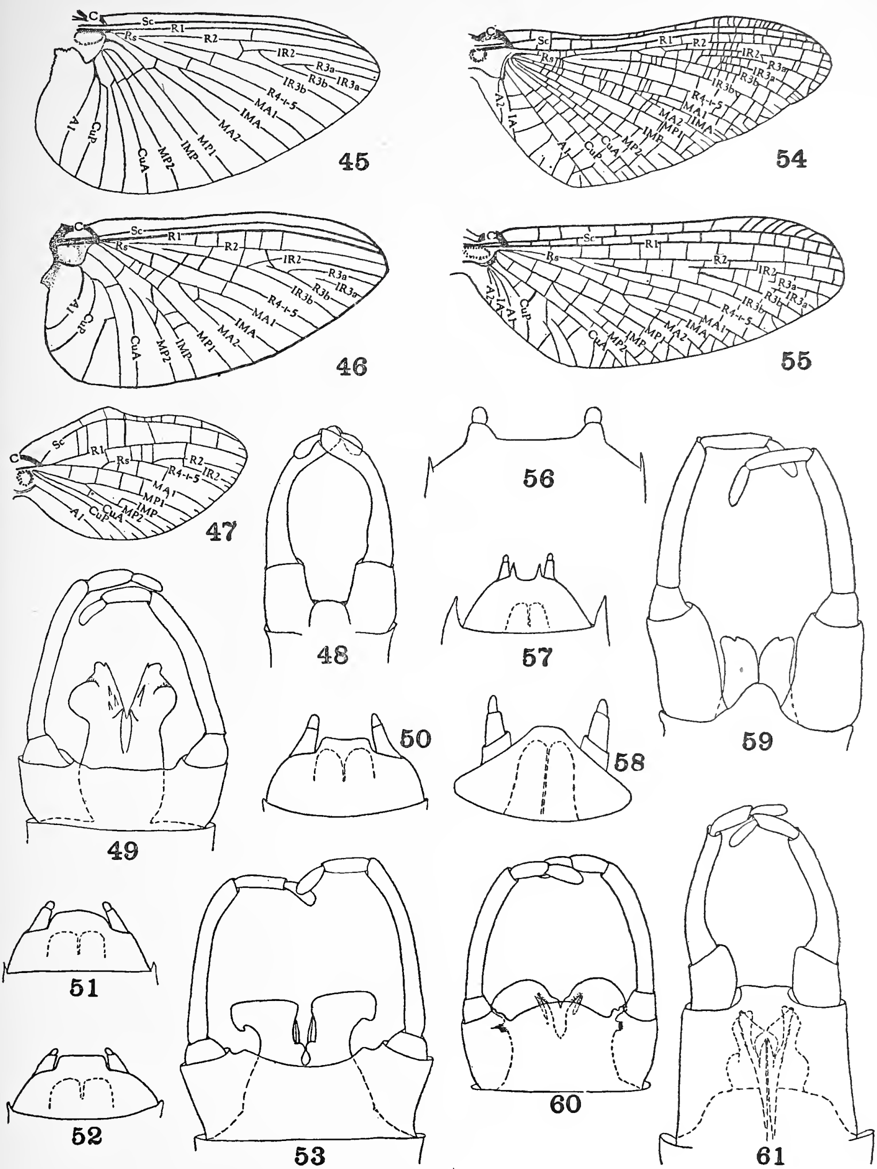


44

PLATE XIX

Figure 45. Fore wing of *Caenis* sp.
Figure 46. Fore wing of *Tricorythus* sp?
Figure 47. Hind wing of *Ephemerella* sp?
Figure 48. Genitalia of male imago, *Callibaëtis* sp?
Figure 49. Genitalia of male imago, *Heptagenia* sp?—maculipennis complex.
Figure 50. Genitalia of male nymph, *Heptagenia* sp?—maculipennis complex.
Figure 51. Genitalia of male nymph, *Ecdyonurus* sp?—interpunctata complex.
Figure 52. Genitalia of male nymph, *Ecdyonurus ithaca.* Need.
Figure 53. Genitalia of male imago, *Ecdyonurus* sp?
Figure 54. Fore wing of *Baëtisca* sp?
Figure 55. Fore wing of *Ephemerella* sp?
Figure 56. Genitalia of male nymph, *Callibaëtis* sp?
Figure 57. Genitalia of male nymph, *Isonychia* sp?
Figure 58. Genitalia of male nymph, *Siphlonurus* sp?
Figure 59. Genitalia of male imago, *Isonychia* sp?
Figure 60. Genitalia of male imago, *Ecdyonurus* sp?—interpunctata complex.
Figure 61. Genitalia of male imago, *Siphlonurus* sp?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Sc
R1
Rs
R2
IR2
R3a
R3b
IR3a
IR3b
R4+5
MA1
IMA
MA2
MP1
IMP
MP2
CuA
CuP
A1
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PLATE XX

Figure 62. Genitalia of male imago, *Heptagenia* sp?
Figure 63. Genitalia of male imago, *Thraulus* sp?
Figure 64. Genitalia of male imago, *Cloeon* sp?
Figure 65. Genitalia of male imago, *Baetis* sp?
Figure 66. Genitalia of male nymph, *Epeorus* sp?
Figure 67. Genitalia of male nymph, *Rithrogena* sp?
Figure 68. Genitalia of male imago, *Leptophlebia* sp?
Figure 69. Genitalia of male imago, *Centroptilium* sp?
Figure 70. Genitalia of male imago, *Pseudocloeon* sp?
Figure 71. Genitalia of male imago, *Ephemera* sp?
Figure 72. Genitalia of male imago, *Blasturus* sp?
Figure 73. Genitalia of male nymph, *Baëtis* sp?
Figure 74. Genitalia of male nymph, *Blasturus* sp?
Figure 75. Genitalia of male imago, *Baëtisca* sp?
Figure 76. Genitalia of male imago, *Hexagenia* sp?
Figure 77. Genitalia of male imago, *Potamanthus* sp?
Figure 78. Genitalia of male nymph, *Choroterpes* sp?
Figure 79. Genitalia of male nymph, *Potamanthus* sp?
Figure 80. Genitalia of male nymph, *Leptophlebia* sp?
Figure 81. Genitalia of male nymph, *Ephemera* sp?
Figure 82. Genitalia of male imago, *Pentagenia* sp?
Figure 83. Genitalia of male imago, *Polymitarcys* sp?
Figure 84. Genitalia of male imago, *Campsurus* sp?
Figure 85. Genitalia of male nymph, *Hexagenia* sp?
Figure 86. Genitalia of male nymph, *Polymitarcys* sp?

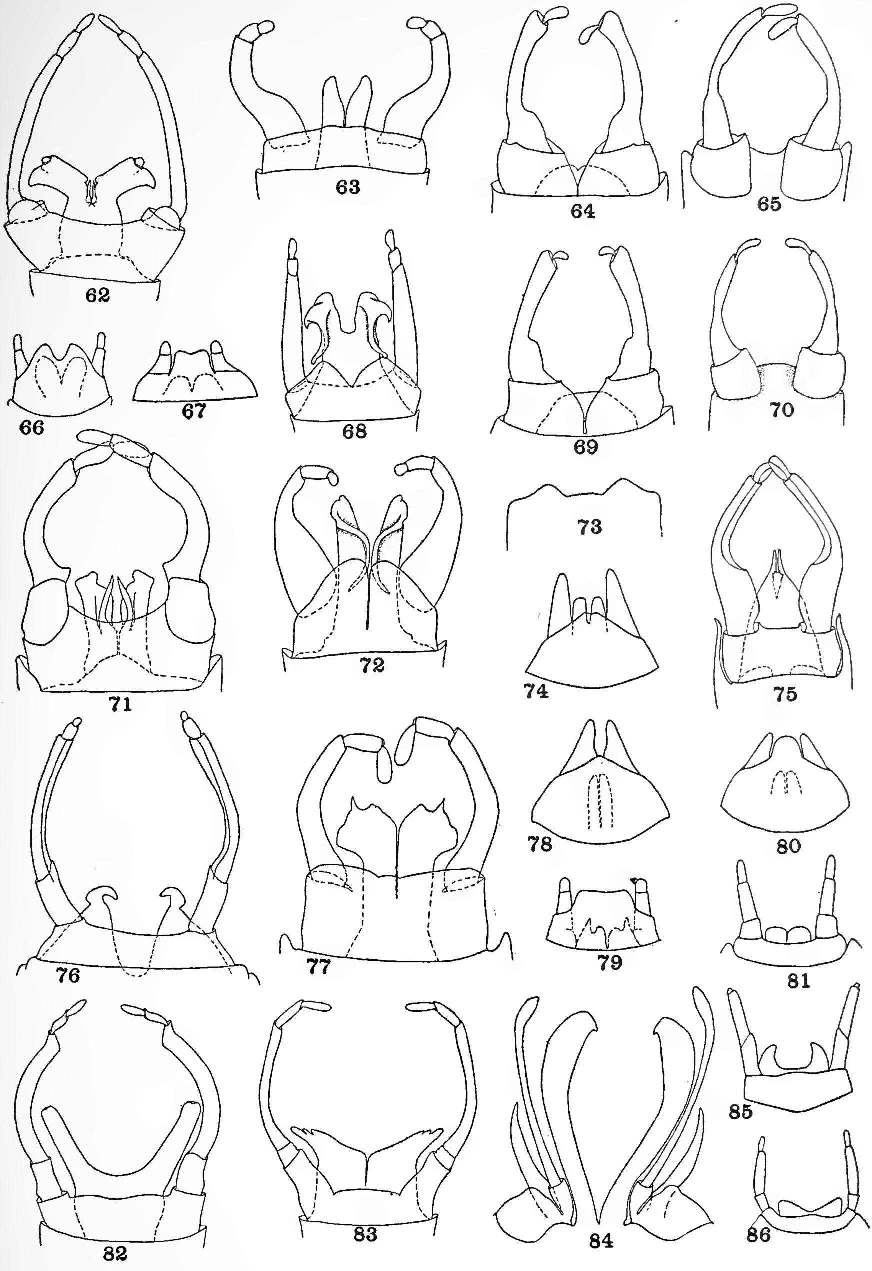
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PLATE XXI

Figure 87. Genitalia of male imago, *Tricorythus* sp?
Figure 88. Genitalia of male imago, *Ephemerella* sp?
Figure 89. Genitalia of male imago, *Caenis* sp?
Figure 90. Genitalia of male nymph, *Caenis* sp?
Figure 91. Right mandible of nymph, *Isonychia* sp?
Figure 92. Genitalia of male nymph, *Ephemerella* sp?
Figure 93. Genitalia of male nymph, *Ephemerella* sp?
Figure 94. Genitalia of male nymph, *Tricorythus* sp?
Figure 95. Right mandible of nymph, *Siphlonurus* sp?
Figure 96. Right mandible of nymph, *Callibaëtis* sp?
Figure 97. Right mandible of nymph, *Ecdyonurus* sp?—interpunctata complex.
Figure 98. Right mandible of nymph, *Rithrogena* sp?
Figure 99. Right mandible of nymph, *Centroptilium* sp?
Figure 100. Right mandible of nymph, *Epeorus* sp?
Figure 101. Right mandible of nymph, *Heptagenia* sp?—maculipennis complex.
Figure 102. Right mandible of nymph, *Ecdyonurus* sp?

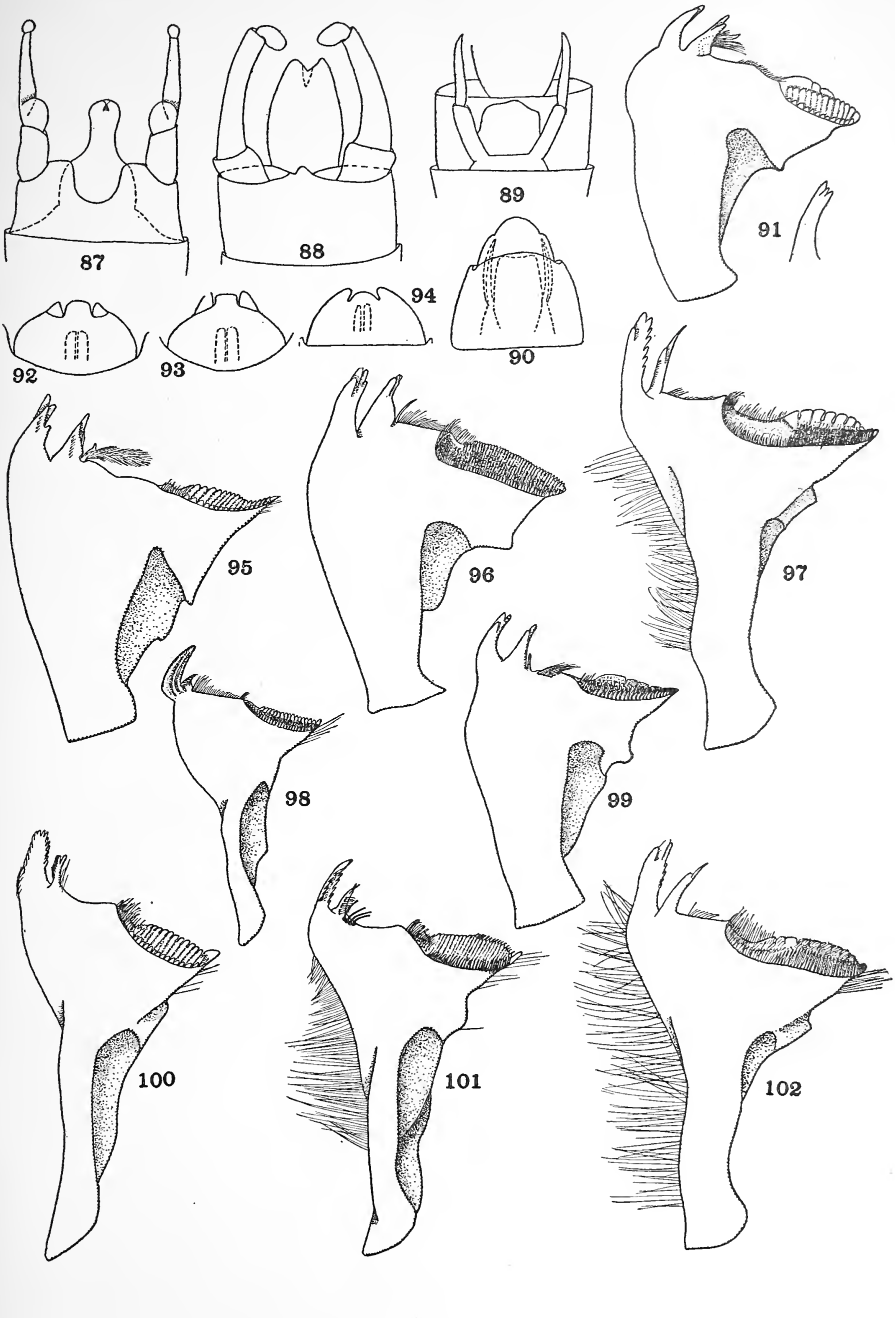
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PLATE XXII

Figure 103. Right mandible of nymph, *Cloeon* sp?
Figure 104. Right mandible of nymph, *Potamanthus* sp?
Figure 105. Right mandible of nymph, *Hexagenia* sp?
Figure 106. Right mandible of nymph, *Polymitarcys* sp?
Figure 107. Right mandible of nymph, *Baëtis* sp?
Figure 108. Right mandible of nymph, *Potamanthus* sp?
Figure 109. Right mandible of nymph, *Ephemera* sp?
Figure 110. Right mandible of nymph, *Pentagenia* sp?
Figure 111. Right mandible of nymph, *Choroterpes* sp?
Figure 112. Right mandible of nymph, *Leptophlebia* sp?
Figure 113. Right mandible of nymph, *Ephemerella* sp?
Figure 114. Right mandible of nymph, *Tricorythus* sp?
Figure 115. Right mandible of nymph, *Blasturus* sp?

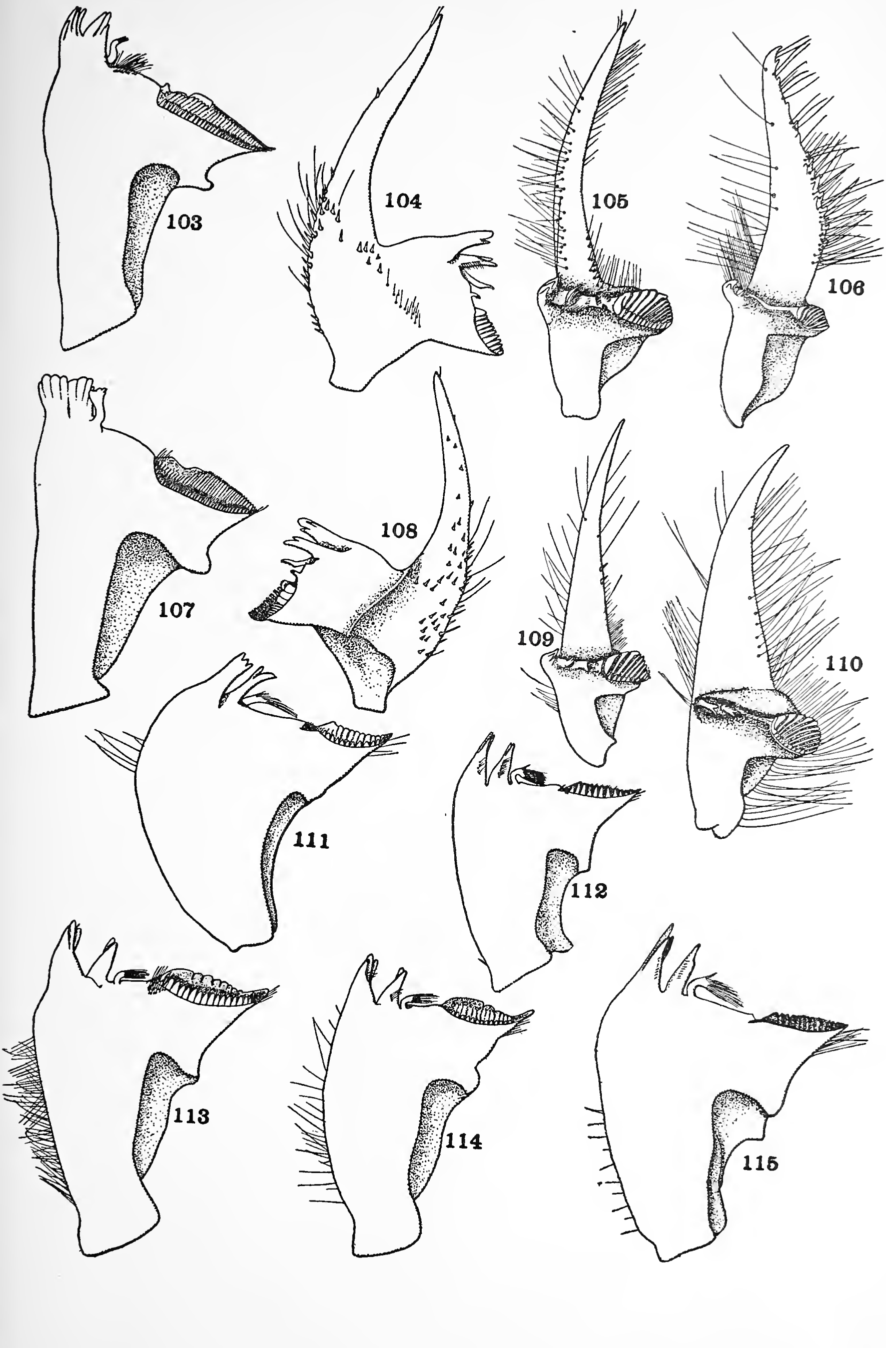
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PLATE XXIII

Figure 116. Right mandible of nymph, *Baetisca* sp?
Figure 117. Right mandible of nymph, *Caenis* sp.
Figure 118. Maxilla of nymph, *Siphlonurus* sp?
Figure 119. Maxilla of nymph, *Isonychia* sp?
Figure 120. Maxilla of nymph, *Rithrogena* sp?
Figure 121. Maxilla of nymph, *Epeorus* sp?
Figure 122. Maxilla of nymph, *Centroptilium* sp?
Figure 123. Maxilla of nymph, *Callibaëtis* sp?
Figure 124. Maxilla of nymph, *Heptagenia* sp?—muculipennis complex.
Figure 125. Maxilla of nymph, *Ecdyonurus ithaca.* Need.
Figure 126. Maxilla of nymph, *Cloëon* sp?
Figure 127. Maxilla of nymph, *Baëtis* sp?
Figure 128. Maxilla of nymph, *Ecdyonurus* sp?—interpunctata complex.
Figure 129. Maxilla of nymph, *Blasturus* sp?
Figure 130. Maxilla of nymph, *Ecdyonurus* sp?

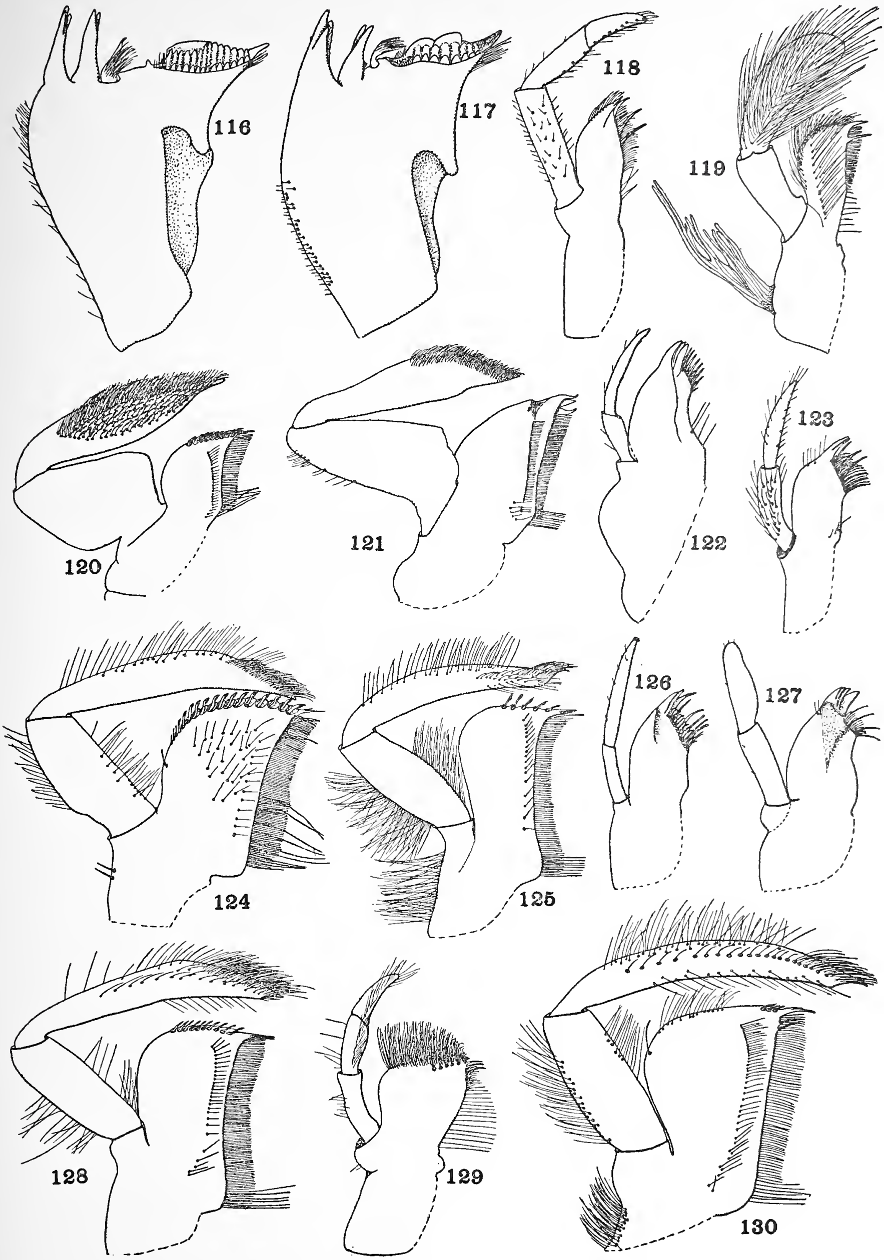
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PLATE XXIV

Figure 131. Maxilla of nymph, *Choroterpes* sp?
Figure 132. Maxilla of nymph, *Leptophlebia* sp?
Figure 133. Maxilla of nymph, *Potamanthus* sp?
Figure 134. Maxilla of nymph, *Polymitarcys* sp?
Figure 135. Maxilla of nymph, *Ephemerella* sp?
Figure 136. Maxilla of nymph, *Ephemerella* sp?
Figure 137. Maxilla of nymph, *Tricorythus* sp?
Figure 138. Maxilla of nymph, *Hexagenia* sp?
Figure 139. Maxilla of nymph, *Ephemera* sp?
Figure 140. Maxilla of nymph, *Pentagenia* sp?
Figure 141. Maxilla of nymph, *Caenis* sp?
Figure 142. Labium of nymph, *Heptagenia* sp?—maculipennis complex.
Figure 143. Labium of nymph, *Siphlonurus* sp?
Figure 144. Maxilla of nymph, *Baetisca* sp?
Figure 145. Labium of nymph, *Ecdyonurus* sp?
Figure 146. Labium of nymph, *Epeorus* sp?
Figure 147. Labium of nymph, *Isonychia* sp?

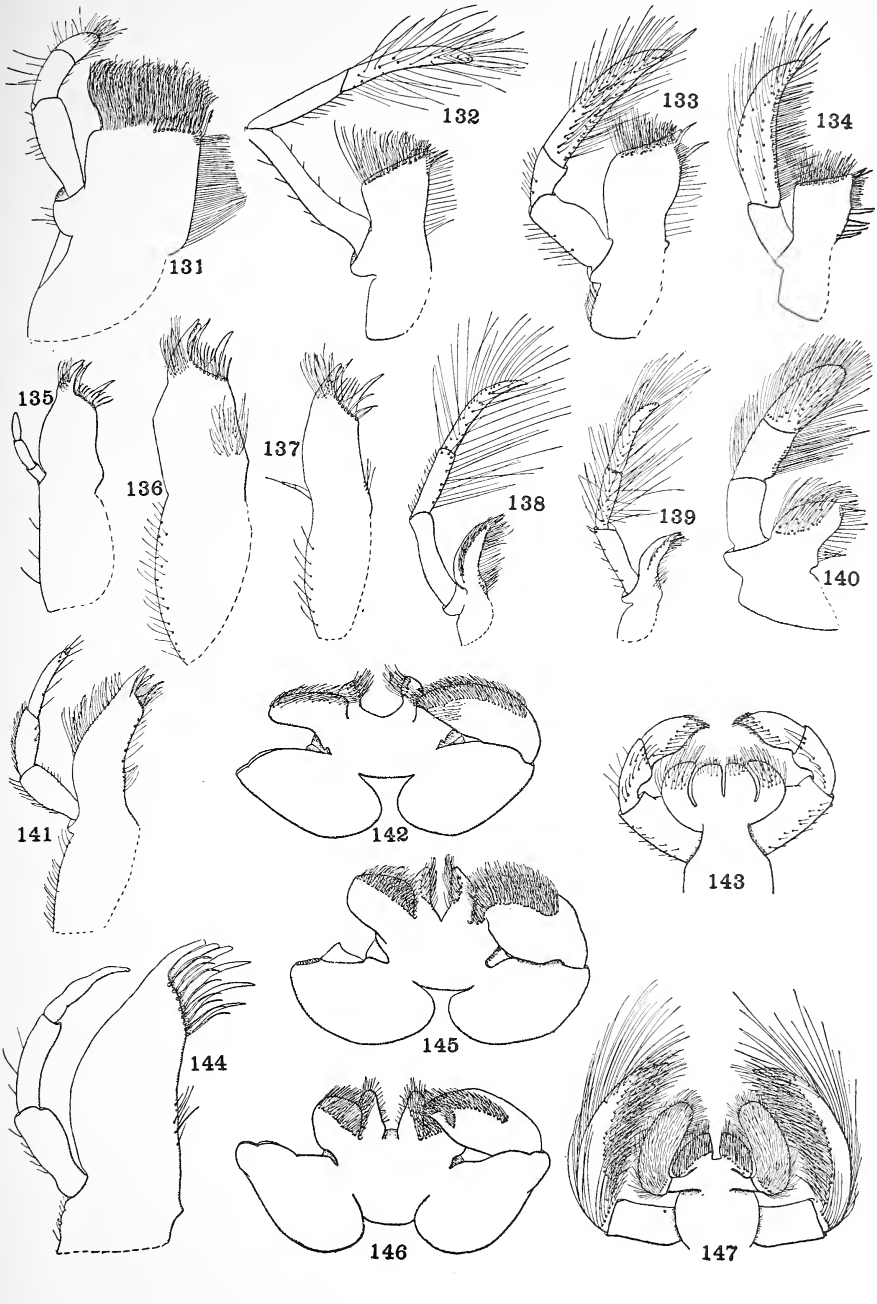
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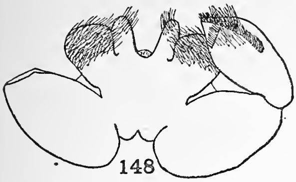
PLATE XXV

Figure 148. Labium of nymph, *Rithrogena* sp?
Figure 149. Labium of nymph, *Ecdyonurus ithaca.* Need.
Figure 150. Labium of nymph, *Centroptilium* sp?
Figure 151. Labium of nymph, *Blasturus* sp?
Figure 152. Labium of nymph, *Polymitarcys* sp?
Figure 153. Labium of nymph, *Ephemera* sp?
Figure 154. Labium of nymph, *Cloëon* sp?
Figure 155. Labium of nymph, *Choroterpes* sp?
Figure 156. Labium of nymph, *Pentagenia* sp?
Figure 157. Labium of nymph, *Callibaëtis* sp?
Figure 158. Labium of nymph, *Tricorythus* sp?
Figure 159. Labium of nymph, *Potamanthus* sp?
Figure 160. Labium of nymph, *Leptophlebia* sp?
Figure 161. Labium of nymph, *Hexagenia* sp?
Figure 162. Labium of nymph, *Baëtis* sp?
Figure 163. Labium of nymph, *Baetisca* sp?
Figure 164. Labium of nymph, *Ephemerella* sp?
Figure 165. Labium of nymph, *Ephemerella* sp?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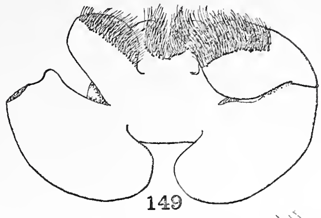
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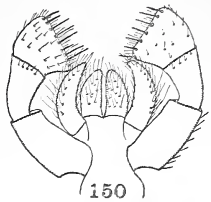
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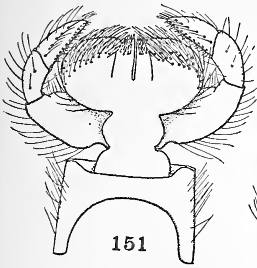
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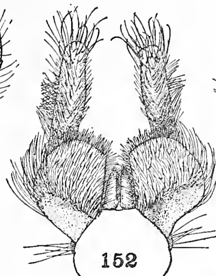
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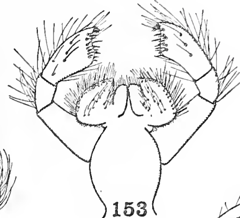
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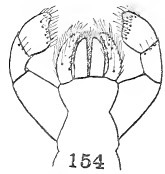
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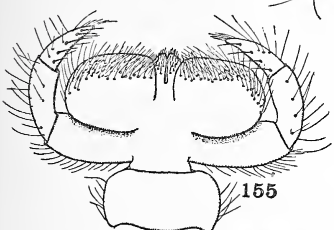
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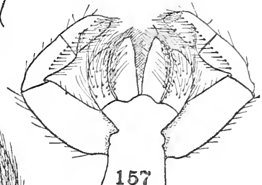
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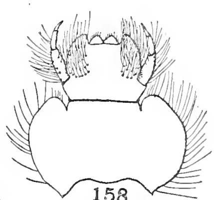
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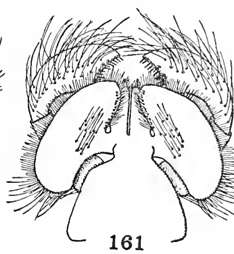
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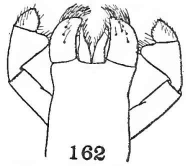
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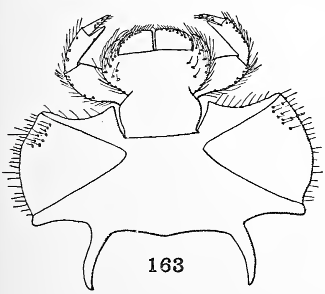
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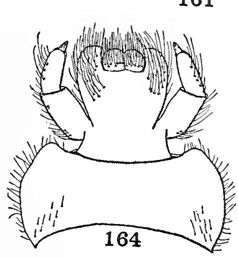
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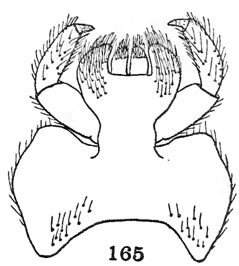
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PLATE XXVI

Figure 166. Lacinia mobilis of nymph, *Siphlonurus* sp?
Figure 167. Lacinia mobilis of nymph, *Baetisca* sp?
Figure 168. Right lacinia mobilis of nymph, *Caenis* sp?
Figure 169. Left lacinia mobilis of nymph, *Caenis* sp?
Figure 170. Right lacinia mobilis of nymph, *Isonychia* sp?
Figure 171. Left lacinia mobilis of nymph, *Isonychia* sp?
Figure 172. Left lacinia mobilis of nymph, *Baëtis* sp?
Figure 173. Right lacinia mobilis of nymph, *Baëtis* sp?
Figure 174. Left lacinia mobilis of nymph, *Ecdyonurus* sp?
Figure 175. Right lacinia mobilis of nymph, *Blasturus* sp?
Figure 176. Left lacinia mobilis of nymph, *Blasturus* sp?
Figure 177. Right lacinia mobilis of nymph, *Leptophlebia* sp?
Figure 178. Left lacinia mobilis of nymph, *Leptophlebia* sp?
Figure 179. Left lacinia mobilis of nymph, *Callibaëtis* sp?
Figure 180. Right lacinia mobilis of nymph, *Callibaëtis* sp?
Figure 181. Right lacinia mobolis of nymph, *Choroterpes* sp?
Figure 182. Left lacinia mobilis of nymph, *Choroterpes* sp?
Figure 183. Right lacinia mobilis of nymph, *Centroptilium* sp?
Figure 184. Right lacinia mobilis of nymph, *Cloëon* sp?
Figure 185. Lacinia mobilis of nymph, *Heptagenia* sp?—maculipennis complex.
Figure 186. Right lacinia mobilis of nymph, *Potamanthus* sp?
Figure 187. Left lacinia mobilis of nymph, *Potamanthus* sp?
Figure 188. Right lacinia mobilis of nymph, *Ephemerella* sp?
Figure 189. Right lacinia mobilis of nymph, *Hexagenia* sp?
Figure 190. Left lacinia mobilis of nymph, *Hexagenia* sp?
Figure 191. Left lacinia mobilis of nymph, *Polymitarcys* sp?
Figure 192. Left lacinia mobilis of nymph, *Ephemerella* sp?
Figure 193. Right lacinia mobilis of nymph, *Ephemera* sp?
Figure 194. Left lacinia mobilis of nymph, *Ephemera* sp?
Figure 195. Left lacinia mobilis of nymph, *Pentagenia* sp?
Figure 196. Labium of nymph, *Caenis* sp?
Figure 197. Left lacinia mobilis of nymph, *Tricorythus* sp?

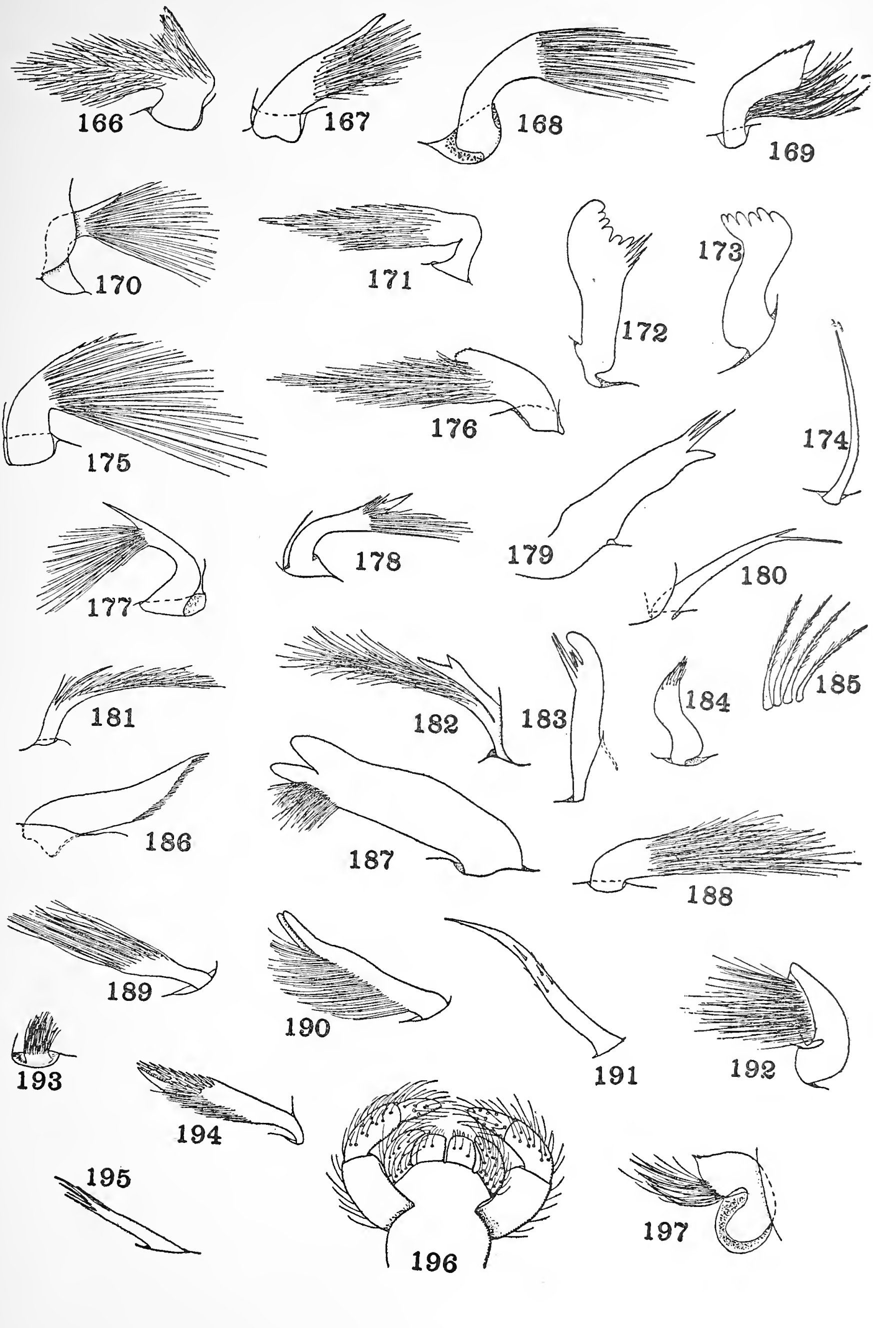
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PLATE XXVII

Figure 198. Anterior lamella of first gill of *Siphlonurus* sp?
Figure 199. Posterior lamella of first gill of *Siphlonurus* sp?
Figure 200. Posterior lamella of third gill of *Isonychia* sp?
Figure 201. Anterior lamella of third gill of *Ecdyonurus ithaca.* Need.
Figure 202. Posterior lamella of third gill of *Ecdyonurus ithaca.* Need.
Figure 203. Seventh gill of *Ecdyonurus ithaca.*
Figure 204. Seventh gill of *Siphlonurus* sp?
Figure 205. Anterior lamella of third gill of *Isonychia* sp?
Figure 206. Anterior lamella of third gill of *Ecdyonurus* sp?—interpunctata complex.
Figure 207. Posterior lamella of third gill of *Ecdyonurus* sp?—interpunctata complex.
Figure 208. Seventh gill of *Ecdyonurus* sp?—interpunctata complex.
Figure 209. Anterior lamella of third gill of *Epeorus* sp?
Figure 210. Posterior lamella of third gill of *Epeorus* sp?
Figure 211. Anterior lamella of third gill of *Heptagenia* sp?—maculipennis complex.
Figure 212. Seventh gill of *Cloëon* sp?
Figure 213. First gill of *Centroptilium* sp?
Figure 214. Third gill of *Cloëon* sp?
Figure 215. Seventh gill of *Heptagenia* sp?—maculipennis complex.
Figure 216. Posterior lamella of third gill of *Heptagenia* sp?—maculipennis complex.
Figure 217. Fourth gill of *Callibaëtis* sp?
Figure 218. Second gill of *Callibaëtis* sp?
Figure 219. Seventh gill of *Callibaëtis* sp?
Figure 220. Third gill of *Baetis* sp?
Figure 221. Third gill of *Centroptilium* sp?

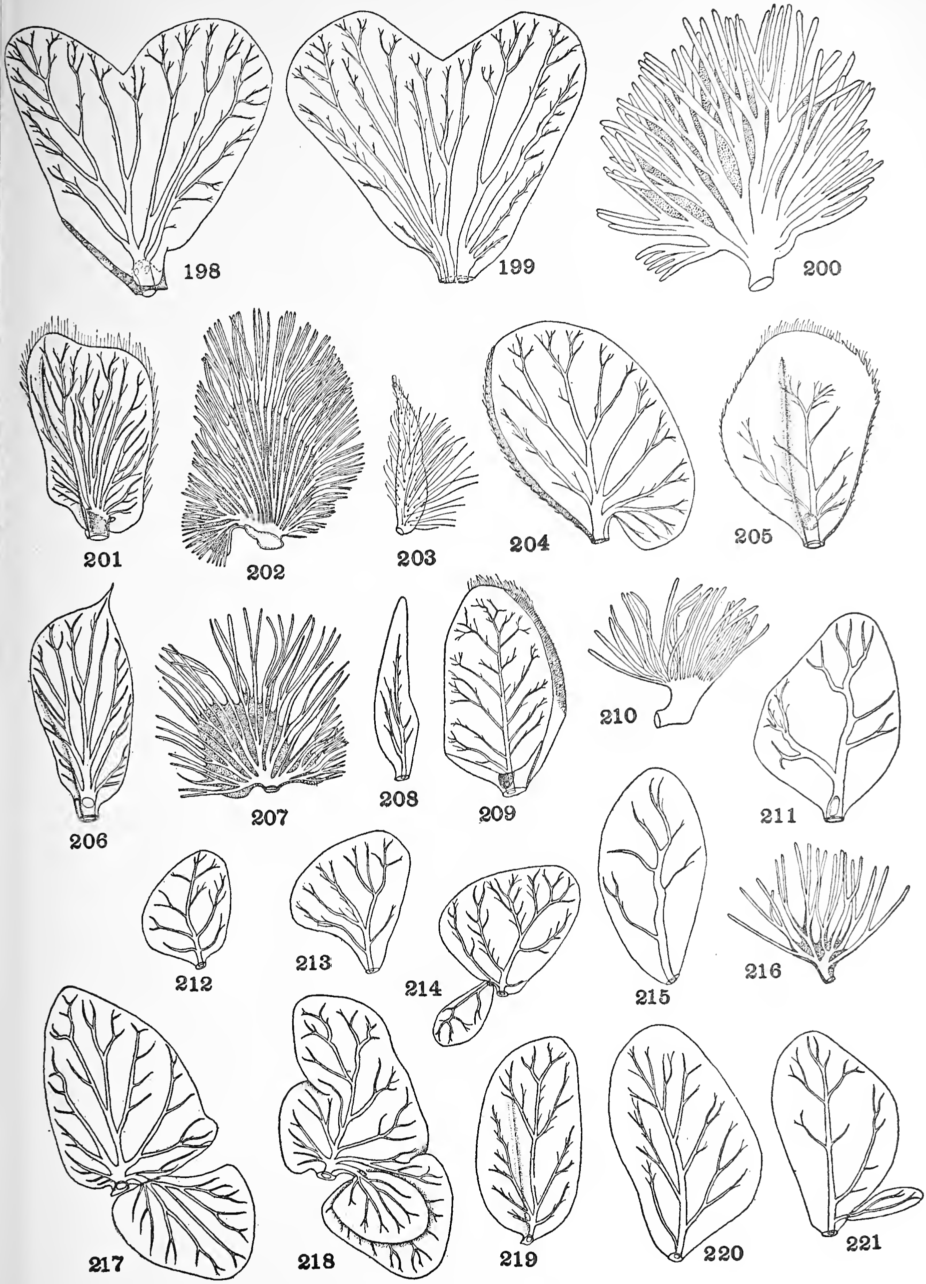
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PLATE XXVIII

Figure 222. Anterior lamella of third gill of *Choroterpes* sp?
Figure 223. Posterior lamella of third gill of *Choroterpes* sp?
Figure 224. First gill of *Choroterpes* sp?
Figure 225. Anterior lamella of third gill of *Blasturus* sp?
Figure 226. Posterior lamella of third gill of *Blasturus* sp?
Figure 227. First gill of *Blasturus* sp?
Figure 228. Third gill of *Leptophlebia* sp?
Figure 229. Third gill of *Potamanthus* sp?
Figure 230. First gill of *Hexagenia* sp?
Figure 231. Posterior lamella of third gill of *Hexagenia* sp?
Figure 232. Anterior lamella of third gill of *Hexagenia* sp?
Figure 233. Anterior lamella of third gill of *Pentagenia* sp?
Figure 234. Posterior lamella of third gill of *Pentagenia* sp?
Figure 235. Seventh gill of twenty day old nymph of *Hexagenia* sp?
Figure 236. Sixth gill of eleven day old nymph of *Hexagenia* sp?
Figure 237. Posterior lamella of third gill of *Ephemerella* sp?
Figure 238. Third gill of *Ephemera* sp?
Figure 239. First gill of *Polymitarcys* sp?
Figure 240. Posterior lamella of seventh gill of *Ephemerella* sp?
Figure 241. Posterior lamella of third gill of *Tricorythus* sp?
Figure 242. Anterior lamella of third gill of *Ephemerella* sp?
Figure 243. Third gill of *Polymitarcys* sp?
Figure 244. First gill of *Ephemerella* sp?
Figure 245. Anterior lamella of second gill of *Tricorythus* sp?

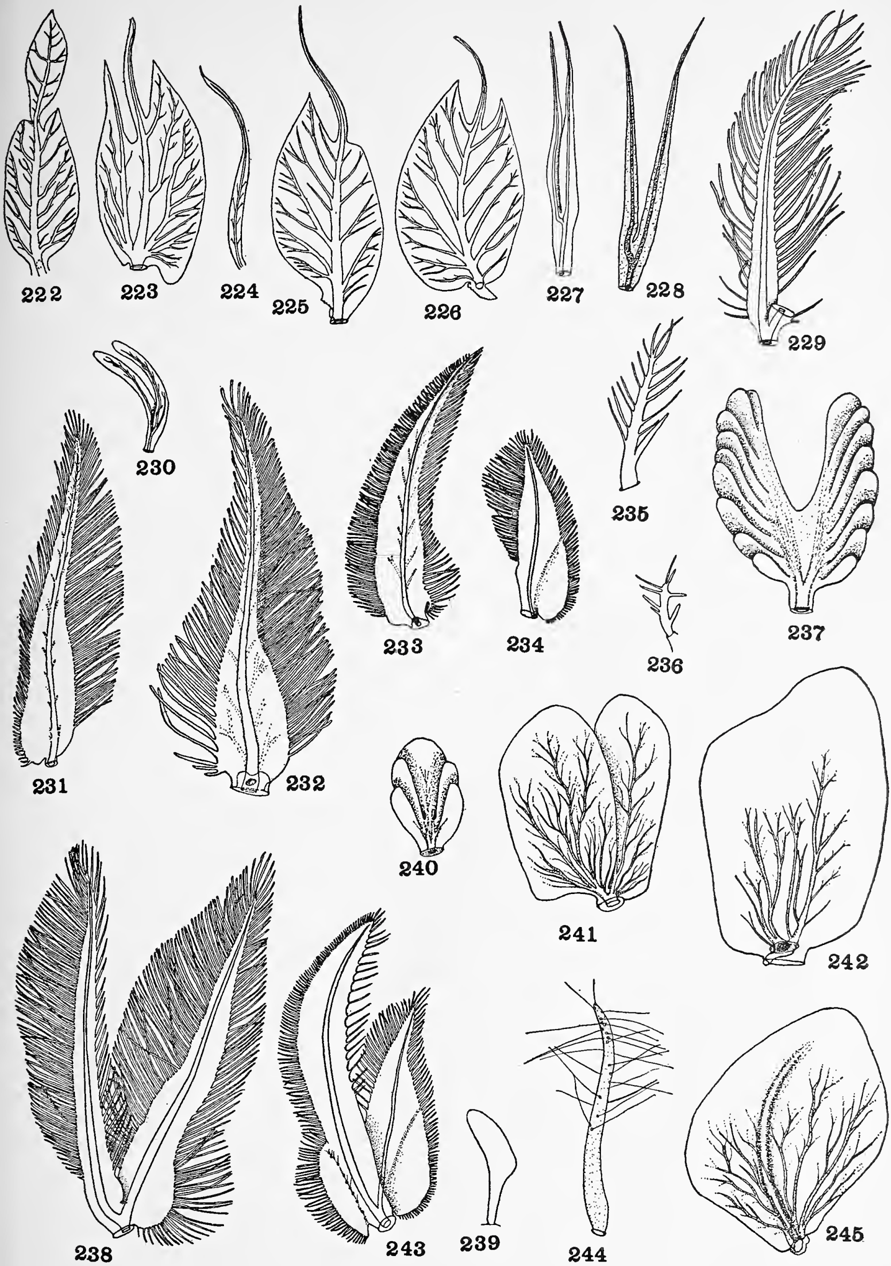
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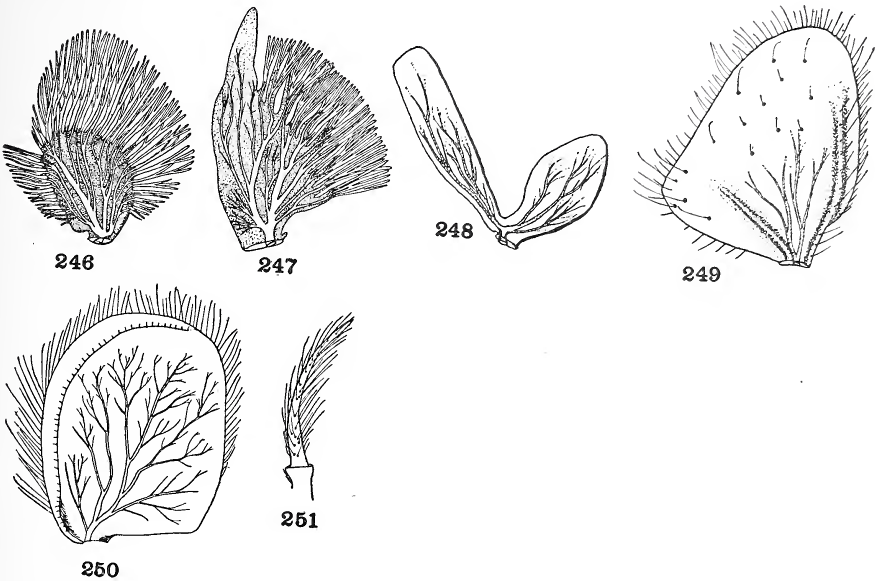
PLATE XXIX

Figure 246. Third gill of *Caenis* sp?
Figure 247. Second gill of *Baetisca* sp?
Figure 248. Posterior lamella of first gill of *Tricorythus* sp?
Figure 249. Anterior lamella of first gill of *Tricorythus* sp?
Figure 250. Second gill of *Caenis* sp?
Figure 251. First gill of *Caenis* sp?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BOOK REVIEW

William Bartram, Interpreter of the American Landscape, by N. Bryllion Fagin, Associate in English, the Johns Hopkins University. 228 pp. octavo. Baltimore, Johns Hopkins Press. 1933. $2.25.

All those interested in early entomological history in America will welcome this new biography. William Bartram not only was a great-uncle of the famous entomologist Thomas Say, but it is also known that he guided at least in part the latter's youthful studies in a way that profoundly influenced his later scientific activities. Bartram also for long years was closely identified as colleague with a large number of other prominent scientific workers of his day, and any sympathetic study of his life obviously would include incidents from and side lights on the careers of numerous of his contemporaries as well. William Bartram, botanist, ornithologist, entomologist, and old time naturalist, was a son of John Bartram, botanist and owner of a long noted botanical garden, and was born at Kingsessing, Pa., February 9, 1739. While still a youth he accompanied his father on numerous natural history collecting trips. After reaching maturity he traveled extensively as naturalist. It is interesting to recall that it was due to Bartram that Alexander Wilson was induced to undertake his "American Ornithology"; also that it was Bartram who drew many of the plates in Barton's "Elements of Botany." He lived, studied and wrote for many years in the old home with a brother to whom the father had willed the garden, and he died at the age of 84 on July 22, 1823. Of Quaker ancestry and a life-long bachelor, he was gentle, shy, and unassuming. Even through the mists of more than a hundred years there are evidences from the quality of his friendships and his goodness of heart that he must have possessed a singularly winning and lovable personality.

The most important single expedition undertaken by him was four years and nine months, from April, 1773, to January, 1778, spent in exploration of various sections of the South, and his most important literary and scientific contribution was his narration in book form of the results of these travels. In 1791 he published the account under the title "*Travels through North and South Carolina, Georgia, East and West Florida, the Cherokee Country, the Extensive Territories of the Muscogulges, or Creek Confederacy, and the Country of the Choctaws; containing an account of the Soil and Natural Productions of those Regions, together with Observations on the Manners of the Indians.*" Parenthetically, it will be remembered that long titles to books were fashionable in those days. The work was reprinted in England and Ireland, and was translated into German, Dutch, and French, and proved to be of sufficiently sustained interest as to be reprinted as late as 1928. A book having such lasting qualities, and making such a deep impression upon discriminating readers, and influencing the thought and literature of the world for almost a century and a half, surely is of itself enough of a phenomenon as to deserve the attention of the student of literary history. Dr. Fagin's study considers the various qualities of the man and his book which gave it such vitality.

While the multiplicity of his scientific interests renders nearly all of Bartram's work of value to students, it is, however, with his entomological contributions that this review is primarily concerned. It is pointed out by Dr. Fagin that insects constitute an important part of Bartram's landscape. Flies in "incredible numbers" torment the horses of his exploration parties "to such a degree as to excite compassion even in the hearts of pack-horsemen." They are "a flying host of persecuting spirits." He is surprised at his failure to notice any bees in West Florida, for "they are so numerous all along the Eastern continent from Nova-Scotia to East Florida, even in the wild forests, as to be thought, by the generality of the inhabitants, aborigines of this continent." He describes with delight the "incredible numbers" of butterflies, and revels in the rich colors of the different species. He observes swarms of grasshoppers, "the favorite delicious food" of rice birds, and describes cochineal insects feeding on cacti. "The female . . . is very large and fleshy, covered with a fine white silk or cottony web, which feels always moist or dewy, and seems designed by nature to protect them from the violent heat of the sun. The male is very small in comparison to the female, and but very few in number.'' However, the most impressive of Bartram's descriptions of insects is that of ''the small flying insects, of the genus termed by naturalists Ephemera.'' Three pages are devoted to them, describing their birth, their ephemeral lives, and their death, and ending in a series of philosophical reflections generated by Bartram's contemplation of them. He assures us that ''The importance of the existence of these beautiful and delicately formed little creatures . . . whose frame and organization is equally wonderful, more delicate, and perhaps as complicated as that of the most perfect human being, is well worth a few moments contemplation; I mean particularly when they appear in the fly state. And if we consider the very short period, of that stage of their existence which we may reasonably suppose, to be the only space of their life that admits of pleasure and enjoyment, what a lesson doth it not afford us of the vanity of our own pursuits.''

The main purpose of Dr. Fagin's biography is to make a comprehensive résumé of the influence of Bartram's writings on the development of nature description; to study the special combination of gifts which he brought to his observation of the American landscape; and, to discuss the various factors which have contributed to his popularity among literary men. The book is interesting and stimulating. Its reading is commended.—J. S. WADE.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF MAY 3, 1932

A regular meeting of the New York Entomological Society was held on May 3, 1932, in the American Museum of Natural History at 8: 15 P. M. Vice-President Ernest L. Bell presided in the absence of President Mutchler. Twenty members and eighteen visitors were present.

The minutes of the preceding meeting were approved and read.

The program committee announced Dr. Herman Spieth as the speaker for the next regular meeting.

The following were proposed for active membership in the Society:

Mr. F. T. Naumann, 179 Harrison St., East Orange, N. J.
James T. Farrelly, 1630 Undercliff Ave., Bronx, N. Y.
Noah A. Levine, 54 West Mt. Eden Ave., Bronx, N. Y.

Dr. Russell Biddle, of the College of the City of New York, read a paper on parthenogenesis, the eighth in the series on the Biology of Insects. His talk was illustrated with slides showing parthenogenetic development of the eggs of bees, aphids, brine shrimps and other lower forms of life.

Mr. Davis stated that no male specimens of walking sticks, *Manomera atlantica,* had been found on Long Island over a period of years.

Mr. Safro stated that all literature describes the woolly apple aphis egg as being white and single. He asked the members if any had ever seen an egg of this aphis that was not black.

Mr. Curran then spoke on ''Some Unusual Habits of Insects,'' saying that one always expects the unusual in insects. Among the peculiarities of the Diptera, he mentioned the Psychodidæ, which live in the drain pipes of houses; the Blepharoceridæ, which live only in the rapids of a stream, where pupation takes place under water on the sides of the stones and from which the adults emerge and fly away; the Acanthomera, whose larvæ live in solid, hard, living wood where they bore large tunnels, in the process of which they may be heard for several feet; the Conopidæ, which deposit their eggs on bees and wasps during flight; the Muscidæ, whose larvæ are retained in the body until almost full grown. In the Lepidoptera, Thecla is attended by ants which stroke the glands secreting honey-dew causing them to be extended and exude a drop of this sweet substance. The caterpillar of the Snake Sphinx Monarch of Peru when disturbed will stand erect showing the markings on its body that are similar to a snake making ready to strike. The division of labor among the scarab beetles was mentioned by Mr. Curran. The social wasps and the social bees show a remarkable degree of instinctive education. Mr. Curran concluded his remarks by relating the peculiarities of the ants, their parasitism and their complicated social structure.

Mr. Angell gave the following new records: *Dorcas raephus* in the University of Minnesota collection from Kansas, also *Ceruchus piceus* from Florida. He exhibited specimens of *Lucanus elephas, Platycerus agassizæ* ♀, and Platycerus, a new species ♂–.

Dr. Melander spoke of a peculiar habit of the insect *Rhamphomyia sociabilis,* the male using insects as bait for the female during mating, also *Embis aerobatica* which spits bubbles until it has built a balloon of them.

MEETING OF MAY 17, 1932

A regular meeting of the Society was held in the American Museum of Natural History on May 17, 1932; President Mutchler in the chair, with twenty-four members and seventeen visitors present.

The minutes of the preceding meeting were approved as read and corrected.

Messrs. Naumann, Farrelly and Levine were elected active members of the Society.

Mr. Fred B. Silliman, of 175 Brooklawn Avenue, Bridgeport, Conn., was proposed for active membership in the Society. On motion, the by-laws were suspended, and Mr. Silliman was immediately elected an active member of the Society.

Dr. Herman Spieth, of the College of the City of New York, spoke on "Biological Control," the concluding paper of the series on the Biology of Insects. Dr. Spieth discussed the factor of climate and the biological factors of disease, insectivorous birds, and parasites which maintain or should maintain the equilibrium of numbers among insects. The first introduction of a parasite from the natural habitat of the pest was accomplished in 1873, when a predatory mite was brought in to control the Phylloxera on grape vines in France. Biological control is most efficient in insular regions such as the Hawaiian Islands and also in California where the climate is warm, thereby making possible two or three generations of parasites in a year; and also in regions such as those mentioned above where there are not many indigenous parasites. The fundamental methods in biological control are many parasites on a single pest, or a single parasite on a single pest. In 1910, Fiske was successful in obtaining a sequence of parasites for the egg, larvae, pupa, and adult of the Brown Tail Moth.

The meeting was then opened to discussion by the members on their early spring collecting.

Mr. Curran spoke of his collecting at Lakehurst in the spring which had not been very successful.

Mr. Davis gave advance notice of a paper by himself on cicadas to be published in the fall. This paper will contain some of the results of the collecting he did on his western trip in the summer of 1931. Mr. Davis said that *Colias eurytheme* had been very prolific on Staten Island during the Spring. *Anax junius* was seen at Lakehurst, Orange, and Cold Spring Harbor in April.

Mr. Ballou spoke on his collection of histerids.

Dr. Driggers had observed an Oriental peach moth pupating in the last week in February.

Dr. Melander spoke on the micro-diptera he had found in the north of Florida. He also spoke of the Field Day of the New York Association for Biology Teachers which was held in Northern New Jersey. The seventy-five members who attended had collected thirty-six different species of insects in two hours. Dr. Melander then said that although eight of the nine speakers in the series on the Biology of Insects were members of the Biology Faculty at the College of the City of New York, there was, strangely enough, no course on Entomology in the curriculum of the college.

The Society unanimously voted its thanks to Dr. Melander for furnishing its meetings with these speakers on specialized subjects during the past season.

Mr. Curran expressed his thanks to Dr. Melander on behalf of the Program Committee. Mr. Curran said that he hoped to broaden the field of the series on the Biology of Insects in the coming year.

Mr. Moennich spoke of his collecting on Long Island during the past few months. On May 14, he found carabids at Alley Pond. Since then he had observed tenebrionids, cucujids, etc., and an egg mass of the praying mantis in Little Neck.

Mr. Safro expressed his appreciation for the series of talks on the Biology of Insects. He also said that too much was expected of Biological Control both in California and here in the east.

Mr. Sanders spoke of the measures taken to control the Brown Tail Moth in Nova Scotia where the Apanteles parasite was introduced. This parasite became an effective means of biological control in Nova Scotia before it did so in Massachusetts. He also spoke of the relationship of certain flies and infantile paralysis which is now being established by scientists.

Professor Hamilton, of New Jersey, spoke on the insects affecting ornamental trees and shrubs. In the past three years there are three groups which have been increasing in number. They are: grubs on the lawns, due to climatic conditions; spider mites on the evergreens, both broad leaf and hair; and the boring insects, which have become prolific, due to the dry weather.

Mr. Thompson mentioned the increase of parasites of the codling moth.

MEETING OF OCTOBER 4, 1932

A regular meeting of the Society was held on Tuesday, October 4, 1932, in the American Museum of Natural History; President Mutchler in the chair; twenty-three members and eight visitors present.

The minutes of the preceding meeting were approved as read.

The treasurer's report was read and accepted.

The Program Committee announced the program for the next meeting on October 18.

Mr. F. S. Blanton, of the United States Entomological Laboratory in Babylon, Long Island, was proposed for active membership in the Society. By a unanimous vote of the members present, the by-laws were suspended and the secretary cast one ballot electing Mr. Blanton an active member of the Society.

Mr. Curran said he had spent the summer in identifying and mounting the flies collected by Mr. Bell in his backyard. Also he had devoted considerable time to collecting pictures and drawings of flies.

Dr. Felt spoke of the damage done by the European elm beetle, the willow leaf-beetle, and the elm leaf-beetle in the recent months. There has been an additional infestation in eight states of the Japanese beetle, thus extending the area of infestation north to Maine, south to South Carolina and west to Michigan.

Mr. Davis showed nearly a hundred pupal skins and a few adults belonging to Brood VI of the 17-year cicada that had been collected during the past summer. On Staten Island the cicadas were found sparingly in many places; Mr. Frederick M. Schott had collected a few at Charlotteburg, Passaic County, New Jersey, and Mr. George B. Wilmott had found a number of pupal skins at Kaaterskill, Greene County, New York. Brood VI occurs from Wisconsin to northern Georgia and covers, as far as known, a greater area than any other brood. The cicadas were probably as numerous in the remaining wooded areas on Staten Island in 1932 as they were in the years 1881, 1898, and 1915. Mr. Davis showed specimens collected in all these years and remarked that some of them had been protected against dermestids for 51 years.

Dr. Hartzell, who attended the International Entomological Congress in Paris from July 16 to July 23, spoke of his travels in Europe during the summer. During the period of the congress, the Entomological Society of France had its centennial celebration in the form of a banquet. Dr. Hartzell remarked on how colorful and how very impressive the roll call of the various foreign delegates was. Leaving the group of American entomologists in Switzerland, Dr. Hartzell went on into Jugo-Slavia in order to study the pyrethrum country of Dalmatia.

After a prolonged absence from the meetings of the Society, Mr. Leng was greeted very cordially by the members of the Society as he rose to speak. He expressed his gratitude and spoke of his pleasure in being present again at a meeting. He mentioned his extensive literary efforts during the last year in regard to the zoology of Porto Rico, the compilation of the Second Supplement to the Leng Catalogue, and the History of Staten Island.

Dr. Melander said that he had spent the summer mounting some 1,500 to 2,000 specimens collected in the past. He exhibited and explained a new type of microscope now made by the Spencer Lens Company. It has an inclination joint, to eliminate stooping, an insect holder which rotates to focus, and a spotlight; the focal point is placed higher than in the ordinary microscope.

Mr. Moennich related some of his experiences on the Long Trail through Vermont over which he had hiked during June. Also he spoke of the *Sericus simmerus,* a Japanese species which he had found on Staten Island. This is the first record of this Sericus on Long Island.

Mr. Ragot announced that he is interested in exchanges. He is specializing in Meloidæ.

Dr. Ruckes related some of his experiences and travels through New Mexico, which he says is a collector's paradise. Due to the wide variations in altitude there are numerous climatic zones, and the lines of demarcation are very abrupt between the several zones in the state. There is a great abundance of genera, while individuals of the same species differ at various altitudes. Dr. Ruckes found many adaptations of insects to the dry climatic conditions.

Mr. Sherman spoke of a visit he had had with Mr. Fall in Tyngsboro, Mass., during September. Mr. Fall has the last word in the way of an entomological den, in which he had 1,400 types segregated. These include types from Europe, Africa, and Brazil.

Three broods from one pair of Polyphemous cocoons had been recorded during the summer by one of Mr. Wuster's customers.

Mr. Pinkus had witnessed the migration of *Catopsilia eubule* (50 individuals in an hour) at Cape May, N. J., on September 18. Other species which he had found to be common in September were: *Atalopedes campestris, Pamphila aaroni, Prenes panoquin,* and *Pamphila logan.*

MEETING OF OCTORER 18, 1932

A regular meeting of the Society was held on October 18 in the American Museum of Natural History; President Mutchler in the chair, with eighteen members and twenty-five visitors present.

The minutes of the preceding meeting were approved as read and corrected.

The Program Committee reported that Mr. Curran would speak at the next meeting.

Mr. Watson read a communication suggesting that Mr. C. F. Groth, Dr. R. Ottolengui, and Mr. Chas. Schaeffer be made Life Members of the Society in due recognition of their long-continued interest in the Society and membership therein since its organization. It was the unanimous desire of those present that these Charter Members be made Life Members and that the Secretary notify each of these gentlemen of this action.

Dr. Herman Spieth read a paper on "The Wing Venation of Insects." He first spoke on the history of the nomenclature for veins, mentioning the work of Hagan, Adolph, Rettenbacher and others. Comstock and Needham have given the foundations to all recent work on this subject although the present workers in this field have varying theories concerning the application of their principles. Dr. Spieth considers Lameere's supposition correct for the nomenclature of the wing veins of the Mayflies except for the anal veins. In the Odonata, Dr. Tillyard has established a workable theory that is correct. There are two biological principles involved in the changes of wing venation throughout the various orders of insects. They are, one, evolutionary changes by additions and modifications; and two, evolution by reduction.

Mr. W. J. Gertsch then spoke on "The Poisonous Nature of Spiders" as follows:

> "The true status of the poisonous nature of spiders has been put on a sound basis within the last few years by various American doctors. Their researches show that the popular dread of spiders is without foundation, except in the case of a few species that have long had bad reputations. A dozen deaths due to the bite of spiders have been described from the United States, but some of these are not definitely attributable to the effect of the venom. In the United States only one species of spider need be feared, the famous Black Widow, a member of a genus of spiders that has been regarded as taboo for hundreds of years. The Tarantula of Europe is no more dangerous than other common wolf spiders. The myth of the disease called Tarantism, supposed to be initiated by the bite of a spider, makes interesting reading, but it has been exploded. As Savory suggests, it may have been initiated by the Bacchantes, when their ritual dancing was made illegal. They fabricated the spider story to continue their ceremonies without being molested. The large hairy four-lunged spiders called tarantulas, in spite of their great size need not be feared by man. Their venom is very effective on cold-blooded animals, but comparatively neffective on Homoitherms. Certain lycosid and ctenid spiders from Brazil are to be regarded as capable of causing painful wounds, but have not been known to be the cause of death in man. A summary of the literature shows that comparatively few spiders are poisonous enough to cause man serious inconvenience."

In response to a question by Mr. Ragot, Mr. Gertsch said that it was necessary to preserve spiders in 95% alcohol, as mounting does not retain the morphological characteristics of the species.

Dr. Melander said that Herbert S. Barber, of the National Museum, has had great success in mounting soft-bodied species by running the specimens through alcohol, thus extracting the body fluid, and then into xylol. He then mounts them up and they remain soft as in the natural state.

Mr. Bernard Benesh, a member of the Chicago Entomological Society, was introduced to the meeting by Mr. Angell. Mr. Benesh spoke briefly on his recent trip through the mountains of Tennessee.

MEETING OF NOVEMBER 1, 1932

A regular meeting of the Society was held on November 1, 1932, in the American Museum of Natural History; President Mutchler in the chair, with eighteen members and thirty-two visitors present.

The minutes of the preceding meeting were approved as read and corrected.

The Program Committee announced that Mr. E. G. Rex would be the speaker at the next meeting.

The following were proposed for active membership in the Society:

Mr. Cyril F. dos Passos, Mendham, New Jersey.
Mr. V. B. Durling, 600 West 166th St., New York City.
Mr. William J. Gertsch, American Museum of Natural History.
Mr. A. S. Pinkus, 1520 East Fifth St., Brooklyn. N. Y.

Mr. Curran gave an excellent and very interesting abstract of the paper by Chas. H. Hicks, ''Nesting Habits of a Solitary Wasp,'' which appeared in the *Canadian Entomologist* for September, 1932. He also showed lantern slides to illustrate the peculiar sleeping habits of *Sphex xanthopterous,* and the method by which the cicada killer brings in its prey.

Dr. Rucks told of an illustration of intelligence in the Sphex which he witnessed in a stream near Ithaca, New York. The Sphex was seen to fly about a hundred yards down stream just far enough above the water so that its loot, a caterpillar, rested on and glided along the surface of the water.

Dr. Ernest Mayr then spoke on ''Collecting Butterflies in the East Indies.'' Dr. Mayr was sent to New Guinea in 1927 by Lord Rothschild to collect birds and butterflies on the various expeditions that he was to make into the interior and up into the mountain ranges of this island which is second in size to Greenland. He found the butterfly fauna to contain just as many beautiful species as that of South America. The Ornithoptera are found rarely in collections because they fly over the tree tops and therefore cannot be captured with any success. Among the more interesting specimens that he took were *Papilia goliath,* with a wing spread of eleven inches; *Papilio weiskei,* which was common on the mountain creeks; *Delias species,* which was found only in the high mountain altitudes; and *Taenaris appina,* which has a very slow wing stroke and is white in appearance, being seen only in the darkest forests. Dr. Mayr then recounted some of his thrilling experiences in traveling over this island which has no means of transportation and where it is necessary to rely on the native boy-carriers and their very bad trails, thus making ''African explorations picnics as compared with those in New Guinea''! In closing, Dr. Mayr spoke of the languages used in Dutch New Guinea and the Malay Archipelago. The universal language is pidgin-english ('pidgin' being a corruption of the Chinese word business) which uses English words and a Polynesian grammar. In order to illustrate the peculiarities and the humorous sound of this language, Dr. Mayr then delivered a sermon on the Feeding of the Five Thousand as he had heard it delivered by a missionary to a congregation of natives.

In response to a motion by Mr. Curran, there was a rising vote of thanks to Dr. Mayr in appreciation of his interesting and most enjoyable talk.

MEETING OF NOVEMBER 15, 1932

A regular meeting of the Society was held on November 15, 1932, in the American Museum of Natural History; President Mutchler in the chair, with twenty-seven members and twelve visitors present.

The minutes of the preceding meeting were read and approved.

Letters from Charles Schaeffer, C. F. Groth, and Dr. R. Ottolengui were read expressing their appreciation of having been elected life members of the Society.

The Program Committee announced that at the next meeting Dr. Ruckes would continue his paper on "The Mouth Parts of Insects," and that Dr. E. P. Felt would speak on "The Development of Insect Control on Shade Trees."

Messrs. Cyril F. dos Passos, V. B. Durling, Wm. J. Gertsch, and A. S. Pinkus were elected members of the Society.

Dr. H. Ruckes delivered the first part of his paper on "The Mouth Parts of Insects," in which their origin and development were contrasted with those of other arthropods. An abstract of this first part will appear, with that for the second part, in the minutes of the next meeting.

Dr. Ruckes' remarks were discussed by Mr. Bird, Mr. Gertsch, Mr. Leonard and Dr. Lutz.

Mr. E. G. Rex, of the New Jersey Department of Agriculture, then spoke on "Japanese Beetle Suppression Work in New Jersey," giving a full and very interesting account of the work done during the year 1932 by the department with the cooperation of the United States Department of Agriculture, with mechanical traps, especially in a region of about seventy-five square miles in Salem County around Mullica Hill and in Cumberland County around Bridgeton. Electrical traps were no longer used due to the necessity of constant attendance. The traps consisted of a funnel painted lustrous white, a cylinder painted lustrous green in which the bait is placed, and a jar beneath for the beetles. A quart jar was found to be entirely inadequate to contain the beetles taken in a single day; therefore gallon jars were substituted and a receptacle of perforated iron instead of glass was used in which the beetles were kept alive, and the odors of decomposition which made the traps unattractive to the beetles were avoided. The aid of 326 farmers was solicited in the campaign and only one refused his cooperation—because there was no money to be paid. A twelve-page illustrated circular of instructions was printed and the traps were well handled by the farmers. A record of daily captures from June 28 to August 4, with three columns to show numbers of quarts removed each time, was distributed with each of the 2,100 traps. Using the gallon trap, six removals were necessary in a single day in some cases. In other cases the traps were filled to the top of the funnel in a single hour and the neighboring cornstalks were still black with the beetles. In one instance, the digging of six ditches, four feet deep, for the disposal of the dead beetles, provided some work for the unemployed.

From the 325 farms, 856 barrels of 50 gallons each were filled with the beetles estimated to be about 526,000,0000 in number. The bait used consisted of bran impregnated with molasses, geraniol specially prepared, glycerine and water. Apple orchards, grapes, and corn are especially attractive to the beetles, and also various plants and trees of no economic value. One of Mr. Rex's slides illustrated the beetles in a beneficial rôle attacking, in great numbers, poison-ivy plants.

About a dozen other species of Scarabæidæ were taken in the traps. Speaking of the somewhat prevalent idea that the beetles were prone to burrow in well kept turf of golf courses, etc., in order to deposit eggs, Mr. Rex said that digging experiments, showing quantities of grubs found, indicated that the principal factor in the selection of territory by females was the ease of digging and that the number of grubs was greater in soil broken by spading or other cultivation. In one cornfield, twenty-two grubs per square foot were found.

The disposal of the beetles captured was a great problem. The method of killing them in 50-gallon barrels which contained 25 gallons of water with 3 quarts of kerosene, and 1 quart of formaldehyde was not satisfactory. As a result of the season's work, it was very evident that much larger receptacles are necessary for the traps. The gallon traps are often very quickly filled to the top and the funnels become congested with excrement of the beetles and many newcomers escape. It is proposed, therefore, to use in the future receptacles of 32 quarts.

Mr. Rex's remarks were listened to with keen interest and were discussed by Dr. Felt and others.

The
New York Entomological Society

Organized June 29, 1892—Incorporated June 7, 1893

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Columbus Avenue.

Annual dues for Active Members, $3.00; including subscription to the Journal, $4.50.

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

Officers for the Year 1933

President, ERNEST L. BELL .... 150–17 Roosevelt Ave., Flushing, Long Island

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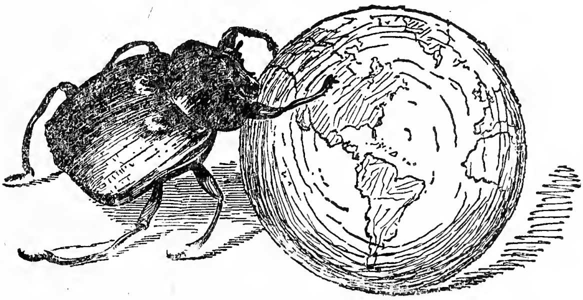

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CONTENTS

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NEW THYSANOPTERA FROM PANAMÁ

By J. Douglas Hood

It was my good fortune last summer to spend six weeks in Panamá, mostly at Barro Colorado Island, in the Canal Zone, and at the historic old town of Porto Bello, collecting, mounting, and studying the Thysanoptera. The new genera and species taken—four of the former and twenty-three of the latter—are described in this paper and in one which has previously appeared.* The desirability of publishing as soon as possible the results of the studies made has excluded from these papers the sixty-nine illustrations which have been prepared, but it is planned to use these and a number of additional ones in a later report on the Thysanoptera of Panamá, to appear after full descriptions of previously-known genera and species have been completed.

It is impossible to acknowledge here my obligations to the many people who did all in their power to aid me; but I must mention Mr. James Zetek, Custodian of the Barro Colorado Island Biological Laboratory, without whose help little indeed could have been done; also Captain Paul P. Blackburn, of the U. S. Navy, who provided a launch and crew for the scientifically profitable Porto Bello trip; and my two companions on Barro Colorado, Miss Sabra J. Hook and my wife, both of them college teachers of biology, who collected many of the most interesting species taken, and who gave liberally of time from their own studies to help in much of the routine laboratory work.

* Hood, J. Douglas, Three New Urothripidæ from Panama; Proc. Biol. Soc. Washington, Vol. 46, pp. 213–216; Nov. 20, 1933.

The types of the new species are in my collection, and in so far as possible paratypes have been deposited with Dr. Thomas Barbour of the Museum of Comparative Zoology at Harvard University. Finally, it must be added that all measurements are of specimens resting free of cover-glass pressure in dried balsam mounts; and measured antennæ are in a strictly horizontal plane and not foreshortened.

Chirothrips xanthius sp. nov.

Female (macropterous).—Length about 1.12 mm. Color bright lemon yellow, with head and distal third of last abdominal segment dark brownish gray (black under lower magnifications), sides of thorax with orange subhypodermal pigmentation, distal portion of abdomen darker yellow; ocellar pigmentation red; legs yellow; fore wings brownish, veins and distal half of posterior margin darkest; hind wings much paler, with a dark median line; antennæ yellow in segments 1–3, 3 palest, 4 yellow with a distal brown cloud, 5 darkened with brown throughout and darker apically, 6–8 uniform brown.—*Head* less than 0.1 longer than wide and two-thirds as long as prothorax, somewhat broadest across eyes, occiput with a few faint close anastomosing lines; cheeks slightly diverging, about 0.1 as long as head and approximately one-fifth as long as eyes; head decidedly elongated between eyes and antennæ, the distance from anterior margin of eyes to front of head only a little less than one-half the length of eyes; front narrow, the interval between antennæ less than one-seventh the greatest dimension of segment 1; two pairs of minute setæ near bases of antennæ, in addition to a slightly longer pair situated close to eyes and far in front of anterior ocellus. *Eyes* about 0.47 as long as head and equal in width to their interval. *Ocelli* subequal, the posterior pair slightly more widely separated and opposite posterior margin of eyes. *Antennæ* about 1.8 times as long as head; segment 1 large and rounded, 2 with distal angle prolonged; length (and width) of antennal segments in microns, I 32(48, greatest width), II 34(46; greatest over-all dimension is 62), III 35(22), IV 34(24), V 32(22), VI 36(17), VII 14(6), VIII 9(4). *Prothorax* trapezoidal, with front and hind margins and sides concave, about 1.6 times as wide as long and 0.65 as wide in front as subbasally; pronotum with scattered minute pale setæ, but without longer setæ at posterior angles, sculpture weak. *Wings* of fore pair 17 times as long as width at middle, curved slightly throughout their length; anterior and posterior veins with 8 and 4 setæ, respectively. *Abdomen* a trifle narrower than pterothorax; segment 10 about 1.3 times as long as basal width, pointed at apex, divided above.

Described from one female taken on a dead branch, Barro Colorado Island, Canal Zone, July 27, 1933, by the author [Hood No. 1013].

The coloration, prolonged head, swollen basal antennal segment, and the absence of major pronotal setæ set this apart as a very distinct species. It is of course a grass feeder, my specimen having simply paused in flight on the branch from which it was taken.

Trichothrips graminis sp. nov.

Female, forma macroptera.—Length about 2.2 mm. Color bright yellow with yellow subhypodermal pigmentation; head blackish brown, yellowish at base; mesothorax and second abdominal segment washed with blackish brown, more darkly on sides; terga 3–8 of abdomen at middle with a narrow transverse brown blotch involving the basal chitinous line; antennæ bright yellow, excepting segment 1 and the base of 2, which are yellowish brown, and 7 and 8, which are overlain with gray; legs bright yellow; fore wings yellow-brown, shaded with gray in posterior half of second fourth; hind wings with a dark brown median vein.—*Head* with length equal to greatest width, sharply constricted at posterior edge of eyes, broadest slightly behind them, and roundly tapering to base, which is only 0.8 the greatest width; lateral surfaces moderately strongly sculptured, giving the cheek a serrulated appearance in dorsal aspect; postocular setæ 80 μ, blunt, their interval fully equal to basal width of head; eyes rounded, protruding, hardly one-third as long as head, less than 0.6 as wide as their interval; interval between posterior ocelli about three times their diameter. *Antennæ* with eighth segment lanceolate and pedicellate; length (and width) of antennal segments in microns, I 64(51), II 70(42), III 70(41), IV 58(39), V 66(38), VI 64(34), VII 63(30), VIII 65(23). *Prothorax* across coxæ about twice the median length of pronotum, which is equal to basal width of head; anterior marginal setæ obsolete, others blunt, inner pair near posterior angles slightly shorter than postoculars, coxal and epimeral shorter and subequal, midlateral and anterior lateral successively shorter; pronotum smooth, without median thickening; legs moderately short and stout, fore tarsi with a strong curved tooth; fore wings with about three accessory setæ. *Tube* equal to basal width of head, nearly 2.5 times as wide at base as at apex, sides thickened.

Female, forma brachyptera.—Color somewhat paler throughout than in macropterous form; eyes much smaller, about one-fifth as long as head and one-fourth as wide as their interval; ocelli wanting; head less narrowed basally.

Male (brachypterous).—Color paler than in macropterous form of female; head nearly 1.2 times as long as greatest width, much less narrowed basally; pronotum with median thickening; tarsal tooth stronger than in female.

Described from 12 females (of which 3 are macropterous) and 2 males, all taken by the author from a standing dead clump of *Panicum maximum* [Dr. Paul C. Standley, det.] at Frijoles, Canal Zone, July 3, 17, 19, and 23, 1933 [Hood Nos. 975, 995, 1006, and 1008, respectively].

The nearly black head, pale antennæ, strongly protruding eyes, and widely separated postocular bristles are distinctive.

Trichothrips orbiceps sp. nov.

Female (macropterous).—Length about 1.65 mm. Color yellowish brown; head and thorax slightly darker at sides, the former with ocellar region also darkened; subhypodermal pigmentation scattered, yellow; legs somewhat paler than body, brownish yellow in color, tibiæ and tarsi paler than femora, fore femora darkened along outer surface; antennæ with segment 1 brownish yellow, 2 yellow, 3 with pedicel yellow and shading to brown distally, 4–8 dark blackish brown; tube yellow, tipped with gray, bright orange in a narrow band near base.—*Head* scarcely 1.1 times as long as greatest width (which is just behind eyes), cheeks roundly converging to base, which is less than 0.8 the greatest width; cheeks with faint anastomosing lines which give them an indistinct serrulated appearance; postocular setæ pointed, 76 μ, their interval very slightly less than basal width of head. *Eyes* about 0.3 as long as head, two-thirds as wide as their interval, not protruding. *Ocelli* moderate in size, their diameter scarcely half the interval between the posterior pair, anterior ocellus situated between bases of antennæ and directed more upward than forward. *Antennæ* with eighth segment fusiform and very briefly pedicellate; length (and width) of antennal segments in microns, I 59(46), II 64(35), III 70(42), IV 63(42), V 55(37), VI 52(32), VII 52 (28), VIII 51(18). *Prothorax* across coxæ about 1.67 times the median length of pronotum, the latter shorter than greatest width of head and with a strong median thickening occupying 0.8 its length; epimeral seta 68 μ, coxal 50 μ, posterior marginal 86 μ, other setæ minute, all pointed; fore tibiæ with inner distal angle slightly produced to form a slender tooth; fore tarsi with a long, stout, nearly straight tooth which is much longer than width of segment 2 of antennæ. *Tube* nearly 0.6 as long as head and just twice as wide at base as at apex, sides nearly straight but not thickened.

Described from a single deälated female taken by the author at Porto Bello, Panamá, July 9, 1933, from a dead branch of a tree overhanging the Rio Cascajal [Hood No. 986].

Closely allied indeed to *T. militaris,* described below, and agreeing well with that species in general coloration, chætotaxy, and the possession of a tooth on the fore tibiæ, but differing markedly in many structural features, such as the short round head with its smaller and more widely separated eyes and smaller ocelli, the nearly complete median pronotal apodeme, the proportionately stouter intermediate antennal segments, the much shorter and stouter tube, etc.

Trichothrips militaris sp. nov.

Female (macropterous).—Length about 2 mm. Color brown, head and thorax darker, especially at sides, the former with ocellar region nearly black; subhypodermal pigmentation scattered, red; femora brown, shading to yellowish distally; all tibiæ and tarsi yellow; antennæ with segment 1 brownish yellow, 2 and proximal half of 3 yellow, remainder of antennæ dark blackish brown excepting the paler basal portion of segment 4; fore wings lightly suffused with brown, darkened with gray along edges, mottled in distal two-fifths; tube bright orange-brown, fading to yellowish distally, extreme tip gray.—*Head* nearly 1.2 times as long as greatest width (which is just behind eyes), cheeks roundly converging to base, which is about 0.8 the greatest width; cheeks and occiput sculptured with faint anastomosing lines which give the cheeks a serrulated appearance in proximal half; postocular setæ pointed, 108 μ, their interval obviously less than basal width of head. *Eyes* about 0.3 as long as head, 1.4 times as wide as their interval, not protruding, with a few enlarged lateral facets along posterior margin. *Ocelli* large, their diameter only a little less than the interval between posterior pair, anterior ocellus directed forward. *Antennæ* with eighth segment fusiform-lanceolate and very briefly pedicellate; length (and width) of antennal segments in microns, I 72(53), II 76(40), III 97(46), IV 98 (45), V 80(38), VI 73(32), VII 63(30), VIII 56(21). *Prothorax* across coxæ nearly 1.75 times the median length of pronotum, the latter slightly longer than greatest width of head and with a short median thickening mostly behind middle; epimeral and posterior marginal setæ about 112 μ, coxal only slightly shorter, other setæ minute, all pointed; fore tibiæ with inner distal angle slightly produced to form a flattened tooth with a central line of thickening; fore tarsi with a strong, nearly straight tooth nearly as long as width of segment 2 of antennæ; fore wings with about 10 accessory hairs. *Tube* about 0.8 as long as head and 2.8 times as wide at base as at apex, sides straight and distinctly thickened.

Described from 5 macropterous females taken by the author on Barro Colorado Island, Canal Zone (type locality), and at Porto Bello, Panamá, July 9–27, 1933, from dead branches [Hood Nos. 986, 987, 989, 990, and 1013].

Readily known from all American species with a pedicellate eighth antennal segment by the antennal coloration, the posteriorly narrowed head, large ocelli, reduced anterior pronotal setæ, strongly toothed tarsi, and the produced inner distal angle of the tibiæ which have suggested the specific name.

Trichothrips occipitalis sp. nov.

Female (brachypterous).—Length about 1.35 mm. Color yellow, with red subhypodermal pigmentation most abundant in prothorax; prothorax, sides of pterothorax, and abdomen shaded with gray, the last paler distally; segment 9 of abdomen darkened with brown in distal two-fifths, tube yellow, tipped with gray; head narrowly darkened at base; legs yellow, tarsal cups brown; antennæ nearly uniform yellowish gray, excepting distal portion of segment 2 and pedicel of 3, which are pale yellow.—*Head* fully 1.5 times as long as greatest width, cheeks almost straight and parallel, narrowed abruptly to the minute eyes, scarcely serrulate; occiput elevated; postocular setæ 68 μ, dilated at apex. *Eyes* only 0.15 as long as head, two facets in lateral profile. *Ocelli* wanting. *Antennæ* with eighth segment lanceolate and pedicellate; length (and width) of antennal segments in microns, I 42 (40), II 49(30), III 50(31), IV 48(32), V 49(28), VI 47(24), VII 45 (24), VIII 45(15). *Prothorax* across coxæ about 2.5 times the median length of pronotum, the latter about 0.56 the length of head and with a median thickening which is slightly more than one-third its length; all setæ present, long and knobbed, anterior marginals 60 μ, anterior laterals 62 μ, midlaterals 64 μ, epimerals 56 μ, posterior marginals 64 μ, coxals 56 μ; legs not long or enlarged, fore tibiæ and tarsi unarmed. *Tube* scarcely 0.5 as long as head and 1.5 times as long as basal width, which is fully 2.2 times the apical; sides nearly straight, not thickened.

Described from two females taken by the writer on Barro Colorado Island, Canal Zone (type locality), and at Porto Bello, Panamá, August 10 and July 9, 1933, respectively, from dead branches [Hood Nos. 1050 and 986].

Very close to the North American *T. angusticeps* Hood, but differing in the longer head, which is yellow instead of brown, and the shorter tube. In both species the head is arched and swollen in the occipital region, when seen from the side.

Trichothrips mediamericanus sp. nov.

Female (macropterous).—Length about 1.2 mm. Color yellowish brown to brown, with scattered red subhypodermal pigmentation most abundant in thorax; head and thorax usually darkened with blackish brown along sides, abdomen paler and more yellowish, tube largely yellow and tipped with gray; legs nearly concolorous with body, tarsi paler; antennæ with segments 1 and 4–8 grayish brown, 2 paler distally, 3 paler basally; wings of fore pair pale grayish brown, darker and with a post-median dark streak in basal half, paler at middle excepting for a small median dark spot.—*Head* about 1.36 times as long as greatest width (which is just behind eyes), arched and swollen in occipital region when seen from the side, cheeks abruptly narrowed to eyes and converging to base, which is nearly 0.9 the greatest width, surface nearly free of sculpturing; vertex conical, somewhat produced, with anterior ocellus at its extremity; *ocelli* nearly equidistant, interval between posterior pair very slightly more than their diameter; postocular setæ 58 μ, broadly dilated at end, their interval about 0.9 basal width of head; *eyes* less than one-fourth as long as head, anterior rather than lateral in position, slightly wider than their interval, posterior facets not enlarged; *antennæ* with eighth segment lanceolate and distinctly pedicellate; length (and width) of antennal segments in microns, I 33(32), II 42(28), III 40(27), IV 42(29), V 44(28), VI 41(23), VII 39(22), VIII 35(16). *Prothorax* across coxæ 2.5 times the median length of pronotum, the latter less than half the length of head and with a short median thickening at middle; setæ broadly dilated at end, anterior lateral 56 μ and longest, others 42–48 μ, coxal 32 μ; fore tibiæ and tarsi unarmed; fore wings with 5 or 6 accessory hairs. *Tube* less than half as long as head, nearly 1.6 times as long as basal width, and more than twice as wide at base as at apex; sides nearly straight and not thickened.

Male (macropterous).—Smaller than female (length 1.0 mm.) and more slender. Fore tarsi unarmed.

Described from a large number of specimens of both sexes, taken at Porto Bello, Panamá (type locality), on Barro Colorado Island and at Frijoles (both in the Canal Zone), in July and August, 1933, by Sabra J. Hook, Helen H. Hood, James Zetek, and the author, from dead branches of various kinds.

The color, size, long dorsally-arched head, conical vertex, knobbed setæ, and short tube make this a very distinct species. Its affinities are with *T. angusticeps* and *T. occipitalis*. It was decidedly the commonest *Trichothrips* encountered in Panamá.

Trichothrips tyrannus sp. nov.

Male (apterous, œdymerous).—Length about 1.3 mm. General color yellowish brown, darkest at sides of pro- and pterothorax and along posterior margin of the former, with scattered, bright red, hypodermal pigmentation in head, thorax, and abdomen; head yellow, darkened with brown in posterior half; antennæ yellow in segments 1 and 2, 3 yellow in basal half and shaded with brown distally, 4 brown but with yellowish pedicel, 5–8 dark blackish brown; legs brownish yellow, fore coxæ dark brown, fore femora narrowly shaded with brown along inner and outer surfaces, middle and hind femora darkly shaded with brown except at either end, their tibiæ less darkened with brown across middle; tube yellow across middle, brownish at either end.—*Head* 1.52 times as long as greatest width (across eyes), and 1.87 times as long as least width (at middle), with a large triangular tooth just behind eyes, cheeks behind tooth nearly straight and slightly diverging to base; ventral surface with a large, rounded, downwardly-projecting swelling involving the whole basal third of head (!), from the anterior surface of which arise two solid, nearly horizontal, anteriorly-diverging chitinous papillæ about 24 μ in length (!); dorsal surface with numerous delicate anastomosing lines of sculpture and a few minute scattered pale setæ; postoculars 56 μ in length, slightly dilated apically, arising in narrowest part of head, and as far apart as outer margins of antennary fossæ; *eyes* minute, only slightly longer than width of first antennal segment but strongly protruding, hardly one-fifth as wide as their interval; *mouth-cone* short and broadly rounded; *antennæ* with eighth segment fusiform-lanceolate and briefly pedicellate; length (and width) of antennal segments in microns, I 58(43), II 60(34), III 56(33), IV 53(34), V 49(32), VI 44(28), VII 40(26), VIII 44(17)—segment I being particularly long and broad. *Prothorax* very large and heavy, nearly 1.4 times as broad as long and fully 1.27 times as long as head, with prominent median thickening; dorsal surface nearly smooth at middle, margins with numerous, close, delicate, anastomosing lines of sculpture; anterior marginal setæ obsolete, anterior laterals small, all others (including coxals) dilated apically and 46 μ in length; fore femora enormous, extending forward to apex of first antennal segment, as broad as head across eyes, with two subapical teeth, of which the upper is much the larger and situated more proximad; fore tibiæ much less than half as long as their femora, with a prominent tooth at proximal two-fifths; fore tarsi with a slightly-curved tooth which is equal in length to the first antennal segment; mesothorax with anterior angles prolonged laterally, sides converging posteriorly, its greatest width only 0.82 that of prothorax across coxæ. *Abdomen* small, narrower than prothorax, tapering to tube, the last about 0.36 as long as head.

Described from a unique male taken by the author from a dead branch at Porto Bello, Panamá, July 10, 1933 [Hood No. 989].

This is a remarkable *Trichothrips*. The female, when discovered, will prove to be an ordinary-looking member of the genus, with a yellow tube and greatly resembling *T. flavicauda* Morgan, differing from it most conspicuously in possessing dilated instead of pointed, postocular and major prothoracic setæ. The cephalic structures described above will not be found even in the gynecoid male.

Eurythrips hookæ sp. nov.

Female (macropterous.)—Length 1.46 mm. (distended, 1.86 mm.). Color dark brown, with pterothorax, base of head, and intermediate abdominal segments paler, 4 and 5 brownish yellow but darker medianly, tube yellow in distal two-thirds, tipped with gray, darkening to brownish orange at base; subhypodermal and ocellar pigment transparent, bright red; legs brown, about concolorous with body, knees paler, tarsi, trochanters, bases of middle and hind femora, and distal ends of middle and hind tibiæ, yellowish; wings suffused with brown, with margins, tip, and middle line in distal two-thirds, somewhat darkened with gray; antennæ nearly uniform dark blackish brown, with base of segment 1 and apex of 2 yellowish, and pedicel of 3 yellow.—*Head* fully 1.2 times as long as greatest width, which is at anterior third of cheeks, the latter straight posteriorly and converging to base, where the head is 0.92 the greatest width; head sharply but slightly constricted at posterior margin of eyes, at this point just narrower than at base, width across eyes about 0.96 the greatest width; *eyes* about 0.32 as long as head and 0.77 as wide as their interval; median ocellus overhanging at the tip of the rounded and darkly reticulated vertex, posterior ocelli nearly five-sixths as wide as their interval; postocular setæ 84 μ, slightly dilated and divided at tip; postocellar setæ small; *antennal segments* 3 and 4 each with one sense-cone on inner surface and two on outer, 5 and 6 with one major sense-cone only on each surface, segment 8 lanceolate, pedicellate; length (and width) of antennal segments in microns, I 44(41), II 60(33), III 78(33), IV 73(32), V 70(30), VI 64(26), VII 48(24), VIII 47(16). *Prothorax* across coxæ slightly more than twice as wide as median length of pronotum, the latter two-thirds as long as head, with a short median thickening, with a few dark anastomosing lines along posterior margin, and fused with inner edge of epimera; anterior marginal setæ minute, the others long and yellowish, anterior laterals 72 μ, the others 92–102 μ, all a little dilated apically, coxals 48 μ and similarly dilated; pterothorax distinctly wider than prothorax; fore tarsus with a short but strong tooth near middle; fore wings without accessory setæ, the three subbasal setæ long and with dilated apices. *Abdomen* 1.25 times as wide as prothorax; tube nearly 0.8 as long as head and fully twice as long as subbasal width, this about twice the apical width, sides straight; major setæ on tergum 9 surpassing tip of tube, terminal setæ 0.8 as long as tube.

Described from one female taken under dead grass and leaves, Barro Colorado Island, Canal Zone, June 26, 1933, by Sabra J. Hook [Hood No. 952].

From the other species of *Eurythrips* with dilated setæ, this may most readily be known by the distinctive coloration, the nearly parallel cheeks, the length of the tube, and the much longer intermediate antennal segments. It is named after its discoverer, Professor Sabra J. Hook, who has collected many new and interesting Panamanian Thysanoptera.

Eurythrips umbrisetis sp. nov.

Female (brachypterous).—Length about 1.4 mm. (distended, 1.73 mm.). Color of head bright yellow, shaded with brown at sides; thorax yellowish brown, the pterothorax darker and concolorous with base of abdomen, the latter shading to nearly blackish brown in last four or five segments, tube paler apically and more narrowly so at base; legs yellow, the fore pair brightest, the middle and hind pairs lightly shaded with brown in femora and tibiæ; antennæ with segments 1 and 2 light brown, excepting whitish base of 1 and apex of 2, segments 3–8 blackish brown save only the yellowish pedicel of 3.—*Head* about 1.16 times as long as greatest width, which is at basal third of cheeks, the latter nearly evenly rounded to eyes and very slightly converging in basal third, with a slightly wider basal collar; head sharply constricted at posterior margin of eyes, at this point narrowest and about 0.82 the least subbasal width, the width across eyes about 0.87 the greatest width; *eyes* about one-fourth as long as head, their width about three-fourths their interval and only a trifle less than their length; posterior ocelli wanting, median ocellus overhanging at the tip of the rounded and somewhat produced vertex; postocular setæ 60 μ, brown in color, much darker than head, and dilated at tip; postocellar setæ small; *antennal segments* 3 and 4 each with one sense-cone on inner surface and two on outer, 5 and 6 each with one major sense-cone only on each surface, segment 8 fusiform, about equal in length to 7, its pedicel very short, narrow, and much broadened at base; length (and width) of antennal segments in microns, I 41(41), II 54(35), III 68(32), IV 61(31), V 60(27), VI 54(26), VII 49(22), VIII 49(14). *Prothorax* across coxæ just twice as wide as median length of pronotum, the latter about 0.86 as long as head, with vestigial median thickening, with a few very faint anastomosing lines along posterior margin, and fused with inner edges of epimera; anterior marginal setæ minute, the others long, dark brown, and dilated at apex, the anterior laterals 64 μ, midlaterals 70 μ, epimerals 64 μ, posterior marginals 72 μ, coxals 40 μ; pterothorax 0.9 as wide as prothorax; fore tarsus with a short but strong tooth at middle; wings pad-like, brown, the fore pair with three long setæ which are dilated at tip. *Abdomen* nearly 1.3 times as wide as prothorax; tube 0.7 as long as head and only 1.6 times as long as greatest subbasal width, this twice the apical width, sides very slightly concave; major setæ on tergum 9 scarcely attaining tip of tube, terminal setæ hardly 0.8 as long as tube.

Described from two females taken under dead leaves of *Panicum maximum* [Dr. Paul C. Standley, det.], at Frijoles, Canal Zone, July 18, 1933, by Helen H. Hood and Sabra J. Hook [Hood No. 1001].

This species resembles *E. ampliventralis* Hinds in having the major body setæ dilated at apex and in the possession of a tube which is about seven-tenths as long as the head. In coloration, too, these species are very much alike. But in *ampliventralis* the antennæ are yellow in the two basal segments, the postocular, prothoracic, and other major setæ are pale in color, and the last segment of the antenna is broad at its base and only seven-tenths the length of the preceding one.

Gastrothrips proteus sp. nov.

Female, forma macroptera.—Length about 1.6 mm. Color shading from light brown in head through dark brown in thorax to nearly black in abdominal segments 6–9, the tube abruptly bright reddish orange and tipped with blackish brown, the subhypodermal pigmentation carmine-red and sparse, ocellar pigmentation of same color; head at bases of antennæ nearly yellow, shaded narrowly with dark blackish brown at sides and base; antennæ yellow in segments 1 and 2, the latter slightly brownish, particularly at sides and around attachment of segment 3, this last clear yellow at extreme base, brownish yellow in about distal two-fifths, and with the intervening portion nearly blackish brown; 4 blackish brown in basal two-fifths and brown beyond, with apex and inner surface somewhat darker; 5 brown at middle, shading to blackish brown at base, apex, and sides; 6–8 nearly black; fore coxæ paler than pronotum, all trochanters yellow or nearly so, femora brown, shaded with blackish brown basally and outwardly, becoming brownish yellow distally, fore tibiæ about concolorous with head excepting their yellowish bases, middle and hind tibiæ dark blackish brown and shading to brown distally, fore tarsi yellow with brown cups, middle and hind tarsi brown; wings suffused with brownish, much darker in basal fifth.—*Head* about 1.1 times as long as greatest width across eyes (which is just appreciably greater than postocular width), cheeks nearly parallel behind eyes for about one-third their length, thence evenly and roundly converging to near base, this least width 0.84 of greatest width; vertex sloping evenly downward, not at all protruding or overhanging; surface of head smooth, save only for a few short minor wrinkles on sides behind eyes; *eyes* small, dorsally about 0.35 as long as head and about half as wide as their interval, ventrally not angulate posteriorly or prolonged; median ocellus about half the diameter of posterior ones, directed nearly upward, posterior ocelli with hind margins opposite middle of eyes and more than six times as far apart as their diameter; postocular setæ 68 μ, pointed, brown, 141 μ apart, a minute pair of setæ about half way between them and base of head, these latter setæ 90 μ apart and equal to a postocellar pair (64 μ apart) and a pair (94 μ apart) at inner anterior angles of eyes, cheeks with four pairs of stouter darker setæ arising from minute tubercles, all projecting beyond outline; *antennæ* formed as in genotype (see Proc. Ent. Soc. Washington, Vol. 14, Pl. VIII, fig 6), slightly more than twice the length of head, segment 8 not pedicellate but with sides parallel in basal half, subconical beyond, not compactly united with 7; segments 3 with one sense-cone on outer surface; 4 with one on inner, one on outer, and one on ventral surface; 5 with one on inner surface, one on outer surface, and a small one near outer surface; 6 with one on inner surface and a minute one near outer surface; 7 with one on dorsum near apex; length (and width) of antennal segments in microns, I 52(41), II 60(34), III 65(31), IV 61(32), V 62(30), VI 59(28), VII 45(23), VIII 37(12). *Prothorax* across coxæ 2.1 times the median length of pronotum, which is about 0.65 that of head; pronotum without sculpture, epimeron distinct; major setæ all present, pointed, brown, anterior marginals minute and about equal to those on cheeks, anterior laterals 20 μ, about equal to midlaterals and coxals, epimerals 64 μ, posterior marginals 52 μ; pterothorax nearly 1.2 times as wide as prothorax; wings of nearly equal width throughout, without accessory setæ, subbasal setæ short, pointed, brown; legs normal, fore tarsus unarmed. *Abdomen* large and broad, about 1.4 times as wide as prothorax, sterna longer than terga, their anterior margins arched cephalad; wing-retaining setæ minute and non-functional, other setæ long, pointed, and brown; tube about 0.88 as long as head, 2.2 times as long as subbasal width and abruptly constricted at apex, where it is about half as wide as near base, the intervening portion slightly tapering; surface of tube minutely longitudinally rugulose in basal two-fifths, irregularly roughened beyond, terminal setæ brown and more than one-third the length of tube.

Female, forma aptera.—Nearly identical with long-winged form in color and structure, save for the absence of wings; cheeks rounded to eyes as well as to base of head, head widest across middle; eyes only a trifle smaller (0.32 as long as head and 0.48 as wide as their interval), ocelli scarcely differing; epimeron and pronotum fused posteriorly.

Male (apterous).—Color as in female, excepting that the femora appear to average a little paler and the tube is less brightly reddish. *Head* usually a little broader across cheeks than across eyes, the cheeks more rounded and curving both to eyes and base of head, each with 5–9 brown setæ arising from low tubercles and forming a quite regular row on each cheek, the largest of these setæ varying in length with different individuals from 14 μ to 27 μ, and varying proportionately in diameter; postocular setæ 68 μ–108 μ; *eyes* about as in apterous female but slightly more protruding; *ocelli* often minute, the anterior one sometimes wanting. *Prothorax* with epimeron and pronotum often fused posteriorly, always without sculpture, front margin always, and median line sometimes, thickened, major setæ pointed, dark, all present, anterior laterals sometimes attaining a length of 40 μ, midlaterals infrequently 55 μ; pronotum along median line sometimes as long as head, but usually much shorter, its posterior *angles sometimes forming an irregular process 108 μ long and with an average width of about 40 μ, this process extending over the pterothorax to the base of the abdomen (!) and with five stout setæ 20–24 μ long arising from prominent radiating tubercles at its tip; sometimes this process is completely wanting, and again it is thumb-like and provided with a single (!) terminal stout seta;* mesothorax with anterior angles prolonged into a thumb-like process of varying length, longest in those individuals with the greatest prothoracic development; fore tarsus toothed, often strongly so, the tooth always curved backward, sometimes much longer than width of tarsus.

Described from 18 females (1 macropterous, 17 apterous) and 7 males (all apterous), from Barro Colorado Island (type locality) and Frijoles, both in the Canal Zone, and from Porto Bello and Old Panamá (city), Panamá, taken June 26–August 14, 1933, by Sabra J. Hook, Helen H. Hood, and the author, from dead leaves and branches.

This is evidently closely related to *G. ruficauda* Hood, the genotype, and *G. anolis* Morgan, resembling both of them closely in color and structure. The former, a species of the eastern United States, has the head wider than long, the antennæ much darker in color, and the eyes acutely angulate posteriorly and slightly prolonged on the ventral surface of the head; the latter species, known from a unique female taken in Puerto Rico, has the tube "not darkened at tip" and the intermediate antennal segments much longer and broader, the third segment measuring 81.6 μ × 32.6 μ as against 65 μ × 31 μ in the present species. The male of neither *G. ruficauda* nor *G. anolis* is known.

The male of *G. proteus* is so extremely variable in thoracic form that some question might arise whether I have not confused two or more species within my description of that sex. However, the females form a thoroughly homogeneous series, and six of the seven males were taken in company with them; furthermore, the extremes in thoracic structure are connected by a nearly continuous series of intergradations, and the other parts of the body do not differ.

Pygothrips breviceps sp. nov.

Female (macropterous).—Length about 1.7 mm. Color dark brown, shading to opaque coal-black in last five abdominal segments; legs brown, with knees, tarsi, and apices of fore and hind femora yellowish; wings light brown, darkened toward base, with a pale median streak which is margined posteriorly with darker brown; antennæ nearly yellow in segments 1 and 2, the former shaded with brown at base; 3 brown, with pedicel yellow, darkly infuscate just beyond pedicel; 4–8 nearly black.—*Head* about as wide as long, broadest just behind eyes, cheeks roundly arched to base, which is 0.8 as broad; eyes contained in length of head about 3.6 times and about three-fifths as wide as their interval; *ocelli* present; postocular setæ 88 μ, pointed; *antennæ* with segment 8 not fused with 7; length (and width) of antennal segments in microns, I 44(40), II 60(33), III 74(32), IV 58(35), V 52(31), VI 50(29), VII 48(25), VIII 30(14). *Prothorax* less than half as long as head, with thickened median line, setæ pointed. Fore wings with 0–2 accessory hairs. Fore femora short, stout; fore tarsi with a stout curved tooth. *Tube* 0.9 as long as head; basal width about 5.4 times the apical width and nearly 0.9 the length; sides nearly straight, rounded to base, apex slightly constricted; with 8 or 10 distinct setigerous tubercles visible in profile on each side.

Described from one female taken by the author on Barro Colorado Island, Canal Zone, July 30, 1933, from a dead branch [Hood No. 1024].

The short and basally narrowed head is distinctive.

Pygothrips zeteki sp. nov.

Male (brachypterous).—Length about 1.4 mm. Color blackish brown, abdomen darker beyond segment 2, shading to coal-black in distal segments and tube; legs light blackish brown, pale yellowish in trochanters, tarsi, and distal ends of all femora; antennæ nearly white in segments 1 and 2, remaining segments brown, 3–6 yellowish basally, 7 + 8 darkest.—*Head* nearly 1.2 times as long as wide, broadest just in advance of base, narrowest across eyes, cheeks nearly straight, vertex subangulate and slightly overhanging; occiput elevated and, as seen from the side, distinctly arched, its surface faintly sculptured; postocular setæ 68 μ, pointed; three pairs of small subequal setæ on dorsum, one of them at inner edge of eyes and slightly in advance of the inner posterior angle of eyes, the second pair directly between these angles, the third pair as far from each other as from postoculars and behind the line of the latter; *eyes* very small, about one-fourth the length of head and little more than 0.6 as wide as their interval, with about three posterior lateral facets larger than the others; *ocelli* wanting; mouth-cone broad, heavy, semi-circularly rounded at apex, reaching nearly across prosternum; *antennæ* 7-segmented, the suture between 7 and 8 incomplete; length (and width) of antennal segments in microns, I 46(37), II 58(36), III 64(36), IV 50(39), V 50(36), VI 50(33), VII + VIII 64(29). *Prothorax* about 2.6 times as wide across coxæ as median length of pronotum, the latter about 0.6 the length of the head; pronotum smooth, without thickened median line; epimeral and posterior marginal setæ 84 μ, others (including coxals) 30–36 μ; fore tarsi with a stout tooth. *Tube* fully 0.8 as long as head, one-tenth broader at base than long, sides rounded, each with 8 or 10 distinct setigerous tubercles; apex slightly projecting; terminal setæ 36 μ.

Described from one male taken at Juan Diaz, Panamá, August, 1933, from a branch of *Psidium guajava*, by Mr. James Zetek, after whom the species is named [Hood No. 1066].

From the other American species which have the terminal abdominal segment black, *P. zeteki* may readily be known by the exceedingly broad tube and the basally widened, instead of narrowed, head.

Lathrobiothrips gen. nov.

(λάθρη, secret or hidden; βιόω, to live; θρίψ, a wood worm—in allusion to the habit of living deeply within scolytid burrows.)

Body glabrous. *Head much longer than wide; vertex transverse, without a pair of forwardly-directed setæ;* eyes not prolonged posteriorly on dorsal surface at sides, but with about three somewhat enlarged facets in this position; mouth-cone large, heavy, and broadly rounded at apex, but scarcely attaining posterior margin of prosternum; *antennæ seven-segmented,* but with a partial suture visible on ventral surface of distal segment. Prothorax moderately large but shorter than head, with distinct median thickening; epimeron not fused with pronotum; fore legs enlarged and their *tarsi strongly toothed in both sexes.* Wings long and straight, not narrowed at middle nor broadened distally, without median vein, but with accessory hairs on posterior margin. *Tube shorter than head, heavy, thickened, longitudinally ridged, constricted at apex, and with short terminal hairs;* other abdominal setæ long, some of those on tergum 9 surpassing tip of tube.

Genotype: *Lathrobiothrips ramuli* sp. nov.

The long heavy ridged tube, broadly-rounded mouth-cone, long head, and the lack of a pair of strong forwardly-directed setæ on the vertex separate this genus readily from its allies.

Lathrobiothrips ramuli sp. nov.

Female (macropterous).—Length 2.2 mm. Brownish yellow in head, shading through yellowish brown in thorax to reddish brown or blackish brown in abdomen, head often shaded with brown posteriorly, thorax blackish brown at sides, prothorax and pterothorax paler posteriorly, abdomen paler in segment 1; tibiæ and tarsi bright yellow; femora yellowish brown, fore pair paler, all tipped with yellow; trochanters yellow; tarsal cups brown; antennæ brownish yellow in segments 1, 2, and basal half of 3, thence shading to light blackish brown in 5–7; fore wings nearly uniform light brownish yellow, hind wings with a narrow pale streak in front of middle and darker in posterior half; subhypodermal pigmentation bright red, not opaque, much broken.—*Head* about 1.36 times as long as greatest width, broadest just behind eyes, sides nearly straight and converging posteriorly to near base, this subbasal width nearly 0.9 the postocular; vertex transverse, not produced nor overhanging, with two minute setæ on either side of median ocellus; postocular setæ pointed, 116 μ, arising one-fifth the distance between eyes and base of head; surface of head shining, cheeks almost wholly free of sculpture, setæ minute and pale; *eyes* scarcely 0.3 as long as head, evenly rounded with curve of head, about 0.8 as wide as their interval, closely and finely facetted; median ocellus in the line of front margin of eyes, posterior ocelli nearly as wide as their interval; *antennæ* 1.9 times as long as head, last segment lanceolate and pedicellate, with partial transverse suture on ventral surface; length (and width) of antennal segments in microns, I 60(55), II 80(41), III 96(48), IV 96(47), V 87(40), VI 82(36), VII 92(30). *Prothorax* across coxæ about 2.2 times the median length of pronotum, the latter about 0.6 the length of head and with a short median thickening; setæ pointed, the anterior marginals (24 μ) and anterior laterals (28 μ) shorter than the others, midlaterals 54 μ, epimerals 104 μ, posterior marginals 104 μ, coxals 68 μ; fore tarsus with a stout and slightly curved tooth which is about two-thirds as long as width of tarsus; fore wings with 14–16 accessory hairs. *Tube* thickened, nearly 0.9 as long as head, about 1.85 times as long as greatest (subbasal) width, and three times as broad subbasally as at apex, the basal sixth roundly narrowed, apex constricted, intervening portion concave basally and convex apically; surface roughened with several sharp longitudinal ridges in basal third (the three or four lateral pairs of these ridges particularly sharp), minutely granulate throughout, and with a scattering of very minute set; major setæ on tergum 9 of abdomen heavy, yellow, pointed, and slightly surpassing tip of tube.

Male (macropterous).—Color and structure almost as in female; fore femora only slightly more enlarged, tarsal tooth a trifle stouter but hardly longer.

Described from 11 females and 4 males from Barro Colorado Island, Canal Zone (type locality), and Porto Bello, Panamá, taken July 30 and July 10, 1933, respectively, by the author [Hood Nos. 1024 and 987]. Most of the material was secured by cutting open twigs in which Scolytidæ had been working.

The characters given under the generic description should permit easy recognition.

Diopsothrips gen. nov.

(*δύο*, two; *'όψ*, face or eye; *θρίψ*, a wood-worm—in allusion to the two types of facets comprising the compound eyes.)

Body glabrous. Head little longer than wide; *vertex with a strong forwardly-directed seta on either side of the anterior ocellus; eyes somewhat prolonged posteriorly on dorsal surface at sides, this prolonged portion composed of about three enlarged facets whose diameter is approximately twice that of the others;* mouth-cone large, heavy, broadly rounded at apex, and nearly or quite attaining posterior margin of prosternum; *antennæ 7-segmented,* the distal segment without dividing suture. Prothorax shorter than head; pronotum with short median thickening; epimeron not fused with pronotum; fore tarsi strongly toothed in both sexes. Wings not narrowed at middle but somewhat broader distally, without median vein or accessory hairs on posterior margin. Abdominal segments transverse; *tube longer than head, heavy, thickened, longitudinally ridged, constricted at apex, and with short terminal hairs;* other abdominal setæ long, some of those on tergum 9 surpassing tip of tube.

Genotype: *Diopsothrips flavus* sp. nov.

From *Symphyothrips* Hood and Williams, the only other genus of Phlæothripidæ with a heavy ribbed tube and antennal segment 7 + 8 *entirely* devoid of a suture even on the ventral surface, *Diopsothrips* differs most markedly, perhaps, in having the mouth-cone broadly rounded rather than pointed, and in possessing a pair of strong forwardly-directed interocellar setæ.

Diopsothrips flavus sp. nov.

Female (macropterous).—Length about 1.7 mm. Color golden yellow, with tube and sides of abdominal segment 9 bright brownish orange; subhypodermal pigmentation opaque pale yellow, principally in thorax and along sides of abdomen*; ocellar pigmentation reddish; anterior one-half or more of head shaded with brown, more darkly on vertex, sides and occiput yellow; pronotum, sides and a broad band across middle of pterothorax, lateral thirds of first and second abdominal terga, and a small median spot on each of terga 3–5 (or 3–6), grayish brown; antennæ yellow in segments 1 and 2 and basal three-fifths of 3, thence nearly uniform blackish brown but paler in distal two-fifths of segment 3 and sometimes in segment 4; wings suffused with gray-brown, with a paler median streak which is bordered posteriorly with darker; legs uniform pale yellow save for the brown tarsal cups.—*Head* a trifle longer than wide, broadest at or near middle, sides evenly curved to eyes and to near base, this last about 0.9 the greatest width; vertex full, rounded, not overhanging, with a pair of strong forwardly-directed setæ (36 μ) at sides of, and slightly behind, the anterior ocellus; postocular setæ pointed, 68 μ, arising at posterior edge of eyes; surface of head smooth and shining, with a few faint lines of sculpture on cheeks only; *eyes* 0.4 as long as head, equal in width to their interval, closely and finely facetted excepting for three enlarged facets on dorsal surface at sides, each of these facets with diameter twice that of ordinary ones and projecting beyond ordinary outline of eye; anterior ocellus in advance of front margin of eyes, posterior ocelli half as wide as their interval; *antennæ* stout, about 2.1 times as long as head, without vestige of suture between segments 7 and 8, the latter forming a rounded lanceolate-pedicellate mass; length (and width) of antennal segments in microns, I 44(42), II 56(34), III 64(37), IV 56(38), V 53(36), VI 46(32), VII 74(29). *Prothorax* across coxæ about 2.6 times the median length of pronotum, the latter about 0.7 the length of head and with a short median thickening; setæ pointed, the two pairs on anterior margin less than half the length of others, midlateral 68 μ, epimeral 82 μ, posterior marginal 76 μ, coxal 56 μ; fore tarsus

* Very rarely, perhaps in specimens which have remained too long in the preservative before being mounted, this pigmentation is scarcely visible by reflected light, while by transmitted light it is reddish rather than opaque black.

with a short stout triangular tooth; fore wings without accessory hairs. *Tube* about 1.25 times as long as head, more than twice as long as greatest (subbasal) width, and fully 3.4 times as broad at base as at apex, sides nearly straight, narrowed slightly at base, constricted at apex, surface roughened with several longitudinal ridges in basal three-fifths or more and with a number of delicate setæ; lateral setæ on tergum 9 of abdomen heavy, yellow, pointed, and slightly surpassing tip of tube.

Male (brachypterous).—Color much as in female, but with the dark markings more or less obsolete; eye, antenna, and tube much as in female, excepting that the finely facetted portion of the eyes has been greatly reduced in size; anterior ocellus usually small, posterior ocelli lacking; prothorax and fore legs enlarged, the former with heavy median thickening, the latter with tarsal tooth straight, triangular, and two-thirds the width of tarsus; prothoracic setæ longer than in female.

Described from 27 females and 13 males from Barro Colorado Island (type locality), and Frijoles, both in the Canal Zone, taken June 30–August 10, 1933, by the author, and in October (?) by Silvestre Aviles, from dead branches and dead *Panicum maximum* [Hood Nos. 965, 1050, 1075, and 1076].

The pale color and darker markings distinguish this species readily from the following one, which is the only other known member of the genus.

Diopsothrips brunneus sp. nov.

Female (macropterous).—Length nearly 2.00 mm. Color nearly uniform rich brown, slightly paler in basal abdominal segments, with tube orange brown and lightly tipped with blackish; subhypodermal pigmentation yellow, opaque by transmitted light, scattered in thorax and along sides of abdomen, with a small amount behind ocelli; ocellar pigmentation red; front and sides of head shaded with blackish brown; legs bright brownish yellow, excepting coxæ, which are brown, the brown shading along outer surfaces of all femora, and the brown tarsal cups; antennæ yellow in segments 2 and 3 and in basal portion of 4, segment 1 and distal portion of 4 gray-brown with a yellowish cast, 5 brown but darker at sides and distally, 6–7 blackish brown; wings suffused with gray-brown, fore pair in middle fifth with a paler median streak bordered posteriorly with darker, the distal two-fifths of wing uniform in color and darkest, the hind wings with the median pale streak extending through most of wing and bordered on either side in distal three-fifths with a darker streak of about equal width.—*Head* a trifle longer than wide, broadest behind middle, sides gradually curved to eyes and slightly more abruptly to near base, this last about 0.9 the greatest width; vertex full, rounded, slightly overhanging, with a pair of strong forwardly-directed setæ (46 μ) at sides of and slightly behind, the anterior ocellus; postocular setæ pointed, 100 μ, arising at posterior edge of eyes; surface of head shining, cheeks with a few distinct transverse anastomosing lines and about four pairs of distinct setæ; *eyes* scarcely 0.4 as long as head, two-thirds as wide as their interval, closely and finely facetted excepting for three enlarged facets on dorsal surface at sides, each of these facets with diameter twice that of ordinary ones and projecting beyond ordinary outline of eye; anterior ocellus in advance of front margin of eyes, posterior ocelli hardly half as wide as their interval; *antennæ* stout, about 2.22 times as long as head, without vestige of suture between segments 7 and 8, the latter forming a rounded lanceolate-pedicellate mass; length (and width) of antennal segments in microns, I 56(48), II 64(39), III 78(42), IV 76(43), V 64(39), VI 55(35), VII 85(31). *Prothorax* across coxæ about 2.1 times the median length of pronotum, the latter about 0.76 the length of head and with a short median thickening; setæ scarcely pointed, the two pairs on anterior margin less than half the length of others, midlateral 84 μ, epimeral 120 μ, posterior marginal 108 μ, coxal 56 μ; fore tarsus with a stout triangular tooth; fore wings without accessory hairs. *Tube* about 1.33 times as long as head, 2.17 times as long as greatest (subbasal) width, and nearly 3.5 times as broad at base as at apex, sides nearly straight, narrowed very slightly at base, rather sharply constricted at extreme apex, surface roughened with several longitudinal ridges in basal three-fifths or more, and with a number of delicate setæ; lateral setæ on tergum 9 of abdomen heavy, orange-yellow, pointed, and slightly surpassing tip of tube.

Described from 6 females taken by Silvestre Aviles and the writer from dead branches, Barro Colorado Island, Canal Zone, August 10 and October (?), 1933 [Hood Nos. 1050, 1075, and 1076].

The larger size, very different and darker coloration, and numerous differences in proportions throughout the body allow this species to be distinguished readily from the genotype, with which it is closely allied.

Sophiothrips gen. nov.

(*σοφία*, knowledge; *θρίψ*, a wood worm—in allusion to the specialized, long sense-cones on the antennæ.)

Body either glabrous or sculptured with anastomosing lines. *Head wider than long; vertex rounded, with a pair of strong, forwardly-directed setæ;* eyes not prolonged posteriorly on dorsal surface at sides, without markedly enlarged facets; mouth-cone rounded at apex, extending well beyond middle of prosternum; *antennæ eight-segmented, but with 8 conical and united with 7 to form a lanceolate pedicellate mass, the separating suture distinct; segments 3–6 each with a pair of sense-cones arising dorso-laterally near apex (one on each side) and curving downward and forward, in macrop-*

terous forms unusually long—longer than the segments from which they arise —and curving beneath the segment in front. Prothorax large, about equal in length to head, and (inclusive of coxæ) trapezoidal in form, without median thickening; epimeron not fused with pronotum; fore legs short, enlarged in brachypterous forms, *tarsi strongly toothed in both sexes.* Wings straight, slightly widened beyond middle, without median vein, and without accessory hairs on posterior margin. *Abdomen with sterna 3–8 medially longer than terga,* the anterior margins of sterna 3–5, at least, curved forward beyond anterior margins of terga; *tube longer than head, heavy, thickened, longitudinally ridged, constricted at apex,* and with short terminal hairs; other abdominal setæ long, some of those on tergum 9 nearly attaining tip of tube.

Genotype: *Sophiothrips squamosus* sp. nov.

A striking genus and one readily separable from its heavy-tubed allies by the massive trapezoidal prothorax, the peculiar form of the abdominal sterna, and in long-winged forms, by the particularly long sense-cones disposed in pairs on the four intermediate antennal segments.

Sophiothrips squamosus sp. nov.

Female, forma macroptera.—Length about 1.2 mm. Color yellowish brown, shading to nearly clear yellow in abdominal segments 5 and 6 (sometimes 3–6) and 9 and 10 (the last often largely reddish, especially at sides), 8 always dark brown, 7 paler brown, thorax and basal abdominal segments darker at sides; legs roughly concolorous with body, mottled, the trochanters clear pale yellow, the femora briefly pale yellow at base and at apex (hind femora more broadly so), the tibiæ pale at extreme base, thence blackish or grayish brown, shading to yellowish tarsi on fore legs and to brownish tarsi on others; fore wings lightly suffused with brown, darker in basal third (especially in scale and along fore and hind margins), paler just beyond, distal half dark; hind wings with a pale median streak which is bordered with darker, especially along its posterior side in distal half of wing; antennæ with segments 1 and 2 nearly clear yellow save only the abruptly darkened blackish brown pedicel of 2; 3 clear yellow in basal portion of pedicel, thence blackish brown to near middle, distal half yellow or brown and with a transverse cloud; 4 and 5 with a dark transverse cloud at middle which sometimes expands to involve most of segment; 6 with at least the pedicel pale yellow, sometimes the basal two-fifths yellow, remainder and segments 7 and 8 always blackish brown; subhypodermal pigmentation yellow by reflected light, dull grayish yellow by transmitted light because of its partial opacity; ocellar pigmentation red.—Dorsal surface of head, prothorax, metathorax, and fore femora *usually* covered with raised rounded areas which are conspicuous and scale-like in appearance. *Head* about 0.8 as long as greatest width, incised at posterior edge of eyes to form a tooth just behind eyes, cheeks concavely converging to base, vertex evenly rounded, anterior ocellus slightly overhanging, interocellar setæ 20 μ in length, directed forward and outward; dorsum only of head with a deep transverse occipital groove which is nearly half as wide as the distance from eye to base of head and nearly free of sculpture except at median line; postocular setæ minute (10 μ), exceeded in length by a stouter seta (20 μ) arising from the genal tooth; *eyes* about one-half as long as head, three-fourths as wide as their interval, evenly rounded and finely facetted; median ocellus slightly in advance of the line of front margin of eyes, posterior ocelli two-thirds as wide as their interval; antennæ about 2.7 times as long as head, sense-cones longer than segments from which they arise; length (and width) of antennal segments in microns, I 32(36), II 44(33), III 54(31), IV 45(32), V 50(31), VI 53(31), VII 34(22), VIII 25(15). *Prothorax* across coxæ about 2.3 times the median length of pronotum, the latter subequal in length to head; setæ pointed, short, the anterior marginals 8 μ, anterior laterals and midlaterals 14 μ, posterior marginals 18 μ, epimerals 40 μ, coxals 17 μ; fore tarsus with a strong slightly curved tooth which is nearly as long as width of tarsus; fore wings without accessory hairs. *Tube* thickened, 1.3 times as long as head and twice as long as basal width, which is about three times the distal, sides nearly straight to the distal constriction; surface roughened with several sharp longitudinal ridges in basal half and with a few minute scattered setæ; terminal setæ less than half the length of tube; major setæ on tergum 9 of abdomen yellow, pointed, not attaining tip of tube, the dorsal pair about three-fourths as long as tube.

Female, forma brachyptera.—Much like preceding form in color and general structure, but usually distinctly œdymerous and male-like in appearance; eyes reduced in size, ocelli nearly or quite wanting, genal tooth usually more prominent; sense-cones shorter; pronotum usually fully 1.5 times as long as head.

Male, forma macroptera.—Not differing markedly from the female of the same form excepting in the somewhat smaller size and the slightly enlarged prothorax, fore legs, and tarsal tooth; pronotum 1.2 times as long as head.

Male, forma brachyptera.—Very similar to female of same form, but with pronotum 1.6 times the length of head.

Described from 10 females (3 macropterous) and 10 males (2 macropterous), all taken under bark on dead branches, at Porto Bello, Panamá (type locality), July 8, 9, and 10, 1933 [Hood Nos. 984 and 987–989], and on Barro Colorado Island, Canal Zone, July 27 and August 6, 1933 [Hood Nos. 1013 and 1039].

The series of specimens before me is tolerably constant in color, whatever difference that exists being due largely, if not enclusively to differences in the ages of the specimens; but in structure they would be a boon indeed to those systematists who must designate every minor genetical variation by a name of some sort. Though the specific name itself means "covered with scales," this is not by any means a constant criterion for separation from the species described immediately below; it is simply a striking character possessed by the great majority of individuals of both sexes, and one which I have never previously seen in a member of the Order Thysanoptera. Several of my specimens have smooth legs, while others have in addition the whole pronotum perfectly smooth save only for a few dark anastomozing lines along the posterior margin. The tooth behind the eyes is likewise extremely variable in size and form, ranging from a mere rounded projection to a dorso-ventrally flattened acute tooth of large size. One species only is represented by these numerous departures from the mean structural condition.

The occipital groove is a prominent feature, but without careful focusing will not be noted excepting in lateral aspect.

Sophiothrips panamensis sp. nov.

Female, forma macroptera.—Length about 1.2 mm. Color nearly uniform brown, somewhat darker in abdominal segments 7 and 8, 9 paler posteriorly (especially medially), tube bright yellow, tinged with red at sides and tipped with black; legs slightly paler than body, with trochanters, tarsi, and ends of all femora and tibiæ pale yellowish, the fore and hind femora more broadly so, tarsal cups brown; wings of fore pair lightly and nearly uniformly suffused with brownish; hind wings with a pale median streak which is bordered with darker, especially along its posterior side in distal half of wing; antennæ with segments 1 and 2 and basal half of 3 pale yellowish gray, 1 lighter at apex, 3 lightly clouded with brown in apical half, 4–6 yellowish in basal third or more, shading to brown at middle, and perceptibly paler beyond, 7 + 8 brown, with paler pedicel; subhypodermal pigmentation opaque yellow and hence black by transmitted light; ocellar pigmentation dark red.—Dorsal surface of body almost wholly free of sculpture. *Head* about 0.9 as long as greatest width; cheeks almost perfectly straight and parallel excepting for a very short but abrupt curving to eyes; vertex evenly rounded, anterior ocellus not overhanging, interocellar setæ about 24 μ in length and directed forward and outward; dorsum of head without trace of a transverse occipital groove, virtually free of sculpture save for an arched transverse line near base; postocular setæ minute (12 μ), exceeded in length by a seta (20 μ) in the same transverse line near sides of head; *eyes* about 0.55 as long as head, three-fourths as wide as their interval, evenly rounded and finely facetted; median ocellus slightly in advance of the line of front margin of eyes, posterior ocelli about two-thirds as wide as their interval; *antennæ* about 2.8 times as long as head, sense-cones longer than the segments from which they arise; length (and width) of antennal segments in microns, I 34(37), II 50(33), III 56(33), IV 52 (32), V 58(32), VI 67(31), VII 44(21), VIII 27(14). *Prothorax* across coxæ about 2.2 times the median length of pronotum, the latter subequal in length to head; setæ pointed, the anterior marginals 12 μ, anterior laterals of about the same length, midlaterals 22 μ, posterior marginals 52 μ, epimerals 74 μ, coxals 56 μ; fore tarsus with a strong slightly curved tooth which is a little longer than half the width of tarsus; fore wings without accessory hairs. *Tube* thickened, about one and one-fourth times as long as head and slightly more than twice as long as basal width, which is about 2.5 times the distal, sides nearly straight to the distal constriction; surface roughened with several sharp longitudinal ridges in basal half and with a few minute scattered setæ; terminal setæ nearly equal to tube in length; major setæ on tergum 9 of abdomen yellow, pointed, nearly or quite attaining tip of tube, the dorsal pair just shorter than tube.

Female, forma brachyptera.—Much like the preceding form in color and general structure, but distinctly œdymerous and male-like in appearance; eyes smaller in size, anterior ocellus and vestiges of posterior ocelli present; sense-cones much shorter; pronotum nearly 1.2 times as long as head.

Described from three females, of which two are macropterous and one brachypterous, taken by the author at Porto Bello, Panamá, July 10, 1933, under bark on dead branches [Hood No. 989].

The color and the absence of an occipital groove will distinguish it from its congener.

Hoplandrothrips nigricestus sp. nov.

Female (macropterous).—Length about 1.25 mm. (distended, 2.0 mm.). Color bright yellow, with head, prothorax, anterior half or third of mesothorax, abdominal segment 1 at sides, and all of 8–10, dark brown or blackish brown, 8 paler than the darker portions of 9 and 10, the last paler in distal half and narrowly so at base; abdominal segments 3–7 each with a transverse median brown dash involving the basal transverse line; prothorax, darkened portion of mesothorax, abdominal segments 1, 2, 8 and 9, and a small lateral area in 5 and 6 with conspicuous bright red subhypodermal pigmentation; ocellar pigmentation bright red; antennæ with segments 1 and 2 brown, the former paler at base, the latter at apex, 3 and basal third of 4 clear pale yellow, 5 in basal fourth and 6 in pedicel yellowish, remainder of antenna dark gray-brown excepting often the paler apical portion of 4; legs light yellow, with tarsal cups, fore coxæ, basal portion of fore femora, and all of hind femora excepting extreme tip, dark brown, the middle legs with femora only slightly darker than tibiæ; wings of fore pair gray, paler in basal fourth and beyond middle, with a dark line or two in intervening portion.—*Head* about 1.18 times as long as wide, broadest at middle, cheeks rounded, more abruptly so to eyes than to base, the latter less than 0.9 the greatest width, without neck-like constriction, slightly narrower than width across eyes; vertex conical, slightly projecting and overhanging, with the anterior ocellus at its extremity; occiput, cheeks, vertex, and a narrow margin around eyes distinctly reticulate, the lines of reticulation giving the cheeks a distinctly serrulated appearance, the reticles on vertex and around eyes most distinct; postocular setæ more than 0.8 as long as eyes, dilated apically, their interval about 2.4 that of eyes, other setæ minute and pale; *eyes* nearly 0.37 as long as head, equal in width to their interval; posterior ocelli with hind margins a trifle less than half the diameter of ocellus in advance of middle of eyes, equal in diameter to their interval, the latter distance greater than that to anterior ocellus; *antennæ* long, about 1.95 times the length of head, slender, segment III distinctly sinuate on outer surface, pedicel curved outward at base, III with sense-cones on inner (outer) surface 1(2), IV 2(2), V $1(1^{+1})$, VI $1(1^{+1})$, VII with the usual one on dorsum near apex; length (and width) of antennal segments in microns, I 36(36), II 48(31), III 65(30), IV 58(29), V 56(26), VI 54(22), VII 48 (20), VIII 41(12). *Mouth-cone* rounded apically, nearly attaining posterior margin of prosternum, labrum slightly surpassing labium. *Prothorax* about 2.5 times as broad across coxæ as median length of pronotum, which is 0.5 that of head; pronotum with a few anastomosing lines in posterior fourth, remainder nearly smooth; all usual setæ present, heavy, dilated at apex, brown in color, anterior marginals 52 μ, anterior laterals 52 μ, midlaterals 56 μ, epimerals 68 μ, posterior marginals 62 μ, coxals 50 μ; pterothorax about equal in width to prothorax; wings of fore pair with about 7 accessory hairs, subbasal setæ dilated apically, the distal one (84 μ) less widely than the others; legs of normal form, fore tarsi with a slight downwardly-directed tooth. *Abdomen* little broader than pterothorax; tube about 0.57 as long as head, 1.9 times as long as greatest subbasal width (which latter is just twice the apical width), sides straight; lateral abdominal setæ yellowish, mostly dilated at apex, those on segment 9 all pointed, terminal setæ equal in length to tube.

Male (macropterous).—Color and structure essentially like that of female; head longer, about 1.24 times as long as greatest width; anterior lateral pronotal setæ longer, 60 μ; antennal segments slightly longer.

Described from 16 females and 7 males taken by the author from dead leaves on Barro Colorado Island, Canal Zone, and at Porto Bello, Panamá, June 28–August 4, 1933 [Hood Nos. 961, 976, 978, 989, 1013, and 1032].

The pale coloration and the basal abdominal dark band which has suggested the specific name are thoroughly distinctive.

Strepterothrips gen. nov.

(*στρέφω*, to turn aside; *πτερὸν*, wing; *θρίψ*, a wood worm—in allusion to the unusual form of the fore wings: a contraction, for euphony.)

Body reticulate and tuberculate dorsally, not shining. Head much longer than wide, very deeply reticulated above, *dorsum arched* as seen from the side, with *two diverging dilated setæ on vertex* above antennæ, postoculars and a pair behind them short and similarly dilated; *antennæ 7-segmented,* no trace of suture between morphological seventh and eighth segments; eyes small, extending onto ventral surface *in a forward direction,* not at all involving sides of head; mouth-cone subacute, about attaining base of prosternum. Prothorax much shorter than head, both it and pterothorax tuberculate in the same general manner as in the Urothripidæ, many of the tubercles setigerous, all major setæ present, short, stout, and much expanded distally; legs tuberculate, short; female with fore tarsus unarmed; male with a tooth on inner surface of femur and a strong curved tarsal tooth (probably a modified claw) arising from ventral distal surface of first segment; wings, when present, *abruptly bent outward before middle, narrowed beyond,* basal portion tuberculate, no accessory setæ. Abdomen tuberculate, with basal segments transverse (in the genotype more than four times as wide as long), setæ short and mostly strongly dilated at apex; *tube long and slender,* with relatively short terminal hairs.

Genotype: *Strepterothrips conradi* sp. nov.

The form of the wings, roughened dorsal surface and long tube ally this genus with *Stictothrips* Hood and *Idiothrips* Faure, from both of which it differs in the long arched reticulated head with the two stout setæ on the vertex; and from *Stictothrips* it differs, too, in having the antennæ seven-segmented instead of eight. The short legs and roughened dorsum are strongly suggestive of the Urothripidæ; but this is merely an interesting example of convergent evolution.

Strepterothrips conradi sp. nov.

Female, forma macroptera.—Length about 1.34 mm. (distended specimens about 1.66 mm.). Color dark brown, with front and sides of head and sides of prothorax darker, and a U-shaped area around notum of pterothorax lighter and underlain with a white pigment (producing white markings visible only by reflected light) which occurs also beneath the membrane between head and prothorax and along sides of abdomen; thorax and abdomen also with scattered red hypodermal pigmentation; antennæ with segment 1 brownish yellow, 2 clear lemon yellow, 3 with pedicel yellow and shading through brown at middle to blackish brown at apex, remainder of antenna nearly black; legs about concolorous with body, with bases of all femora, apex of fore femora, both ends of all tibiæ, and all tarsi yellow; wings pale brown, lighter in basal portion and narrowly so at middle, darker at tip; tube dark blackish brown, paler at base and in apical fourth.—*Head* about 1.37 times as long as wide, dorsum arched as seen from the side, cheeks straight and very slightly converging to a subbasal constriction, across which it is fully 0.9 the greatest width; vertex rounded, overhanging, tuberculate, and with a pair of stout expanded setæ 28 μ long arising from a pair of tubercles which flank the forwardly-directed median ocellus; dorsum of head very deeply reticulate on either side of median line excepting at base of head, the lines of reticulation becoming tuberculate on cheeks and giving the latter a serrate appearance, some of these tubercles with minute pale setæ, the median line itself with a narrow and minutely tuberculate strip extending from vertex to near base and bordered on either side with a regular row of about 11 setigerous tubercles; postocular setæ and a pair situated 45 μ behind them similar in form to the pair on vertex and like them arising from tubercles, but measuring only 20 μ, the interval between postoculars 92 μ, between following pair 68 μ; *eyes* small, about 0.21 as long as head and less than 0.6 as wide as their interval, composed of relatively few facets which are more or less separated from one another and of which about two at posterior lateral margin are distinctly larger; eyes larger on ventral surface, extending farther posteriorly and closer toward median line; ocelli of posterior pair with their hind margins about opposite center of eyes, their greatest diameter scarcely one-third their interval; *antennæ* particularly short, only 1.2 times as long as head, with segment 3 small and weak, and segment 7 lanceolate and pedicellate, the intervening segments subglobose, pedicellate, and with prominent encircling lines of sculpture; length (and width) of antennal segments in microns, I 36(26), II 49(31), III 34(26), IV 37(30), V 39(28), VI 38(25), VII 56(21). *Prothorax* across coxæ about 2.4 times as broad as median length of pronotum, which is about 0.55 that of head; pronotum with two large shallow foveæ on each side, the posterior pair connected by a shallow transverse groove and bounded externally by a sharp overhanging ridge, the whole surface of pronotum tuberculate, many of the tubercles setigerous, most of them connected by low rugæ; the usual major setæ (including coxals) similar to postoculars and, excepting the 30 μ-long epimerals, equal in length to them, all arising from tubercles; pterothorax slightly wider than prothorax; wings broad in proximal third and curving posteriorly, then recurving and continuing in the original direction, this distal portion of wing somewhat more than half the total length of wing and very slightly widening to apex; proximal portion of wing tuberculate in anterior portion and with three widely separated setæ which are similar to postoculars, equal to them in length, and which arise from tubercles; recurved portion of wing with a median vein-like strengthening and transversely striate along both margins; distal portion of wing roughened but scarcely reticulate; no accessory setæ; legs tuberculate, the middle and hind femora with transverse lines on inner surface; fore tarsus unarmed. *Abdomen* hardly as broad as pterothorax, with a longitudinal furrow for the reception of the wings, the wing-retaining setæ dark and prominent, the three major setæ on posterior margins of terga nearly colorless, arising from tubercles, dilated and fringed at apex, the innermost pair 48–56 μ; median groove and terga 8 and 9 with weak reticulation which becomes asperate at sides of these terga, the asperæ becoming tubercles on the basal terga where the reticulation is absent; tube long, and slender, 0.87 the length of head and 6.3(!) times as long as greatest subbasal width, which is only 1.27 times the apical width, sides subparallel in basal three-fifths (excepting a slightly widened and cross-striated portion at extreme base), tapering roundly to apex in distal two-fifths, longest terminal setæ 136 μ.

Female, forma brachyptera.—Very similar to the macropterous form, excepting as follows: *Head* almost exactly rectangular, with vertex truncate rather than rounded and anterior lateral angles more prominent because of the smaller eyes, which are dorsally about one-sixth the length of head and but little more than one-half their interval, and very much shorter and narrower on ventral surface; ocelli wanting. *Pterothorax* with notal plates less differentiated; mesothorax transparent in region of wing bases and metanotum transparent along sides and posterior margin, thus allowing the white subhypodermal pigmentation to show through prominently; wings present as short pads, the fore pair rounded, thick, tuberculate, with two dilated setæ and a finger-like process extending downward from the posterior distal portion. *Abdomen* with median dorsal groove and wing-retaining setæ absent, the median portion of terga tuberculate like lateral portions, some of the tubercles extending as short teeth beyond their posterior margins.

Female, forma aptera.—Very similar to the macropterous and brachypterous forms: *Head* almost as in the latter, but with the eyes much more reduced on the dorsal surface and consisting of about six facets only, entirely wanting from the ventral surface. *Pterothorax* with notal plates still less differentiated, widened as though by fusion with the wing-pads of the preceding form, the mesonotum with a lateral expanded seta such as occurs on the fore-wing pad of the brachypterous form! Coloration as in that form, except that the widening of the dark mesonotum prevents the white subhypodermal pigmentation from showing through along its lateral margins, the white blotch being thus confined to the sides and posterior margin of the metanotum. *Abdomen* as in brachypterous form.

Male (apterous).—Length about 1.14 mm. (distended specimens 1.32 mm.). Color about as in female but paler.—*Head* relatively longer and more slender, about 1.65 times as long as wide; prothorax nearly 2.5 times as broad across coxæ as median length of pronotum, which is about 0.54 that of head; pronotum with a single fovea on each side, connected by a shallow groove; pterothorax much narrower than prothorax and subequal in width to abdomen; fore femora often longer than head, usually about two-thirds as wide as head, with either a tubercle (often very small) or tooth (frequently long and acute) on lower inner surface beyond middle; fore tibiæ with a small, often flattened, bidentate process arising from inner surface at apex; fore tarsi usually with a prominent hooked tooth (probably morphologically a claw) arising from ventral inner end of first tarsal segment, this tooth nearly as long as width of tarsus and with three long hairs converging accurately to its tip.

Described from 52 females and 15 males, all from Barro Colorado Island, Canal Zone, and all taken from dead branches of various species of trees and vines, July 29–August 14, and October (?), 1933, by James Zetek, Silvestre Aviles, and the author.

It will be noted that this striking new genus and species was taken by Mr. James Zetek and myself. Both of us received an early and lasting stimulus in biological work from Professor Abram H. Conrad, Head of the Department of Biology of the Crane Technical High School of Chicago. In naming this species after him, with the endorsement if not at the suggestion of Mr. Zetek, I am expressing a deep and permanent obligation which both of us have felt for a score or more of years.

Sedulothrips tristis sp. nov.

Female (macropterous).—Length about 3.1 mm. (distended, 3.6 mm.). Color of body and legs nearly uniform dark blackish brown, *without white markings when observed by reflected light,* subhypodermal pigmentation bright red; antennæ concolorous with legs in segments 1 and 4–8, segments 2 and 3 brownish yellow excepting extreme base of 2 and distal third of 3. —Head nearly twice as long as greatest width, distinctly wider across middle of cheeks than across eyes; eyes nearly touching posteriorly on dorsal mid-line, the interval about equal to the diameter of the posterior ocelli; postocular setæ less than twice as long as diameter of posterior ocelli; mouth-cone just attaining anterior margin of mesosternum; length (and width) of antennal segments in microns, III 200(50), IV 140(48), V 135 (45), VI 92(37), VII 77(29), VIII 40(18); depth of pronotal emargination only one-third the median length of pronotum; lateral setæ on segment 9 of abdomen three-fourths the length of head.

Male (macropterous).—Smaller than female, with eyes more prominent.

Described from 34 specimens, of which 10 are males, taken on Barro Colorado Island (type locality), Canal Zone, and at Porto Bello, Panamá, July 3–27 and August 10, 1933, by Miss Sabra J. Hook and the author, on dead branches of various trees.

Readily known by the complete absence of white abdominal markings.

NEW SPECIES OF SERICA (SCARABÆIDÆ), VII

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The name *alternata* has served for many years to ease the taxonomic conscience about California species of *Serica*, just as the name *vespertina* did about eastern species which could not be identified. The California species are, however, much more numerous and therefore more difficult to recognize. In many forms, individual variation in external characters exceeds specific differentiation in the genus. The writer therefore believes that the species can never be recognized from general descriptions no matter how fully and carefully they are drawn up. This view was especially forced upon him in working on the forms named in the present paper. Full descriptions were first drafted from the holotype specimens and then the paratype series checked against the descriptions. The result was chaos, and the writer feels that to publish such descriptions would be a gesture lacking in sincerity. It is hoped that the brief descriptive notes which follow may be of some value, but the real diagnoses are frankly the writer's figures of the genital armatures of the males.

Serica alternata Le Conte

Serica alternata Le Conte. Journ. Acad. Nat. Sci., Phil., 2, III, p. 276, 1856.

The writer is indebted to Dr. Nathan Banks for the privilege of studying the Le Conte material and extracting the genitalia of the males. Three specimens bear the original type number, 3219, and two appear to have been added later. Since numbers 1 and 3 are females, number 2 should be regarded as the holotype. The type locality is recorded as San Diego, California. Specimen number 4 is a female of another species, and number 5 is a male conspecific with number 2.

Male. Length 7 to 9.5 mm.; width 4 to 5 mm. Color dark chestnut; surface subshining and elytra moderately iridescent. Disk of clypeus slightly tumid in its apical third, finely and densely punctured, margins of clypeus moderately reflexed, anterior angles prominent and broadly rounded, clypeal notch obsolete; front more finely and sparsely punctured than clypeus. Measurements of head in mm.: diameter through the eyes, 2.2; distance between inner eye margins, 1.4; extreme width of anterior reflexed margin, 1.2; antennal club, 0.75; dorso-ventral diameter of eye, 0.75. Pronotum subshining, finely and closely punctate; width through posterior angles, 3.6 mm.; width through anterior angles, 2.4; median length, 2.1. Elytra with distinct, almost line-like striæ showing about three confused rows of fine punctures. Intervals only slightly convex and sparsely punctured. Alternate intervals 2, 4, 6, etc., slightly wider than the others. This character, which accounts for the name *alternata*, is not specific, but almost subgeneric.

The specimen from which the detailed measurements were taken, and from which the figures (Pl. XL) were drafted measures 8.5 mm. in length, bears the label "Carmel, Calif., VI, 23, 1933, L. S. Slevin," and is being deposited in the U. S. National Museum. Length of male genital armature 2.5 mm.

Specimens examined: 280 ♂, 94 ♀.

New Mexico: "N. Mex.," 2 ♂; Koehler, 1 ♀; Las Vegas, 2 ♀; Magdalena Mts., 1 ♀; White Mts., Rio Ruidoso, 1 ♂, 2 ♀.

Colorado: "Col.," 1 ♂; Buena Vista, 1 ♂; Durango, 1 ♂; San Miguel, 1 ♂; South Park Region, 1 ♂.

Arizona: "Ariz.," 1 ♂, 1 ♀; Ash Creek, Graham Mts., 1 ♂; Grand Canyon, 1 ♂, 1 ♀; Oak Creek Canyon, 2 ♀; Oracle, 1 ♂; Prescott, 1 ♂; Verde Valley, 1 ♀.

California: "Calif.," 5 ♂, 2 ♀; Alhambra, 3 ♂; Atwell Mill, Tulare Co., 1 ♂; Arroyo Seco Creek, Monterey Co., 1 ♂, 1 ♀; Bakersfield, 1 ♀; Carmel, 180 ♂, 18 ♀; Chittenden, 1 ♂; Claremont, 1 ♂; Colton, 1 ♂; Cuyamaca Mts., San Diego Co., 1 ♂; Garden Grove, 2 ♂, 1 ♀; Laguna Beach, 1 ♀; Los Angeles Co., 2 ♂, 6 ♀; Matilija, 1 ♀; Monterey, 7 ♂, 1 ♀; Oxnard, 7 ♂, 9 ♀; Pasadena Co., 5 ♂, 5 ♀; Pomona, 6 ♂, 3 ♀; Redondo, 2 ♂; Riverside, 2 ♂, 3 ♀; San Diego, 2 ♂, 3 ♀; Santa Ana, 2 ♂, 1 ♀; Santa Paula, 1 ♀; Saticoy, 24 ♂, 35 ♀; Whittier, 1 ♂; Yosemite Park, 1 ♀.

Utah: Cedar City, 4 ♂; Green River, 1 ♂; Orderville, 1 ♂; Parowa Canyon, 3 ♂; Schwitz Indian Reservation, 1 ♀; Zion National Park, 2 ♂.

Serica alternata exolita new subspecies.

Male. Length, 9.5 to 10.5 mm.; width, 5.5 to 6 mm. Color, brown (chestnut to bay), surface subopaque and faintly iridescent.

On the average, this form differs from typical *alternata* by its distinctly larger size, more distinct clypeal suture, finer and less dense clypeal punctuation, more broadly rounded apical angles of clypeus, and less abruptly and strongly reflexed anterior clypeal margin. The sides of the pronotum are a little less strongly arcuate and the surface somewhat less convex than in *alternata*.

The male genital armature (Pl. XLI) is relatively very thick and stocky with the left clasper abbreviated and its apex showing a distinctive emargination of varying strength.

Type: Male. Giant Forest, Tulare Co., August 8, 1903. (California Academy of Sciences.)

Paratypes: 13 ♂, 7 ♀, all from California.

"Cal.," 1 ♂; "Colony Road," 1 ♀; Cloughs Cave, Tulare Co., 1 ♂; Giant Forest, Tulare Co., 4 ♂, 5 ♀; Kaweah, Tulare Co., 1 ♂; Sequoia National Park, 1 ♂, 1 ♀; (not typical but referred here: San Diego, 2 ♂; San Joaquin Valley, 1 ♂; Laguna Mts., 1 ♂; Southern California, 1 ♂).

Serica alternata patruela new subspecies.

Male. Length, 9.5 to 10.5 mm.; width, 5 to 6 mm. Color, brown (dark chestnut to auburn), subopaque with the elytra moderately iridescent.

This form agrees with *exolita* in size but differs from it rather definitely in the form of the clypeus. The clypeal margins are less strongly reflexed than in any other form yet described from the southwest; the low angle of elevation of the anterior margin reminds one of the clypeal pattern in the Canadian species *tristis* Le Conte. The disk of the clypeus is nearly flat and breaks off rather suddenly into a strongly marked, subterminal, transverse ditch. This character varies somewhat in intensity, but when it is well marked it affords one of the most diagnostic characters available in this section of the genus.

The male genital armature (Pl. XLI) shows its most diagnostic feature in the subspatulate tip to the relatively narrow claspers.

Type: Male. Pasadena, California, July 7, 1931 (Wm. Ackerknecht) (California Academy of Sciences).

Paratypes: 28 ♂, 45 ♀, all from California.

Pasadena, 24 ♂, 43 ♀; Camp Baldy, Los Angeles Co., 2 ♀; (not quite typical but referred here: Burbank, 2 ♂; Sierra Madre, Los Angeles Co., 2 ♂).

Patruela and *exolita* are here listed as subspecies because the evidence at hand indicated inconstancy of form and intergradation with *alternata*. This is one of many cases where facts concerning the biology of the forms would throw much light upon their relationship. To secure such data it is best to point out the problem and name the forms in accordance with the present evidence. It is probable that additional varieties may be defined with profit under the name *alternata*.

Serica acontia new species.

Male. Length, 8 mm.; width, 4.6 mm. Color, brown (auburn to bay), subopaque with a trace of iridescence.

Clypeus relatively wide apically, with prominent, broadly rounded angles; middle of apical reflexed margin arched inwardly; disk with small punctures separated by one-half to two-thirds their own diameter. Clypeal suture very fine but distinct due to a slight impression or angulation between the clypeus and the front. Puncturation of the front variable, but sparser and finer than that of the clypeus. Measurements of head in mm.: diameter through the eyes, 2.06; distance between inner eye margins, 1.44; antennal club, 0.7; dorso-ventral diameter of eye, 0.6.

Pronotum finely punctured, punctures separated by one to two times their own diameter. Measurements of pronotum in mm.: width through posterior angles, 3.6; width through anterior angles, 2.2; median length, 2.06.

Elytra with the odd numbered intervals (especially 5, 7 and 9) slightly narrower than the others; striæ line-like with a confused row of fine punctures, separated by slightly more than their own diameter. Intervals flat with scattered punctures, especially near the striæ. Measurements of elytra in mm.: median length, 6.3; greatest width, 4.6.

Genital armature of male (Pl. XLII) essentially symmetrical, with javelin-like claspers,—hence the name *acontia*; length, 3.2 mm.

Female. Differs from the male in having slightly shorter antennal clubs, 0.5 mm. instead of 0.7 mm., and in having the last sternite less evidently emarginate at the middle.

Type: Male. Paradise Valley, King's River, California, July 15, 1917 (R. L. Beardsley) (California Academy of Sciences).

Paratypes: 11 ♂, 2 ♀, all from California.

Paradise Valley, 1 ♂; Fresno Co., Huckleberry Meadow, 6,500 ft., 7 ♂, 2 ♀; Sequoia National Park, 2 ♂; Tulare Co., 1 ♂.

Serica repanda new species.

Male. Length, 6.5 to 7 mm.; width, 4 mm. Color, brown (chestnut to bay), subopaque, marginal fimbriate hairs relatively sparse and inconspicuous.

Closely resembles *acontia*, but seems to differ as follows: size smaller, clypeal angles less rounded; clypeal suture less evident; front more strongly and closely punctured; pronotum narrower basally; striæ of elytra broader and deeper, making the intervals appear distinctly more convex. Measurements of head in mm.: diameter through the eyes, 1.9; distance between inner eye margins, 1.33; extreme width of anterior reflexed margin, 1.16; antennal club, 0.55; dorso-ventral diameter of eye, 0.55. Measurements of pronotum in mm.: width through posterior angles, 3.05; width through anterior angles, 1.94; median length, 1.77. Measurements of elytra in mm.: length, 5; width, 4.

Genital armature of male (Pl. XLIII) of the same general type as in *acontia* and *falcata*; length, 2.4 mm.

Type: Male. Tuolumne Co., California, Coquillett collection (U. S. National Museum).

Paratypes: 4 ♂, all from California.

Tuolumne Co., 3 ♂; Yosemite Valley, 1 ♂.

Serica falcata new species.

Male. Length, 8 mm.; width, 4.3 mm. Color, brown (amber to argus), surface opaque, elytra with a distinct, greyish bloom or pollen showing a trace of iridescence in shifting lights. External characters in general so similar to those of *acontia* that they may as well be indicated by comparison with that species. Color distinctly paler, with greyish pollen and iridescence stronger than in *acontia*. Pronotum evidently smaller and narrower behind than in *acontia*, as indicated by the following measurements: width through the posterior angles, 3.3 mm.; width through the anterior angles, 2.2 mm.; median length, 1.9 mm.

Genital armature of male (Pl. XLIV) of the same fundamental type as that of *acontia*, but differing radically in the relative proportions of the parts and showing a distinct asymmetry in the claspers; length, 2.4 mm.

Female. Differs but slightly from the male in the usual secondary sexual characters.

Type: Male. Santima Road, Cash Creek, Oregon, July 20, 1910 (J. C. Bridwell) (California Academy of Sciences).

Paratypes: 17 ♂, 7 ♀.

California: "Calif.," 1 ♂; Whitehall, Eldorado Co., 3 ♂.

Nevada: "Nev." (Horn collection), 3 ♂.

Oregon: Same data as type, 9 ♂, 7 ♀.

Washington: Wenatchee, 1 ♂.

Serica stygia new species.

Male. Length, 9.5 mm.; width, 5 mm. Color, brown (dark bay to chestnut) with a fairly strong rainbow sheen or iridescence.

This species, also, resembles *acontia* but differs by its larger size, darker color, strong iridescence, and somewhat coarser and more conspicuous fimbriate hairs of the margins and under surface; the short, sparse hairs of the lateral striæ of the elytra are also more evident, and the striæ stronger, with the intervals somewhat more convex.

Genital armature of male (Pl. XLV) with unusually angular claspers; length, 3.3 mm.

Type: Male. Camp Baldy, Los Angeles Co., California, July 28, 1920 (California Academy of Sciences).

Paratypes: 8 ♂, 6 ♀, all from California.

"Calif.," 4 ♂; Burbank, 1 ♂; Los Angeles Co., 3 ♂, 6 ♀.

Serica prava new species.

Male. Length, 8 mm.; width, 4.3 mm. Color, brown (chestnut to auburn), surface subopaque and faintly iridescent. External characters so similar to those of *acontia* that apparently the narrower and less convex pronotum is the chief feature of differential value. Measurements of pronotum in mm.: width through the posterior angles, 3.3; width through the anterior angles, 2.1; median length, 1.83.

Genital armature of male (Pl. XLVI) very distinct from, though somewhat allied to, that of *stygia*; length, 2.3 mm.

Type: Male. Los Angeles Co., California, July, Coquillett collection (U. S. National Museum).

Paratypes: 13 ♂, 11 ♀, all from California.

"Calif.," 3 ♂; Clarement, 3 ♂, 4 ♀; Cold Creek, 1 ♂; Colton, 1 ♂; Los Angeles Co., 3 ♂, 7 ♀; Mt. Wilson, 1 ♂; "Pom. Mts.," 1 ♂.

Serica senta new species.

Male. Length, 8 to 9.5 mm.; width, 5 to 5.5 mm. Color, brown (auburn to bay), subopaque but with a distinct sheen and iridescence in shifting lights.

Senta appears to average larger than *acontia*. In its general characters, it so closely resembles the *acontia*-like forms named above that individual variation appears to exceed its specific differentiation and one must, therefore, depend upon the male genital armature for certain recognition.

Genital armature of male (Pl. XLVII) radically different from that of *acontia*, but clearly allied to that of *solita*; length, 3.2 mm.

Senta can easily be distinguished from *solita* by lacking the rows of prominent bristling hairs on the elytra.

Type: Male. Sacramento Co., California, Horticultural Commission collection (California Academy of Sciences).

Paratypes: 5 ♂, 4 ♀, all from California.

Sacramento Co., 1 ♂; Sacramento, 1 ♂; Yuba Co., 3 ♂, 4 ♀.

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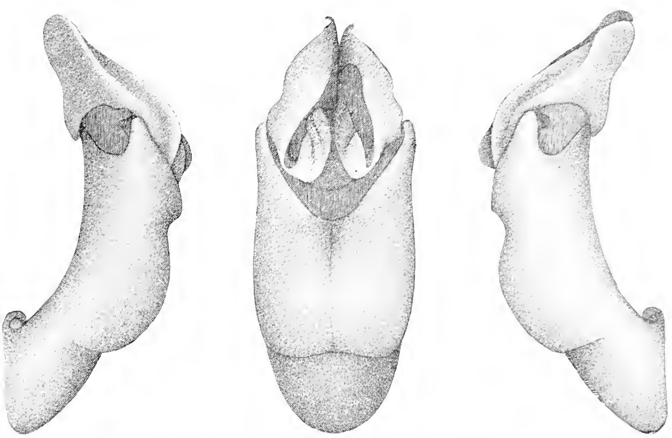
(These plates should be bound in volume XLI, following page 440)

(In text, this plate is referred to as XL)



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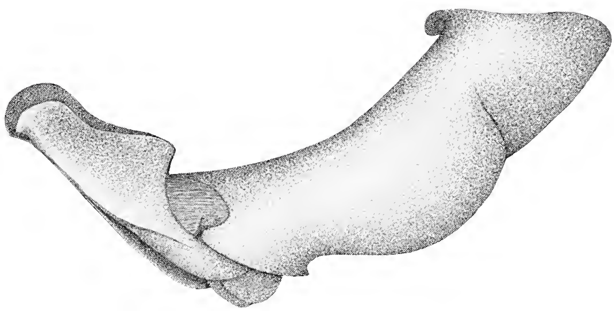

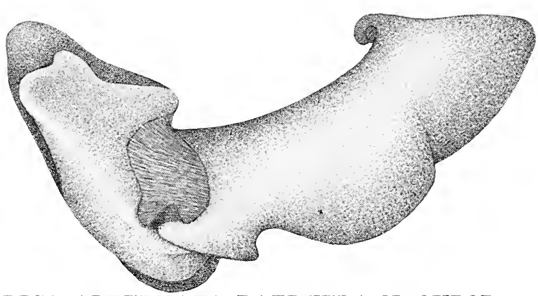

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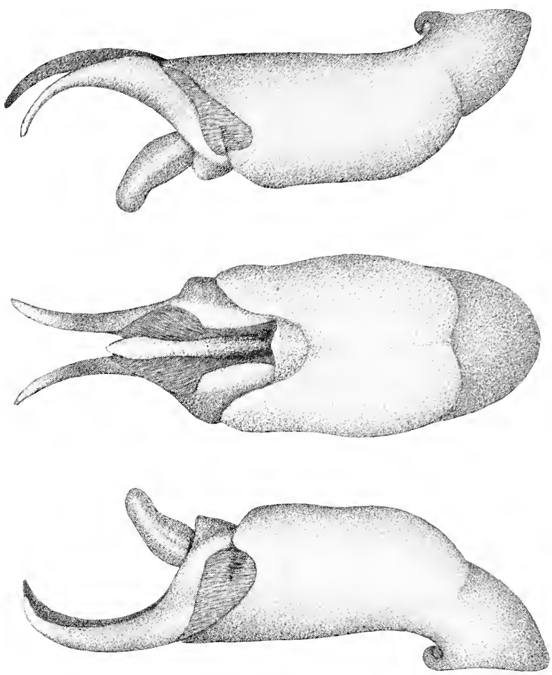

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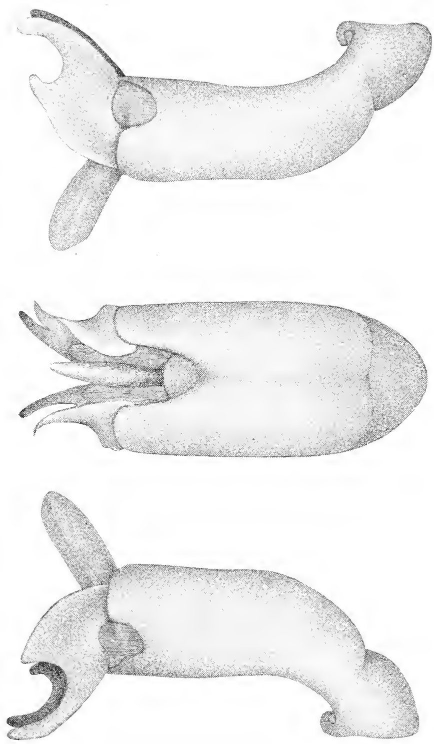

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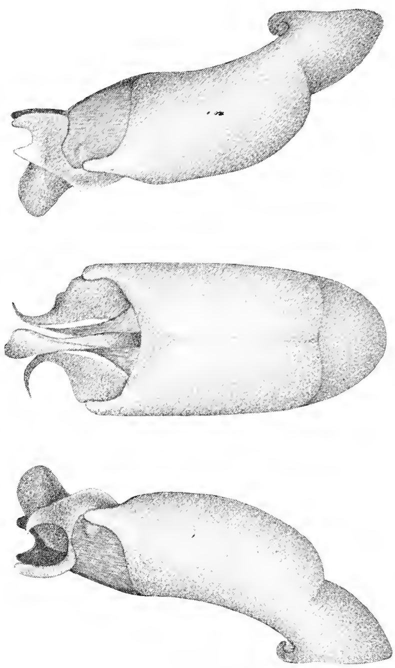

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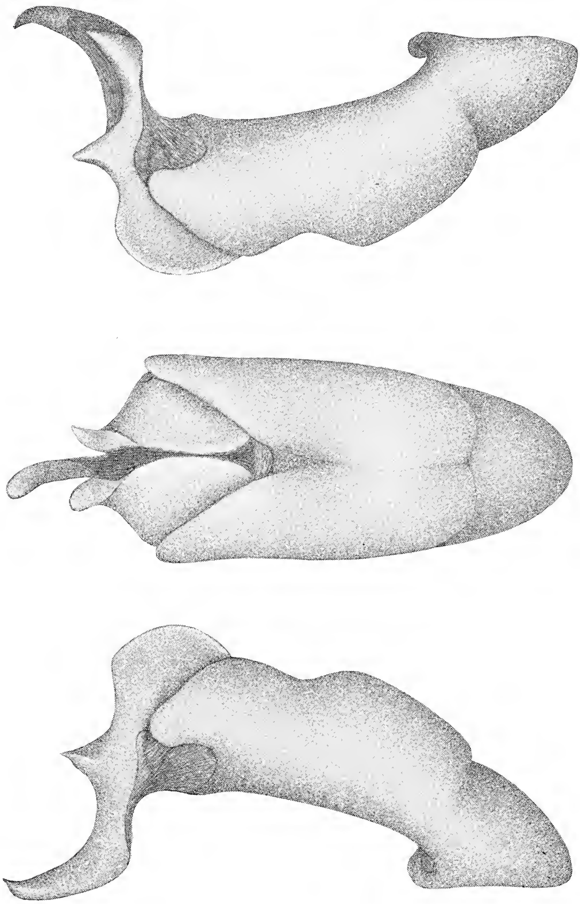

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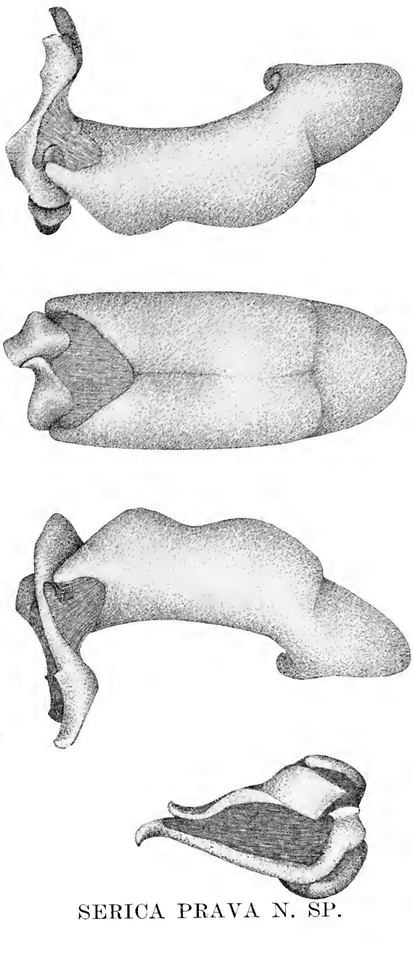

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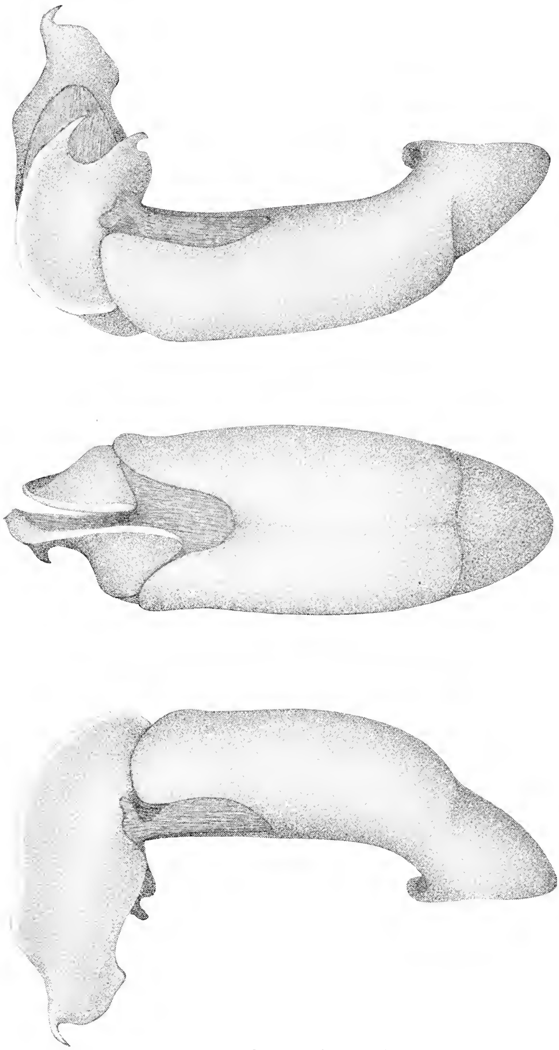

SERICA SENTA N. SP.

THE GENOTYPES OF THE NORTH AMERICAN HADENINÆ (LEPIDOPTERA NOCTUIDÆ)*

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This article is published with a twofold purpose, first, to help those who may be interested in this group of insects, and second, to give other workers an opportunity to criticize and correct any erroneous genotypic designations. Much time and effort have been spent in delving through the literature on Lepidoptera and the writer believes that the information set forth in this article is correct. However, there is always the chance of overlooking some important article or statement and for this reason the writer urges those who can make any corrections to send him this information. These corrections will be published later and due credit will be given to those who helped to clear up any oversights that may have found their way in this article.

Genus *Acerra* Grote. 1874, Bulletin of the Buffalo Society of Natural Sciences, Vol. 2, p. 162.
  Genotype: *Acerra normalis* Grote. The genus is monotypical with a new species.

Genus *Admetovis* Grote. 1873, Bulletin of the Buffalo Society of Natural Sciences, Vol. 1, p. 133.
  Genotype: *Admetovis oxymorus* Grote. The genus is monotypical with a new species.

Genus *Aethria* Hubner. See *Hadena.*

Genus *Aletia* Hubner. 1822, Verzeichness bekannter Schmetterlinge, p. 239.
  Genotype: *Noctua vitellina* Hubner (Europaischer Schmetterlinge Noctuidæ ff. 379, 589, 1796). Type of subsequent designation by Moore in 1881 in the Proc. Zool. Soc. of London, p. 333. Other species included in the original description of the genus were *conigera* Schiff. and *turca* Linn.

* This work was carried on at the entomological laboratory of the Mass. State College, Amherst, Mass.

Genus *Alysia* Guenee. 1868, Entomologist's Monthly Magazine, Vol. 5, p. 3.

Genotype: *Alysia specifica* Guenee. The genus is monotypical with a new species.

Genus *Anarta* Ochsenheimer. 1816, Die Schmetterlinge von Europa, Vol. 4, p. 90.

Genotype: *Noctua myrtilli* Linn. (Fauna Suecica p. 311, 1761). Type by subsequent designation by Curtis in 1826 in British Entomology, Vol. 3, p. 145. Other species in the original description—*cordigera* Thunb. (*albirena* Hub.), *melaleuca* Thunb. (*leucoptera* Esp., *mœsta* Hub.), *radiosa* Esp. (*lyncœa* Hub.), *vidua* Hub. (*tristis* Hub.), *funebris* Hub., *rupicola* W.V. (*helyophila* Hub., *pallium* Borkh.), *heliaca* W.V., Hub., Borkh. (*fasciola* Esp., *arbuti* Fabr.).

Genus *Aplecta* Guenee. See *Hadena.*

Genus *Astrapetis* Hubner. See *Hadena.*

Genus *Barathra* Hubner. 1822, Verzeichness bekannter schmetterlinge, p. 218.

Genotype *Noctua albicolon* Hubner (Europaischer Schmetterlinge Noctuidæ ff. 542, 543, 1796). Type by elimination. The other species, *brassicæ,* included in the original description designated as type of *Mamestra.*

Genus *Borolia* Moore. 1881, Proceedings of the Zoological Society of London, p. 334.

Genotype *Borolia furcifera* Moore. Designated by the author in his original description of the genus.

Genus *Buchholzia* Barnes and Benjamin. 1926, Pan Pacific Entomologist III, p. 68.

Genotype *Arsilonche colorada* Smith. Proc. U. S. Nat. Mus., XXII, p. 414, 1900. Designated by the authors in their original description.

Genus *Cardepia* Hampson. 1905, Catalogue of the Lepidoptera Phalænæ, Vol. V, p. 234.

Genotype *Mamestra irrisor* Erschoff. "Lepidoptera gesammelt aus der wissenschaftlichen Forschungsreise nach Turkestan," St. Petersburg, 1874. Designated by the author in his original description of the genus.

Genus *Cea* Grote. 1883, Papilio, Vol. III, p. 78.

Genotype *Cea immacula* Grote. The genus is monotypical with a new species.

Genus *Ceramica* Guenee. See *Mamestra.*

Genus *Chabuata* Walker. 1857, List of Lepidopterous Insects in the British Museum, Vol. XIII, p. 1034.

Genotype *Chabuata ampla* Walker. The genus is monotypical with a new species.

Genus *Charæas* Stephens. 1829, Illustrations of British Entomology, Haustellata, Vol. II, p. 108.

Genotype *Venosæ cespitis* W.V. Schiffenmuller, Systematisches Verzeichness der Schmetterlinge Wiener Gegend, p. 82, 1776. Type designated by Westwood in 1840 in his Synopsis of the Genera of the British Insects, Vol. I, p. 93, 1839–1840. Other species listed in the original description of the genus—*confinis* Stephens, *fusca* Haw., *nigra* Haw., *graminis* Linn.

Genus *Copimamestra* Grote. See *Mamestra.*

Genus *Craterestra* Hampson. 1905, Catalogue of the Lepidoptera Phalænæ, Vol. V, p. 17.

Genotype *Stibœra lucina* Druce. Biologia Centralia Americana, Heterocera, I, p. 296, pl. 27, ff. 27, 1889. Type designated by the author in his original description of the genus. Other species listed in the original description of the genus—*Perigea niveopicta* Butl., *P. terranea* Butl., *Hadena media* Walk., *Mamestra hoplites* Staud., *M. yakima* Smith, *Axylia bifascia* Hamp., *A. albicosta* Hamp., *Craterestra subterminata* Hamp., *C. semifusca* Hamp., *C. subvelta* Walk., *C. definiens* Walk.

Genus *Crocigrapha* Grote. See *Hadena.*

Genus *Dargida* Walker. See *Hadena.*

Genus *Dianthœcia* Boisduval. 1834, Silbermann's Revue Entomologique, II, p. 246.

Genotype *Noctua carpophaga* Borkh. Europaischer Schmetterlinge, IV, p. 422, 1792. Type designated by Grote in 1874 in the Bull. Buffalo Society of Nat. Sciences, Vol. II, p. 13. Other species listed in the original description—*cucubali* Hub. (*Noctua rivularis* Fab.), *capsincola* Hub., *silenes* Hub., *corsica* Ramb., *tephroleuca*

Bois., *cæsia* Hub., *filigrama* Treit. (*Noctua polymita* Hub.), *magnolii* Bois., *albimacula* Treit. (*Noctua concenna* Hub.), *conspersa* Hub., *compta* Hub.

Genus *Diataraxia* Hubner. See *Hadena*.

Genus *Discestra* Hampson. 1905, Catalogue of the Lepidoptera Phalænæ, V, p. 14.

Genotype *Mamestra chartaria* Grote, 1873, Bull. Buffalo Soc. Nat. Sci., I, p. 138, pl. iv, f. 12. Type designated by the author in his original description of the genus. Other species included in the original description—*M. florida* Smith, *M. eremistis* Pung, *Discestra arenaria* Hamp.

Genus *Engelhardtia* Barnes. 1923, Bulletin of the Brooklyn Entomological Society, XVIII, p. 125.

Genotype *Lathosea ursina* Smith. Canadian Entomologist, XXX, p. 324, 1898. Type designated by the author in his original description of the genus.

Genus *Epia* Hubner. 1822, Verzeichness bekannter Schmetterlinge, p. 214.

Genotype *Phalæna irregularis* Hufnagel. Berlinische Magazin, etc., III, p. 394, 1767. Type designated by Hampson in 1905 in Cataolgue of the Lepidoptera Phalænæ, V, p. 226. Other species included in the original description—*E. silenes* Hub.

Genus *Epineuronia* Staudinger. This name was suggested by Staudinger to replace *Neuronia* Hubner, which is preoccupied by Leach for a genus of *Trichoptera* in 1815 (Edinburgh Encyclopedia, IX, p. 136). *Neuronia* Hubner. 1822, Verzeichness bekannter Schmetterlinge, p. 215.

Genotype *Bombys popularis* Fab. (*graminis* Schiff., *lolii* Esp.). "Systema Entomologiæ Fabricii," p. 577, 1775. Type designated by Hampson, Catalogue of the Lepidoptera Phalænæ, V, p. 216, 1905. *Popularis* is also type by elimination, for the only other species included in the original description, *perplexa* Schiff., is considered the same as *carpophaga* Bkh. and *carpophaga* was selected as genotype of *Dianthœcia* in 1874 by Grote.

Genus *Eriopyga* Guenee. 1852, Species General des Lepidopteres (Noctuidæ), I, p. 203.

Genotype *Eriopyga punctulum* Gn. The genus is monotypical with a new species.

Genus *Eupsephopœctes* Grote. See *Hadena.*

Genus *Eurypsyche* Butler. 1886, Transactions of the Entomological Society of London, p. 392.

Genotype *Eurypsyche similis* Butler. The genus is monotypical with a new species.

Genus *Faronta* Smith. 1908, Annals of the New York Academy of Sciences, XVIII, p. 106.

Genotype *Faronta aleada* Smith. The genus is monotypical with a new species.

Genus *Hadena Schrank.* 1802, Fauna Boica, II (2), p. 158.

Genotype *Trigonophoræ cucubali* Schiffenmuller. Systematisches Verzeichness der Schmetterlinge Wiener Gegend, p. 84, 1776. Type designated by Grote in 1895 in The Entomologist's Record, VI, p. 78, 1895. Schrank would include in his genus the following species—*pinastri* L., *cespitis*–, *graminis* L., *typica* L., *leucophœa*–, *chenopodii*–, *contigua*–, *dentina*–, *cæsia*–, *atriplicis* L., *prasina*–, *præceps* L., *thallassina*–, *pisi* L., *brunnea*–, *hepatica* L., *perphyrea*–, *oleracea* L., *xanthographa* L., *leucographa*–, *chrysographa* Anh., *meticulosa* L., *satura*–, *lucipara* L., *serena*–, *cucubali*–, *capsincola*–, *protea*–, *convergens*–. These are the species belonging to Denis and Schiffenmuller's families O and P. (Systematisches Verzeichness von den Schmetterlinge Wiener Gegend, pp. 267 and 281, 1801.)

The following genera may be synonomic with *Hadena.*

Genus *Aethria* Hubner. 1822, Verzeichness bekannter Schmetterlinge, p. 218.

Genotype *Trigonophoræ serena* Schiffenmuller. Schiffenmuller, Systematisches Verzeichness Wiener Gegend, p. 84, 1776. Type designated by Hampson in 1905 in the Catalogue of the Lepidoptera Phalænæ, V, p. 60. Hubner also included *A. glauca* Hub. in his genus.

Genus *Aplecta* Guenee. 1852, Guenee, Species General des Lepidopteres (Noctuidæ), II, p. 74.

Genotype *Phalæna nebulosa* Hufnagel. Berlinisches Magazin, III, p. 418, 1767. Type designated by the author in his original description. Other species included in his original description—*herbida,* W.V., *occulta* Linn., *implicata* Lef., *imbrifera* Gn., *nimbosa* Gn., *latex* Gn., *condita* Gn., *schœnnherri* Bdv., *speciosa* Hb., *tincta* Brahm., *advena* W.

Genus *Astrapetis* Hubner. 1822, Verzeichness der bekannter Schmetterlinge, p. 218.

Genotype *Venosæ dentina* Schiff. Systematisches Verzeichness der Schmetterlinge Wiener Gegend, p. 82, 1776. Type designated by Hampson in 1905 in the Catalogue of the Lepidoptera Phalænæ, V, p. 60. Other species included in the original description—*remissa* Hub., *distincta* Hub., *contigua* Schiff. (*spartii* Borkh.), *genistæ* Borkh., *valida* Hub., *satura* Schiff. (*perphysia* Esp.), *gemina* Hub., *achates* Hub.

Genus *Crocigrapha* Grote. 1875, Canadian Entomologist, VII, p. 57.

Genotype *Perigrapha normani* Grote. Canadian Entomologist, VI, p. 115, 1874. The genus is monotypical.

Genus *Dargida* Walker. 1856, Walker, List of the Lepidopterous Insects in the British Museum, IX, p. 201.

Genotype *Dargida grammivora* Walker. The genus is monotypical with a new species.

Genus *Diataraxia* Hubner. 1822, Verzeichness bekannter Schmetterlinge, p. 219.

Genotype *Noctua splendens* Hubner. Hubner, Europaischer Schmetterlinge Noctuidæ, fig. 400, 1776. Type designated in 1905 by Hampson in the Catalogue of the Lepidoptera Phalænæ, V, p. 60. Other species included in the original description—*fibrosa* Hub., *temera* Hub., *leucostigma* Hub., *oleracea* Linn., *aliena* Hub., *suasa* Schiff., *chenopodii* Schiff.

Genus *Eupsephopœctes* Grote. 1873, Bulletin of the Buffalo Society of Natural Sciences, I, p. 137.

Genotype *Eupsephopœctes procinctus* Grote. The genus is monotypical with a new species.

* * * * * *

Genus *Haderonia* Staudinger, 1895, Deutsche Entomologische Zeitschrift von Gesell. Iris, VIII, p. 320.

Genotype *Haderonia subarschanica* Staudinger. The genus is monotypical with a new species.

Genus *Heliophila* Hubner. 1806, Tentamen.

Genotype *Noctua pallens* Linn. "Systema Naturæ," X, p. 510, 1758. The genus is monotypical.

Genus *Laucania* Ochsenheimer. 1816, Die Schmetterlinge von Europa, IV, p. 81.

Genotype *Noctua pallens* Linn. Type designated by Curtis in 1827 in his "British Entomology," IV, p. 157. Since *Leucania* has the same genotype as *Heliophila* the two are identical and *Leucania* sinks as a synonym of *Heliophila,* the latter having priority. Other species included in the original description of *Leucania*—*straminea* O., *impura* Hub., *pudorina* W.V., (*impudens* Hub.), *obsoleta* Hub., *comma* Linn. (*pallens* Esp., *turbida* et *congura* Hub.), *l-album* Linn.

Genus *Himella* Grote. 1874, Proceedings of the Academy of Natural Sciences of Phila., p. 200.

Genotype *Himella fidelis* Grote. Type selected by Grote in his original description.

Genus *Hyperepia* Barnes and Lindsey. 1922, Bulletin of the Brooklyn Entomological Society, XVII, p. 56.

Genotype *Hyperepia pi* B. & L. The genus is monotypical with a new species.

Genus *Hyphilare* Hubner. See *Mamestra*.

Genus *Hypotrix* Guenee. 1852, Species General des Lepidopteres (Noctuidæ), I, p. 369.

Genotype *Hypotrix purpurigera* Gn. Type designated by Hampson in 1905 in the Catalogue of the Lepidoptera

Phalænæ, V, p. 291. Other species listed in the original description—*falvigera* Gn., *carneigera* Gn.

Genus *Hyssia* Guenee. See *Mamestra*.

Genus *Ichneutica* Meyrick. 1886, Transactions of the New Zealand Institute, XIX, p. 13.

Genotype *Ichneutica ceraunias* Meyrick. The genus is monotypical with a new species.

Genus *Lasiestra* Hampson. 1905, Catalogue of the Lepidoptera Phalænæ, V, p. 47.

Genotype *Dianthœcia phoca* Moschl. Entomologische Monatschrift, Wien, VIII, p. 197, pl. 5, fig. 15, 1864. Type designated by the author in his original description. Other species included in the original description—*Polia montana* Leech, *Dianthœcia subdita* Moschl., *Mamestra promulsa* Morr., *Scotogramma uniformis* Smith, *Dianthœcia dovrensis* Staud., *Hadena elwesi* Hamp., *Dianthœcia deliciosa* Alph., *Scotogramma perplexa* Smith, *Mamestra persa* Alph.

Genus *Lasionycta* Aurivillius. 1892, Spangberg Entomolgisk Tidskrift, XVIII, p. 285.

Genotype *Phlogophora skrœlingia* H–S. Europaischer Schmetterlinge, VI, p. 57; Noctuidæ, f. 624, 1845. The genus is monotypical.

Genus *Leucania* Ochsenheimer. See *Heliophila*.

Genus *Lophoceramica* Dyar. 1908, Proceedings of the Entomological Society of Washington, X, p. 32.

Genotype *Tricholita artega* Barnes. Canadian Entomologist, XXXIX, p. 64, 1907. The genus is monotypical.

Genus *Magusa* Walker. See *Pastona*.

Genus *Mamestra* Ochsenheimer. Die Schmetterlinge von Europa, IV, p. 76.

Genotype *Noctua brassicae* Linn. Systema Naturae, p. 516, 1758. Type designated by Duponchel in 1829 in Godarts and Duponchels Histoire Naturelle des Lepidopteres, VII, Part II, pp. 71–72. Other species included in the original description of the genus—*pisi* Linn., *splendens* Hub., *oleracea* Linn., *suasa* W. V. (*dissimilis* Knoch, *W-latinum* Esp.), *aliena* Hub., *ab-*

jecta Hub. (*nigricans* View.), *chenopodii* W. V. (*verna* et *saucia* Esp.), *albicolon* Hub., *furva* W. V., *persicariae* Linn.

The following may be synonymic with *Mamestra*

Genus *Ceramica* Guenee. 1852, Species General des Lepidopteres (Noctuidae), I, p. 343.

Genotype *Mamestra picta* Harris (*exusta* Gn.). Harris, "Report of the Insects of Massachusetts Injurious to Vegetation," p. 329, 1841. Type designated by Grote in 1898, Abhandlung des Naturwissenschaftliche Vereins zu Bremen, XIV, p. 72. Other species included in the original description of the genus *maryx* Gn., *vindemialis* Gn., *U-album*—.

Genus *Copimamestra* Grote. 1883, Annals and Magazine of Natural History (5), XI, p. 54.

Genotype *Noctua brassicae* Linn. Same species as the genotype of *Mamestra* if we may accept Hampson's designation made in 1905 in The Catalogue of the Lepidoptera Phalaenae, V, p. 11. The other species listed by Grote in his original description is a new species *Copimamestra occidenta* and is also available. The writer expects to discuss this matter further in a later paper.

Genus *Hyphilare* Hub. 1822, Verzeichness bakannter Schmetterlinge, p. 239.

Genotype *Heliophilae albipuncta* Schiffenmuller. Systematisches Verzeichness der Schmetterlinge Wiener Gegend, p. 84, 1776. Type designated by Hampson in 1905 in The Catalogue of the Lepidoptera Phalaenae, V, p. 436. Other species included in the original description of the genus—*lithargyria* Esp.

Genus *Hyssia* Guenee. 1852, Species General des Lepidopteres (Noctuidae), I, p. 345.

Genotype *Mamestra cavernosa* Eversmann. Bulletin Soc. Imperiale Moscou, III, p. 547, pl. 5, fig. 3, 1842. The genus is monotypical.

Genus *Melanchra* Hubner. 1822, Verzeichness bekannter Schmetterlinge, p. 207.

Genotype *Noctua persicariae* Linn. "Fauna Suecia," p. 319, 1761. The genus is monotypical.

Genus *Meterana* Butler. 1877, Proceedings of the Zoological Society of London, p. 385.

Genotype *Dianthecia pictula* White. White, in Taylor's "New Zealand and its Inhabitants," pl. 1, fig. 3, 1855. The genus is monotypical.

While these genera have been considered synonymic with *Mamestra,* only one, *Copimamestra,* has this status. These two having the same genotype are identical. The other genera have genotypes which lack the curved claw on the fore tibiæ present in *brassicæ* and they, therefore, should be grouped by themselves.

Genus *Melanchra* Hubner. See *Mamestra.*

Genus *Meliana* Curtis. 1889, British Entomology, XVI, p. 13.

Genotype *Meliana flammea* Curtis. In "British Entomology," V, pl. 201, 1828; Curtis describes a new genus *Melia,* designates *Tinea sociella* Fab. as type and includes *flammea* Curtis. In his index published in 1839, he wrote *Meliana* instead of *Melia.* If we accept *Meliana* as distinct from *Melia* then we may consider *flammea* Curtis the type of a monotypical genus *Meliana,* for so it appears in the Index "Meliana flammea, pl. 201, vol. 5."

Genus *Meterana* Butler. See *Mamestra.*

Genus *Miodera* Smith. 1908, Annals of the New York Academy of Science, XVIII, p. 101.

Genotype *Miodera stigmata* Smith. The genus is monotypical with a new species.

Genus *Monosca* Walker. See *Nephelodes* Guenee.

Genus *Monostola* Alpheraky. 1892, Memoires sur les Lepidopteres Romanoff, Tome VI, p. 37.

Genotype *Monostola asiatica* Alph. The genus is monotypical with a new species.

Genus *Morrisonia* Grote. 1874, Bulletin of the Buffalo Society of Natural Sciences, II, p. 53.

Genotype *Cloantha evicta* Grote. Bulletin of the Buffalo Society of Natural Sciences, I, p. 84, pl. 2, fig. 18, 1873.

The type was selected by Grote in his original description of the genus. The other species included by Grote is *vomerina* Grote.

Genus *Naesia* Walker. 1858, List of the Lepidopterous Insects in the British Museum, XV, p. 1741.

Genotype *Naesia moesta* Walker. The genus is monotypical with a new species.

Genus *Neleucania* Smith. 1902, Proceedings of the United States National Museum, XXV, p. 203.

Genotype *Neleucania niveicosta* Smith. Proceedings of the United States National Museum, XXV, p. 203. Type designated by Hampson in 1905 in The Catalogue of the Lepidoptera Phalaenae, V, p. 576. Other species included in the original description of the genus—*bicolorata* Gr., *citronella* Smith, *patricia* Gr., *praegracilis* Gr.

Genus *Neuria* Guenee. 1852, Species General des Lepidopteres (Noctuidae), I, p. 166.

Genotype *Noctua reticulata* Linn. (*saponariae* De Geer). Linn., "Entomologica Fauna Suecicae descriptionsibus aucta Lugundi," II, p. 254, 1789. Type selected by Hampson in 1905 in The Catalogue of the Lepidoptera Phalaenae, V, p. 208. Other species included in the original description—*dentigera* Evers.

Genus *Neuronia* Hubner. See *Epineuronia* Staudinger.

Genus *Nephelodes* Guenee. 1852, Species General des Lepidopteres (Noctuidae), I, p. 129.

Genotype *Noctua emmedonia* Cramer (minians Gn.). "Papillons Exotique," III, p. 92, pl. 247 D. Type selected by Grote in 1874 in the Bulletin of the Buffalo Society of Natural Sciences, II, p. 18. Other species listed in the original description—*violans* Gn., *rubeolans* Gn.

Genus *Monosca* Walker. 1869, Characters of Undescribed Lepidoptera, Heterocera, p. 29.

Genotype *Monosca subnotata* Walker. The genus is monotypical with a new species. *Subnotata* is considered a synonym of *minians, emmedonia.* If this is so then the two genera are identical, having the same species for genotype.

Genus *Ommatostola* Grote. 1873, Bulletin of the Buffalo Society of Natural Sciences, I, p. 112.

Genotype *Ommatostola lintneri* Grote. The genus is monotypical with a new species.

Genus *Parameana* Barnes and Benjamin. 1924, Contributions to the Natural History of the Lepidoptera of North America, V, No. 3, p. 154.

Genotype *Hadena laetabilis* Smith. Canadian Entomologist, XXXI, p. 263, 1899. Type designated by the authors in their original description of the genus. Other species included in the original description of the genus—*Cerma marina* Smith, *Trachea smargdina* Newn., and probably *Namangana canoa* Barnes.

Genus *Pastona* Walker. 1858, List of the Lepidopterous Insects in the British Museum, XV, p. 1754.

Genotype *Pastona rudis* Walker. The genus is monotypical with a new species.

Genus *Magusa* Walker. 1865, List of the Lepidopterous Insects in the British Museum, XXXIV, p. 1223.

Genotype *Magusa albiguttalis* Walker. The genus is monotypical with a new species. According to Hampson *albiguttalis* Walker is the same as *rudis* Walker, so that the genus *Magusa* sinks as a synonym of *Pastona*.

Genus *Perigonica* Smith. 1890, Entomologica Americana, VI, p. 123.

Genotype *Perigonica angulata* Smith. 1890, Entomologica Americana, VI, p. 123. Type selected in 1905 by Hampson in The Catalogue of the Lepidoptera Phalaenae, V, p. 434. Other species included in the original description of the genus—*Perigonica fulminans* Smith.

Genus *Perigrapha* Lederer. 1857, "Die Noctuinen Europas," p. 136.

Genotype *Atrosignatae i-cinctum* S. V. Schiffenmuller's Systematisches Verzeichness der Schmetterlinge Wiener

Gegend, p. 78, 1776. Type selected by Hampson in 1905 in The Catalogue of the Lepidoptera Phalaenae, V, p. 403. Other species included in the original description of the genus—*circumducta* Led.

Genus *Philochrysa* Grote. See *Xanthopastes* Hubner.

Genus *Polia* Hubner. 1806, Tentamen.

Genotype *Noctua dysodea* Schiff. (*Polia flavicincta* W. V.) "Systematisches Verzeichnes der Schmetterlinge Wiener Gegend," p. 72, 1776. The genus is monotypical.

Genus *Pseudothodes* Morrison. 1874, Canadian Entomologist, VI, p. 253.

Genotype *Orthodes vecors* Guenee. Species General des Lepidopteres (Noctuidae), I, p. 376, 1852. The genus is monotypical.

Genus *Scotogramma* Smith. 1887, Proceedings of the United States National Museum, X, p. 469.

Genotype *Anarta submarina* Grote. Canadian Entomologist, XV, p. 4, 1883. Type selected by the author in his original description of the genus. Other species included in the original description of the genus——*perplexa* Smith, *phoca* Mosch., *inconcinna* Smith, *umbrosa* Smith.

Genus *Sideridis* Hubner. 1822, Verzeichness bekannter Schmetterlinge, p. 232.

Genotype *Noctua evidens* Hubner. "Europaischer Schmetterlinge," Noctuidae, fig. 369, 1796. Type designated in 1905 in The Catalogue of the Lepidoptera Phalaenae by Hampson (V, p. 436). Other species included in the original description of the genus—*ferruginea* Schiff. (*rubecula* Esp.), *xanthographa* Schiff., *nictitans* Linn. (*chrysographa* Schiff.), *luteago*—Schiff.

Genus *Stretchia* Hy. Edw. 1874, Proceedings of the California Academy of Science, p. 266.

Genotype *Stretchia plusiaeformis* Hy. Edw. The genus is monotypical with a new species.

Genus *Trichoclea* Grote. Papilio, III, p. 30.

Genotype *Trichoclea decepta* Grote. The genus is monotypical with a new species.

Genus *Trichocosmia* Grote. 1883, Canadian Entomologist, XV, p. 6.

Genotype *Trichocosmia inornata* Grote. The genus is monotypical with a new species.

Genus *Tricholita* Grote. 1875, Bulletin of the Buffalo Society of Natural Science, II, p. 215.

Genotype *Hydroecia semiaperta* Morrison. Canadian Entomologist, VI, p. 105, 1874. Type designated by the author in his original description of the genus.

Genus *Trichopolia* Grote. 1883, Papilio, III, p. 76.

Genotype *Trichopolia dentatella* Grote. Papilio, III, p. 76. Type designated in 1905 by Hampson in the Catalogue of the Lepidoptera Phalaenae, V, p. 361. The other species listed in the original description is also a new species, *ptilodonta* Grt. This Grote doubtfully placed in the genus so it should not be selected as type.

Genus *Ulolonche* Smith. 1887, Proceedings of the United States National Museum, X, p. 471.

Genotype *Mamestra niveiguttata* Grote. Bulletin of the Buffalo Society of Natural Sciences, I, p. 140, pl. IV, fig. 16. 1873. Type selected by Grote in Abhandlungen des naturwissenschaftlichen Vereins zu Bremen, XIV, p. 74, 1898. Other species included in the original description of the genus—*Taeniocampa modesta* Morr., *Ulolonche fasciata* Smith.

Genus *Ursogastra* Smith. 1906, Journal of the New York Entomological Society, XIV, p. 12.

Genotype *Ursogastra lunata* Smith. The genus is monotypical with a new species.

Genus *Xanthopastes* Hubner. 1822, Verzeichness bekannter Schmetterlinge, p. 211.

Genotype *Phalaena timais* Cramer. Papillons Exotique, III, p. 148, pl. 275 B, 1782. Type selected by Grote in Abhandlungen des naturwissenschaftlichen Vereins zu Bremen, XIV, p. 85, 1898. Other species included in the original description of the genus—*xanthomista*

Hub., *flavicincta* Schiff., *dysodea*—Schiff., (*chrysozoana* Borkh.), *flavivibica*—(*polymita* Schiff., *serena* Esp., *filigrama* Ochs.).

Genus *Philochrysa* Grote. 1863, Proceedings of the Entomological Society of Philadelphia, II, p. 338.

Genotype *Philochrysa regnatrix* Grote. The genus is monotypical with a new species. However *regnatrix* Grote is the same as *timais* Cram., thereby making *Philochrysa* a synonym of *Xanthopastes.*

Genus *Xylomania* Hampson. 1905, Catalogue of the Lepidoptera Phalaenae, V, p. 389.

Genotype *Xylomiges hiemalis* Grote. Type designated by the author in his original description of the genus. Hampson includes many species in his genus. Grote's description of *hiemalis* is in the Bulletin of the Buffalo Society of Natural Sciences, II, p. 71, 1874.

Genus *Xylomyges* Guenee. 1852, Species General des Lepidopteres (Noctuidae), I, p. 147.

Genotype *Noctua conspicillaris* Linn. "Systema Naturae," X, p. 515, 1758. Type designated by Grote in the Bulletin of the Buffalo Society of Natural Sciences, II, p. 27. 1874. Other species included in the original description of the genus—*eridania* Cr., *putrida* Gn., *amygia* Gn., *sunia* Gn.

Genus *Zosteropoda* Grote. 1874, Bulletin of the Buffalo Society of Natural Sciences, II, p. 67.

Genotype *Zosteropoda hirtipes* Grote. The genus is monotypical with a new species.

The *Hadeninæ,* like many of the other subfamilies of the *Noctuidæ,* is sadly in need of revision. Some of the characteristics used to separate the various genera are so minute that one questions their taxonomic value. Some of Hubner's "Verzeichness" names should be dropped entirely for Hubner himself did not consider them as having generic rank. There are genera listed in this article which have no representatives in this country but they have been included because our genera have been considered synonymic with them or *vice versa.* A careful study of these will lead to the omission of some of them from our faunal list. In a subsequent paper, the writer hopes to discuss the probable status of the various genera, the classification being based on a morphological study of their genotypes.

Note. Buchholzia is preoccupied, so Barnes and Benjamin substituted the name Eubuchholzia (Bull. Brooklyn Ent. Soc. 1929, p. 184).

Probably the following genera should be included in this article. They will be discussed in a subsequent paper.

Afotella Barnes, Benj.—type *Hadena cylindrica* Grt.
Hadenella Grote—type *H. pergentilis* Grt.
Epipsiliamorpha B. Benj.—type *Agrotis alaskae* Grt.

SHORT STUDIES IN THE CHRYSOMELIDÆ (COLEOPTERA)

By CHAS. SCHAEFFER

(Continued from Page 325, Sept. issue)

Cryptocephalus luteolus Newn.
C. defectus Lec.
C. sanfordi Blatchl.
C. sanfordensis Clav.

In "Blatchleyana" Prof. Blatchley refuses to accept the above synonymy. I have seen and examined the type of *defectus* Lec. in Cambridge and Mrs. D. Blake, while in London a few years ago, kindly sent me at my request a good description and figure of the type of *luteolus* together with some additional notes by Mr. Bryant, which leaves no doubt in my mind that the above synonymy is correct. Moreover, there is no other small *Cryptocephalus* which agrees so well with the descriptions.

Cryptocephalus bispinus Suffr.

Form of *calidus* but much larger; castaneous, head and pronotum marked as in *calidus;* elytra flavous, suture, lateral margin partly and two vittæ on each elytron black. Head finely punctate, punctures well separated; pronotum shining, sparsely and finely punctate; elytra smooth and rather shining, punctures forming the usual rows rather small but larger basally, the sixth and seventh interrupted at middle and more or less confused at their apical part. Anterior margin of prothorax below arcuate-truncate, not lobed; prosternum more or less convex at middle, impressed at sides and coarsely punctate, apex deeply emarginate, the angles prolonged and acute; ventral segments of abdomen finely not closely punctate, punctures coarser on the last segment, pygidium coarsely and closely punctate. Length: 6 mm.

Florida: Gulfport (Reynolds), Lakeland, Nov. (Davis); Georgia (Suffrian).

The description was written under the impression that it was a new species but later, going over Suffrian's descriptions, I came to the conclusion that it was his *bispinus,* though in my three females, the elytral punctures are apparently finer than in Suffrian's specimens. It is not a synonym of *callidus.*

This species is about the same size as *gibbicollis* but more slender, the pronotum not declivous in front and the tibiæ are castaneous, reddish and apically more or less black in the latter species. One specimen has the lateral black elytral vittæ interrupted at middle.

Cryptocephalus insertus Hald.
C. calidus Suffr.

I have been quite uncertain about this species, but on close investigation it appears that Dr. Leconte's suggestion of being possibly a variation of *calidus* is correct. In a number of specimens of *calidus* examined the punctuation of pronotum, elytra, also the elytral vittæ are variable. In his table of *Cryptocephalus** Dr. Leconte separates *insertus* from *calidus* by the pronotum smooth and elytral striæ coarser and somewhat impressed in the former and pronotum feebly punctulate and elytra with fine not impressed striæ in the latter. However, Haldemann in his description of *insertus* says "pronoto polito, punctulato," of the elytra "elytris valde profunde seriatum punctatis." Accordingly there is no difference in the pronotal punctuation of the two and the only remaining one, judging from the descriptions, is whether the elytral series of punctures are fine or coarse. Apparently this is not alone a variable character but as shown in some specimens a few of the rows may consist of large punctures and the rest of fine ones in the same specimen. As the punctuation of pronotum and elytra of other species of Cryptocephalus is also more or less variable and the two extremes are connected by intermediate forms *calidus* should be made a synonym of *insertus.*

The plate extending over the posterior portion of the last ventral segment mentioned by Haldemann and thought to be a male character of *insertus* is visible not only in some males of *calidus* but also in one female. It is also present in both sexes of other species of Cryptocephalus and Anomæa.

* Trans. Am. Ent. Soc. VIII, 1880, p. 202.

Cryptocephalus albicans Hald.

This species is wrongly placed as a synonym of *gibbicollis* in the Leng catalogue. It is much narrower and more slender than the latter, the pronotum is not at all gibbous in front but is relatively feebly convex and the paler markings at best indistinct, the elytra are rather dull.

Cryptocephalus egregius new species.

Rather robust, shining, elytra yellow with eight black spots and an elongate, short, common sutural spot below the scutellum, black; pronotum largely yellow, with a large, black, elongate-oval central spot reaching base and apex, this spot is divided at middle in about apical third by a very narrow white line, on each side of the central spot is a smaller, more or less rounded, spot, connected at middle with the central spot by a narrow black line; and about equidistant between the former and the lateral margin a smaller black spot; margins narrowly black. Head yellow, clypeus, the space around the antennal insertion and a spot between the eyes above black; labrum reddish. Antennæ entirely reddish. Below black, prosternum, mesosternum at middle, first ventral segment between the posterior coxæ yellow and a spot on each side of the last ventral segment and legs reddish. Head on each side with a few moderate punctures. Pronotum, seen from above narrowed apically; lateral margins straight behind and feebly, arcuately narrowing to apex; surface sparsely punctate, a little more closely apically at middle, the black lateral markings and elongate central spot apically very finely rugulose. Elytral series of punctures moderate, not coarse; the black markings on each elytron consist of an elongate, common, sutural mark of irregular outline, a spot on umbo and two below this latter, an elongate, oblique, subbasal mark, a large mark near suture occupying more or less the first three intervals, a spot slightly higher situated between the fifth and seventh or eighth row of punctures and two subapical spots. Prosternum lobed at base, at apex broadly, arcuately emarginate, lateral angles not prolonged nor acute, but rather broadly rounded. Mesosternum narrowing from apex to base, apical margin shallowly emarginate, angles prolonged. Ventral segments moderately coarsely punctate. Pygidium coarsely rugosely punctate. Length: 5.25 mm.

Ft. Valley, Georgia, (Scott and Fiske) type; Calvert, Texas.

Type in National Museum collection, paratype in my collection.

By the peculiar markings of the pronotum, the prosternum at apex between the coxæ arcuately emarginate with lateral angles not prolonged, but somewhat rounded and mesosternum between the coxæ not straight and parallel-sided but distinctly narrowing from apex to base with apical angles prolonged this new species will be readily known. In the paratype the small spot next to the large central one of the pronotum is free and not connected with the latter.

Cryptocephalus simulans conjungens new variety.

Form, size and sculpture of *simulans* from which it differs in having the large, castaneous central space of pronotum more or less broadly connected with the small lateral spot, producing a different lateral outline—in typical *simulans* the large, dark central space is apparently never connected with the small lateral spot and its lateral margin is more or less broadly emarginate—the color of the elytral markings is castaneous—black in *simulans* the second elytral interval is usually entirely of that color, the postscutellar sutural dark mark is at best faintly indicated and the metasternum and abdomen are more uniformly castaneous.

Chisos Mts., Brewster Co., Texas (Mitchell and Cushman).

Type and paratypes in National Museum collection and paratypes in my collection.

The different locality and the differences noted above which appear to be constant in the twelve specimens I have seen entitle this form to a separate name.

The serial punctures of the elytra in this form are usually larger but that is variable in both as is the punctuation of pronotum.

Cryptocephalus simulans eluticollis new variety.

Pronotum fulvous on the disk, anteriorly, laterally and two rather faint, oblique basal spots very slightly paler, near lateral margin at middle a small, dark spot; body below entirely fulvous; markings on elytra slightly reduced, the elongate, postscutellar sutural mark and the dark spot below middle on the second interval absent. Length: 5 mm.

Hot Springs, Arizona, (Barber and Schwarz).

Type and paratype in National Museum collection, and a paratype in my collection.

The prothorax in this form can almost be called unicolorous flavous, with a small black spot near the lateral margin at middle.

A specimen of *simulans* from the Santa Rita Mts., Arizona, in the National Museum collection is much paler than the typical form and has the reduced markings and pale underside of the above described form but the pale anterior and lateral margins and the oblique subbasal marks of prothorax are rather sharply defined.

Cryptocephalus snowi new species.

Form elongate, color below including legs, dark reddish, prosternum, first ventral segment at middle and a spot on each side of last ventral segment and pygidium yellow; head yellow with a small spot between the eyes and around the antennal insertion reddish brown, antennæ entirely yellowish; pronotum reddish-brown, anterior margin narrowly, two oblique basal spots connected at base and laterally widely yellow but the latter color interrupted by a narrow branch from the reddish brown discal color but not extending to the lateral margin; basal, lateral and anterior margins narrowly black; elytra yellow with three partly interrupted black narrow vittæ, the internal one occupying the space between the first and second row of punctures, the median one between the third and fourth row interrupted near its apex, the outer one interrupted twice, before and below middle.

Head sparsely punctate with moderate punctures; pronotum shining, finely and very sparsely punctulate, punctures almost invisible; elytra smooth, moderately shining, the first and second row of punctures united below middle, third and fourth united near apex, fifth and seventh united near apex and between them the sixth is represented by a few punctures, sutural row very short, consisting of from four to six punctures below the scutellum. Body below with white pubescence; anterior margin of prothorax very feebly lobed at middle; prosternum convex, at apex triangularly emarginate, apical angles acute and moderately prolonged; ventral segments moderately closely punctate; pygidium rather closely and coarsely punctate, less closely at apex and along middle carinate. Length: 5.25 mm.

Douglas, Arizona, Aug. (Snow).

Type and paratype in my collection and paratypes in the collection of the Kansas University.

This species was identified for the late Prof. Snow as my *simulans* but the latter is less elongate and a little more robust with the pronotum distinctly punctate, rather coarsely and closely so at sides, in the former there is also a more or less distinct additional black mark on the elytra situated between the very short scutellar striæ below the scutellum, which is never present in *snowi*, the short, elongate umbonal spot of the elytra is of equal width in its entire length in the latter species, but in *simulans* and varieties this spot is dilated inwardly at apex, forming a somewhat pipe-like pattern.

Cryptocephalus cowaniæ new species.

Slightly narrower than *badius,* dark brown with similar elytra markings, but the last interval is also flavous from base to the antemedian, oblique, pale spot, connected at base with the pale basal markings. The pronotum at apical margin is narrowly flavous, also laterally a large, somewhat quadrate, apical spot and below this a narrower, elongate one and two oblique basal spots flavous. The head flavous with an inverted V-like mark at middle. Prosternum, mesosternum and the first ventral segment between the coxæ yellow, on all the ventral segments laterally and each side near apex of pygidium a yellow spot.

Head rather closely punctate, pronotum sparsely and finely punctate. Elytral series of punctures rather coarse, the sixth and seventh row interrupted; the first and last row not confused at apex. Prosternum at base not lobed nor produced into a spine-like process; at apex feebly emarginate with the lateral angles feebly produced. Ventral segments of abdomen sparsely punctate and sparsely pubescent. Pygidium sparsely and moderately coarsely punctate and carinate at middle. Length: 4 mm.

Williams, Arizona, July, (Schwarz and Barber) taken on *Cowania stansburiana.*

Type and paratypes in the National Museum collection, paratypes in my collection.

The male has on each side of the apex of prosternum an erect sharp, spine-like process, which is of very unusual occurrence in *Cryptocephalus.*

The clypeus is rather parallel-sided and not or at most very feebly narrower at base than apex.

Some specimens have the markings of elytra as in *badius,* except that the last interval is basally for a short distance also yellow, but the majority of specimens have an additional oblique spot at about middle of the second to the fourth interval, which, however, is variable in size and occasionally reduced to a very small spot. Specimens of *badius* marked like these and with lateral, apical margins and hind angles of pronotum yellow are said by Dr. Leconte to occur but the narrower form of *cowaniae,* the parallel-sided clypeus and the erect spines on each side of the apical margin of prosternum of the male will readily separate the two.

Dr. Leconte in his table of the species of *Cryptocephalus** separated *schreibersi, tinctus, lateritius* and *striatulus* from the

* *Trans. Am. Ent. Soc.,* VIII, 1880.

rest of the species by having a very coarsely punctured pronotum, but as the punctuation in some of the other species is very variable, one following the table is apt to be misled by certain specimens of *aulicus, trivittatus* and others, which have a coarsely and densely punctate pronotum. However, there is a better and more reliable character to separate these from the rest of the species. In all our species except the four mentioned above and *incertus* the combined first and second row of elytral punctures unite clearly with the last at apex, in the other four and *incertus* the coalescens of the striæ at apex is interrupted and confused by a number of more or less coarse punctures on the intervals, which are absent in our other species.

The following are listed as doubtful without number at the end of the list of the species of *Cryptocephalus* in the Leng catalogue.

Cryptocephalus pseudolus Suffr.

I have very little doubt that this is *C. pumilus* Hald., which is very variable in coloration. The upper surface is either entirely pale, without markings or more or less distinctly marked on pronotum and elytra. The most fully marked specimen seen has a large, black, more or less M-like design on the pronotum and the fourth and sixth elytral intervals at base and slightly below middle, the second interval from base to not quite to middle and the suture black.

Cryptocephalus luscus Suffr.

This is a Diachus allied in coloration to *chlorizans,* but differs from the latter in being "bei fast gesicher Breite um die Hälfte kürzer," the pronotum slightly longer and the elytral punctures coarser and distinct to apex. It was described from Georgia.

Cryptocephalus geminatus Newn.

This is the same as *Bassareus lituratus vittatus* Suffr., which latter name being later proposed becomes a synonym of *geminatus* Newn.

Bassareus mammifer Newn.

Bassareus speciosus Melsh.

B. speciosus Melsh. is a plain synonym and not a var. of *mammifer.*

The markings in *mammifer* usually do not seem to vary very much though I have a few specimens from Great Falls, Md., (Shoemaker) which have on each elytron one or two additional yellow spots above the larger apical spot on the second and third interval as in *egenus* but the yellow median fascia is entire and as wide as in typical *mammifer* and one of the specimens has also an additional lateral subapical spot on the last two intervals.

Bassareus egenus Suffr.

This is listed as a variety of *mammifer* but it seems to me, judging from the description, to be a very small specimen of *formosus*. The markings on the elytra are apparently the same as in the latter species but on each elytron the outer of the two subapical spots of *formosus* is absent. I have a specimen from White Mills, Pa., which agrees fairly well with Suffrian's description in size and markings but with the lateral subapical spot present though more obscure than the rest of the markings.

Bassareus formosus confluentinus new variety.

Differs from typical *formosus* in having the markings of elytra confluent, forming either black, reddish brown or red and yellow more or less irregular, transverse fasciæ; prothorax more or less reddish; underside black or dark red; legs pale. Length: 4 mm.

Massachusetts; New York; Long Island and Van Cortlandt Park; Pennsylvania; White Mills.

This is var. α of Leconte's table but not *sulphuripennis* as given there, the latter is his var. β.

Nodonota basalis Jacoby.

Nodonota arizonica Schffr.

The rather full description of the female of the Mexican *Noda basalis* by Mr. Jacoby, the only sex known to him, agrees so very well with my *arizonica* that I have no doubt about the correctness of the above synonymy.

Euphrytus snowi new species.

MALE: Dark bronze, lateral margins of elytra and underside more or less metallic green, last ventral segment pale, legs and antennæ pale, except the last five or six of the latter black.

Head distinctly punctate with moderate punctures which are slightly more closely but not densely placed in the clypeal region; antennæ elongate, reaching back beyond middle of elytra, outer five joints wider than inner and the last two more so then the three preceding joints. Pronotum nearly as wide as base of elytra, sides entire and arcuately narrowing from near base to apex, widest part about basal fourth; hind angles small, but distinct, anterior angles distinct but not prominent; punctures well separated on the disk, finer anteriorly and denser laterally. Elytra rather elongate, surface even, intervals not elevated, but slightly finely transversely rugose, especially apically; punctuation irregular but apically forming two or three more or less regular rows. Body beneath finely punctate; prosternum anteriorly truncate and very narrow between the coxæ; posterior femora rather suddenly dilated below at about middle and then gradually narrowing to apex, the external angle of the dilation acute and tooth-like. Length: 5 mm.

FEMALE: Differs from the male in shorter antennæ with the last joints not quite as wide, the hind femora simple, the last ventral segment not pale and as usual the first joints of anterior and middle tarsi narrower.

Arizona: Douglas, August, (Snow), Santa Rita Mts., July (Snow).

While the majority of specimens seen have pale legs they are darker in one specimen, four specimens have the upper surface blue and legs and antennæ dark but do not differ otherwise.

Paratypes of both sexes in the collection of Kansas University and a blue specimen in the collection of Mr. Chas. Liebeck. This species differs from *intermedius* in more elongate form, even, not subcostate elytral intervals, the dentate and in basal half strongly dilated hind femora of the male and the narrower prosternum. It is a typical *Euphrytus.*

Euphrytus parvicollis new species.

Piceous or brownish with a more or less distinct metallic gloss, pronotum more distinctly metallic, legs, including the tarsi, and antennæ pale, except the last and penultimate joint at apex blackish; body beneath more or less pale, metasternum and first three ventral segments of abdomen dark.

Head sparsely punctate with moderate punctures, which are more dense in the clypeal area; antennæ reaching backwards a little beyond the middle of elytra, the outer joints scarcely wider than the inner. Pronotum distinctly narrower than the elytra, sides entire, rather evenly but not strongly arcuate, a little more than apical third, then gradually narrowing to apex; apical angles rather distinct but not acute nor prominent, basal angles more or less acute but very small; surface finely not very closely punctate, punctures larger and more closely placed at sides. Elytra wider than prothorax, humeri distinctly exposed; intervals more or less convex, subcostate, stronger so apically and laterally; punctuation more or less confused basally but arranged between the costæ in irregular double rows of punctures gradually changing into a single row apically. Body beneath sparsely punctate; prosternum truncate at apex, very narrow between the coxæ; posterior femora short and moderately incrassate, simple not dentate. Length: 5 mm.

Arizona: Sta. Rita Mts., (Marsden), (Snow, June); Nogales (coll. Liebeck).

The Snow specimen, a paratype in the collection of Kansas University, has the underside entirely pale and a specimen in the collection of Mr. Chas. Liebeck from Nogales has the entire underside and legs dark. The latter is a female, the other two are males.

This species is very close to *intermedius* in almost all its characters but in *parvicollis* the prothorax is much narrower, the elytral humeri distinctly exposed, the antennæ almost entirely pale except the last two joints and the outer joints scarcely dilated and nearly the same as the inner joints.

Colaspis oregonensis Cr.

Doctor Horn in his table of the species of *Colaspis** separates *oregonensis* from *chrysis* only by color—blue, dull green or bronze in the former and bright green in the latter. However, bright green specimens of *oregonensis* occur also and may cause a little trouble as no other reliable characters are given in the descriptions to separate the two species. These bright green *oregonensis* do look very much like *chrysis* but the anterior angles of prothorax are prominent and drawn out more or less laterally into a small, subacute denticle and the apical margin of clypeus is arcuate-truncate, in *chrysis* the anterior prothoracic angles are not denticulate but narrowly rounded and the anterior margin of clypeus is more or less distinctly emarginate. Of *oregonensis* I have also a bright green specimen from Prescott, Arizona.

Colaspis arizonensis new species.

Size and form of *nigrocyanea;* elytra dark blue, scutellar area, pronotum, except the green lateral margins, and head which are dark bronze; antennæ, legs and underside black or piceous. Head moderately closely punctate, punctures denser in the clypeal region; antennæ reaching about the middle of elytra, outer joints slightly wider than the inner. Pronotum transverse, sides entire and arcuately narrowing from base to apex, apical and basal

* *Trans. Am. Ent. Soc.*, XIX, 223.

angles obtuse; surface rather densely punctate, punctures sparse at middle of apical margin and denser at sides. Elytra slightly wider than prothorax, irregularly punctate, punctures forming single rows apically, on the disk the punctures are smaller and more sparsely placed, denser and larger laterally. Body below shining, ventral segments dull, sparsely punctate; posterior femora moderately incrassate. Length: 5 mm.

Arizona, Cochise Co., (G. Franck).

I received a single female specimen of this distinct species from the late George Franck, possibly collected in the Huachuca Mountains by Biedermann from whom he received at one time material.

Compared with *nigrocyanea* it is of nearly the same form and size but with sides of pronotum entire and the punctuation of the latter and elytra is very different and consists of rather moderate sized punctures—very large, especially on the elytra, and more fovea-like in *nigrocyanea*. *C. moesta* Horn, from Lower California, judging from the description, has the pronotum more finely and less closely punctate and the elytra "vaguely subcostate near the apex," and in form is compared with *Rhabdopterus picipes* but larger and more robust.

C. arizonensis by its entire sides of pronotum and wider prosternum than usual is rather an aberrant *Colaspis* though *nigrocyanea* and one or two other species which also have a wider prosternum but otherwise belong in *Colapsis;* the undulate sides of pronotum are very vague or even absent in some specimens of certain species. The entire, not undulated, lateral margin of pronotum would rather place it in the *Iphimeitini* than in the *Colaspiini* but there is apparently no genus described in the former tribe where it could be safely placed. Mr. Jacoby in the "Biologia" places several new species with wider prosternum in his genus *Euphrytus* and one of these with not dilated hind femora as rather doubtful and the two species he places in *Coytiera,* a genus apparently closely allied to *Euphrytus,* are also not strictly congeneric. The *Eumolpinæ* appear to need tribal and generic revision with possibly the erection of a few new genera for some of these aberrant species, which would help greatly in their correct identification and lessen the existing confusion.

Colaspis nigrocyanea Horn

This species occurs also in Brownsville, Texas, but most of the specimens are not quite as dark as the Arizona specimens, though otherwise agree with the latter in every respect. Of all our *Colaspis* it is the most coarsely sculptured species and judging from the descriptions is so very close to the Mexican *dugesi* Lef. and *melancholica* Jac. that I suspect the three names refer to the same insect.

Colaspis viriditincta Schffr.

I described this as a variety of *brunnea* but it is a distinct species. It is a more slender insect, the elytral intervals are not very distinctly costate except at apex, but are very narrow and irregular, the first two near the suture are a little wider, the elytral punctures are larger and more crowded, nearly obliterating the very narrow costæ at base; the posterior tibiæ of the male are dilated internally at middle; the prothorax is narrower, less broadly rounded at sides and appears to be longer.

Colaspis viridiceps new species.

MALE: Narrower and more slender than *brunnea;* color above flavous, head, lateral margins of pronotum and underside metallic-green, legs pale; antennæ pale, except the seventh and last three joints black.

Head moderately closely punctate but very sparsely posteriorly. Pronotum distinctly sinuate and angulate laterally; anterior angles obtuse, posterior angles prominent, but small and acute; surface rather closely, but not densely punctate at sides, at middle sparsely. Elytra with seven intervals elevated, between these a double row of moderately large punctures, except the sutural, first and last, which have an entire, more or less regular, single row of punctures. Body below finely and sparsely punctulate; prothorax below at sides more coarsely punctate; prosternum rather very narrow between the coxæ. Length: 4 mm.

Arizona: Wheatfields near Globe (Duncan).

The metallic-green head, sides of pronotum distinctly sinuate and angulate, also the more slender form and the first two striae of elytra with a single row of punctures will readily separate this species from *brunnea* and allies. The Mexican *hypochlora* has the pronotum subangulate and is apparently close to *viridiceps* but the head in the former is pale and no variations in this respect are mentioned of this rather common and widely distributed insect, also all the elytral intervals are said to be geminate-punctate.

Colaspis crinicornis new species.

MALE: More elongate and slender than *brunnea* with wider and more sparsely punctured pronotum and posterior tibiæ medially dilated internally. Color above and antennæ flavous, except the last joint of the latter black, lateral margins of elytra darker with faint metallic tint; body below slightly darker, metasternum sub-metallic. Head not densely punctate, punctures well separated; antennæ with each of the last six joints carrying along the inner edge four or five erect, long hairs, besides the usual ones at apex of each joint. Pronotum transverse, its widest part nearly twice as wide as long; sides feebly angulate slightly behind middle, anterior angles distinct, though not prominent, posterior angles prominent but small; surface not closely punctate at sides, punctures well separated; elytra with intervals more or less distinctly elevated, between these are single and double rows of moderate punctures, of these the sutural, first and last row uniseriate, the others in part more or less uni- and biseriate. Body beneath sparsely punctate; prosternum nearly as wide as anterior coxa; hind tibiæ gradually, arcuately dilated internally. Length: 4.5 mm.

Brownsville, Texas, (O. Dietz).

The more elongate form, wider pronotum, slightly wider prosternum, the internally dilated posterior tibiæ, also the erect, rather long hairs on each of the last six antennal joints separates this apparently distinct species from the males of *brunnea* or var. *flavida*. In some males of *brunnea* a few of these have long hairs, besides the usual apical ones on the antennal joints, which can be seen in a certain light, but they are apparently never as plainly visible and not as long as in *crinicornis* and fewer in numbers.

The female is unknown to me.

Colaspis lata new species.

FEMALE: Larger and more robust than *brunnea* with four distinct, entire costae on each elytron, the intervals between these divided by feeble, narrow, longitudinal elevations, which are rather indistinct and more or less obliterated in about basal half or less. Color above flavous, elytral punctures more or less and lateral margin metallic green, seventh and last three antennal joints black; body below metallic green, except sides of prothorax and apex of last ventral segment and legs pale.

Head posteriorly sparsely punctate, between the eyes and clypeus more closely punctate. Pronotum in its widest part nearly twice as wide as long; sides feebly angulate; anterior angles obtuse, posterior angles very small;

surface moderately closely punctate on the disk but very dense and rather cribrately punctate at sides. Each elytron with four distinct entire costæ, the densely punctate intervals between these divided by feebly, narrow, costulate elevations, which are rather indistinct and more or less obliterated in about basal half or less, the moderately coarse and rather dense punctuation is arranged in more or less distinct geminate rows of punctures. Prosternum about as wide as each coxa; metasternum finely punctate, punctures on ventral segments sparser and larger, last ventral segment broadly arcuate at apex. Length 5 mm.

Nebraska: Harrison. Two specimens collected and given to me by my friend E. L. Bell together with other material from that locality. The larger and more robust form, the wide prosternum and the elytral sculpture separates this distinct species from any of the allied North American *Colaspis.*

Colaspis flavocostata new species.

MALE: Larger, more elongate and slender than the fully colored variety *costipennis* with the four distinct pale costate intervals of each elytron narrower. Color of upper and under surface metallic-green; legs antennæ, except the five outer joints which are black, the four costate elytral intervals and the more or less visible narrower elevations between the four, pale.

Head rather sparsely punctate. Pronotum in its widest part about one third wider than long, sides slightly sinuate; anterior angles distinct, posterior angles very small and slightly prominent; surface closely punctate, very densely so at sides. Elytra with four entire, but narrow, costæ, between these, still narrower subcostae elevations, which are more distinct at apex than at base; the punctuation consists of closely placed moderately coarse punctures, biseriately arranged, uniting near apex into a single row. Body below finely punctulate except prothorax at sides as usual with larger punctures; prosternum as in *brunnea.* Length: 4.75 mm.

M.D.
Florida: Chipola Lake, April (Leonhard). 1927

In coloration, etc., this species is near *costipennis* but is a larger and more slender insect with narrower pale elytral costæ and denser elytral punctuation than in the latter variety.

The single female differs scarcely from the male except as usual, the pronotum is, however, of a somewhat golden-yellow color, with lateral and basal margins metallic-green.*

* While this paper was in the hands of the printer I saw a few specimens, in the collection of Mr. F. M. Schott, taken at Greenwood Lake, New Jersey, which agree, in every respect, with the Florida specimens. They were beaten from pitch pine.

Colaspis brunnea floridana new variety.

MALE: Above flavous, lateral margins of elytra metallic-green, elytral punctures and sutural interval more or less infuscate; below more reddish but legs and prothorax flavous; antennae pale, fifth and the last two joints black.

Head not closely punctate, punctures moderate and scarcely denser on clypeus. Prothorax about one fourth wider in its widest part than long along middle; sides arcuate, scarcely undulate or angulate; anterior angles obtuse, posterior angles distinct but obtuse; surface not closely punctate, punctures moderate in size, generally well separated and not denser at sides. Elytra with well defined costiform elevations, eight on each elytron, separated from each other by either uniseriate or biseriate rows of punctures, of these the last, the first and the sutural row are uniseriate, the latter two unite clearly near base, the others are partly uniseriate and partly biseriate but all are uniseriate near apex. Body below finely punctulate, prothorax, as usual more coarsely. Length: 4 mm.

Florida: Frt. Myers, August, (M. D. Leonhard); Gainesville, July, (J. S. Rogers).

Paratypes are in the collection of Mr. H. Dietrich. This distinct form is readily separated from *brunnea* and its varieties by its larger prothorax and different elytral punctuation and the usually wider first and second interval. The first two elytral intervals are generally wider than the rest in the specimens which have most of the rows of punctures except the first two, almost entirely biseriate, other specimens in which some of these rows are nearly uniseriate the intervals are only slightly narrower than the first two; the first two rows of punctures, that is the sutural and first and the last in this form are always uniseriately punctate, in *brunnea* and varieties only the sutural row of punctures and the last are clearly uniseriately punctate.

Colaspis brunnea and its varieties are supposed to be very variable and according to Dr. Horn connected by intermediate specimens. I haven't seen any specimens which I would consider intermediate between *costipennis* and *brunnea* or its two other varieties and I believe that several more or less distinct forms will be found associated with *brunnea, flavipes* or *suilla* as defined by Dr. Horn when critically investigated.

Xanthonia pinicola new species.

Form of *villosula* but larger and elytral punctuation confused; elytra pale to dark brown, either uniform in coloration or marked more or less with black; pubescence inclined, uniform. Pronotum darker, densely and confluently punctate. Underside more or less piceous, legs and the last two ventral segments often paler; punctuation of the ventral segments close, denser at sides and slightly finer on the last two segments. Length 4 mm.

Huachuca and Pinal Mts., Arizona, beaten from pine.

Type and paratypes in Nat. Museum collection, paratypes in my collection.

The punctuation of the elytra is somewhat variable, in a certain light, in some specimens the punctures appear to form regular rows. The pubescence of the elytra is uniform, inclined as in *vagans,* in *decemnotata* dual, consisting of inclined and erect hairs, in *villosula* the hairs are erect, forming single rows on the intervals.

The male has the last ventral segment of abdomen slightly and shallowly impressed at middle, on each side of the impression a more or less distinct tubercle and the anterior femora simple, not toothed nor even a feeble indication of it.

Fidia viticida texana new variety.

Larger than typical *viticida,* black, pubescence of upper surface longer, denser and coarser. Length: 7 mm.

New Braunfels, Texas.

Myochrous floridanus new species.

Form of *denticollis* with tridentate sides of prothorax but size generally larger, upper surface brown without metallic tint, variegated with ochreous and brown scales. Sculpture of prothorax rather coarsely and densely rugose; elytral punctuation coarser and more densely and irregularly placed than in *denticollis.* Body below metallic, legs castaneous, scales cinereous. Length: 5–5.75 mm.

Florida: St. Augustine, November, (Engelhardt); Rockbluff, April M.D. (Leonhardt).

Type and paratypes in Nat. Museum collection, paratypes in my own and Mr. Dietrich's collection, the latter is a small specimen from Rockbluff.

A small number of specimens show scarcely any variation except in size. The legs in this species are apparently always reddish, in *denticollis* metallic, at least the femora more or less and finely punctate with narrower and longer, more hair-like scales, the latter in *floridana* are rather moderately coarsely punctate with shorter and slightly wider scales.

This species is closely related to the Cuban *M. dubius* F. of which I have, through the kindness of Mr. H. S. Barber, three specimens before me. These have the same pronotal sculpture as in *floridana,* but the upper surface of elytra and femora are distinctly metallic.

It is also related to *movallus,* from which it differs in coarser sculpture of prothorax and elytra, the latter dark brown shining without metallic tint and clothed with dark brown and ochreous scales.

Myochrous movallus Johnson.

Of this, more recently described species from S. Dakota, I have a single specimen from Atherton, Mo., which agrees in every respect with a paratype kindly given me by its describer, except that the scales of the upper surface are uniformly cinereous.

While the teeth at sides of prothorax are a little variable in all the species, they are apparently always very small and feeble and one or even two appear to be occasionally absent in *movallus.*

Myochrous pauxillus new species.

Form of *denticollis* but much smaller and pronotum not tridentate at sides but angulate below middle. Pronotum finely strigate-rugose and with cinereous small, narrow scales, which are not closely placed. The punctures of elytra are as in *denticollis,* that is, rather large and closely placed and the vestiture consists of small, narrow, cinereous scales, which are not dense and are easily abraded. Length: 3.75 mm.

Brownsville, Texas, (O. Dietz).

This small species appears to be close to *squamosus,* but the prothorax is wider anteriorly and distinctly angulate at sides below middle, the punctures of elytra are larger and more closely placed and the scales are narrower and not densely placed. The tooth on anterior tibiæ is very small.

KEY TO THE SPECIES OF MYOCHROUS ERICHSON

1. Pronotum at sides tridentate or occasionally bidentate in a specimen 2
   Pronotum at sides not dentate 7
2. Anterior tibiæ with a prominent acute tooth below middle 3
   Anterior tibiæ without acute tooth 6

3. Underside and legs reddish, generally larger and more slender than *floridanus* or *denticollis* .... *magnus* Schffr.
   Underside metallic 4
4. Legs reddish without metallic tint, posterior femora rather moderately coarsely punctate, with short, white scales 5
   Legs entirely or at least the femora more or less metallic, the latter finely punctate; posterior femora with very narrow scale-like hairs, pronotum finely strigate-rugose .... *denticollis* Say
5. Generally larger, prothorax rather coarsely and confluently punctate; upper surface without metallic tint with scales dark brown and ochreous .... *floridanus* n. sp.
   Smaller, prothoracic sculpture as in *denticollis;* upper surface metallic with cinereous and paler brown scales intermixed or entirely cinereous. *movallus* Johnson
6. Smaller and more slender than *floridanus* and *denticollis;* scales denser and more persistent, underside metallic, legs reddish, femora occasionally faintly piceous; pronotum more distinctly punctate and scarcely rugose .... *longulus* Lec.
7. Pronotum distinctly angulate at sides below middle; scales of upper surface narrow, elongate and easily abraded; punctures of ventral segments of abdomen larger and more closely placed, especially on the first segment .... *pauxillus* n. sp.
   Pronotum not angulate at sides below middle; scales of upper surface rather broadly oval, dense and persistent; punctures of ventral segments of abdomen smaller and more widely separated .... *squamosus* Lec.

Metachroma coronadense Fall.

The single specimen described by Mr. Fall is apparently a male as my female, besides being a little more robust and larger than the male, differs in having the fifth elytral interval to about middle and the seventh to ninth from base to beyond middle strongly elevated. The male is closely allied to my *novemstriatus* but is smaller, with pronotal punctures finer and antennæ shorter.

Species with costate elytra in the female as in *Nodonota* are rather unusual in this genus and only one other to my knowledge has the elytra costate laterally, that is the Mexican *M. bipunctata* Jac., and though nothing is said about the sex of the specimen described it is very likely a female.

Chrysochus auratus F.

Of this common species, which is recorded only from the east, I have western specimens from Colorado: Jefferson Co., (Engelhardt); Arizona: Sierra Ancha Mts., (Duncan) and Prescott (Kunze); California: Sta. Clara Co., (Coleman). The Arizona specimens have the outer antennal joints more elongate than the eastern specimens.

Chrysochus cobaltinus Lec.

Specimens of this species were collected at Salt Lake City, Utah, by Mr. Wm. T. Bather and I have also a specimen from Jefferson Co., Colorado, collected by Mr. E. L. Bell. Besides the blue or greenish blue color, this species differs from *auratus* by having shorter and somewhat stouter antennal joints, especially the last four or five.

Colaspoides violaceipennis Horn

The description of the Mexican *Chrysodina purpureicollis* Jac. agrees so well with our insect that I suspect the two are the same. *Colaspoides* differs principally from allied genera—*Nodonota, Chrysodina,* etc., by the possession of post-ocular lobes of the prothorax below, which are absent in the genera mentioned above; in *violaceipennis* there are no post-ocular lobes. Besides the absence of lobes of the prothorax Dr. Horn separates *Chrysodina* from its allies by the pronotum having no basal marginal line, which is also the case in *Colaspoides;* therefore *violaceipennis* should have been placed in *Chrysodina* and not in the latter genus. Mr. Jacoby in the "Biologia" remarking on the difficulty of the characters suggests that the shape of the outer joints of the antennæ would be a valuable character in separating *Chrysodina* from *Nodonota.* These joints are short and almost transverse in the former genus and elongate in the latter, though in both they are dilated. The outer joints of the antennæ in *violaceipennis* are as suggested by Jacoby for *Chrysodina,* this and the prothorax below without lobes and in addition the clypeus not being triangularly emarginate does make it more possible that the two insects are the same. Our *Chrysodina globosa* has the outer antennal joints less abruptly dilated and more elongate.

Hydrothassa boreella Schffr.

Of this species, which was described from western Canada—British Columbia, Alberta and Manitoba—I have a specimen from Danby, N. York, (E. G. Anderson) taken on *Caltha palustris,* May 14, and several specimens taken by Mr. F. M. Schott at Greenwood Lake, N. Jersey, May 17.

Labidomera suturella Chev.

I have a specimen, collected by O. C. Poling at Alpine, Texas, which seems to be this Mexican species. The head, pronotum, underside, legs and a narrow sutural vitta of elytra, which gradually widens toward apex, greenish-blue, elytra otherwise reddish without markings. The size about the same as our common *clivicollis.*

Calligrapha scalaris floridana new variety.

Smaller than typical *scalaris,* more shining and more finely and sparsely punctate, color of pronotum and elytral markings rather olive green. Length: 7–8.25 mm.

Lake Okeechobee, Florida (Blatchley).

This is what the late Frederic Knab had labelled "rhoda var. floridana." It is of the same size as *rhoda* and has the same markings but it has only one clearly defined, rounded subbasal spot within the subhumeral arcuate stripe as in typical *scalaris,* while *rhoda* has two spots and has the elytra more coarsely punctate. The two subbasal spots of *rhoda* are occasionally confluent, forming one large spot, but then apparently always of irregular outline and generally divided by a row of punctures. These subbasal spots in *scalaris, philadelphica* and allied species are less variable than the rest of the elytral markings and are valuable in separating closely allied species.

Calligrapha vicina new species.

Form and size of *philadelphica.* Head and pronotum metallic green, the latter more shining than in *philadelphica,* legs, antennæ and palpi reddish. Elytra pale, markings metallic green, consisting of a heavy humeral lunule which encloses two, more or less linear, spots, suture and subsutural intervals dark metallic green, the latter behind middle narrowly pale for a very short distance, an arcuate stripe, next to the metallic suture, broadly interrupted at middle, on the disk numerous small spots of variable size and an isolated median spot near lateral margin. Elytral epipleuræ pale with outer margin reddish. Length: 8 mm.

Olcott, New York (H. Dietrich), and one labelled Genessee Co. A paratype in the collection of Mr. Dietrich.

This species is heavier marked than *philadelphica* with sutural and subsutural interval more or less metallic green and is therefore apt to be confused with *amelia* or its var. *confluens,* but these have only one, more or less rounded subbasal spot enclosed by the humeral lunule, while *vicina* has two more or less linear spots and the pronotum in *amelia* and var. is more shining. It is more closely allied to *spiraeæ* but is larger and slightly more robust and the two subbasal spots are generally larger and more elongate, especially the outer, in *spiraeæ* the two subbasal spots are usually small and more or less rounded.

Calligrapha alni Schffr.

This species extends further south than recorded. Mr. Dietrich has taken it at E. Aurora, N. Y., and Mr. Shoemaker at Ramsey, N. Jersey.

Calligrapha apicalis Notm.

I have a specimen of this species from Canada. It was described and so far only recorded from northern New York.

Calligrapha verrucosa Suffrian

This is not a synonym of *multipunctata* but a distince species. It is always larger and slightly more elongate, with elytra more densely punctate and the two intervals next to the suture largely red, but never with a dark sutural line as in typical *multipunctata.* The markings on elytra are always black—more or less metallic green in *multipunctata*—and frequently strongly elevated.

Say confused this species with his *multipunctata,* it is his var. a.

Calligrapha multipunctata Say.

This is a very variable insect. Typical *multipunctata* have the underside and markings on prothorax red, which latter consist of an arcuate line interrupted at middle, basal margin at middle and a spot below the arcuate line. However, the color of the underside, also markings on pronotum, are variable and in the latter become gradually confluent and darker, of which the extreme form with pronotum dark metallic but apical margins and sides pale is var. *bigsbyana* Kirby.

Calligrapha multipunctata var. **suturella** new variety.

Similar to var. *bigsbyana,* that is, pronotum dark metallic green with pale anterior and lateral margins, markings on elytra slightly heavier than usual but sutural and subsutural intervals entirely metallic green. Length: 7.5 mm.

Claremont, New Hampshire (R. P. Dow).

As the markings of related species are variable to a certain extent, this new variety may be mistaken for a variation of *apicalis* Notm. on account of the entirely green sutural and subsutural intervals but the latter belongs to the group of species which have a dark spot at middle of last elytral interval, which is always absent in *multipunctata* and its varieties *bigsbyana* and *suturella.*

Calligrapha lunata Fab.

If the two color phases, *lativittis* and *medionota,* are admitted to our list then two more have to be recognized.

When Achard described these two varieties he named a third one, *bowditchi,* which is overlooked in our list. Achard did not see a specimen of the latter but proposed the name for the "form of *lunata*" mentioned and described, but not named, by Bowditch in Trans. Am. Ent. Soc., XXXVII, 1911, p. 326. Of this form Bowditch had two specimens, one from Marion, Mass., and the other from Mexico, but the latter locality is open to doubt as *lunata* does not occur in Mexico. The three specimens I refer to the variety *bowditchi* are from Casco Bay, Maine; one of these is typical, the other two nearly so, having the wide, red lateral vittæ at apex not entirely connected with the red sutural vitta.

The other variety is *hybrida* Say, which is at present listed in our Catalogue as a synonym of *lunata.* It is apparently a good western race as all the specimens seen are from Colorado, Nebraska and Manitoba. In this variety the wide, lateral red vitta on each elytron of typical *lunata* is broken up into three narrow vittæ of which the inner one is often very irregular and confused.

While the pronotum is generally unicolorous reddish in the typical form and all the varieties one of my Colorado specimen has the anterior angles widely flavous.

Calligrapha elegans californica Linell.

This variety, recorded only from California, has been taken at Coeur d'Alene, Idaho, by Mr. Notman.

Chrysomela basilaris Say.

This species is evidently wrongly identified by Crotch, 1873, Linell, 1896, and apparently by everybody following the two authors.

According to Say's description this species is green, very slightly glossed with violaceous and the lateral margin of pronotum **much** thickened. This latter expression he also uses in his description of *auripennis* but not of *flavomarginata* of which he only says "lateral margin (of pronotum) thickened." Accordingly the lateral margin of pronotum in *basilaris* is the same as in *auripennis,* that is, the marginal groove of pronotum is entire and the specimens identified by Crotch and Linell as *basilaris* are *flavomarginata* with unicolored elytra (var. *vidua* Rog. of which *subseriata* Lec. is a synonym) in which the marginal groove of pronotum does not reach the apex.

I have a specimen from Yellowstone Park, Wyoming, and have seen another from Sioux Co., Nebraska, which agree well with Say's description of *basilaris.* This species by its unicolored, shining green, upper and under surface, including the legs and its entire marginal groove of pronotum, will be easily known from any of our species of *Chrysomela* except possibly *inornata* of which I am not certain. A specimen from the Gap, Alberta, in coll. Hopping, which has the upper surface bluish black with very faint greenish reflections, underside and legs slightly paler bluish green which is possibly *inornata* and except darker coloration and slightly more closer punctuation of pronotum and elytra this specimen hardly differs from the bright green Wyoming specimen which I take to be Say's *basilaris.*

Chrysomella auripennis cyanea new variety.

Slightly more elongate than typical *auripennis* but entirely dark blue above and below. Length: 7–10 mm.

Arizona: Huachuca Mts., Sta. Rita Mts., Superstition Mts., Flagstaff, and Williams; S. W. Utah; New Mexico.

Type and paratypes in Nat. Museum collection, paratypes in my collection.

I have seen a great number of specimens of *auripennis* from Texas and further north and east, and while the color of elytra varies a good deal from reddish cupreous to dark green not a single specimen from these localities had the elytra entirely blue. On the other hand, all the specimens I collected in the Huachuca Mts., Arizona, or have seen from the localities mentioned above were entirely blue and as these blue specimens have been mistaken for *inornata* especially by those using Linell's key it is advisable to give it a name.

The variety *cyanea* differs from what I take to be *inornata* by having the sides of pronotum from a little below apical to basal angles more or less divergent—in *inornata* slightly convergent—the elytral punctures are of uniform size forming irregular rows and the intervals are almost without punctures, only a few very small punctures may be seen here and there—in *inornata* the punctuation is denser, consisting of rather numerous larger and some smaller punctures.

The variety *cribraria* is black, feebly bronced above and below with a slight bluish tint at sides of metasternum and inhabits the southeastern States.

Phyllodecta americana pallipes Schffr.

Of this variety I have specimens from the Catskill and Adirondack Mts., N. Y., and one from Alaska. The color in these is metallic green.

Lina interrupta F.

This species is apparently more variable in certain localities than it is in others. In a small number of specimens received from Mr. Musgrave and collected by him at Fairmount, W. Va., the majority were typical but showing more or less variation in reduction or extension of elytral markings. A few were var. *quadrimaculata* and one was an aberration of var. *æneicollis*. This latter, as in typical *æneicollis*, has the pronotum uniformly metallic black, the elytra pale, humeral umbo, a transverse moderately wide fascia which at middle is rather strongly constricted on each elytron, also a transverse subapical spot, suture and a sutural spot at apex black.

Melasomida arizonica Cr.

This species occurs also at Alpine, Texas; it is so far only recorded from Arizona and Mexico.

STUDIES IN THE PYRROPYGINÆ, WITH DESCRIPTIONS OF NEW SPECIES (LEPIDOPTERA, RHOPALOCERA, HESPERIIDÆ)

BY E. L. BELL

(Continued from Page 295, Sept. issue)

M. amans (Fig. 23).

Skinner, Ent. News, vol. xxxi, pp. 132, 133. 1920.

Although *amans* was described in the genus *Mimoniades* an examination of the type shows that it is a member of the genus *Mahotis* and allied to *nurscia* Swainson. A specimen from Huancabamba, Central Peru, in the collection of the Academy of Natural Sciences, Philadelphia, Penna, which very closely agrees with the type, differs from *nurscia* principally in the following characters: on the upper side in the more orange color of the discal band of the primaries and the more extensive blue scaling of the secondaries; beneath the band of the primaries is more orange colored in the two upper spots, although they have a slight pinkish tinge. The blue overscaling beneath has a slight greenish tinge in the type, in *nurscia* the tinge is purplish. The fringes of the secondaries are white cut by black at the veins, in *nurscia* they are black or only a little greyish between the veins.

The termination of the claspers differs from that of *nurscia*, as shown in the figures, though the rest of the details are very similar.

Distribution. Type locality: Neiva, Colombia. Huancabamba, Central Peru (A.S.). Peru (A.M.).

M. malis (Fig. 20).

Godman and Salvin, Proc. Zool. Soc. London, p. 153, pl. xiv, fig. 6, 1879.

Mabille and Boullet, Ann. des Sciences Nat., 9th series, pp. 188, 189, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, pl. 164 d, 1921.

Malis differs from *nurscia* in the secondaries being crossed on the upper side by two more or less obsolete bands of bluish scales, one discal and the other antemarginal; on the under side in not having the broad bluish area but instead of it three bands of bluish spots, the central one often irregular and connected with the outer one by small blue spots.

The form of the male genitalia is very similar to that of *nurscia.*

Distribution. Type locality: "Frontino, Antioquia." Colombia; Amazons (A.M.). Colombia (B.).

Ardaris

Watson, Proc. Zool. Soc. London, (1), p. 13, 1893.
Orthotype, *Pyrrhopyga eximia* Hewitson.

A. eximia.

Hewitson, Trans, Ent. Soc. London, p. 167, 1871. Exot. Butt., vol. 4, Pyrrh. pl. 2, fig. 12, 1871.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, p. 189, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 843, pl. 164 e, 1921.

There were no specimens of this species available for examination.

Distribution. Type locality: Venezuela.

Metardaris

Mabille, Gen. Ins., Hesp., p. 11, 1904.
Haplotype, *Pyrrhopyga cosinga* Hewitson.

The genitalia of *cosinga* have the uncus stout at the base, sharply tapering to a bifid apex, the basal flanges are long, projecting forward well beyond the apex of the uncus. The claspers terminate in a short, upcurved arm, with a sharp tooth from the upper angle of the rather blunt apex, back of which the dorsal edge is serrate for a short distance; at the base is a long, sharp pointed projection, inwardly directed.

M. cosinga (Fig. 21).

Hewitson, Bolivian Butt., p. 20, 1874. Exot. Butt., vol. 5, Pyrrh. and Eryc. pl., fig. 39 (not fig. 38), 1875.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 189, 190, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 843, pl. 164 e, 1921.

According to the Hewitson figure this very variable species has, in the typical form, a deep orange color of the maculation of the upper side. The series before the writer contains a considerable number of specimens which are sharply separated in color of the maculation. The late Mr. Jose Steinbach, of Santa Cruz, Bolivia, who collected most of these specimens, wrote, at the time of sending them, that he had found a large number of individuals at an elevation of 3,600 meters in the mountains north of Cochabamba and that they were so benumbed by the cold that he had no difficulty in collecting them by picking them of the bushes where they rested. These specimens have the maculation very heavy and ranging from a deep yellow to orange-yellow, the palpi, abdominal rings and anal tuft red. Further down the slope of the mountains he found another colony, between 2,200 and 2,300 meters elevation. It was late in the day when he found this colony and they had apparently gone to rest, he again had no difficulty in collecting them by hand. The maculation of the upper side of these specimens is much reduced and tends to become obsolete and is very pale yellow, on the under side of the wings it is a little heavier but of the same pale color, the palpi, abdominal rings and anal tuft are orange-brown. A pupa sent at the same time shows that the larva spins a thin cocoon among the leaves of a bush, probably the food-plant, the anal extremity of the pupa being firmly attached to the thin cocoon. The pupa has a considerable number of long, yellowish hairs on the dorsal surface of the thorax and on the entire abdomen. As it attempted to emerge during the long journey from Bolivia, the color and size are probably different than when collected.

Distribution. Type locality: Bolivia.

M. cosinga form **sanguinea.**

Mabille, Gen. Ins., Hesp., p. 11, 1904.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 189, 190, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 843, 1921.

This form differs in having the maculation reduced and red. The form of the genitalia does not differ from that of typical *cosinga*.

Distribution. Type locality: Bolivia.

M. cosinga form **obscura.**

Mabille, Gen. Ins., Hesp., p. 11, 1904.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, pp. 189, 190, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 843, 1921.

According to the description this form differs in the absence of the maculation of the upper side of the wings, but present beneath and yellow. Mabille and Boullet cite in synonymy "*Stigiana, Territa,* Stgr. in litter," the writer has been unable to find any description of them.

Distribution. Type locality: not given in the original description, but Mabille and Boullet mention Bolivia for specimens in the collection of the Paris Museum and Mabille.

Granila

Mabille, Gen. Ins., Hesp., p. 11, 1904.

Haplotype, *Pyrrhopyga paseas* Hewitson.

Genitalia. The uncus is long, tapering to a single, down-curved, sharp point. There are no basal flanges. The girdle is of moderate length, the saccus rather long. The ædœagus is short, somewhat bulbous in the middle. The claspers terminate in two, short, irregular arms, the lower one carrying numerous serrations. The two sides show some asymmetry.

G. paseas (Fig. 22).

Hewitson, Exot. Butt., vol. 2, Pyrr. pl. I, fig. 5, 1857.

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, p. 190, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 843, pl. 163 a, 1921 (both figures are females, the second one *albimacula* Mab. and Boull.).

Both sexes have the hyaline spots yellow, the female having less pointed primaries and broader secondaries with a prominent tooth projecting from about the center of the outer margin. This projection in the outer margin of the secondaries was noted by Hewitson in his description and his figure is that of a female.

Distribution. Type locality: Brazil. Brazil (A.M.). Tapyta, November; Villarica, Paraguay; Rio Grande do Sul, Brazil. (B).

G. paseas form **albimacula.**

Mabille and Boullet, Ann. des Sciences Nat., Paris, 9th series, p. 190, pl. 13, fig. 4, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 843 (as synonym of *paseas*), pl. 163 a (as female of *paseas*), 1921.

Mabille and Boullet's figure is clearly that of a female with white instead of yellow maculation. Draudt places *albimacula* in synonymy as the female of *paseas,* but as Hewitson states in his description of *paseas* that the females differ from the males only in the shape of the wings and as the writer has several females which have the maculation yellow as in the males, it seems just as well to retain the name *albimacula* for the form with white maculation. Whether this form is restricted to the female or not is unknown to the writer.

Distribution. Type locality: Brazil.

Jemadia

Watson, Proc. Zool. Soc. London, (1), p. 14, 1893.

Orthotype, *Pyrrhopyga hospita* Butler.

Group "*punctati.*"

(Shoulder-covers with white spots).

Genitalia. The termination of the uncus is divided. A somewhat rounded, smooth flange, of variable length, projects forward from the base. In some species a well developed scaphium is present. The girdle is rather long, the saccus moderate to short. The ædœagus is usually stout, of variable length, sometimes with a serrate flange toward the apex. The claspers terminate in a more or less stout arm, usually serrate on the outer and dorsal edges, or some part of them.

I. Primaries with the lowest subapical spot in interspace 5.

a. Secondaries with two basal rays and one on the abdomminal fold (sometimes absent) and a submarginal band. Four white dots on shoulder-covers.

J. **hospita** (Fig. 24).

Butler, Ann. and Mag. Nat. Hist., vol. xx, p. 128, 1877.

Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, p. 261; vol. 3, pl. 74, figs. 4, 5, 6, 1893.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 194, 196, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 843, pl. 166 b, 1921.

patrobas Hewitson, Exot. Butt., vol. 2, (descr. partim, not pl. I, fig. 1), 1857.

pseudognetus Mabille, Ann. Soc. Ent. Belg., vol. xxi, p. 21, 1878. (Id. pp. 17, 18).

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 194, 196, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 843, 1921.

ulixes Plotz, Stett. Ent. Zeit., vol. xl, pp. 520, 521, 1879.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 194, 197, 1908 (as *ulyxes*).

Draudt, Seitz Macrolep. of the World, vol. 5, p. 843, pl. 163 c, 1921 (as *ulyxes*).

hephaestos Plotz, Stett. Ent. Zeit., vol. xl, p. 521, 1879.

Druce, Trans. Ent. Soc. London (2), p. 376, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, pl. 163 e, 1921.

hephaestus Moschler, Verh. Zool.-bot. Gesell. Wien, pp. 324, 325, 1882.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 195, 197, 1908 (as *hephaestos*).

Draudt, Seitz Macrolep. of the World, vol. 5, p. 844, 1921.

imitator Mabille, Ann. Soc. Ent. Belg., vol. xxxv, (C. R., p. cx), 1891.

Mabille and Vuillot, Novitates Lep., fasc. 10, p. 102, pl. xiv, fig. 2, 1893.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 194, 196, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 843, pl. 163 c, 1921.

lisetta Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 195, 197, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 844, 1921.

Hospita is widely distributed and variable, the hyaline spots in interspaces 3 and 4 are particularly subject to contraction and finally disappear in the form *dorylas* Plotz; the basal and subbasal transverse blue stripes of the primaries may be well developed or obsolescent; the submarginal blue band of the same wings may extend almost to the apex of the wing or be much shortened; the two basal, white rays of the secondaries may be strongly developed or reduced to narrow lines, but in either case they each terminate in a distinct point, that is, they are not flown together into a single point; the submarginal blue band of the same wings may be very broad or very narrow, much extended or much reduced. The bands on the underside of the wings may also present many variations. The outer margin of the secondaries may be somewhat rounded, almost straight, or a little excavate.

There does not seem to be any necessity for the retention of distinctive names for the many minor variations in maculation, which accounts for much of the extensive synonymy here recorded.

Capt. Riley has sent the writer an excellent photograph of the type of *pseudognetus* Mabille, which shows it to be a rather large and well marked individual of *hospita*. There are specimens in the writer's collection, from Colombia, which very well agree with the description and the photograph and which do not differ in the form of the genitalia from that given by Godman and Salvin for *hospita*.

It is assumed that the Draudt figure of *ulixes* Plots, in Seitz Macrolep., is taken from the Plotz drawing of that insect and the writer cannot see that it differs in any important detail from *hospita.*

It is also assumed that the Draudt figure of *hephaestos* (changed to *hephaestus* in the corrections of *errata* on the plates, p. 1139) was taken from the Plotz drawing. It also appears to be *hospita.*

The Moschler type of *hephaestus* is a female and the writer is indebted to Prof. Martin Hering, of the Zoologisches Museum, Berlin, for an excellent photograph of it as well as a fine drawing of the genitalia. It appears to be the female of *hospita.*

The very excellent figure of *imitator* published by Mabille and Vuillot shows an evident *hospita* with the hyaline spots in interspaces 3 and 4 very much reduced and a photograph of the type received from Capt. Riley confirms this characteristic. As this is merely a transitional form to one in which these spots have completely disappeared there does not seem much need for the retention of the name.

Godman and Salvin state that Hewitson in describing the female of his *patrobas* has evidently referred a specimen of *hospita* as its male and that the specimens in his collection, as arranged by him, show that he has confused the two species.

Lisetta, according to the photograph of the type sent by Capt. Riley, and which was made by Mr. Tams, of the British Museum, together with all of the other photographs of the Mabille, and Mabille and Boullet types in this genus, has the same scheme of maculation as that of *hospita,* differing in the narrower blue bands of the wings, especially the submarginal band of the secondaries, which is also shortened, and the slightly excavate outer margin of those wings. The type specimens of *lisetta* came from Peru and Bolivia and Butler's type of *hospita* came from Peru. There are specimens from Bolivia in the collection of the writer which very well agree with the photograph of the type of *lisetta* and which do not materially differ from *hospita* in the form of the genitalia. The photograph of the type shows that the specimen is rather poorly spread and that the head is missing.

The scaphium is well developed. The claspers terminate in a rather long arm with the apex sharply pointed, or truncate, or rounded, and serrate; toward the base of the arm rises a strong, serrate, tooth-like projection, which varies in length among individuals. The aedoeagus carries a peculiar flange near the center. The figure of the genitalia here is from a Bolivian specimen which well agrees with the photograph of the type of *lisetta*.

Distribution. Type locality, *hospita,* Peru. *Pseudognetus,* not given, but Mabille and Boullet give Colombia. *Ulixes,* Surinam. *Imitator,* Bogota. *Hephaestos,* Surinam. *Hephaestus,* Paramaribo. *Lisetta,* Peru and Bolivia. Honduras; Colombia; Ecuador; Bolivia; Brazil, (B). Guatemala; Nicaragua; Panama; Colombia; Ecuador; E. Peru (G. & S.).

J. hospita form **dorylas.**

Plotz, Stett. Ent. Zeit., vol. xl, p. 522, 1879.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 196, 197, 1908 (as shown of *hewitsonii*).

Draudt, Seitz Macrolep. of the World, vol. 5, p. 843, 1921 (as synonym of *imitator*).

paulensis Schaus, Proc. U. S. Nat. Museum, vol. xxiv, p. 424, 1902.

Draudt, Seitz Macrolep. of the World, vol. 5, pp. 843, 1921 (as synonym of *imitator*).

Dorylas is the form of *hospita* in which the two hyaline spots in interspaces 3 and 4 of the primaries have disappeared on the upper side, sometimes they are indicated on the underside.

Mabille and Boullet are apparently incorrect in their interpretation of the Plotz description of *dorylas,* as they place it in synonymy with *hewitsonii.* Draudt places *dorylas* as a synonym of *imitator,* but the Mabille and Vuillot figure shows that insect to have the two spots mentioned, and in any event the Plotz name has many years priority. The writer is indebted to Prof. Martin Hering, of the Zoologisches Museum, Berlin, for a fine photograph of the Plotz type of *dorylas* and a drawing of the genitalia, which prove beyond any doubt that it is a form of *hospita.* In this photograph the two spots are absent above and minutely indicated beneath.

A superficial examination of the type of *paulensis* shows it to be this form of *hospita*. The two spots are faintly indicated on the upper side, when examined under a lens and a little more distinct on the underside.

Distribution. Type locality; *dorylas,* Porto Cabello. *Paulensis,* São Paulo, Brazil.

J. **sosia** (Fig. 25; Figs. 37, 38).

Mabille, Ann. Soc. Ent. Belg., vol. xxi, pp. 17, 21, 22, 1878.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 195, 197, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 844, pl. 163 d, 1921 (as *gnetus* Fabricius).

zamorae Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 195, 197, 1908.

This species much resembles *hospita* but is larger than the average individual of that species, the maculation of the secondaries usually heavier, especially the submarginal band of the underside, which is very broad and long; the two basal white rays of the upper side of these wings are flown together into one broad white ray which terminates in a single point, not two as in *hospita*. It is sometimes difficult to satisfactorily separate large and heavily marked *hospita* individuals on the superficial appearances, but if they are males the form of the genitalia will readily separate them.

The Draudt figure of *gnetus* very well represents this species, the upper and under side of which are also given in this paper.

The photographs received from Capt. Riley, of the types of both *sosia* and *zamoræ,* show without doubt that the two names represent the same insect.

The claspers terminate in a broad, angular, serrate lobe, the upper point of the angle directed obliquely backward. The aedoeagus carries the small flange similar to that of *hospita*.

Distribution. Type locality not given. Mabille and Boullet say "Amer. Merid." Colombia; Ecuador (B).

J. **gnetus** (Fig. 26; Fig. 42; Fig. 43).

Fabricius, Spec. Ins., vol. 2, p. 135, 1781.

Mabille, Ann. Soc. Ent. Belg., vol. xxi, pp. 20, 21, 1878.

Watson, Proc. Zool. Soc. London, p. 14, 1893.
Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., p. 197, 1908.
vulcanus Cramer, Pap. Exot., vol. 3, p. 87, pl. 245, figs. C, D, 1782.
Mabille, Ann. Soc. Ent. Belg., vol. xxi, p. 20, 1878.
Watson, Proc. Zool. Soc. London, p. 14, 1893 (as synonym of *gnetus*).
Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 194, 197, 1908.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 844, pl. 163 e, 1921.
megalesius Hubner, Verz. bek. Schmett., p. 110, 1820.
menechmus Mabille, Ann. Soc. Ent. Belg., vol. xxi, pp. 17, 18, 21, 1878.
Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 195, 197, 1908.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 844, 1921 (not plate 163 d).

Considerable confusion obtains in regard to this species. Capt. Riley informs the writer that the Fabrician type of *gnetus* is contained in the British Museum collection and he has sent an excellent photograph of it, made by Mr. Tams, as well as a photograph of the Mabille type of *menechmus,* which show the two names to represent but one species. The type is a female and he states that it very well agrees with Cramer's original drawing of *vulcanus* (not any published figure of it). The figure of *vulcanus* is also that of a female, as stated by Cramer in his description, and has apparently lost something of accuracy in the course of reproduction in Pap. Exot. Capt. Riley also states that he has examined the type of *menechmus* and the other two specimens in Mabille's series and that they agree with *gnetus.*

The Draudt figure of *menechmus* (plate 163 d) is very obviously *hewitsonii* Mabille, while that of *gnetus* on the same plate is in reality *sosia* Mabille.

In *gnetus* Fabricius the submarginal blue band of the primaries extends in a straight line, parallel to the outer border of the wing, passing outside of the two hyaline spots in interspaces 3 and 4 and the subapical spots, as far as vein 6. This characteristic is well shown in the Draudt figures of *vulcanus*, especially that of the female and is illustrated in the figures given in this paper. The submarginal band on the upper side of the secondaries begins very broad just below vein 7 and diminishes rapidly in width to vein 2, on which it terminates in a sharp point, thus the five spots composing it form a triangular band, below vein 2 to the anal angle the band is very narrowly continued. Beneath the band begins on the costal margin but retains the triangular shape as far as vein 2, below which it is a small blue spot. The band is blue or bluish-white. The secondaries have two distinct teeth, on the outer margin, one at the end of vein I b and one at the end of vein 2, above which the wing is excavate. The peculiarity of the submarginal band of both wings has not been found in any other species in this genus, examined by the writer, except *suzetta* Mabille and Boullet which closely approaches it, the band of the secondaries usually being a little narrower in *suzetta* that in *gnetus*. The two are readily separated by the white spots on the shoulder-covers of *gnetus* and white line in the same place in *suzetta*.

The uncus is rather long, at the apex terminating in two sharp pointed arms; the flanges at the base very small. The scaphium well developed. The claspers terminate in a rather abruptly upturned, sinuous arm, deeply serrate at the tip; the dorsal edge of the clasper is produced forward into a stout tooth above the base of the terminal arm and there is another large tooth on the dorsal edge of the inner plate of the disc near the base. The aedoeagus is bulbous at the base.

Distribution. Type locality, *gnetus*, "Hab. in Indiis". *Vulcanus*, Surinam. *Menechmus*, not given; Mabille and Boullet give Brazil; Amazone. Iquitos, Peru; Ecuador (B). Rio Negro, Brazil (A.M.).

b. Secondaries with an additional median blue band.

J. hewitsonii (Fig. 27; Fig. 39).

Mabille, Ann. Soc. Ent. Belg., vol. xxi, p. 19, 1878. (Id. pp. 17, 18.)

Hewitson, Exot. Butt., vol. 2, Pyrrh. Pl. I, fig. 2 (not fig. I), 1857, (as *vulcanus* Cramer).

Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, p. 262; vol. 3, pl. 74, figs. 7, 8, 9, 1893.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser. pp. 194, 197, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 844, pl. 166 b; pl. 163 d, (as *menechmus*), 1921.

Hewitsonii is one of the most common species of *Jemadia* and easily recognizable. It naturally varies in size, color of the bands (blue in some and with a greenish tinge in others) and the extent to which the bands are present. There is a tendency for the submarginal band on the upper side of the secondaries to become obsolete.

The spelling of the original description is used here although in literature generally the name is spelled "*hewitsoni.*"

The flange at the base of the uncus is small and rather weakly developed, in some cases can hardly be seen. The uncus is rather long and a little angular, terminating in two pointed arms. The ædœagus is stout and has a flange near the apex. The terminal arm of the claspers is a little upturned toward the apex and has numerous serrations on the dorsal edge. The inner plate of the disc has a large tooth on the dorsal edge.

Distribution. Type locality, Hewitson gives Brazil for his figure 2. Colombia; Ecuador; Santa Cruz, Bolivia; Peru; Aracatuba, Brazil. (B). Panama. (G. & S.).

J. hewitsonii form le cerfi.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 195, 197, pl. 13, fig. 5, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 844, pl. 163 d, 1921.

The Mabille and Boullet figure appears to be a rather small individual of *hewitsonii* with the submarginal blue band of the upper side of the secondaries almost absent. There is a specimen in the collection of the writer, which very well agrees with the figure, as well as numerous transitions between this and the typically marked form.

Distribution. Type locality, Guiana. Obidos, Brazil, (B).

J. fallax.

Mabille, Ann. Soc. Ent. Belg., vol. xxi, p. 22, 1878. (Id. p. 17).

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 194, 195, 197, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 844, pl. 163 e, 1921.

The description states that there are three series of hyaline spots on the primaries. The first basilar band is white, the second blue and connected by a blue dash with the submarginal band which ends at the extra-discal spot. A blue dash under the discal hyaline band. On the secondaries the rays are reduced and united into a white basal band; there are two blue bands, the inner one short, broad and not extending to the anterior border of the wing which is broadly white and crossed only by the black line which cuts the rays. The submarginal blue band is narrow and a little macular. Beneath the submarginal band is very broad and white and touches the border of the wing.

Capt. Riley informs the writer that the Draudt figure represents this species reasonably well, the broad blue diagonal streak between the cell of the forewing is stronger in the type, extending up to vein 2. On the hindwing the narrow submarginal band is overemphasized in the figure, but it shows correctly the considerable removal of the band from the margin of the wing. This figure shows an insect very similar in appearance to *zonara* Hewitson and like that species has a white line on the shoulder covers, but Mabille and Boullet have placed it in this group having white dots on the shoulder-covers. Capt. Riley states that the type of *fallax* is devoid of the head, abdomen and the scales of the thorax. Under these circumstances it seems very difficult to ascertain accurately whether *fallax* is really a distinct species or not.

Distribution. Type locality, Brazil.

J. albescens.

Rober, Ent. Mitteil., vol. xiv, pp. 87, 88, 1925.

Although this species is compared with *zonara* in the description, it is stated that there are two white dots on the right side of the collar (shoulder-covers), and it is therefore included here. The description states that there is a yellowish-white hair tuft on the sides of the abdomen close to the wing base. The primaries are extended at the apex, the secondaries narrowed anally. Primaries with a discal hyaline band, extra discal spots and four subapical spots. The sub-basal band runs from the sub-costal vein to the inner border, nearly white with a sprinkling of greenish, followed by a light green band placed nearer to the discal hyaline band than in *zonara.* The two dashes beneath the discal hyaline band are green. The submarginal band of the secondaries is short, narrow and gradually lost anally, separated from the others at the anal angle. The discal band is blue-green, the basal stripes are greenish-white, more developed on the under side.

Distribution. Type locality, Macas, Ecuador.

2. Lowest subapical spot of primaries in interspace 4. Four white dots on the shoulder-covers.

J. patroclus.

Plotz, Stett. Ent. Zeit., vol. xl, p. 522, 1879.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., p. 196, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 844, pl. 166 c, 1921.

According to the description there is only one extra-discal spot, that in interspace 3. The five subapical spots are followed by a dot in interspace 9. On the hindwing beneath the outer blue band is cut by a black, wavy line and the two blue bands are not connected, the black central stripe is uncleft.

Mabille and Boullet express the opinion that *patroclus* is associated with the group containing *azeta* and *patrobas,* but Draudt states that the excellent figure of Plotz shows that there are four white dots on the collar (shoulder-covers) instead of a white line as found in the *azeta* group. Despite the fact that there are white dots in the Plotz figure, it is the writer's belief that there is an inaccuracy of some kind which cannot now be satisfactorily explained and that patroclus really belongs in the group associated with *patrobas*. Sometimes the loss of a few scales breaks the continuity of the white line of the shoulder-covers and gives the appearance of spots instead of it. Also personal experience with promiscuous mending of specimens, and *Jemadia licinus* for instance, occasions the thought of the possibility of something of this kind in *patroclus*. The insect is included here until more definite evidence can be obtained.

Distribution. Type locality, Peru.

3. Secondaries very short. Shoulder-covers with one white dot on each side.

J. brevipennis.

Schaus, Proc. U. S. Nat. Museum, vol. xxiv, p. 425, 1902.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 845, 1921.

The description states that the collar is black. The usual bands and stripes of the body and wings are green or greenish. The extra-discal hyaline spot in interspace 4 is placed above that in interspace 3. The submarginal band of the primaries extends to vein 5, that of the secondaries is broad, does not extend to the costal margin, tapers toward the anal angle and is interrupted by the veins. Beneath the submarginal band of the secondaries is broad, widest at the costa. The secondaries are unusually short.

The type appears to be a female, but the superficial examination was not conclusive as to the sex. The head is black with a small white dot in front of each antenna. The shoulder-covers have a white dot on each side, the rest is black. The species is included here on account of the two white dots on the shoulder-covers.

Distribution. Type locality, São Paulo, Brazil.

Group "*lineati.*"

(Shoulder-covers with a white line).

Genitalia. In the species of this group which have been examined, most have an uncus which terminates in a single point, curved downward. In *alburna* and *suzetta* the uncus terminates in two points. The basal flanges vary considerably. The scaphium is well developed in a few species. The ædœagus is rather short, a little thick and variable in shape. The terminal arm of the claspers is usually rather long, serrate on the dorsal edge, and sometimes on the ventral edge, and often with small teeth on the outer side toward the apex and usually with an upward projection from the dorsal edge at the base, though this is absent in some species.

1. Primaries above with hyaline spots in interspaces 3 and 4 separated and in an oblique line toward the apex of the wing (may be absent in *macleannani*). Four subapical spots, in interspaces 5, 6, 7, 8, and sometimes a dot in 9. Secondaries beneath with the outer blue band enclosing a black line or a narrow blue streak is split from it by a black line. Outer band followed by a short blue band between it and the median blue band.

J. polyzona.

Latreille, Enc. Meth., vol. 9, p. 736, 1823.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 192, 196, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 844, pl. 163 a, 1921.

Riley, Trans. Ent. Soc. London, (2), p. 232, 1926.

Capt. Riley has sent to the writer a fine photograph of the upper side of this species, from a specimen bearing the identification label "*polyzona*" in Latreille's own handwriting and the locality label "Cayenne." The photograph shows an insect somewhat larger and with broader blue bands than *jamina* Butler, at least when compared with specimens of that species in the writer's collection. The discal band of hyaline spots is narrow, the two extra-discal spots in interspaces 3 and 4 are longer vertically than horizontally and are well separated. Of the four subapical spots, the upper in interspace 8 is very minute, the lowest in interspace 5 ends pointedly on vein 5. The costal margin is broadly striped with blue. The blue bands of the upper side of the secondaries do not extend above vein 7, but there is a small whitish dot near the base above that vein. The submarginal band is slightly cut by a thin black line, near its outer edge, in the four upper interspaces. Capt. Riley states that the blue markings are unusually large and brilliant, especially toward the hind margin of both wings and that they are larger and paler than in any of the specimens of *jamina* in the British Museum collection.

There are two specimens, both females, in the collection of the writer, from St. Laurent, French Guiana, which are believed to be *polyzona,* as a photograph of one of them sent to the British Museum agrees with specimens of that sex of *polyzona* in their collection. In these two specimens the stripes on the tegulæ, the palpi, pectus, and hairing on the under side of the thorax are slightly tinged with yellow.

In *jamina* the subapical spots are broader, the lowest nearly square, being very broad on vein 5; the two extra-discal hyaline spots are close together, and are approximately the same length vertically and horizontally, the upper, outer corner of the lower spot touching, or nearly so, the lower, inner corner of the upper spot.

In view of these differences in maculation it seems just as well to keep *polyzona* and *jamina* separated until the male material of *polyzona* can be examined.

The Draudt figure of *polyzona,* while rather poor in some particulars and giving white dots on the shoulder-covers instead of a white line, shows very well the wide separation of the two extra-discal hyaline spots.

Distribution. Type locality, Latreille mentions a specimen from Brazil, and states that it is also found in Surinam and probably Cayenne.

J. jamina (Fig. 28).

Butler, Trans. Ent. Soc. London, p. 499, 1870.

zimra Hewitson, Exot. Butt., vol. 4, Pyrrh. pl. 2, fig. 11, 1871.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 192, 196, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 844, pl. 163 a, 1921.

Jamina resembles *polyzona* but differs from it as noted in the remarks under that species.

Hesperia zimra Hewitson, Ann. and Mag. Nat. Hist., 4th ser., vol. 19, p. 77, 1877, sometimes given in reference to this species, is a very different insect and not a member of the *Pyrrhopyginæ*.

The Draudt figure of *zimra* male agrees very well with the specimens at hand, except that the lower of the two extra-discal spots is too round. The figure of the female is quite similar to the two female specimens mentioned under *polyzona* and which are believed to be that species, it especially agrees in the two narrow, well separated, extra-discal hyaline spots, and the sub-apical dot in interspace 8 being removed basally.

The terminal arm of the claspers terminates in a rather rounded apex, with a slight projection of the ventral edge in the right clasper, this is absent in the left clasper; from the center of the dorsal edge rises a broad serrate flange and a short serrate tooth at the base. The form is quite similar to that given by Godman and Salvin, Biol. Centr.-Amer, Rhopal., vol. 3, pl. 74, fig. 12, for *macleannani*.

Distribution. Type locality, not given. Santa Cruz, Bolivia; Paraguay, (B).

J. macleannani.

Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, pp. 262, 263; vol. 3, pl. 74, figs. 10, 11, 12, 1893.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 193, 196, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 845, pl. 166 b, 1921.

This insect must be very closely related to *jamina* Butler. The description states that the two extra-discal hyaline spots may be present or absent, figure 10 shows only the one in interspace 4, reduced to a minute dot, figure 11 shows both spots reduced to small dots.

The form of the genitalia apparently does not materially differ from that shown in this paper as *jamina* Butler.

Distribution. Type locality, Panama.

J. extrema.

Rober, Ent. Mitteil., vol. xiv, pp. 157, 158, 1925.

This species was described from a female from an unknown locality. The description states that it belongs to the "*lineati*" and resembles the female of *zimra*. The writer does not know the species.

2. Primaries with a single extra-discal hyaline spot, in interspace 3. Five subapical spots, in interspaces 4, 5, 6, 7, 8, and a dash or dot in interspace 9, which may be absent. Secondaries beneath same as in Division 1.

J. **azeta** (Fig. 29).

Hewitson, Trans. Ent. Soc. London (2), p. 479, 1866.

Godman and Salvin, Biol. Centr-Amer., Rhopal., vol. 2, p. 264; vol. 3, pl. 74, figs. 16, 17, 1893.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 193, 196, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 845, pl. 163 b, 1921.

Considerable difficulty attends the separation, on superficial characters, of *azeta* and the other species with very similar maculation. It appears to be impossible to use the formation of the bands on the under side of the secondaries for separation purposes. The only accurate way to separate them is by the form of the male genitalia. The identification of *azeta* and *patrobas* in this paper is based on the work of Godman and Salvin in the Biologia, which should be correct, as they had access to the Hewitson types in the British Museum, and all of their work has been very carefully and correctly done.

The uncus is long, the flanges at the base are large, somewhat triangular, and serrate. The ædœagus is short, stout and bulbous toward the base and with a small triangular flange near the apex. The claspers terminate in a long thin arm, somewhat broadened at the tip; the arm extends a little obliquely upward from its base and is then projected downward and outward, the inner half of the dorsal edge is serrate, a small, serrate flange arises from the side near the base and is directed obliquely backward, at the apex of the arm is a tuft of long hairs (not shown in the figure). At the base of the terminal arm, on the ventral side there is a short rounded lobe which also carries a tuft of long hairs.

Distribution. Type locality, "Amazon (St. Paulo)." Macas, Ecuador (B). Guatemala; Panama; Peru; Amazons Valley; Bolivia; South Brazil (G. & S.). Honduras (A. M.).

J. azeta form **melanina.**

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 193, 196, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 845, pl. 163 c, 1921.

From the description, *melanina* is apparently a form with reduced maculation, but whether it is *azeta* or an allied species can only be determined by an examination of the genitalia.

Distribution. Type locality, Bolivia.

J. patrobas (Fig. 30).

Hewitson, Exot. Butt., vol. 2, Pyrrhop. pl. 1, fig. 1 (as *vulcanus*); *patrobas* loc. cit. text partim., 1857.

Godman and Salvin, Biol. Centr.-Amer., vol. 2, pp. 263, 264; vol. 3, pl. 74, figs. 13, 14, 15, 1893.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 193, 196, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 845, pl. 163 b, 1921.

The confusion of two species in the Hewitson description, under the name *vulcanus,* has been amply cleared up by Godman and Salvin in their remarks on *patrobas,* and by Mabille in his description of *hewitsonii* for Hewitson's figure 2 in Exotic Butterflies.

The claspers terminate in a long, rather sinuous arm, the apex sharp or bluntly rounded, serrate on the dorsal edge and with a toothlike projection from the base directed obliquely inward. The inner plate carries some short serrations on the dorsal edge. The basal flanges of the uncus are small, with fine serrations at the apex.

Distribution. Type locality, "New Granada." Bogota, Colombia; Ecuador; Yungas, Bolivia. (B.). Colombia; Central America. (A. M.). Panama; Colombia. (G. & S.).

J. miodesmiata.

Rober, Ent. Mitteil., vol. xiv, pp. 88, 89, 1925.

Described from one male as being very similar to *patrobas*, differing in the reduced maculation. Only an examination of the genitalia will confirm the identity of this specimen as a good species or a form of one of the others.

Distribution. Type locality, "West Colombia, (Rio Magdalena)."

J. merops new species. (Figs. 31, 40, 41).

Male. Upper side. Primaries black, a transverse discal band of three white hyaline spots from the upper edge of the cell to the center of interspace 1; a narrow, oblong white hyaline spot in interspace 3; five white hyaline, subapical spots in interspaces 4, 5, 6, 7, 8, the first four in an oblique line, the fifth slightly inward, just over the inner angle of the fourth spot. The transverse band next to the base of the wing is very much reduced and bluish-white; the following band narrow and bluish. The two streaks under the discal band are green. The submarginal band green, first stopping under the extra-discal hyaline spots, and then under the subapical spots, and then in traces outside of the subapical spots in interspace 5. A very thin blue line above the extra-discal spot. Secondaries black, the space above vein 7 to the costal margin tinged with purplish and with a minute white dash near the base of the wing; basal band white, discal band narrow, green on each end and white in the center; the submarginal band narrow, green; abdominal fold black with a few green scales at the end of the discal band.

Beneath. Primaries black, base below the cell pale brown; inner marginal area purplish; costal margin in the basal quarter bluish-white; a transverse, broken, sub-basal band of bluish-white; the discal hyaline band as above, narrowly edged with bluish-white and almost continued to the costal margin by two bluish-white stripes; extra-discal spot and subapical spots as above, narrowly edged with bluish-white; the submarginal blue band ends at the extra-discal spot; a narrow blue stripe at the extreme end of the cell. Secondaries black; a white basal band, a narrow green discal band, then a short green band, then the submarginal band, which is split in two by a black line at vein 7, the two parts extending to vein 1 b; all of the bands reach the costal margin, if only in scattered scales; the abdominal space heavily sprinkled with blue.

Shoulder-covers with a white line. The color and maculation of the head and body and their appendages, and the fringes, is similar to that of the other allied species in this group.

This species resembles *azeta, patrobas* and the other closely allied species in color and maculation. In the specimens at hand the subapical spots of the primaries differ from those of *azeta* and *patrobas* in that the lower four are in a straight line with each other and only the fifth is slightly out of alignment, in the two last named species the subapical series is a little curved, though sometimes the extension of the upper spots straightens the band a little, but in either case the spots are all in a line with each other. This difference is present in the specimens at hand, but it might not hold good if a long series of all of the species were compared.

The form of the male genitalia conclusively proves that this species is distinct from either *azeta* or *patrobas*. The uncus is similar to some of the other species; the basal flanges are smooth and irregularly tapered to a point. The girdle is long; the saccus short. The ædæagus short, stout and triangular at the apex. The claspers terminate in a broadened lobe with numerous serrations, and short teeth on the side. On the dorsal edge of the terminal arm are some serrations back of the lobed apex.

Expanse: 66 mm.

Type material. Holotype male, Colombia, in collection of the American Museum of Natural History, New York City. One male paratype, Santa Cruz, Bolivia, in collection of the author.

J. theseus new species. (Figs. 32, 44, 45).

Male. Upperside. Primaries black, the usual discal white hyaline band of three spots, above which, on the costal margin are some blue scales; an oblong hyaline spot in interspace 3, above which is a blue stripe; five subapical spots in interspaces 4, 5, 6, 7, 8, and a dash in interspace 9, the spots in interspaces 6, 7, and 8 are curved inwardly. A basal and sub-basal transverse band, the first one white and the second one blue; two large blue stripes under the discal hyaline band; an irregular submarginal blue band, the first part stopping under the extra-discal spot, the second part under the subapical spots and the third outside of them. Secondaries black, the costal area above vein 7 purplish with a minute whitish spot at the base and a larger one between the submarginal and discal bands. A bluish-white basal band, extended in a long thin stripe along the abdominal fold; a pale bluish discal band; a broad, blue submarginal band of the same width throughout, not tapering toward the anal angle; these last two bands are brightly colored. The abdominal fold with bluish-white scales at about the center.

Beneath. Primaries black, basal area brown, inner marginal area purplish; hyaline spots repeated and edged with blue; the basal transverse band broken into spots; the sub-basal white and broader than above; the costal margin striped with blue; the inner margin with a blue stripe; the two lower spots of the submarginal band very large and quadrate. Secondaries black, costal margin blue; a very narrow basal stripe; a broader sub-basal band; a slightly curved discal band; a short band of from two to five spots; a broad submarginal band cut by a black line from vein 7 to vein 2; all of these bands are bright, pale blue; abdominal fold and inner margin pale blue.

Shoulder-covers with a white line. The rest of the maculation of the head, body and appendages is similar to the allied species.

The maculation in this species is heavy and in pattern likewise resembles the other species in the *azeta, patrobas* group but the form of the genitalia amply proves it to be quite specifically distinct from the others. The small dash in interspace 9 of the primaries is somewhat more pronounced than in the specimens of *azeta* and *patrobas* at hand; the broad submarginal blue band of the upper side of the secondaries, of equal width, differs from that of the two species mentioned.

The uncus is similar to that of allied species, the flanges at the base somewhat triangular and serrate. The ædæagus stout, with a triangular apex. The terminal arm of the claspers is very long and curved, the apex pointed, numerous serrations on both edges and short teeth on the side.

Expanse: 64 mm.

Type material. Holotype male, Brazil, one male paratype from Colombia and one male paratype from Macas, Ecuador, in collection of the author; one male paratype, Jungilla, Ecuador, 4,000 feet, in collection of Academy of Natural Sciences, Philadelphia, Pa.

J. umbrata.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 193, 196, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 845, 1921.

The description states that the fifth subapical spot is minute and more apparent beneath than above. The extra-discal spot square, above it a square blue spot. The submarginal blue band ending at the extra-discal spot. The characters given for the under side of the secondaries offer no basis for the separation of *umbrata* from the other similarly marked species. An examination of the genitalia will be necessary to determine the distinctness of this species.

Distribution. Type locality, Bolivia.

3. Primaries with two extra-discal hyaline spots, in interspaces 3 and 4, in an oblique line toward the apex of the wing. Three subapical spots in interspaces 6, 7, 8, and a dash in 9. Secondaries beneath with the outer blue band not divided by a thin black line, and not followed by a short blue band between it and the median blue band.

J. alburna (Fig. 33; Figs. 46, 47, 48).

Mabille, Ann. Soc. Ent. Belg., vol. 35, (C. R. p. cx), 1891.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 192, 196, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 844, pl. 163 b, 1921.

The primaries have but three subapical spots, followed by a small dash in interspace 9. The basal band is very short, the sub-basal band very broad and brightly colored. The submarginal band is also bright blue, beginning below vein 1 and tapering to a point outside of the second subapical spot. No stripes under the discal hyaline band. The discal hyaline band is approximately straight on its inner edge and curved on the outer edge. The secondaries have the submarginal and discal blue bands broad and brightly colored, the first a little curved and the second somewhat sinuous. Beneath the submarginal band of both wings is broader than above and brilliant.

The female is larger than the male, the wings more rounded, the hyaline discal band broader. In addition to the two short teeth on the outer margin at the anal angle of the secondaries, there is also a broad projection from just before vein 3 to just beyond vein 4. The pattern of the maculation is identically the same as in the male.

Although Mabille in the original description used the spelling "*alburna*," it appears in all of the literature that writer has seen as "*alburnia*." The original spelling is used in this paper.

If the Draudt figure actually represents a specimen of this species, it is rather poor.

The uncus terminates in two rather long slender arms. The basal flanges are long, and broad, the apex rounded, and covered with short teeth in the outer two-thirds. The ædœagus is short, with a bulbous base. The claspers are broad, the terminal arm ending in an upturned, serrate flange, back of which is another broad, serrate flange with a tooth-like projection from the lower, inner angle. The inner plate of the disc carries two tooth-like projections from the dorsal edge extending obliquely downward toward the base.

Distribution. Type locality, Chanchamayo. Parana, Brazil; Ecuador. (B.).

4. Primaries with four subapical spots in interspaces 5, 6, 7, 8, that in 8 sometimes very minute. The extra-discal hyaline spot in interspace 4 in a line above that in interspace 3. Secondaries same as in Division 3.

J. **zonara** (Fig. 34).

Hewitson, Trans. Ent. Soc. London, 3rd ser., vol. 2, p. 480, 1866. Exot. Butt., vol. 4, Pyrrh. pl. 2, fig. 10, 1871.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 193, 196, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 845, pl. 163 b, 1921 (male only, not the female).

In the specimens at hand the sub-basal blue band of the primaries is united with the blue streak below vein 1 along the inner border of the wing and this in turn is united, or nearly so, with the narrow submarginal blue band. The discal blue band of the secondaries is composed of two pointed spots, coalescent on vein 2, the upper one very broad on vein 7. Between vein 7 and the costal margin, toward the angle of the wing, is a larger whitish spot, which may be diffuse and indistinct. The outer blue band of the secondaries is very narrow and tends to become obsolete. Beneath the sub-basal band of the secondaries is very broad and whitish; the discal band much narrower than above and straight; the spot in the cell cut by the discocellular; the outer band much broader than above.

None of the specimens at hand exactly agree with the Hewitson figure, but the pattern of the maculation is the same and the small differences are likely due to individual variation.

The Draudt figure of the female of *zonara* appears to be some other species, as the two extra-discal spots of the primaries are placed like those of *polyzona* and not like those of *zonara.*

The uncus terminates in a downcurved sharp point. The ædœagus is short. The terminal arm of the claspers is short and broad, the apex rounded, serrate on the dorsal edge, with two serrate projections near the base. The inner plate of the disc has a number of serrations on the dorsal edge.

Distribution. Type locality, Amazon. Upper Amazon; Bogota, Colombia; Manicore, Brazil. (B.). Amazons. (A. M.).

J. suzetta (Fig. 35; Figs. 49, 50, 51).
Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 193, 194, 196, 1908.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 845, 1921.

The specimens at hand agree with the photograph of the type which Capt. Riley has sent. *Suzetta* has a broad sub-basal blue band of the primaries which is not united with the blue stripe below vein 1 but extends to the inner margin of the wing, the usual blue stripe being reduced to a short dash near the anal angle. The submarginal blue band is straight, narrow, and extends outside of the extra-discal and subapical hyaline spots to interspace 5 or 6. The secondaries have the discal bluish band somewhat similar to that of *zonara,* but usually with a diffuse whitish spot above vein 7; the submarginal blue band is broader than in *zonara,* beginning below vein 7 and tapering toward the anal angle, sometimes much reduced and absent below vein 2, sometimes there is another spot above vein 7 and a bluish stripe on the costal margin. On the under side of the secondaries the basal band is narrower than in *zonara* and not so purely white.

The series at hand presents considerable variation in the development and color of the bands, in some specimens the bands of the secondaries have a greenish tinge, in others they are blue; in some the palpi are almost entirely black, having but a few white hairs interspersed at the side, the pectus almost entirely black, the white spots beneath the antennæ much reduced, the white line on the shoulder-covers reduced to a few scales so that at first glance they appear to be black, in other individuals the usually white parts are fully developed. No difference in the form of the male genitalia accompanies these variations.

The female is larger than the male, and the arrangement of the bands is identically the same in both sexes. The secondaries of the female are broader and there is a pronounced projection in the outer margin between veins 3 and 4.

The uncus terminates in two well developed arms with a triangular apex; the basal flanges are short and roundish. The scaphium well developed. The ædœagus short, and bulbous a little beyond the base. The terminal arm of the claspers is triangular, serrate on the dorsal edge and with a stout serrate projection at the base.

Distribution. Type locality, Bolivia. Aracatuba, Brazil; Iquitos, Peru; Ecuador; Santa Cruz, Bolivia. (B.). Colombia; Amazons. (A. M.).

J. scomber.

Druce, Trans. Ent. Soc. London, (2), p. 379, pl. xxi, fig. 4, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, pl. 163 c, 1921 (as *perplexa*).

The description states that the type is a female. Both surfaces of the wings black, with the sub-hyaline spots and pale bluish bands usual in the genus, but distinguished from all of the others by a broad, ultra basal, whitish-blue band on the forewing above and a large, whitish, undivided basal area on the same surface of the hindwing. On the under side the blue bands are as in *hospita* Butler, except that the extreme abdominal margin is black and not blue.

Druce's figure is very good, the shoulder-covers show a white line, the abdomen above with white hairs at the base, followed by two white rings, the rest black. The submarginal blue band of the primaries is slightly broken at vein 3, but otherwise almost straight, passing well outside of all of the hyaline spots to near the apex of the wing. The figure shows a large insect with a heavy body. Druce states that there is another specimen from Peru in the collection of Mr. H. J. Adams.

Capt. Riley has kindly examined the specimens in the British Museum collection and informs the writer that the posterior tibiæ have spurs, which precludes the possibility of *scomber* being synonymous with *Nosphistia perplexus* Mabille, where it is usually placed in the literature. In addition the maculation does not agree with that of *perplexus*.

The Draudt figure fairly well agrees with that of Druce, except that the bands of the wings are green and not blue and that the white maculation of the thorax and abdomen above is a little more extensive than in the Druce figure.

Distribution. Type locality, Pozuzu, Peru, (5,000-6,000 ft.).

J. gigantea.

Rober, Ent. Mitteil., vol. xiv, pp. 156, 157, 1925.

This species is described from a female from an unknown locality. The detailed description states that there is a white line on the collar (shoulder-covers), and with the other characteristics given it seems to belong here.

5. Primaries without hyaline spots.

J. ahira.

Hewitson, Trans. Ent. Soc. London, 3rd ser., vol. 2, pp. 479, 480, 1866. Exot. Butt., vol. 4, Pyrrh. pl. 2, fig. 9, 1871.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 192, 196, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 845, pl. 163 a, 1921.

According to the description there are no hyaline spots of the primaries. The wings are black, the primaries with two transverse bands of white near the base, a broad, trifid, silver-blue band, at first longitudinal and parallel to the inner margin, then at a right angle to it; toward the apex three indistinct spots of the same color. Secondaries with a white band near the base and in the middle with a broad band of pale blue. Beneath as above except that the longitudinal part of the band of the primaries is absent. The figure shows a white line on the shoulder-covers.

Distribution. Type locality, "Amazon (Para)."

Nosphistia

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 173, 197, 1908.

Haplotype, *Pyrrhopyga perplexus* Mabille.

N. perplexus (Fig. 36).

Mabille, Ann. Soc. Ent. Belg., vol. xxi, pp. 17, 20, 1878.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., pp. 197, 198, 1908 (as *perplexa*), vol. xvi, pl. 1, fig. 2, 1912.

There is a male specimen in the collection of the writer which agrees with the description, and the figure given by Mabille and Boullet. The sub-basal blue band of the primaries is united with the blue streak on the inner margin, this, and the submarginal blue band, much resembles *Jemadia zonara* Hewitson. The discal blue band of the secondaries is short, broad and rounded at the top, and pointed on vein 2, where it is cut into two small sections. The submarginal band is composed of minute spots and follows the contour of the pronounced anal lobe. Between veins 6 and 7 there is a large diffuse bluish spot and a stripe of the same color on the costal margin. Beneath the discal band of the secondaries is extended, above and below, in spots; the submarginal band broader than above, the spot above vein 7 sharply defined. The posterior tibiæ lack the spurs found in the genus *Jemadia,* and *scomber* Druce, which possesses these spurs, is removed from the synonymy of *perplexus* as previously stated under that species.

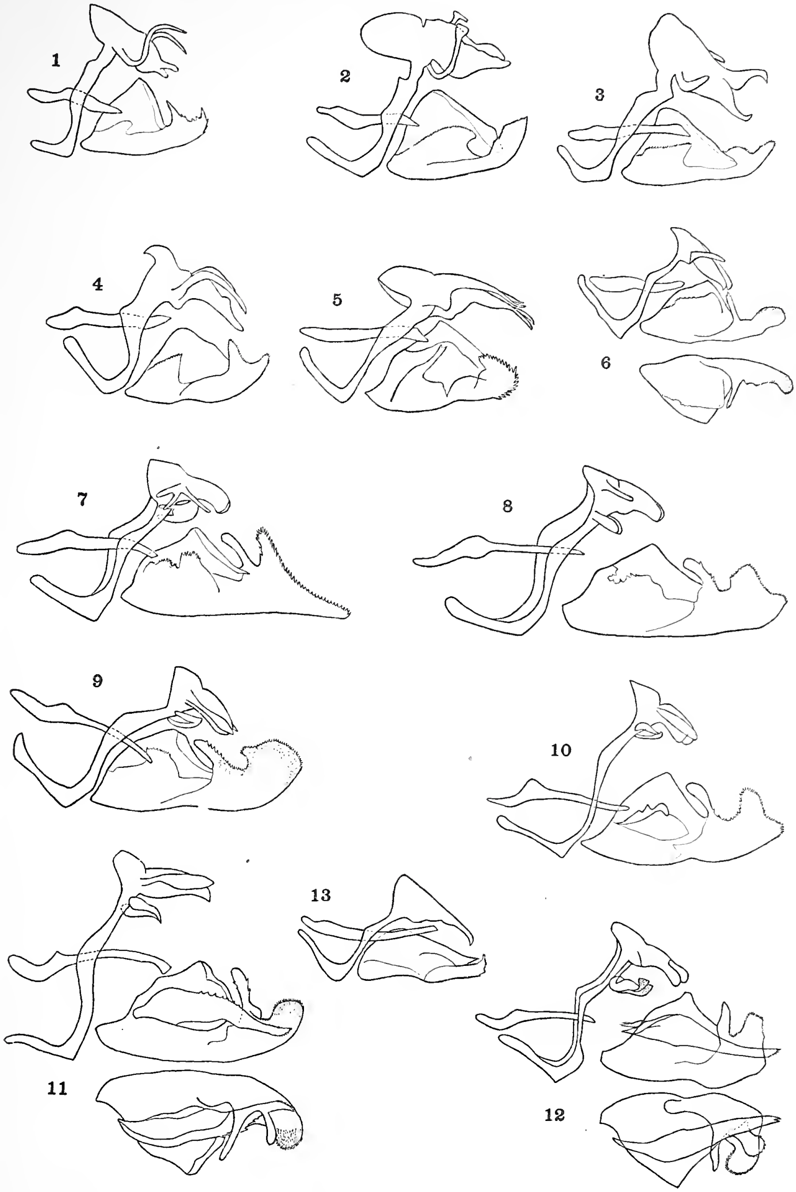
The genus is usually spelled ''*Nosphittia*'' and this species ''*perplexa*'' neither of which agree with the original spelling as followed in this paper.

The uncus terminates in two, short arms, curved downward and pointed at the apex, the basal flanges are well developed, smooth, and rounded at the apex. The terminal arm of the claspers is long and narrow, serrate on the dorsal edge, at the base with a stout upward projection with a serrate apex.

Distribution. Type locality, not given in the original description, Mabille and Boullet give Brazil. Ecuador (B.). La Merced, on the upper Rio Pastaza, below Banos, Ecuador, 4,000 ft. (W. J. Coxey) (A. S.).

PLATE XXX

Figure 1. *Mysoria pallens* Mabille.
Figure 2. *Mysoria affinis* Herrich-Schaffer.
Figure 3. *Mysoria amra* Hewitson.
Figure 4. *Mysoria thasus* Cramer.
Figure 5. *Mysoria galgala* Hewitson.
Figure 6. *Amenis pionia* Hewitson.
Figure 7. *Yanguna spatiosa* Hewitson.
Figure 8. *Yanguna cosyra* Druce.
Figure 9. *Yanguna staudingeri* Plotz.
Figure 10. *Yanguna thelersa* Hewitson.
Figure 11. *Yanguna timæus* Bell.
Figure 12. *Yanguna rubricollis* Sepp.
Figure 13. *Yanguna parima* Plotz.



PYRRHOPYGINÆ

PLATE XXXI

Figure 14. *Yanguna terticus* Bell.
Figure 15. *Yanguna mopsus* Bell.
Figure 16. *Yanguna arinas* form *temenos* Bell.
Figure 17. *Yanguna creusæ* Bell.
Figure 18. *Yanguna sarpedon* Bell.
Figure 19. *Mahotis nurscia* Swainson.
Figure 20. *Mahotis malis* Godman & Salvin.
Figure 21. *Metardaris cosinga* Hewitson.
Figure 22. *Granila paseas* Hewitson.

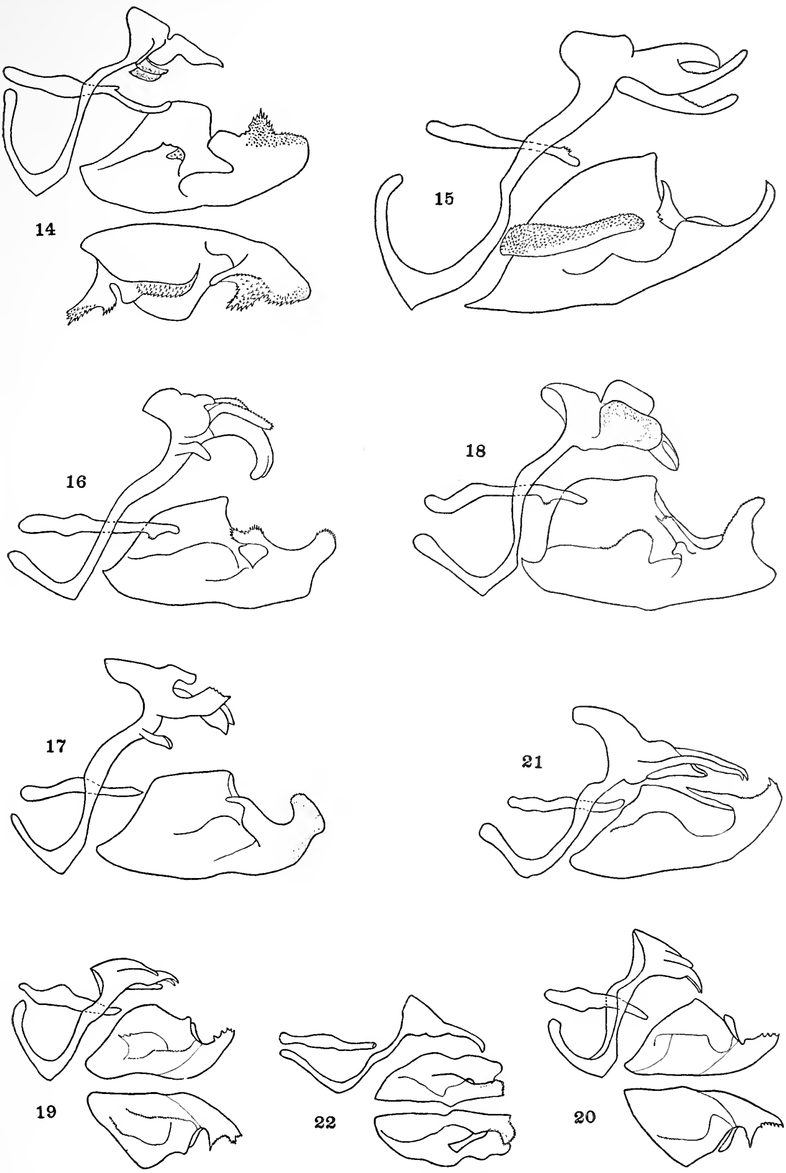


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PLATE XXXII

Figure 23. *Mahotis amans* Skinner.
Figure 24. *Jemadia hospita* Butler.
Figure 25. *Jemadia sosia* Mabille.
Figure 26. *Jemadia gnetus* Fabricius.
Figure 27. *Jemadia hewitsonii* Mabille.
Figure 28. *Jemadia jamina* Butler.
Figure 29. *Jemadia azeta* Hewitson.

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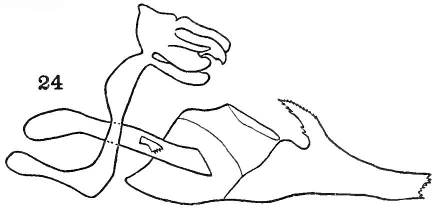

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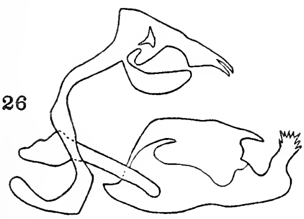

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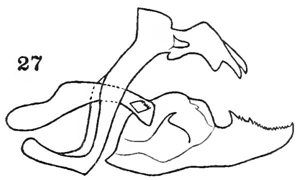

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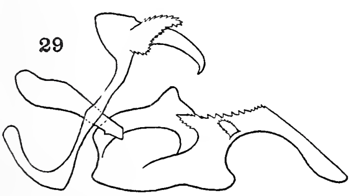

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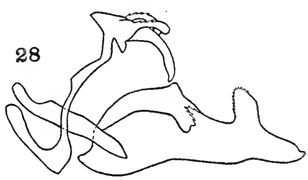
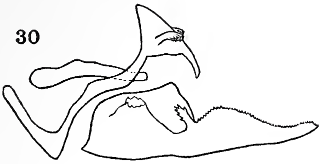


PYRRHOPYGINÆ

PLATE XXXIII

Figure 30. *Jemadia patrobas* Hewitson.
Figure 31. *Jemadia merops* new species.
Figure 32. *Jemadia theseus* new species.
Figure 33. *Jemadia alburna* Mabille.
Figure 34. *Jemadia zonara* Hewitson.
Figure 35. *Jemadia suzetta* Mabille & Boullet.
Figure 36. *Nosphistia perplexus* Mabille.

30



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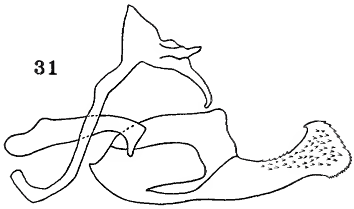

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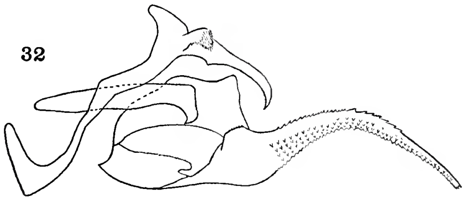

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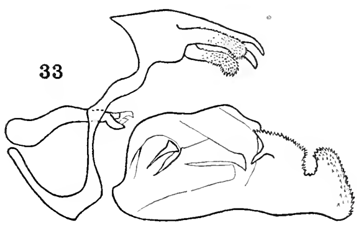

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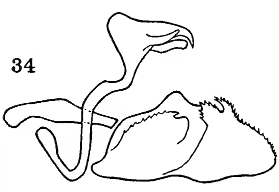

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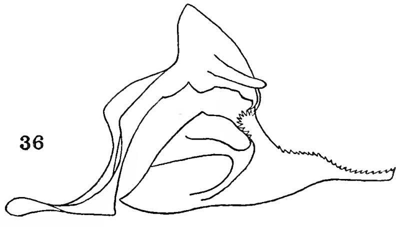
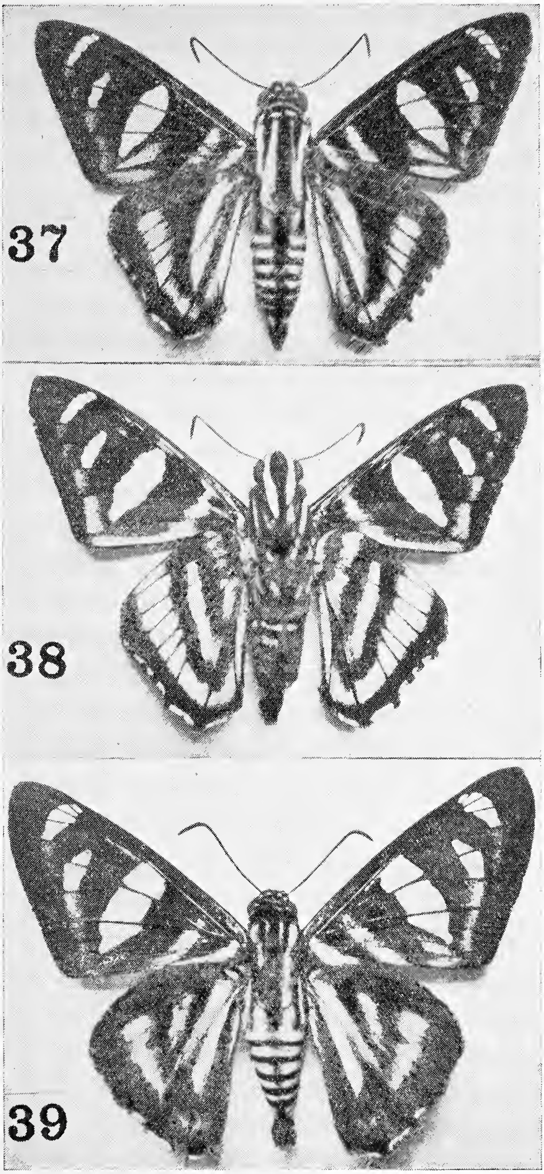


PYRRHOPYGINÆ

PLATE XXXIV

The figures on this and the four following plates are natural size.

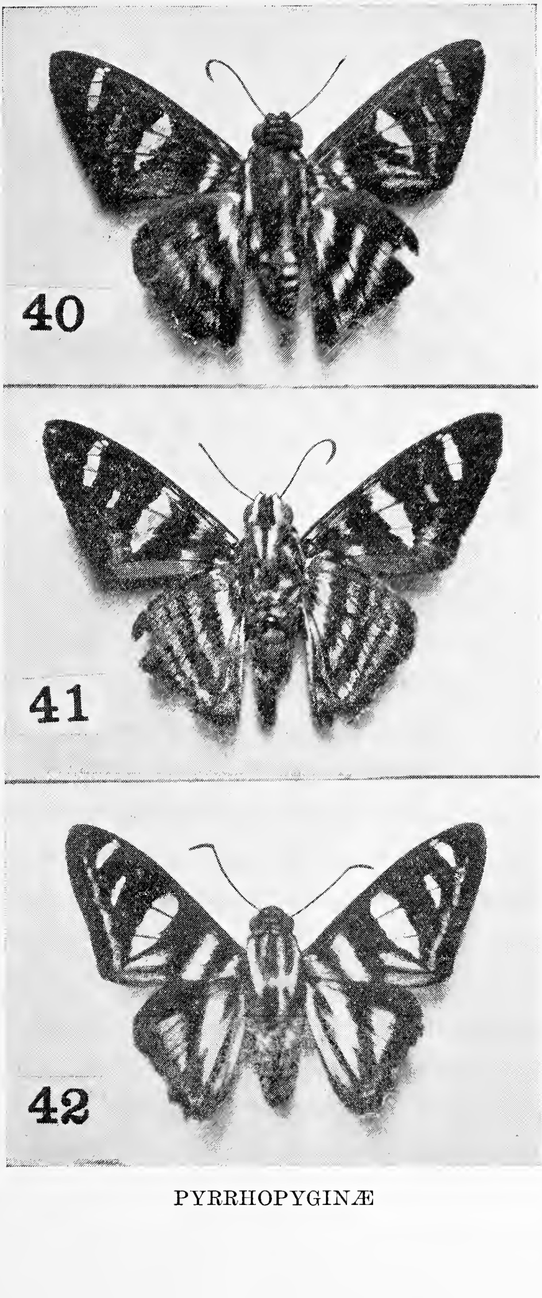
Figure 37. *Jemadia sosia* Mabille. ♂. Upper side.
Figure 38. *Jemadia sosia* Mabille. ♂. Under side.
Figure 39. *Jemadia hewitsonii* Mabille. ♀.



PYRRHOPYGINÆ

PLATE XXXV

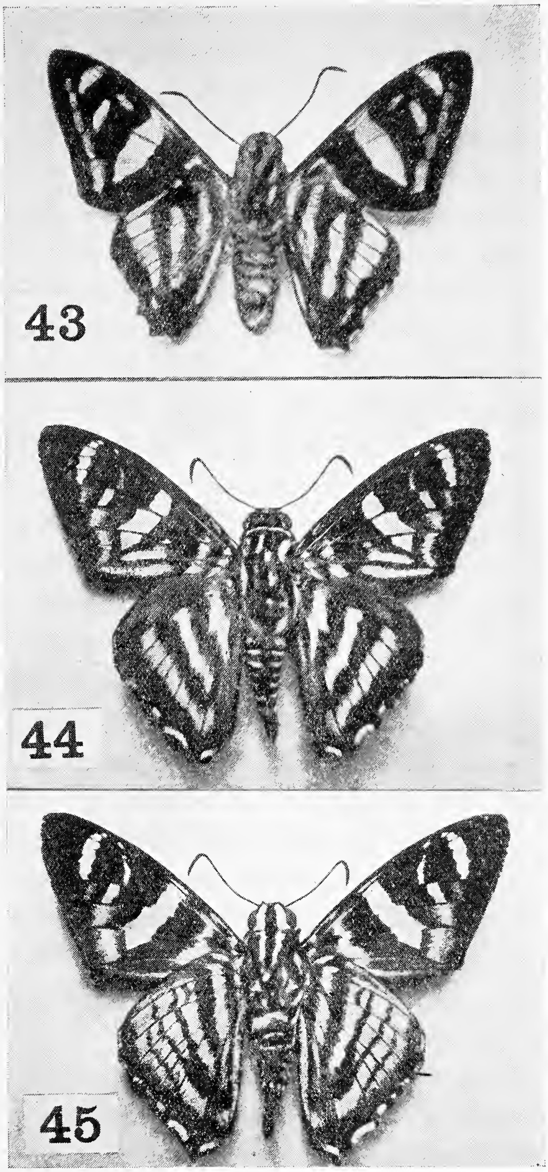
Figure 40. *Jemadia merops* new species. ♂. Upper side. (Paratype).
Figure 41. *Jemadia merops* new species. ♂. Under side. (Paratype).
Figure 42. *Jemadia gnetus* Fabricius. ♂. Upper side.



PYRRHOPYGINÆ

PLATE XXXVI

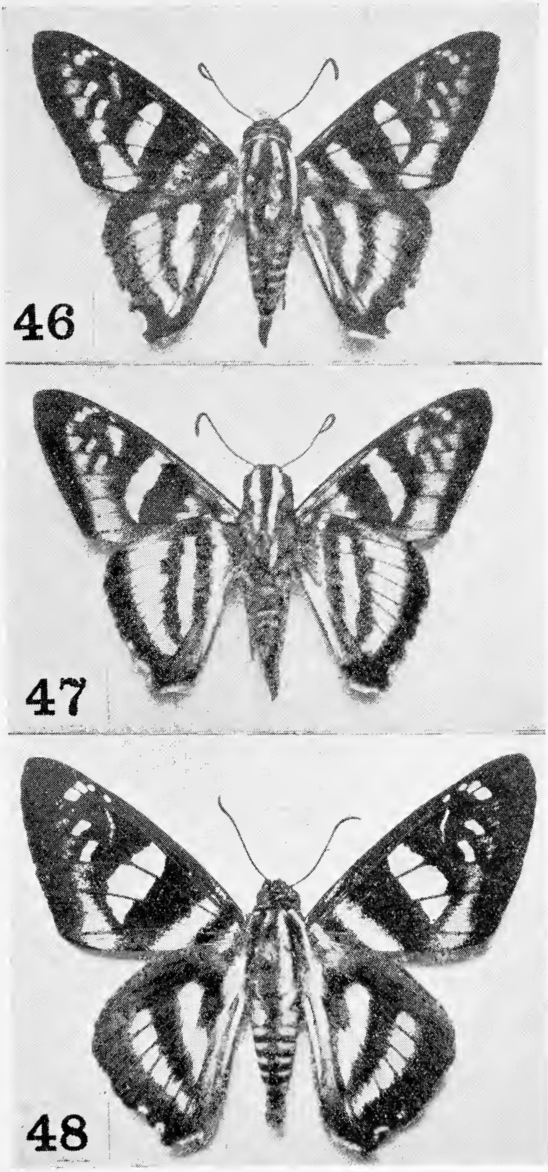
Figure 43. *Jemadia gnetus* Fabricius. ♂. Under side.
Figure 44. *Jemadia theseus* new species. ♂. Upper side. (Paratype).
Figure 45. *Jemadia theseus* new species. ♂. Under side. (Paratype).



PYRRHOPYGINÆ

PLATE XXXVII

Figure 46. *Jemadia alburna* Mabille. ♂. Upper side.
Figure 47. *Jemadia alburna* Mabille. ♂. Under side.
Figure 48. *Jemadia alburna* Mabille. ♀.

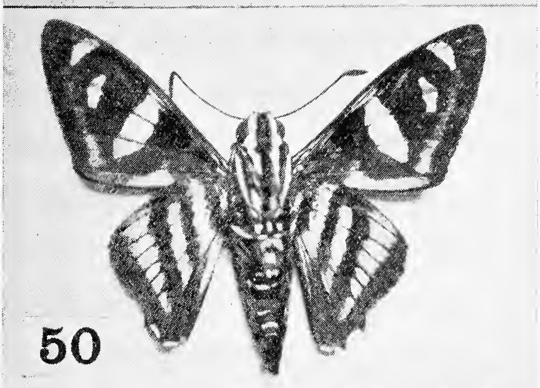


PYRRHOPYGINÆ

PLATE XXXVIII

Figure 49. *Jemadia suzetta* Mabille & Boullet. ♂. Upper side.
Figure 50. *Jemadia suzetta* Mabille & Boullet. ♂. Under side.
Figure 51. *Jemadia suzetta* Mabille & Boullet. ♀.

49



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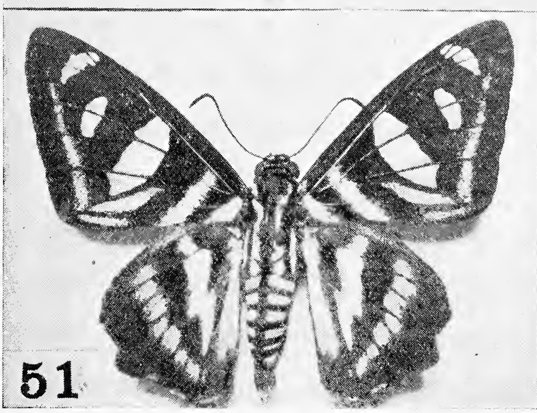

51

PYRRHOPYGINÆ

A NEW SUBFAMILY OF LYGÆIDÆ, INCLUDING A NEW GENUS AND TWO NEW SPECIES OF PAMPHANTUS STÅL. [HEMIPTERA-HETEROPTERA: LYGÆIDÆ]

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AND
S. C. BRUNER
CUBAN AGRICULTURAL EXPERIMENT STATION

In examining some Hemiptera collected in the Sierra Maestra Mountains of eastern Cuba, the writers found two new species of an undescribed genus closely related to *Pamphantus* Stal. As a result of the study of these specimens and an examination of the known, as well as the two new species of *Pamphantus* from Cuba and Haiti, we have come to the conclusion that a new subfamily must be erected to receive them. The genus *Pamphantus* with the monotypic species *elegantulus* Stal was placed by that author in his subfamily Myodochinæ, Division Rhyparochromaria. But neither that genus nor the closely related new genus *Neopamphantus* possesses the necessary characteristic opaque glandular spots on the sides of the fourth visible ventral segment; besides which, several of the anterior ventral segments are fused, none of the sutures are there visible, and only the last three pairs of spiracles are placed ventrally. Therefore, as these genera show no structural affinity to any other genus in Stal's division, they must be removed and made the basis of a new subfamily, the Pamphantinæ. The broad, impunctate head, bulging or prominent eyes, in part the nearly pellucid, shining, linearly punctate hemielytra, the position of the spiracles, and the character of the odoriferous orifice suggest, especially in the genus *Neopamphantus,* a rather close relationship to the Geocorinæ. However, because of the spinous character of the fore femora and other characters hereafter mentioned, they cannot be included in that subfamily.

Apparently, the members of this group are limited to the West Indies and nothing is recorded concerning their habits except for the mention of the myrmecoidy of two species, *P. elegantulus* and *P. mimeticus* by Doctor J. G. Myers and G. Salt in the Trans. Ent. Soc. Lond. 428, 429, 1926. Only a few specimens of the two genera have thus far been collected, but doubtless with more intensive collecting other examples will be discovered. It may be remarked in this connection that *Lygæus (Pterotmetus) stenoides* (Guérin) in La Sagra, Hist. d'Isle de Cuba-Ins. p. 400, 1857, very probably is a *Pamphantus* but whether it is the same as *P. mimeticus* Barber, it is impossible to decide from the very meager description.

Pamphantinæ new subfamily.

Body elongate, shining. Head broad, impunctate above, nearly or quite as wide as posterior lobe of pronotum; eyes large, either strongly projecting or subglobose, neither posteriorly produced nor in contact with anterior margin of pronotum; abruptly contracted behind eyes; antenniferous tubercles very short, remote from bucculæ, commonly visible from above. Antennæ with the basal segment short, slightly surpassing apex of tylus. Tylus slightly exceeding juga. Bucculæ small, confined to apex of head. Rostrum slender, slightly enlarged first segment not reaching base of head. Pronotum most commonly longer than wide; lightly, obtusely constricted behind the middle; calli of the anterior lobe large; lateral margin not expanded, either very obsoletely or not at all carinate; posterior margin lightly declivous. Scutellum most commonly as long as wide. Commissure as long or slightly longer than the scutellum. Lateral margins of the clavus nearly parallel or slightly expanded posteriorly, punctate in linear series. Corium in part nearly pellucid; lateral margins either parallel or posteriorly somewhat expanded; provided with two lines of punctures, one along the claval suture, the other just outside of and parallel to the median vein; posterior margin very oblique, forming an acute angle with posterior costal margin. Membrane complete, equalling or slightly exceeding apex of abdomen; veins few and simple, often very faint or obsolete. Odoriferous orifice similar in location and structure to that in the Geocorinæ. Legs moderately long; all femora somewhat incrassate, often subclavate; the fore femora slightly more incrassate and armed with a single long spine beyond the middle often preceded towards apex by one or more minute tubercles. Hind tibia devoid of spines or setæ but sometimes finely pilose. Tarsus with basal segment as long as or slightly longer than second and third segments conjoined. Venter shining, impunctate; at least the first three visible segments fused, with no evidence of incisures; the two obvious opaque glandular spots on the sides of the fourth segment so characteristic of the Rhyparochromini missing; the last three pairs of spiracles situated on the venter.

Type genus: *Pamphantus* Stal, the genotype of which is *Pamphantus elegantulus* Stal.

Neopamphantus new genus.

Closely related to *Pamphantus* Stål (1874) but differing in having more prominent, distinctly protruding subglobose eyes, between which the vertex is depressed (Figs. 4 and 5), head shorter and more depressed anteriorly. Hemielytra distinctly broadened behind clavus, together broader when folded than pronotum across posterior lateral angles, costal margins more or less arcuate posteriorly, subparallel only towards base. There are five readily distinguishable longitudinal veins in the membrane while in *Pamphantus* there are commonly only four, which may be nearly obsolete, at least in male specimens of *elegantulus* (Figs. 6 and 7).

Body and appendages very sparsely pilose, somewhat shining. Head very short and depressed, punctate below; slightly exserted, and abruptly constricted behind; concavely narrowed to apex above; broad, width across eyes subequal to diameter of posterior lobe of pronotum, much broader than anterior lobe in front; eyes very large, subglobose, strongly protruding as in the genus *Ninyas* but directed outward; vertex depressed between eyes. Ocelli set a little closer together than from the eyes. Rostrum reaching at least to middle of mesosternum. Antennæ rather short, about one-half the length of body or slightly longer, first segment very short, stout, passing apex of head, second and fourth subequal, the latter somewhat incrassate and fusiform. Pronotum distinctly punctate, longer than broad, more or less distinctly constricted near or behind center; posterior lobe broader than anterior lobe, the latter without collar; lateral margins with obtuse carina from constriction to near apex; disc with smooth, flat, calloused areas on either side. Scutellum rather small, punctate, equilateral or somewhat broader basally. Hemielytra elongate; corium in part and clavus punctate in linear series. Membrane attaining or exceeding apex of abdomen with five more or less elevated, simple, longitudinal veins. Costal margins subparallel basally, then broadened and more or less arcuate; greatest width across hemielytra exceeding that of pronotum at posterior lateral angles. Pro-, meso-, and metapleura punctate, the latter more finely; the odoriferous orific as in *Pamphantus*. Femore incrassate, anterior pair more strongly so, fusiform and armed below slightly beyond center with a strong sharp spine; tibiæ normal; hind tarsi with basal segment as long as other two united. Venter smooth, impunctate; first three or four visible segments fused.

Genotype: *maculatus* new species.

Neopamphantus maculatus new species (Plate XXXIX).

Male. Above dilute olivaceous flavescent fading to flavotestaceous, distinctly maculated with dark brown on pronotum and hemielytra as follows: A percurrent median vitta on posterior lobe of pronotum, narrowed towards each extremity; a large, obliquely placed, smooth, impunctate, oval spot very near each posterior lateral angle; extreme apex of clavus; an irregular macula on outer half of corium opposite apex of clavus, with another elongated macula on inner half extending posteriorly to membrane and a third covering apex of corium and extending inwards on membrane for a short distance. These maculæ are not sharply delimited and are somewhat variable in intensity and size. In addition, the calli on anterior lobe of pronotum more or less embrowned and with an indefinite, pale brown border along outer side of claval suture. Disc of areas on membrane between the five pale, longitudinal veins stained with dilute brown, this color between the first three extending to apex. Scutellum yellowish white. Head somewhat more testaceous than pronotum; tylus somewhat infuscated; the slightly elevated Y-shaped area in center and broad area bordering eyes paler; eyes dark brown and the pale ocelli margined with red. Antennæ concolorus with general color of head, apex of segment 4 darker. Below, general coloration similar to dorsum; abdomen paler; narrow posterior margin of propleurum and an ill-defined small mark above each coxa brown; also a blurred brown, more or less distinct streak on each side of venter. Legs pale, similar to thorax, femora with a broad indefinite dark brown band near center and another before apex, evanescent on anterior pair; intermediate and posterior legs with apex and band very near base of tibiæ, apical segment of tarsi and claws more or less embrowned.

Head about one-third as long as pronotum, as seen from above; width across eyes equal to posterior lobe of pronotum, much broader than anterior lobe in front; vertex depressed, provided with a slight, longitudinal, median elevation; below, coarsely punctate. Eyes large, strongly projecting straight outwards and slightly upwards. Ocelli of moderate size, well separated from each other; located near posterior margin; antenniferous tubercles rounded, rather prominent, barely visible from above. Antennæ somewhat longer than head and pronotum together, not attaining apex of scutellum when folded backwards (at least in female); segment 1 stout, shortest; segment 2 more than twice as long as 1, about as long as 4, which is narrow fusiform, thicker towards apex; very finely pubescent; segments 2 and 3 very sparsely pilose. Rostrum extending behind center of mesosternum; segment 1 not reaching base of head; somewhat shorter than 2, equally as long as 3 and subequal to 4. Pronotum nearly twice as broad behind as in front (10:6); entire surface, except as noted below, closely and coarsely punctate; transverse constriction broad, well marked, more so on sides, located somewhat behind center; anterior lobe constricted behind head, distinctly narrowed in front but gradually broadened caudad with sides rounded to greatest width immediately anterior to transverse constriction; smooth obtuse lateral carina nearly percurrent; a glossy rounded flat callosity on each side of disc crossed by a row of four coarse punctures; posterior lobe somewhat elevated; a small, smooth area just before each posterior lateral angle. Scutellum equally as long as broad; apex acute; coarsely punctate basally and on sides; disc impunctate. Clavus with three rows of punctures, inner row shorter but continued along border of commissure; commissure about as long as scutellum. Corium with costal margin subparallel at base then distinctly but gently arcuated behind center of clavus; apex extending somewhat behind middle line of membrane; glassy; a longitudinal row of coarse punctures near claval suture and another along and outside of elevated median vein. Membrane distinctly surpassing apex of abdomen, with five thick elevated longitudinal veins, fifth (anal) vein curved outward, then sharply bent inward before center. Mesopleurum coarsely punctate; mesosternum smooth; metapleurum finely punctate. Femore incrassate; anterior pair stouter, fusiform, extending to apex of head and armed below beyond center with a strong, dark, acute spine directed obliquely forward, subequal or slightly longer than apical diameter of tibiæ, beyond which is a small rounded elevation; segment 1 of hind tarsi somewhat longer than 2 and 3 together. Venter smooth, polished; lateral margins impressed; slightly shorter than head and thorax conjoined. Body beneath, head, and legs provided with a few long, scattered, suberect hairs.

Female. Similar to male but larger; costal margins somewhat more expanded and more distinctly arcuate; transverse constriction of pronotum slightly more distinct and the brown maculæ larger and more strongly marked.

Length, male, 4.37 mm.; width across humeri, 0.96 mm.; greatest width across hemielytra, 1.12 mm. Length, female, 4.90–5.37 mm.; width across humeri, 1.03–1.09 mm.; greatest width across hemielytra, 1.37–1.50 mm.

Type female: Turquino Peak, Sierra Maestra Mountains, Oriente Province, Cuba, elevation 4,500–5,000 feet, July 20, 1922, C. H. Ballou and S. C. Bruner, collectors. U. S. N. M. Cat. No. 44844.

Paratypes: Two males (imperfect) from the Sierra Maestra Mountains, Cuba, and three females from the Sierra Maestra Mountains and Turquino Peak, elevation 3,000–5,500 feet, July 10–20, 1922; in collection of United States National Museum, H. G. Barber, and the Estación Experimental Agronómica, Cuba, No. 9830.

Neopamphantus calvinoi new species (Plate XL, Fig. 1).

Male. Body and appendages nearly uniform pale flavescent with a few dark markings as follows: A small, fuscous, irregularly oval spot above on disc of posterior lobe of pronotum; a similar obliquely placed spot immediately in front of each posterior lateral angle, and another similar rounded spot on propleurum above insertion of coxæ. The very pale corium is marked with a fuscous spot near costal margins, slightly cephalad of apex of clavus, and there is a similar but larger, elongated spot over inner margin of apex; whole inner angle of corium from median row of punctures stained with wine-pink; inner and apical angles of clavus also very narrowly darkened with fuscous; membrane light amber yellow clouded longitudinally through center with light fuscous, darker on disc. Scutellum ivory white over disc and apex. Head yellowish, paler through center and next to eyes; eyes dark brown; ocelli pale, bordered with red. Legs and antennæ entirely immaculate except segment 4 of latter, which is somewhat dusky apically. Venter stained with salmon pink below over basal half; indications of an incomplete line of blurred fuscous dashes on sides.

Head about two-fifths as long as pronotum as seen from above; slightly narrower across eyes than posterior lobe of pronotum, much broader than anterior lobe in front; vertex smooth, depressed between eyes, disc slightly convex; coarsely punctate below. Eyes very large, globose, strongly projecting straight outwards. Ocelli and antenniferous tubercles as in *maculatus*. Antennæ longer than head, pronotum, and scutellum combined, attaining apex of scutellum when folded backward; similar in structure to *maculatus*; segment 2 two and a half times as long as 1, subequal to 4. Rostrum extending somewhat behind center of mesosternum; segment 1 not quite attaining base of head, distinctly shorter than 2, subequal to 3 and 4 conjoined. Pronotum and scutellum very similar to those parts in *maculatus* but the latter broader; hemielytra also similar except that the costal margins of posterior two-thirds of corium are slightly more expanded and arcuate, and the veins of the membrane are less elevated and distinct. Below very similar to *maculatus*, slightly more pilose; the legs, especially the tibiæ, distinctly longer and more slender.

Length, 4.5 mm.; width across humeri, 1.03 mm.; greatest width across hemielytra, 1.15 mm.

Type male: Sierra Maestra Mountains, Oriente Province, Cuba, elevation 3,000–3,250 feet, July 10–20, 1922, C. H. Ballou and S. C. Bruner, collectors. U. S. N. M. Cat. No. 44845.

This insect is readily distinguishable from *maculatus* by the paler coloration, more restricted dark markings above, the pink coloration on inner portion of corium, the immaculate legs, larger eyes, broader scutellum, and the longer and more slender legs. The antennæ also appear to be relatively longer, although these are mutilated in the male specimen of *maculatus*.

This species is named in honor of Dr. Mario Calvino, of San Remo, Italy, former Director of the Cuban Agricultural Experiment Station, who did much to encourage the study of entomology in Cuba, and made possible the expedition to Turquino Peak that yielded the foregoing, as well as many other species new to science.

Pamphantus pallidus new species.

Color pale yellow testaceous, non-pilose. Antennæ, rostrum, and legs concolorous. Ocelli rimmed with red. Pronotum with an ovate fuscous spot near each humeral angle. Corium, midway between base and apical angle just within the expanded costal margin, provided with a fuscous spot and the apical angles infuscated. Membrane with the inner apical angle and the central disk posteriorly embrowned.

Head very slightly inclined, impunctate above, but little wider than long and not quite as wide as the diameter of the anterior lobe of the pronotum; abruptly contracted behind eyes, so that they appear rather prominent; ocelli over twice as far apart as each is removed from the eyes; central disk beneath punctate. Antennæ with the basal segment very slightly exceeding apex of head, over one-third as long as second; third segment just over twice as long as first and a little shorter than second; terminal segment longest of all; relative lengths of the segments as follows: I, 0.20 mm.; II, 0.52 mm.; III, 0.44 mm.; IV, 0.60 mm. Apex of rostrum reaching to middle of mesosternum. Pronotum but little longer than wide, laterally and dorsally very lightly impressed, leaving a rather shallow groove across the disk just behind the middle, anterior margin, laterally, somewhat contracted; anterior lobe with lateral margins obscurely carinate, the disk broadly smooth, rather closely punctate just before and behind this smooth area; posterior lobe somewhat wider than the anterior one, closely punctate anteriorly, more sparsely so posteriorly; the ovate fuscous spot within the humeral angles smooth. Pro- and mesopleura rather closely, the metapleurum more finely punctate. All femora incrassate, the anterior pair more so and armed before middle with a prominent inclined spine, with a very obsolete tubercle before this. Posterior tibia very finely pilose. Scutellum a little wider than long; its length equal to that of the claval commissure, provided with a few coarse punctures. Hemielytra with the clavus provided with three regular rows of punctures; corium almost pellucid; posterior two-thirds of the costal margins plainly expanded; apex extended beyond the middle point of the membrane; the surface provided with the two rows of punctures as in the other members of the genus, one, straight, parallel to the claval suture, the other, arcuate, located just outside of and parallel to the median vein. Membrane provided with three or four rather obscure, longitudinal veins. Venter smooth, impunctate; first four visible segments (male) fused. Length, 3.60 mm.; humeral diameter, 0.80 mm.

Type male: Sierra Maestra Mountains, 1,000 meters, Cuba, July 10–20, 1922, C. H. Ballou and S. C. Bruner, collectors. U. S. N. M. Cat. No. 44842.

By reason of its color, it is quite distinct in appearance, resembling in that respect *Cymus virescens* Fabricius. Besides the difference in color, the greater length of the antenna will distinguish it from the other species.

Pamphantus atrohumeralis new species.

Color pale yellowish white, shining; marked with fuscous as follows: A narrow, median, longitudinal stripe on the pronotum; a calloused, ovate spot at each humeral angle; two fasciæ on the posterior margin of the corium, one near the inner angle and the other at the extreme apical angle; a broad longitudinal band extending from about the middle to the apex of the membrane; a spot near outer angle of the metapleurum. [Antennæ missing.]

Head as wide as posterior lobe of pronotum; space between eyes (vertex) one-third wider than an eye; front of head strongly declivous. Ocelli placed closer to eyes than to median line of head. Antenniferous tubercles very short. Pronotum as long as width across humeri; transverse constriction feeble, placed just behind middle; calli on anterior lobe large, somewhat oblique; rather closely and coarsely punctate; lateral margins of anterior lobe very lightly carinate; posterior margin truncate before the scutellum. Propleurum coarsely and rather closely punctate; mesosternum impunctate. Odoriferous orifice as in *P. elegantulus.* Scutellum with its length equal to its basal diameter, finely punctate. Clavus lightly expanded posteriorly; provided with two rows of punctures. Commissure a little longer than scutellum. Corium nearly pellucid, the lateral margins nearly parallel on the basal third, thence very slightly expanded; surface provided with the usual two lines of punctures, one parallel to the claval suture; the other parallel to the median vein. Membrane reaching apex of abdomen, nearly pellucid, with little evidence of veins. Venter smooth, shining, the first four visible segments of the male fused. All of the femora slightly incrassate; fore femora armed with a prominent slender spine one-third of the way from the apex. Length, 2.8 mm.; humeral diameter, 0.6 mm.

Type male: Le Trou, Haiti, October 2, 1925, W. A. Hoffman, collector. U. S. N. M. Cat. No. 44843.

This is the first species to be described outside of Cuba. It is most closely related in general color and structure to *P. vittatus* Bruner.

KEY TO GENERA AND SPECIES OF PAMPHANTINÆ

1. Eyes large, strongly projecting, substylate; vertex between eyes smooth, depressed. Head strongly inclined anteriorly. Ocelli set a little closer together than each is removed from the eyes. Costal margins of corium strongly expanded posteriorly.............*Neopamphantus* n. gen. 2

   Eyes prominent but not substylate; vertex between eyes either flat or slightly convex. Head most commonly moderately inclined anteriorly. Ocelli set closer to the eyes than to each other. Costal margins of corium at most only slightly expanded posteriorly..*Pamphantus* Stål 3

2. Apex of corium reaching well beyond middle line of membrane. Posterior femora shorter, not posteriorly extended as far as apex of corium. Antennæ shorter, second and fourth segments equal. Cicatrices and legs maculate with fuscous..................*N. maculatus* n. sp.

   Apex of corium reaching to middle line of membrane. Posterior femora longer, extending posteriorly nearly or quite to apex of corium. Antennæ longer, fourth segment distinctly longer than second. Cicatrices and legs concolorous.............................*N. calvinoi* n. sp.

3. Dorsal and ventral parts of the body, for the most part, as well as the femora, castaneous. Head, pronotum, and corium anteriorly, sparsely, long pilose. Pronotum distinctly longer than wide, the transverse constriction situated well behind middle; the anterior lobe nearly twice as long as posterior one. Scutellum longer than wide, about as long as claval commissure (1926 Trans. Ent. Soc. Lond., Part II, 434), *P. mimeticus* Barber

Dorsal and ventral parts of the body not castaneous. Pronotum not at all or but little longer than wide; transverse constriction rather slight and situated just behind the middle. Scutellum nearly as wide as long 4

4. Color orange-yellow; corium anteriorly and membrane anteriorly and laterally, white. Last three segments of the venter black. Apex of corium not posteriorly extended to middle line of membrane. Scutellum shorter than claval commissure. Head and pronotum laterally with a few fine hairs (1874 Enum. Hem. IV, 157)................ *P. elegantulus* Stål.

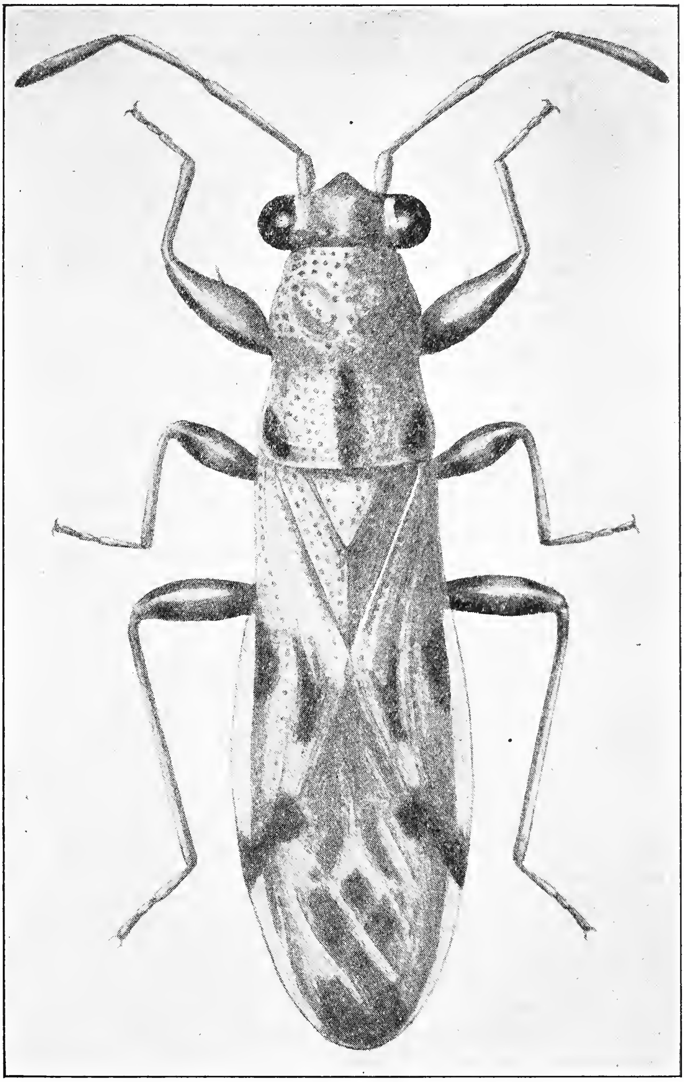
Color either pale yellow-white or pale testaceous-yellow. Last three segments of the venter concolorous. Apex of corium extended to a point posteriorly to middle line of membrane.......................... 5

5. Color pale yellow-testaceous with few fuscous markings; pronotum devoid of a longitudinal median stripe. Antennæ long, very nearly half as long as entire body. Ocelli nearly three times as far apart as each is removed from the eyes. Scutellum plainly shorter than claval commissure.................................. *P. pallidus* n. sp.

Color pale yellow white, at least the pronotum furnished with a longitudinal, median, fuscous stripe. Antennæ shorter, much less than half as long as body [missing in *P. atrohumeralis*].................... 6

6. Space between eyes (vertex) distinctly over twice the diameter of an eye. Head moderately inclined anteriorly. Ocelli only a little further apart than each is removed from the eyes. Pronotum a little longer than wide, devoid of a fuscous spot at humeral angles. Hemielytra with a broad fuscous stripe extending from clavus to apex of membrane (1932 Bull. Bklyn. Ent. Soc. XXVII, 141)......... *P. vittatus* Bruner

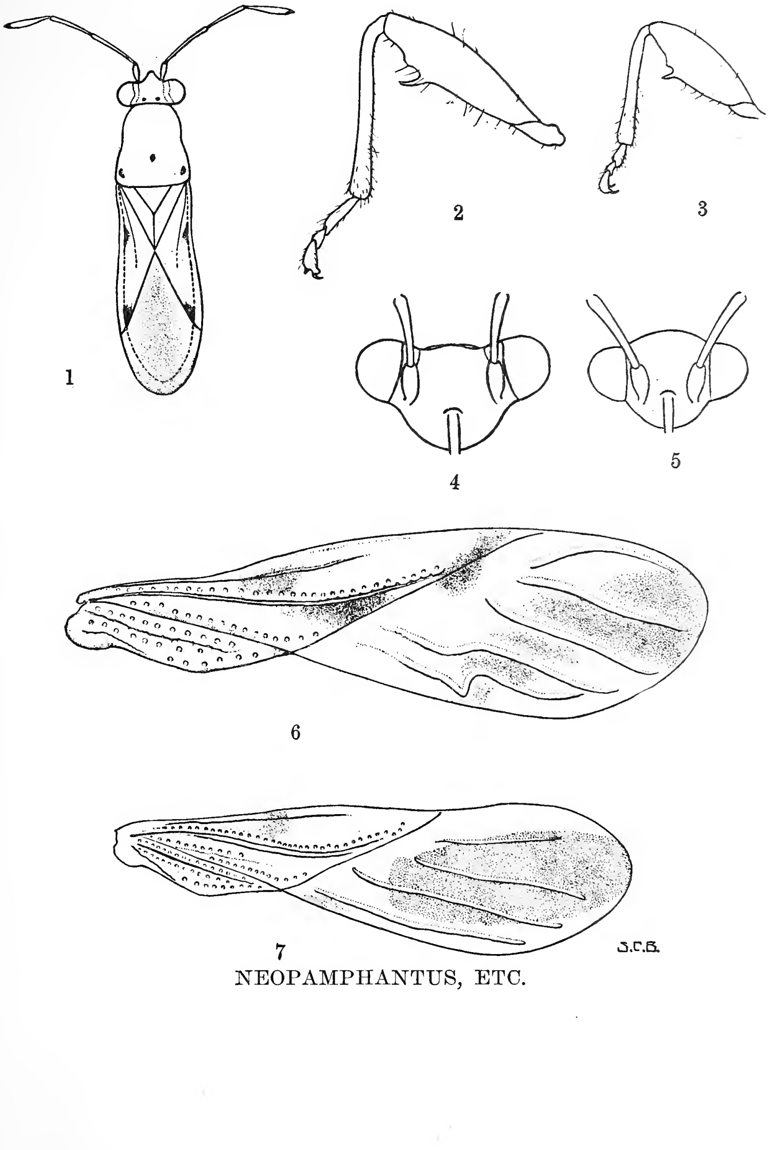
Space between eyes (vertex) less than twice as wide as an eye. Head more strongly inclined anteriorly. Ocelli set much closer to the eyes than to each other. Pronotum about as long as wide, with a distinct ovate, fuscous spot at each humeral angle. Hemielytra devoid of a longitudinal stripe. Membrane broadly vittate posteriorly, *P. atrohumeralis* n. sp.



NEOPAMPHANTUM MACULATUS

PLATE XL

Figure 1. *Neopamphantus calvinoi* n. sp.
Figure 2. *Neopamphantus maculatus* n. sp. foreleg (male).
Figure 3. Same of *Pamphantus elegantulus* Stål.
Figure 4. Outline of head of *Neopamphantus maculatus* from in front.
Figure 5. Same of *Pamphantus elegantulus.*
Figure 6. *Neopamphantus maculatus,* hemelytron.
Figure 7. *Pamphantus elegantulus,* hemelytron (female). The venation of hemelytra is not so sharply defined as indicated in these figures.



NEOPAMPHANTUS, ETC.

A NEW SPECIES OF BELONUCHUS NORDM. (COL. STAPHYLINIDÆ)

BY KENNETH W. COOPER
FLUSHING, N. Y.

Belonuchus schaefferi n. sp.

Head black, quadrate, but slightly wider than the prothorax, with a small number of large, sparse, foveiform punctures scattered laterally; median line impressed apically and becoming feeble basally; mandibles long, slender, curved at apical third, straight basally; antennæ with the three basal joints elongate, shining, subimpunctate, micro-aciculate, glabrous, excepting scattered bristles; first joint but slightly longer than the two following; second joint shorter than third; joints four to eleven opaque, finely and densely punctate, bristled, and with very fine, dense, secondary pubescence; fourth joint quadrate; joints five to ten transverse; eleventh joint slightly longer than wide, emarginate apically; gular sutures diverging anteriorly from a point at apical portion of basal third, just within the apical third the sutures abruptly become nearly parallel to the basal suture of the mentum; gula with large setigerous puncture at apical edges of its lateral suture; mentum subtruncate, and with setigerous puncture at apical third of side margin; gula, genæ, mentum, oral portions and dorsal surface of the head very finely and regularly micro-aciculate; eyes pale yellow, very finely faceted, transverse, about twice their longest diameter from the base of the head. *Prothorax* black, slightly longer than wide, slightly narrower than head, widest at apical third; sides slightly converging towards the base, nearly straight; the base evenly rounded; shining, iridescent, micro-aciculate, with discal series of five punctures; first puncture close to apical margin, separated from first of following four by twice its own diameter; second, third, and fourth but their own diameters apart; fifth about three times its diameter from fourth, and just behind middle of disc; basal angles with an irregular row of coarse, foveiform punctures; finely margined and with the lower inflexed margin gradually joining the upper marginal line just before the apical angle, furthest separated from upper margin at basal third. *Scutellum* black, equilateral, with close-set coarse but shallow punctures, impunctate at margins and apex, micro-aciculate. *Elytra* red, wider than thorax, longer than wide, punctures fine and widely separated, with short, sparse, yellow, inclined pubescence on scutellar area and side margins, scattered setæ not evident. *Abdomen* black, deeply margined, shining, iridescent, micro-aciculate; third dorsal widest, thence tapering feebly to apex; punctures fine, sparse, and irregular, asperulate; pubescence sparse, pale yellow to dark brown, inclined, longer than elytral hairs, scattered setæ not evident; sixth ventral segment with very feeble, broad, sinuation. *Under-surface* black, shining, iridescent, micro-aciculate; punctures fine, sparse, irregular, asperulate, notably more dense and regularly placed than the dorsal system. *Legs* femora and tibiæ black, tarsi deep castaneous-brown. *Length Holotype,* 14.5 mm.; *Paratype,* 13 mm.; *width Holotype,* 2.5 mm.; *Paratype,* 2.2 mm.

Holotype, Texas: Brownsville (F. Armstrong); in the Chas. A. Schaeffer Collection.

Paratype, same data; in author's collection.

Remarks: *Holotype* has the left mesothoracic leg missing: *Paratype* lacks both mesothoracic legs.

The sexes of the specimens have not been determined, but they both seem to be of the same sex (probably male, as evidenced by the apically sinuato-truncate sixth abdominal segment).

This species seems at once recognizable from our species having red elytra and the entire body black. From a specimen determined as *B. ephippiatus* Say it differs by its smaller size, less robust form, less punctate thorax, and by its totally different gula habitus. In *ephippiatus* the gular sutures diverge at the oral slope, and the mentum has its setigerous punctures in the apical angles themselves. From *B. punctiventris* Casey it may be recognized by its more elongate form, its shining, iridescent, and more sparsely punctured abdomen, the elytra are longer than wide, and it exhibits a more extreme form of gula development. Should the types prove to be males, the feeble sexual characters would at once distinguish this new species from *punctiventris.* Its larger size and comparatively more parallel form, greater number of punctures in the pronotal series, and different coloration of the legs separates *schaefferi* from *laticeps* Casey, *jacobianus* Casey, and *texanus* Casey. It may also be known from *jacobianus* and *texanus* by its coarsely punctate scutellum. If males, the sexual characters of the abdomen most approximate those found in *B. texanus.*

It is with considerable pleasure I dedicate this species to that most obliging and untiring of Entomologists, Mr. Charles A. Schaeffer, of the Brooklyn Museum, N. Y. Naming this beetle in his honor but poorly shows the affection I hold for him; it is the addition of one more "schaefferi" to our faunal list which already contains so many thus named in honor and admiration by his numerous friends.

MRS. THOMAS SAY

BY HARRY B. WEISS AND GRACE M. ZIEGLER

While we were gathering material for our "Thomas Say, Early American Naturalist," published in 1931, certain facts accumulated about Mrs. Say, and these were set forth in Chapter XVI. Recently Miss E. L. Sistare, of New York City, kindly allowed us to examine a small bundle of papers and drawings that had once been the property of Mrs. Say, her great-aunt, and as a result we are able to publish the following notes. Miss Sistare has presented the material to the Academy of Natural Sciences of Philadelphia.

The material for the most part consists of some 27 sheets of pencil drawings of shells, made by Mrs. Say for the "American Conchology." Some are colored and some carry the dates 1827, 1833 and 1834, in addition to names and localities. There are also five plates of shells, most of them having been engraved by Tiebout, and various letters principally from officers of the Academy addressed to Mrs. Say. These letters are summarized as follows:

On February 10, 1845, the secretary of the Académie Impériale des sciences de Russie addressed Mrs. Say, in French, from Saint Petersbourg, thanking her for a collection of fresh water shells from America.

On December 15, 1855, Mr. D. D. Owen wrote to Mrs. Say from New Harmony telling her not to worry about the cemetery lot, as he had purchased it with the intention of retaining it for the purpose for which it had been set apart. An unsuccessful effort had been made to prevent its sale, but so long as Mr. Owen purchased it in order to retain it as a private cemetery everything came out all right.

David Dale Owen was, of course, the son of Robert Owen, the social reformer. He went to New Harmony with his father in 1828 and later returned to Europe and studied geology and natural history. He returned to New Harmony in 1833 and two years later graduated from the Ohio medical college. In 1837 he was employed by the Indiana legislature to make a geological survey of Indiana. In 1839 he was in the service of the United States government and worked on the mineral lands of Iowa. From 1854 to 1857 he was State Geologist of Kentucky, and from 1859 until his death in New Harmony on November 13, 1860, he was State Geologist of Indiana. His various published reports are matters of record.

On April 14, 1863, Mr. E. T. Cresson wrote to Mrs. Say on stationery headed ''Hall of the Entomological Society, No. 518 South 13th Street, Philadelphia,'' requesting a photograph of her, so that it could be placed in the album of the Society along side of their portrait of her husband.

On April 21, 1863, Mr. Cresson acknowledged with thanks Mrs. Say's offer to contribute certain works to the Library of the Society and said that ''Insectes d'Afrique et d'Amerique, par Palisot de Beauvois'' would be a very desirable addition.

Mrs. Say apparently supplied a photograph of herself, for on July 29, 1863, Mr. Cresson acknowledged the receipt of it with thanks and in addition wrote as follows: ''Could you put us in the way of procuring a good (painted) portrait of Mr. Say, of as late a date as possible? We are extremely anxious to obtain one to hang up in our meeting room. Any information on the subject will be thankfully received.''

Mrs. Say was apparently living at Newburgh, N. Y., in 1863, as Mr. Frank Knight, recording secretary of the Society, acknowledged on May 12, 1863, the receipt of several works on entomology, which she had donated.

At the January 2, 1868, meeting of the Conchological Section of the Academy of Natural Sciences of Philadelphia, Mrs. Say was elected a member, according to the notice sent to her at Newburgh, N. Y., by S. R. Roberts, Recorder. However, her certificate of membership was not mailed to her until December 1, 1878, as in a letter of that date Mr. S. R. Roberts explains that the delay was due to the difficulty of obtaining the signatures of some officers. The certificate is signed by Isaac Lea, Director; George W. Tryon, Jr., Vice-Director; E. R. Beadle, Secretary, and S. R. Roberts, Recorder.

Dr. Isaac Lea was the distinguished paleontologist and conchologist who was elected a member of the Academy in 1815.

He was president of the Academy from 1858 to 1863 and was in his time the greatest authority on fresh-water mollusks. He died in 1886 at the age of 95.

George W. Tryon, Jr., was a member of the Academy from 1859 until his death in 1888, and an active and distinguished conchologist. He was editor of the *American Journal of Conchology* and of the first 10 volumes of the First Series and the first four volumes of the Second Series of the *Manual of Conchology,* which he personally financed and which he bequeathed to the Conchological Section of the Academy.

The Rev. E. R. Beadle was a diligent collector of shells and minerals and a member of the Academy from 1866 to 1879, when he died at the age of 66.

S. Raymond Roberts was elected a member of the Academy in 1866 and at the time of his death in 1928 was the oldest surviving member. He published on shells and was the author of a portion of Volume VII of the First Series of the *Manual of Conchology.* He had an important series of the family Cypræidæ, in which he specialized, principally as a collector. He was treasurer of the Conchological Section for many years and also treasurer of the *Manual of Conchology* until his death.

In 1871 Mrs. Say was living at 9 East 48th Street, New York City, as a notice from the American Entomological Society was sent to her on May 4th of that year by Charles A. Blake, corresponding secretary, thanking her for three volumes of "Say's American Entomology," and another one on September 23, 1871, for her present of four volumes of "Donovan's British Insects." Other letters from Mr. Blake to Mrs. Say, dated Philadelphia, Pa., December 19, 1874; May 1, 1875, and August 4, 1877, thank her for her photograph, a box of Neuroptera, and a "book of butterflies."

When Mrs. Say was 70 years old, or in September, 1870, she paid a visit to Philadelphia and visited the home of J. E. Mitchell, at Chestnut Hill. A month later, or on October 20, 1870, Mr. Mitchell sent her a photograph of his home and a historical statement about Indian Rock, at Chestnut Hill, which he had promised her. Mr. J. E. Mitchell was a member of the Academy from 1874 until 1887, when he died at the age of 70. Apparently he was interested in the history of the Academy and in those connected with it during its early days.

Among the interesting papers that Mrs. Say had saved is a little slip listing some of the plants that grew in the Say garden at New Harmony. This is dated "N. H.—1833—" and is quoted in full as follows:

Bulbous and Tuberous roots now in our garden—
Leucojum vernum
Hyacinthus orientalis
Hyacinthus botryoides
Lilium superbum or canadense
Iris pumila and two or three native species
Pæonia officinalis (double red)
Narcissus pseudo-narcissus
Narcissus very double yellow
Narcissus poeticus
Lilium candidum
Succulent plants in our garden—
Cactus flagelliformis
Cactus r'tangularis
Cactus fillamentosa?
Cactus opuntia
Mesembryantheum cordatum
N.H.—1833—

Although Thomas Say's attendance at the Wistar Parties has been recorded, it was of interest to find among the papers an invitation addressed to "T. Say, Esq., Post Office," reading as follows: "Dr. Hare requests the pleasure of Mr. Say's company on Saturday Evening next. (Wistar Party) Dec. 18th, 1822."

On the back of this invitation Thomas Say wrote a letter, dated December 18, 1822, in which shells are discussed and also the unethical conduct of a person named Vitry, who had apparently failed to return borrowed material to the rightful owner. From the text of the letter, the name of the addressee being omitted, one gathers that it may have been sent to a French conchologist and also, in view of its abbreviated and crowded writing, that it may be simply an extended draft of Say's reply. In one corner of the invitation part of the letter, Mrs. Say wrote a little note which does not seem to refer to anything with which we are familiar.

Of entomological interest are the original paintings by T. R. Peale of the three insects on Plate 42 of Say's "American Entomology." These are *Pompilus formosus, P. unifasciatus* and *P. terminatus.* Mrs. Say kept these among her possessions and it is good to relate that after so many years they will now find a permanent home in the Academy.

Mrs. Say, in addition to her skill at sketching shells, tried her hand at engraving, and there have come down to us several prints showing her early attempts. On one which is reproduced herewith, Mrs. Say had written below: "Upon the death of our Engraver 1834 (April) I thought I could acquire a knowledge of engraving and practiced by myself.—L. W. Say." On the back of another print of a shell, Mrs. Say wrote as follows: "First attempt. August, 1834. L. W. Say. I could have learned etching very soon—but an engraver was procured." The en-

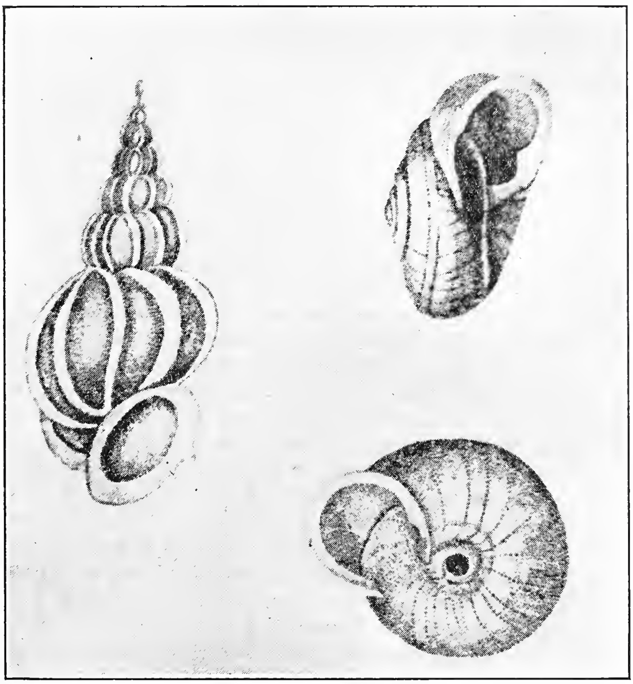


Figure 1. Engraved by Mrs. Say.

Figure 2. Sketch of A. Maclure's dog, made by James Morton.

graver who died was Cornelius Tiebout, well known in engraving circles.

Another sketch, which Mrs. Say saved, although not of scientific interest but of considerable human interest, is that of the head of A. Maclure's dog Flora. Alexander Maclure was the brother of William Maclure, generous friend of the Philadelphia Academy of Natural Sciences and its president from 1817 to 1840. Beneath the sketch is the statement that it was made by James Morton, son of Dr. S. G. Morton of Philadelphia. Dr. Samuel G. Morton was the well-known Philadelphia physician, author and one-time president of the Academy. His son James St. Clair was born in Philadelphia on September 24, 1829. He graduated from the United States Military Academy in 1851 and was assistant professor of engineering there at one time. He also held various military positions, explored certain parts of Central America and was killed during the Civil War.

The following information relative to Mrs. Say's family was compiled from the notes which she made and which were found among her papers. It is of course incomplete, but it may be useful to those interested in the Sistare family.

"Gabriel Sistare, from whom descended the Sistare family in New London, Connecticut, was born at Barcelona in the kingdom of Spain, May 1, 1726. He arrived in this town 9th October, 1771, in his own ship, Montsaratta, dismasted in a gale of wind, bound from the Havana to Cadiz, with a cargo of Spices and Sugar. In consequence of contrary winds he was driven on this Coast, and on the 28th September, 1771, he spoke an American vessel, from which, he took a pilot, and on the 9th October arrived safely in New London; he spent the remainder of his life there. He died on the 21st February, 1795, and his remains were interred in City burying ground, over which place stands a Stone Table, on which is inscribed his death and character.

"Joseph Sistare, son of Gabriel and Eliza Sistare, was born on the 22d April, 1774, in New London—he died at the same City of consumption, on Friday, 21st August, 1829, aged 55

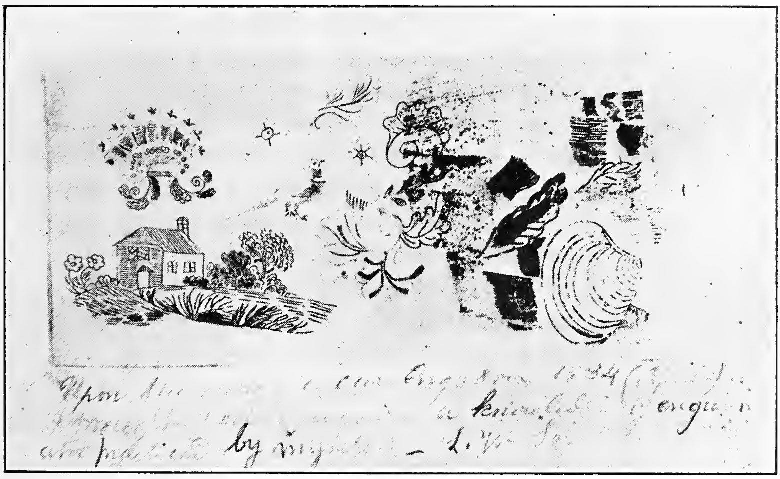


Figure 3. Mrs. Say's early attempt at engraving.

years, three months and one day. He died at the house of his father-in-law, John Way, and was buried in the New London burying ground.

"Nancy Way, daughter of John and Lucy Way, was born in N. London on Friday, 6th of October, 1775. She died at the house of her daughter, Delia Ann Hilger, wife of Maurice Hilger, in October, 1860.

"On Sunday evening, the 1st February, 1795, Joseph Sistare and Nancy were married by Rev. Henry Channing, Pastor of the First Ecclesiastical Church in New London."

Lucy Way Sistare, who later became Mrs. Thomas Say, was one of 10 children born of this union, the others being John Way Sistare, Leonard Sistare, Ovaneto Sistare, Horace Sistare, George King Sistare, Delia Ann Sistare, Mary Holt Sistare who was born in New York City in 1812 but who died when only two weeks old, Frances Elizabeth Sistare who was born on Monday, September 5, 1814, at half-past eleven p. m. and who died on November 8, 1871, at the home of her husband, Henry Ball, 9 East 48th Street, New York, and Sarah Lord Sistare who was born on November 4, 1816.

Mention has been made of the residence of Mrs. Say at 9 East 48th Street in 1871, and from the above account it is noted that this was the home of her sister and brother-in-law. Another note refers to the marriage on June 16, 1868, of Virginia C. Sistare and Warren Fisher at the home of Henry Ball, corner of 48th Street and Fifth Avenue, New York.

It is noted that Horace Sistare married Lucy Scarbrough, at whose death on November 29, 1840, there were two children surviving: Frances Elizabeth Sistare, born January 30, 1835, and Alice Douglas Sistare, born January 15, 1838. Four other children born of this marriage died in childhood.

An obituary notice of George K. Sistare refers to him as one of the oldest and best-known bankers and brokers in New York, who confined his transactions chiefly to choice investments for institutions and private persons and to negotiating state and municipal loans, especially of New York and Brooklyn. He died on January 25, 1880, at his residence at 104 West 43d Street, in the seventy-first year of his age. He was survived by a widow and four children, two daughters and two sons, W. H. M. and George K. Sistare, who succeeded to his business two years prior to his death.

In addition to the foregoing, Mrs. Say saved other little notes, of interest only to herself, and a printed "List of the Linnean Society of London, 1830," containing the name of her husband as a foreign member.

In closing we wish to express our thanks to Miss E. L. Sistare for saving the manuscripts and drawings and for her kindness in making them available to us. And we are grateful also to Mr. James A. G. Rehn for supplying information about some of the officers of the Academy.

BIOLOGICAL NOTES UPON THE FIREBRAT, THERMOBIA DOMESTICA PACKARD[1]

BY J. A. ADAMS

ABSTRACT

Firebrats were reared at 37° C. The cycle from egg to egg was completed in about eleven weeks. Growth and molting continue after sexual maturity. Rolled oats and beef are suitable food. Development was more rapid when water was provided. The eggs and tiny nymphs are highly resistant to dessication.

The firebrat, common as it is, has been given scant attention by entomologists. Packard described it in 1873, placing it in the Linnean genus Lepisma. Bergroth (1890) removed it to Thermobia from an invalid genus, Thermophila. The early economic entomologists mentioned it in their reports without proposing any adequate control. It has remained for Spencer (1929 and 1930) to investigate the life history and reactions. The bulk of his work has not, to the writer's knowledge, appeared. Wakeland and Waters (1931) have worked out what promises to be the first satisfactory method of control. Space does not suffice to list the histological and other works which have been done upon Thermobia.

Preliminary life history studies have been undertaken and the present paper intends to present facts which may be of interest to other workers. Results of a more detailed study will appear subsequently.

The inability of the firebrat to climb upon vertical glass or metal surfaces renders it fairly easy to trap and to confine. Its habit of living under the even conditions of dark, warm cellars seems to make easy its transition to apparatus of constant temperature and humidity. Rearings were made in such apparatus as is described by Brindley and Richardson (1931) at 37° C. and 50 to 70 per cent relative humidity. The insects were kept in battery jars containing folded paper or fragments of clay pots. Water was provided upon cotton wicks fed from glass

[1] Contribution from the Department of Zoölogy and Entomology, Iowa State College, Ames, Iowa.

The writer is greatly indebted to Dr. Carl J. Drake for the excellent facilities of his Department and not a little personal counsel.

containers. Food was placed in the jars in small paper boxes. The eggs were conveniently collected since the insects oviposit readily into wads of cotton batting. The jars were left uncovered and the air within the cabinet kept in constant motion. The jars were shielded from the direct rays of the heating filament.

THE EGG

The newly laid egg is pearly white, becoming creamy white upon exposure. It is elliptical in long section and circular in cross section. It weighs about .3 mg. Six eggs from one female had an average long diameter of .98 mm. and an average short diameter of .78 mm. The first ten eggs taken from a colony of about 290 individuals just beginning to reproduce averaged 1.00 × .77 mm. Twenty-five eggs laid on the same day in a breeding jar containing numerous females of considerable age averaged 1.09 × .77 mm. The shortest measured .97 × .76 mm.; the longest 1.29 × .75 mm. and the broadest 1.00 × .83 mm. The greater constancy of the short diameter may be attributed to the limitations of the oviducal structures. Eggs of odd shapes were found where oviposition occurred in crevices, often having flattened forms suggestive of Irish potatoes. The eggs are scarcely adhesive. The chorion of turgid newly laid eggs is shiny and smooth with sparse minute markings. The chorion of partially dessicated or incubated eggs is granular in appearance. Although the hatching of hundreds of eggs has been recorded no clear case of infertility or diapause has been found.

The period of incubation at 37° C. is from fourteen to eighteen days, with most eggs hatching in fifteen days. Eggs were hatched in small glass dishes over humidity controlling solutions of potassium hydroxide, sodium chloride and magnesium chloride. The hatching time seems to be about the same at low and high humidities. It is interesting to note that 10 eggs incubated at 30 per cent relative humidity hatched 10 evidently healthy nymphs.

NYMPHS

In the last few days of incubation the curled embryo, with its dark ommatidia, is readily visible through the chorion. The nymph emerges, head first, from an irregular rupture through one end of the chorion. Newly hatched nymphs are waxy white, about .6 mm. in width and 2.1 mm. in length, omitting appendages. They present a more primitive appearance than the mature form. The body is without scales and the appendages are relatively short. The heart beat can be readily observed and after feeding commences the darkened bolus of food is visible within the animal. The first molt occurs in about two days. The number of molts is evidently indefinite. With successive molts, scales, genitalia, styli, and mature proportions appear.

Reproduction begins well before the individual has reached maximum body weight. In a colony of about 245 growing nymphs, eggs were first found when the average weight of the nymphs was 9.2 mg. It must not be assumed that this is an average body weight for sexual maturity since some nymphs were much larger than others. In general at 37° C. the cycle from egg to egg was 11 to 12 weeks. Egg laying is continued for a period not yet defined. A number of old females have been ovipositing for five months. One female laid 25 eggs in 23 days.

Maximum body weight appears to be attained about two months after sexual maturity. The firebrats reared under favorable controlled conditions of temperature and humidity attain sizes seldom seen in specimens under ordinary circumstances. Five females, which had been regarded as fully grown for three months and which had been fertile, weighed from 25.3 to 34.5 mg. The males which belonged to the same lot and which had been confined with these females varied in weight from 16.4 to 29.5 mg.

The firebrat females are evidently highly sensitive to disturbance. In a colony of about 150 males and females the following record of egg production was obtained:

April 7th–11th—Not disturbed in interval, 205 eggs.
April 12th–16th—Daily disturbed in interval, 9 eggs.
April 17th–21st—Not disturbed in interval, 70 eggs.
April 22d—Not disturbed in interval, 22 eggs.
April 23rd–May 3rd—Not disturbed in interval, 112 eggs.
May 4th–8th—Not disturbed in interval, 110 eggs.
May 9th–18th—Daily disturbed in interval, 24 eggs.
May 19th–24th—Not disturbed in interval, 260 eggs.

There are not adequate data for a statement upon the sex ratio. In most populations counted the females have outnumbered the males.

The molting firebrat emerges from a mid-dorsal cleft of its skin extending the length of the thorax. At the molt the defaced surfaces are restored to the fully scaled condition. The anatomy of regenerated structures was not studied. Specimens intentionally mutilated have molted within a week, regenerating the distal halves of antennæ and cerci and even the three distal segments of a rear leg. Four fertile females at least five months of age were brushed entirely free of scales. They molted in five to eight days and regained their original appearance.

Temperature Relations

Thermobia can endure, without apparent injury, temperatures which will produce heat rigor in some forms. After a consideration of the environments in which the insects were trapped a temperature of 37° C. was chosen for the rearing cabinet. The first generation of firebrats reared was tested for reactions to heat in a specially devised thermal gradient, the description of which is to be published elsewhere. The results showed that these firebrats strongly preferred temperatures around 36° to 39° C. and that temperatures above 43° C. and below 32° C. were avoided. It is not to be overlooked that these firebrats might have been, to some extent, acclimated.

The high temperature which will kill in one hour was found to be about the same as that found in previous work upon the larvæ of *Pyrausta nubilalis* Hubn. and agreed with Bachmetjew's well known conclusions upon maximum temperatures for insects. Nearly full grown firebrats were exposed in small, specially devised, closed, glass chambers containing saturated sodium chloride solution which should give a humidity near 74 per cent. Ten hours of exposure at 45° C. produced no noticeable effects. A similar exposure at 47° C. killed one out of four. A ten-hour exposure at 48° C. killed all. A three-hour exposure at 48° C. killed three of four. A one-hour exposure at 49° C. likewise killed three of four.

Low temperature reactions were little studied. A few individuals were taken singly in a specially designed tube and cooled with a flow of escaping carbon dioxide, at the rate of about one degree in two minutes, from 22° C. to —2° C. and allowed to warm again at about the same rate. The animals became wholly inert at the low temperature but recovered apparently normal activity within the hour after return to room temperature.

Moisture Relations

Firebrats have been reared at 37° C. and 50 to 70 per cent relative humidity both with and without being given water to imbibe. More rapid growth resulted where water was given. In one experiment those reared with water weighed about 50 per cent more than those receiving none. The food was given with only such moisture as it held in air at room conditions. The insects readily eat food which is actually moistened but such is not practicable owing to molds. They also readily approach wet cotton wicks, although drops of water are avoided.

Firebrats have been reared through the life cycle from egg to egg without having access to water. The development under these conditions has been decidedly slower, and oviposition retarded and decreased.

The firebrat is evidently tolerant to a very wide range of humidity. Nymphs, newly hatched, in closed containers, over distilled water, survived several days until overcome by a condensation film. Others, hatched over potassium hydroxide solutions of saturation deficiencies calculated to give low humidities of 30 and 40 per cent, and fed but given no water, had their first molt in the usual time. Newly hatched nymphs were placed in vials with food and no water and the vials placed in a dessicating jar over a solution of magnesium chloride with an excess of the chloride. When examined at the end of three days they appeared about normally active. The chloride, according to physical tables, gives a relative humidity of near 33 per cent.

These low humidity tests were made only in closed containers. No tests were made with moving air.

Food Habits

Owing to the heavy tufts of cephalic hairs the action of the mouthparts is not readily observed. Firebrats lift and carry fragments of rolled oats or eggs of their own kind in their jaws.

In the present experiments raw rolled oats and raw dried beef were the standard foods. The oats were used as they come from the mills of the Quaker Oats Company. The beef was dried and ground. The two foods were given together without being mixed. Paper bearing a glaze was present in all the jars but was not scraped by the insects except under force of starvation.

Small trials have readily shown that starved firebrats will also devour the eggs, exuviæ, and bodies of their own kind. A gradual decline in population among growing nymphs can be attributed to cannibalism. It is probable that weak individuals are killed during ecdysis and that cannibalism serves an important biologic function in carrying the line of life over periods of adversity.

Where 100 newly hatched nymphs were fed on glazed paper only, the population gradually declined till at the end of two months but four individuals were left. These had an average body length of near 3.5 mm. or about half that in a similar group fed on oats and beef. Where beef alone was given, with, of course, glazed paper present but scarcely touched, the population of 100 declined to 51 in the first month, 25 in the second and 18 in the third.

Olfactometric data have been negative. The odour of ground rolled oats did not seem to be attractive to firebrats at a distance of eight centimeters even after two days' starvation. No marked preference was shown between the odour of oleic acid and cleaned air. Strong, positive responses to dry food particles and avoiding responses to resting drops of water, oil, etc., followed only upon direct antennal contacts.

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INDEX TO NAMES OF INSECTS AND PLANTS IN VOLUME XLI

Generic names begin with capital letters. New genera, subgenera, species, subspecies varieties and new names are printed in italics.

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