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PROCEEDINGS OF THE
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# THE MOUTH PARTS OF THE CICADA.

By R. E. Snodgrass, *Bureau of Entomology.*

This paper is presented to show the anatomical structure of the sucking apparatus of the cicada (*Tibicena septendecim*). None of the published accounts of Hemipteran mouth parts have made the subject fully clear to the writer, and it is hoped that the descriptions and figures here given may justify a new treatment of an old subject. But the facts are disconcerting—they raise perplexing questions of interpretation that will not fit with any current view on the homologies of the Hemipteran head plates and the setæ. While the basic mouth structure appears to be the same throughout the order of the Hemiptera, a further study of the embryological origin and development of the head plates and the mouth appendages is needed. The intricate mechanism in the adult is difficult to set forth clearly in words and for this reason the figures on plates I and II are made the basis of the descriptions and comparisons.

Figure 1 (Plate I) represents the head of a young Locustid, showing the generalized type of Orthopteran mouth parts.

Figure 2 is the same with the mandible removed from its basal connection (*md*), exposing the large tongue-like hypopharynx (*Hphy*) and its lateral membranous connection (*a*) with the base of the mandible.

Figure 3 is the same again but with both the mandible and the maxilla cut off, leaving the stump (*mx*) of the latter still attached to the head.

Figure 4 shows a corresponding view of the head of a fully matured adult seventeen-year cicada. The prominent ridged facial plate (*Ft*) is designated the *front* because of the attachment of the pharyngeal muscles (Plate II, figure 15, *PhyMcl*) to it as in other insects. The labrum-like plate below (*Clp*) is called the *clypeus* because it appears to correspond with the clypeus of the Locustid (fig. 1, *Clp*). The tapering appendage (*Lm*), ensheathing the bases of the setæ, likewise appears to be the *labrum*, though some writers call it the epipharynx. On the side of the head are two important sclerites (*A* and *B*) which will be referred to simply by the letters designating them. The second one (*B*) terminates below in a free lobe (*b*) carrying a soft appendage (*c*) which, with its mate on the other side, protects the rear side of the setal bases. Behind this is the long labium (*Lb*) which encloses the setæ within a groove along its front surface. Sclerite *A* is hidden at its lower end between the clypeus (*Clp*) and the lobe *b* of sclerite *B*. The parts are all tightly compressed and difficult to study in the mature condition.

Figure 5 is the head of an adult cicada just as it emerges from the pupal skin. The general shape is very different from that of the fully matured insect (fig. 4). All the parts are soft and stand apart from one another in a way that shows much more of the true anatomical structure. Especially is it to be noted that sclerite *A* is prolonged downward in a large appendicular structure (*a*), which scarcely shows at all in the normal mature head. The bases of the setæ (*Set*) are here exposed behind *a*, disappearing entad to the sclerite *B*.

Figure 6 is the head of an imago toward the end of emergence from the pupal skin. The parts have assumed more of the adult form, but are still soft and easily separated as shown in this drawing. Here we get a very different idea of the form and relationships of the mouth parts from that given by the hardened and consolidated mature head (fig. 4). We are at once struck by the resemblance to the mutilated Locustid head (fig. 3). Minus setæ, the cicada might be an Orthopteron minus mandibles and maxillæ. The clypeus and labrum hang down in front of the mouth (*Mth*) the same in each. Behind the mouth is a median hypopharynx (*Hphy*) connected on each side by a flaring membranous wing (*a*) with the lateral wall of the head (or would be so connected in the Locustid if the hole where the mandible was attached were closed over). The labium (*Lb*) is suspended from the neck membrane (*mb*). The lateral head sclerite *A* is separated from the front by a suture forming a high ridge on the inside of the head, which contributes to the support of the pharynx. But the suture continues upward before the base of the antenna and is continuous with the one from the other side over the upper end of the front. While in this respect it differs from the frontogenal suture of the grasshopper, it resembles that in the cockroach and other insects where the front forms a distinct facial plate. The outer surface of plate *A* is minutely but conspicuously punctate in transverse, semi-spiral rugæ, and in certain lights has a bright silvery color. The lower posterior part bears a prominent clump of long hairs. The lower edge of the plate appears to be continuous with the hypopharynx below, but internally it is separated from the latter by a strong ridge. Separating plate *A* from *B* is a deep membranous groove with a thin chitinous bar lying along the entire length of its floor and continuous below with the base of the first seta. This bar will be more fully described in connection with figures 13 and 14.

Figure 7 is a ventral view of the adult head. The mouth (*Mth*) is forcibly opened by prying the clypeus forward with the dissecting needle; and the base of the labium (*Lb*) is turned back, thereby pulling the setæ away from the hypopharynx. The lateral head sclerites (*A*,*A*) are seen to be directly continuous with the wings (*a*,*a*) of the median hypopharynx (*Hphy*). Behind the latter are the two deep pouches from which issue the setæ (*1Set* and *2Set*). The lobes (fig. 6, *b*) of the plates *B*,*B* are cut off near their bases (*b*) for the sake of clearness. This view of the head tells its own story and little more need be added by way of description.

The mouth is deceptive in the natural condition. So closely is the hypopharynx applied to the epipharynx in a mature specimen that it is difficult to see that the insect has any mouth at all. Yet it is really a wide slit reaching from one upper angle of the clypeus to the other. When closed, the upper part of the hypopharynx fits snugly into a median depression of the epipharynx; then the narrow median channel along the ridge of the hypopharynx is converted into a tube which remains as the *functional mouth*, opening above into the pharynx and below just above the tip of the hypopharynx. This condition can be mentally pictured from figure 7 if it be imagined that the clypeus is allowed to drop down again against the hypopharyngeal wings (*a*,*a*). The median part of the hypopharynx would then be received into the epipharyngeal cavity above it, and its channel, now transformed into a tube, would open into the base of the furrow in the labrum (*Lm*). Thus the wide Orthopteran mouth is narrowed down to a tiny median pore to serve the needs of the sucking Hemipteron.

Figure 8, showing a front view of an emerging cicada's head, from which the clypeus and labrum have been removed, gives the same parts from a different angle. The labium is not shown, in order to give a clearer view of the bases of the setæ. Where the clypeus is detached the bases of the dilator muscles of the pharynx (*PhyMcl*) are seen, and below them the invaginated roof (*e*) of the pharynx (seen also at *e* on figure 6). The second setæ (*2Set*) are normally united along their inner faces by interlocking grooves and ridges to form a conducting tube for the liquid food; but in the drawing they are separated for clearness, though it is indicated how their bases embrace the tip of the hypopharynx as they flare apart to enter the pouches behind the hypopharyngeal wings (*a*,*a*). The liquid arising between them is thus delivered immediately to the mouth pore above the tip of the hypopharynx. The appendages *c* and *c* are separated, but it can be seen how they would come together behind the bases of the setæ in the normal condition.

Figure 9 gives a rear view, on a mature specimen, of the parts referred to in figure 8. The labium is removed from its membranous base (*lb*). The appendages *c* are closed behind the bases of the setæ, which are clasped farther along by the sheath-like furrow of the labrum (*Lm*), beyond which again they would normally be held in the hollow of the labium.

Figure 10 is a lateral view of the clypeus, labrum and hypopharynx, showing particularly the line (*Mth*) of the tightly closed mouth. The dorsal part of the hypopharynx (*Hphy*) is concealed in the median depression of the epipharynx (*Ephy*). The swelling (*d*) below the hypopharynx encloses the salivary pump, seen in the sectional view (fig. 15, *SalPmp*).

Figure 11 is the same as figure 10 but with the mouth artificially opened, fully exposing the hypopharynx (*Hphy*).

Figure 12 is a ventral view of figure 10. The hypopharynx (*Hyphy*) and its wings (*a,a*) are seen fitting snugly against the upper part of the epipharynx along the mouth line (*Mth*), and the median part of the hypopharynx into the median depression of the lower part of the epipharynx (*Ephy*). The opening of the mouth pore (*mth*) is just above the tip of the hypopharynx and just within the furrow of the labrum (*Lm*). The setæ lie lengthwise in this furrow, to which they converge from their bases close along the sides of the hypopharynx, the inner or second pair closely embracing the hypopharyngeal tip.

Figure 13 shows the setal pouches of the left side exposed by the separation of head sclerites *A* and *B*, most of which are also removed. The setæ appear to be produced into the head cavity as apodemes for the muscles that operate them. The first seta has two apodemal arms: one (*1RAp*) a long slender rod having the retractor muscles (*1Rmcl*) inserted upon its upper end; the other (*1PAp*) a wide plate bent over at the top, where it is loosely connected with plate *A*, having the protractor muscles (*1PMcl*) inserted upon its anterior face. The retractor muscles are attached on the dorsal wall of the epicianium posterior to the ocelli. The protractors go downward and forward to their attachment along the front part of sclerite *A* and against the high apodemal ridge between this sclerite and the lower part of the front (*Ft*). The second seta (*2Set*) has only one apodemal arm (*2Ap*) which carries the insertion of the protractor muscles (*2PMcl*) and that of one of the retractors. The other retractor is inserted directly upon the base of the seta. Both bundles (*2RMcl*) are attached to the vertex between the inner margin of the compound eye and the bases of the retractors of the first setæ. The protractors (*2PMcl*) are attached to the lower part of head sclerite *B* and to its lobe *b*. The apodeme of the second seta and the protractor apodeme of the first are connected by a thin sheet of muscle fibers indicated by the set of parallel lines crossing the setal bases. The outer edge (*f*) of the protractor apodeme of the first seta (*1PAp*) forms the chitinous strip in the thin membranous floor of the deep groove between sclerites *A* and *B*. Its distal end is loosely connected with the upper end of plate *A* in the fully matured head. A chitinous plate lies entad to the base of the second seta and its distal end (*h*) is loosely connected with the occipital rim of the cranium. This plate, however, has no connection with the seta and appears to belong to the setal pouch. The remaining parts shown in this figure may be identified by reference to the other drawings.

There is here, indeed, an apparent analogy between the musculature of the setæ and that of the mandibles and maxillæ of biting insects, the retractors being the flexor muscles and the protractors being the extensor muscles. The function of the two sets is in a sense reversed, however, since in the Hemiptera the hard work falls on the protractors; and it must be admitted that no other type of musculature could accomplish the out and in motion of the setæ. Hence, we must not give too much weight to evidence based on the musculature purporting to establish homologies between these two sets of organs.

Figure 14 shows the apodemes of the first seta in the head of an imago that has not yet escaped from the pupal skin. Head plate *B* is cut off from *C*, and sclerite *A*, carrying the hypypharynx (*Hphy*), is swung forward. The membranous floor of the groove between *A* and *B* is removed entirely and none of the muscles (seen in figure 13) are shown. At this stage the muscle plate (*1PAp*) shows a distinct central shaft having every appearance of being of apodemal origin. Below, it disappears in the wall of the funnel-shaped base of the seta. Above, it fades away but the narrow upper end of the plate is fused with head plate *C* at the point *g* a short distance below the origin (*ten*) of the anterior arm of the tentorium. At a later stage both of these connections appear to be with plate *A*, but this is due to their fusing with the edge of the latter across the intervening suture. In the fully matured head (fig. 13) the upper end (*g*) of this plate (*1PAp*) is only loosely connected with sclerite *A*. The retractor apodeme of the first seta (*1RAp*) at this early stage arises independently from the hypoderm above the setal base. When the head is mature the apodemal bases and the seta are all consolidated into one continuous structure.

Figure 15 is a median vertical section of the head illustrating the mechanism of the pumping apparatus and showing also the salivary glands and the salivary pump. The pharynx (*Phy*) is a large bulb-like cavity with the front or dorsal wall (*e*) deeply invaginated so that in the collapsed condition it almost fills the interior. The sides of the pharynx are braced to the walls of the head by complicated chitinous wings not shown in the figures. The space between the mouth parts of insects is usually called the mouth or buccal cavity, but it is properly only an external space like that between the bases of the legs; the true mouth is the lower part of the pharynx where the hypopharynx shuts against the epipharynx. Figure 7, showing the cicada's mouth forced open, reveals the pharyngeal cavity beyond; when the mouth is shut the only inlet to the pharynx is through the narrow channel on the hypopharnyx. On figure 15 this channel shows in section at *Mth*.

The dilator muscles of the pharynx (*PhyMcl*) are feather-like bundles of fibers attached to the front and inserted on stalk-like tendons attached in a row along the median line of the pharyngeal roof. The latter collapses by its own elasticity when the dilator muscles relax. The contraction of the muscles lifts the roof, thus sucking the liquid food into the lumen of the pharynx through the tubular mouth from the channel between the second pair of setæ. When the roof drops back, its lower end comes down first and closes the mouth pore, preventing the liquid from making its exit where it entered and, at the same time, forcing it upward into the rear part of the pharynx and into a secondary pharyngeal bulb (*phy*) located just over the tentorium (*Ten*). The lumen of this bulb is apparently dilated by muscle fibers extending from its dorsal wall to the epicranium. From this chamber the liquid is fed into the tubular œsophagus (*Œ*). Both the stomach and the rectum of living cicadas are usually filled, often tensely distended, with a clear liquid, even at the close of their natural lives when their life functions are over.

There are two large sets of salivary glands (fig. 15, *Gl*) on each side of the head. Their duct unites above the base of the labium with the duct from the other side, and this common duct appears to open at the very tip of the terminal point of the hypopharynx. In the base of the hypopharynx it is connected with the chamber of the salivary pump (*SalPmp*). The function of this organ is supposed to be that of forcibly expelling the saliva from the duct. The aperture of the latter is placed where the saliva will enter the setal channel just where the latter opens to the mouth pore. The saliva of Hemiptera is thought to function as an irritant or solvent in the tissues pierced by the setæ, and perhaps to have digestive properties as well. In the first case the force pump is necessary to drive the liquid down the setal channel and into the punctured food tissue, but when this is accomplished it would seem as if farther pumping would counteract the upward flow of the food liquid. Perhaps we do not entirely understand the action of the salivary pump. Anyhow, its piston is worked by two powerful muscles, the right one of which (*Mcl*) is seen in the figure. It is attached partly to the tentorium and partly to a large plate entad to the occipital rim of the head, and connected with the posterior braces of the pharynx.

The foregoing descriptions and the figures should make the mere anatomy of the cicada's head and mouth parts reasonably clear, and the work of other writers shows that the structure is fundamentally the same throughout the Hemiptera. But a satisfactory interpretation of the parts in terms of general insect morphology is quite another matter. Most entomologists have regarded the Hemipteran setæ as the homologues of the mandibles and maxillæ of biting insects. Suppose we carry out a direct comparison between the head of an adult cicada (fig. 6) and the head of a grasshopper (figs. 1, 2 and 3) by transferring the setæ of the former to the mutilated head of the locust (fig. 3) and inserting them into the bases of the mandibles (*md*) and the maxillæ (*mx*). Do we convert the Orthopteron into a Hemipteron by such imaginary grafting? By no means, for the first setæ would then arise at the *sides* of the hypopharynx (fig. 3, *Hphy*), above its membranous connections (*a*) with the lateral head walls; whereas, in the cicada (fig. 6), all the setæ arise from deep pouches *behind* the wings (*a*) of the hypopharynx. On the other hand, if we leave the Orthopteran head as it is in figure 3, minus mandibles and with but stumps of maxillæ (*mx*), and insert the setæ at the point *x* between the hypopharynx (*Hphy*) and the base of the labium (*Lb*) we transform it, in external appearance, into a veritable Hemipteron. Note, in this case, how the lobe *b* and its appendage *c* in the cicada (fig. 6) correspond with the stump of the grasshopper's maxilla (fig. 3, *mx*). Now, observing the position of plate *A* on the cicada head and its relation to the hypopharynx, the question naturally arises, does the sclerite *A* in any manner represent the Orthopteran mandible?

Our only safe guide to morphology is comparative embryology—when we are sure we have all the facts in the case. The first writer on Hemipteran development, Mecznikov (1866), stated that the embryonic mouth appendages of the Homoptera are, in an early stage, the same as those of other insects; but that, at the time the labial appendages are uniting with each other, the mandibular lobes fuse with the side walls of the head and the maxillary lobes are reduced to small spurs. He further describes the setæ as independent structures subsequently developed from retort-shaped masses of cells within the head. According to Mecznikov, then, we might suppose that the mandible becomes sclerite *A* or a part of it, and the maxilla the appendage *c*, or *c* and *b* (fig. 6). The setæ would be in this case neither mandibles nor maxillæ but new organs developed for the special function of piercing and sucking.

Later, J. B. Smith (1892) proposed an interpretation somewhat similar to this in which he identified sclerite *A* as the mandible and named it the "mandibular sclerite," while both setæ on each side he regarded as parts of the maxilla, but he claimed, furthermore, that the supposed labium (*Lb*) is also formed from parts of the maxilla, and that a true labium is lacking. In this he went so far from the beaten path that none of his interpretations have been taken seriously. But if we could adopt Mecznikov's statements as true, the problem of interpreting the Hemipteran head and mouth parts would be greatly simplified.

Unfortunately for our peace of mind, however, no subsequent embryologist has agreed with Mecznikov, while all have agreed with one another that the setæ are developments of the true mandibular and maxillary embryonic appendages. Witlaczil (1882) stated that it is not difficult to show that the mandibles and first maxillæ are not lost in development, as described by Mecznikov, but, sinking into the head, form the retort organs from which the setæ are chitinous outgrowths. Heymons (1899) showed that the mandibular appendages of the embryo are developed entirely into the first setæ, but that each maxillary appendage divides at an early stage into a basal part and a distal part, the first fusing with the lateral wall of the head, the other becoming the second seta. Muir and Kershaw (1911, 1912) have verified Heymons' statements in both the Homoptera and the Heteroptera. All writers, except Smith, agree that the labium of the adult is formed from the fused labial appendages of the embryo.

Therefore, we must either admit that the Hemipteran mouth setæ are the true mandibles and maxillæ, or we must produce evidence to show that the more recent students of Hemipteran embryology are mistaken in their facts. Up to the present Mecznikov is discredited, and all direct anatomical comparisons of the Hemipteran with the Orthopteran head fail to give satisfaction. To adjust our ideas we must begin by assuming that the bases of the mandibles in the Hemiptera have moved posteriorly across the bridge of the hypopharynx (fig. 7, *a*, *a*) and have sunken into pouches, along with the maxillæ, *behind* the latter. Heymons, in one of his figures, appears to indicate that this migration of the mandibles has taken place, though he does not specifically describe it.

It would seem then, that the embryological evidence should end all discussion concerning the homologies of the setæ, but when we examine the details of their external connections with the head, their internal apodemes, and the muscles that move them, and then attempt to reconcile these features with those of other insects a whole new set of troubles confronts us. Muir and Kershaw (1911a), discovering that the first seta on each side has a basal arm (figs. 13, 14, *f*) reaching clear up to the dorsal end of sclerite *A* on the floor of the deep sulcus between sclerite *A* and *B*, established this point (*g*) as the true mandibular articulation (anterior) with the head. Furthermore, they substantiate this interpretation with the fact that the invagination for the anterior arm of the tentorium (*ten*) is located just above the end of the setal arm. The same view has been adopted by

Cogan (1916). Taking the attachment of this bar to head plate *C* as a definite anatomical landmark, these authors are forced to regard the large facial plate (figs. 4, 5, 6, *Ft*) as the "clypeus," of which the lateral plates *A* and *A* become posterior lobes. The free sclerite (*Clp*) in front of the mouth then is the "labrum" and the terminal grooved piece, holding the bases of the setæ, the "epipharynx."

With these interpretations, however, we are involved in several difficulties which the writers proposing them do not consider. First we have the anomaly of the hypopharynx forming a bridge between the posterior lobes of the assumed clypeus (fig. 7, *A*, *a*, *Hphy*, *a*, *A*). Internally there are more perplexing complications. The dilator muscles of the pharynx (fig. 15, *PhyMcl*) are attached to the plate (*Ft*) which in other insects, including the Thysanoptera, is the front, but which is now presumed to be the clypeus! Finally the protractor (extensor) muscles of the mandible become attached to the clypeus (not to the gena or to a ridge between the gena and the front as is normal in other insects). These are startling innovations and the same writers, Muir and Kershaw (1911 a) do not apply them to the head of a thrips in making comparisons between the Hemiptera and the Thysanoptera. In the thrips they name the facial plate, to which the dilator pharyngeal muscles are attached the front; the plate below this and in front of the maxillary plates they identify as the clypeus; while the terminal sclerite forming a sheath for the setæ, as *Lm* of figures 6 and 12 does in the cicada, they call the labrum. Peterson (1915) identifies these parts of the Thysanoptera the same as do Muir and Kershaw. Yet the parallelism between the head sclerites of Hemiptera, Thysanoptera and Orthoptera is so apparent that the present writer has adopted the identifications given on figure 4 for the Hemiptera. Since the protractor muscles of the first seta (fig. 13, *1PMcl*) are attached to sclerite *A* and to a high ridge between *A* and the apparent front (*Ft*) it seems reasonable to regard *A* as at least a part of the gena, and yet, how can the mandibular articulation be behind any part of the gena? In any case the mandibular bases must be admitted to have shifted to a position *behind* the base of the hypopharynx, so we might regard the sulcus between plates *A* and *B* as a split in the gena produced by the downward growth of the lateral parts of the head.

However, again we are invoking far-fetched explanations, and accepting the point *g* as the articulation of the mandible only leads us into still further difficulties when we study the internal connections of the first setæ. If *g* is the mandibular articulation, then the strip of chitin running from it to the funnel like base of the first seta must be the base of the mandible (figs. 13, 14, *f*). In which case the protractor (extensor) muscles are attached directly to the mandible and not to an apodeme! Yet the retractor (flexor) muscles are attached to a true apodemal arm of the seta. To avoid this difficulty it might be proposed that the sulcus between sclerites *A* and *B* is the attenuated apodemal invagination, making the plate (fig. 13, 14, *1PAp*) arising along its floor from *g* to the setal base, the true extensor apodeme with its muscles attached to the side walls of the head. Contradicting such an assumption, however, is the structure of the plate itself in the head of an immature cicada. Here (fig. 14) there is a very evident cartilage-like shaft extending through the middle of the plate from its upper end into the base of the seta. This shaft has the appearance of being of apodemal origin and suggests that the two wings forming the plate have grown from it, the outer coming in contact and fusing with the floor of the sulcus. The retractor apodeme at this stage has an independent origin in the hypoderm at the base of the seta (fig. 14, *1RAp*).

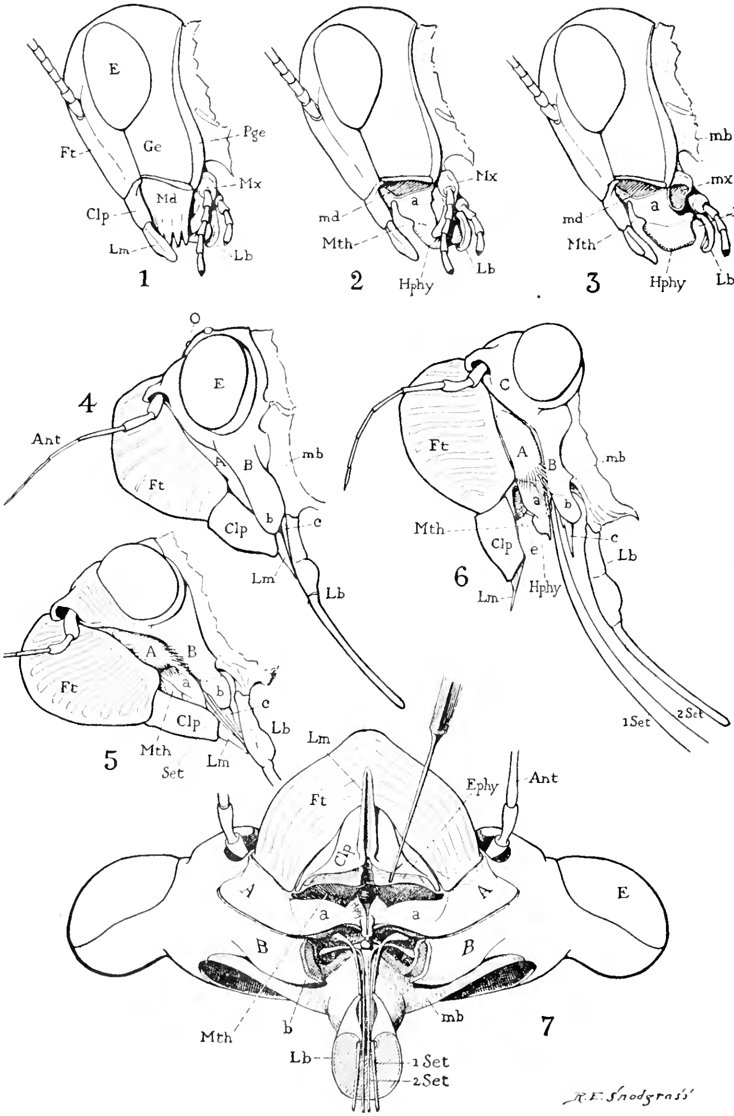
So again we are but led into morphological absurdities. If the plate carrying the insertion of the protractor muscles is a true apodeme it should arise near the base of the seta as does that carrying the retractor muscles, but there is no evidence of its having any such origin (fig. 14) while its distal end is attached to (continuous with) the head plate *C* at the point *g*. If *g*, on the other hand, is its origin, as it should be since the invagination for the anterior arm of the tentorium (*ten*) is just above it, and we may easily assume that the mandibular base has been moved down, how could it come about that the distal end of a mandibular apodeme should become attached to the mandible!

Any way we turn, in an effort to make these parts fit the facts of other insects, we encounter these baffling incongruities. Both Muir and Kershaw (1911 a) and Peterson (1915) homologise the Hemipteran setæ with the setæ of the Thysanoptera, but they do not agree as to which is which, and both portray internal connections in the Thysanoptera which can not be clearly identified either with those of the mandibles of biting insects or with those of the setæ of the Hemiptera. The whole problem seems to become only more bewildering the more we study it, and we may well wish that Mecznikov had been right—in fact, in desperation we can almost believe that he must be right, that the Hemipteran setæ can not be and are not either mandibles or maxillæ. Of course, it may not be necessary to assume that the ancestor of the Hemiptera ever had biting mouth parts of the type possessed by modern mandibulate insects. Their primitive head appendages may have evolved directly into setæ while they evolved into mandibles and maxillæ in the others. However, if any such gulf exists between the Hemiptera and the mandibulate orders we should expect it to be indicated also in the rest of their organization.

An interesting comparison may be made in two other orders of insects. The Corrodentia and some of the Mallophaga, both possessing strong biting mandibles and simple, one-lobed maxillæ have also a pair of short mouth rods, one on each side, issuing from pouches entad to the bases of the maxillæ. Each rod has an internal apodemal prolongation of its shaft to which are inserted retractor muscles attached to the epicranium and protractor muscles attached to the base of the maxilla. The distal ends of the rods are usually forked. Some writers explain these rods as being the modified inner lobes of the maxillæ which are otherwise one-lobed. Since the embryologists have shown that the lower end of sclerite *B* of the Hemipteran head is formed from the body of the maxilla, and that the second seta is formed from a maxillary lobe, we can trace here such a clear analogy with the maxillary structure in the Corrodentia and the Mallophaga as to suggest that these insects present a more primitive condition of the Hemipteran maxilla than does the Hemipteran embryo itself. It would be a great relief if the supposed mandibular seta of the Hemiptera could be so easily compared with some other known structure. In any case it should prove highly interesting if we can find in the Corrodentia and Mallophaga a suggestion of the link between the Hemipteran mouth parts and those of biting insects. But the relationship of these orders and the homologies of the mouth rods and the setæ have already been discussed by Börner (1904) in a paper on insect phylogeny. This author would derive the Hemiptera and the Corrodentia, including the Mallophaga, from a common stem, with the Thysanoptera intermediate but related rather to the Hemipteran branch, while the Siphunculata are doubtfully connected with the Mallophaga.

LIST OF SYMBOLS AND LETTERING USED ON PLATES I AND II.

| | |
|---|---|
| *A*, | anterior lateral head sclerite. |
| *a*, | lateral wing of hypopharynx. |
| *Ant*, | antenna. |
| *2Ap*, | apodeme of second seta. |
| *B*, | posterior lateral head sclerite. |
| *b*, | free lower end of *B*. |
| *C*, | side of epicranium |
| *c*, | soft appendicular lobe of *b*. |
| *Clp*, | clypeus. |
| *d*, | swelling below salivary pump. |
| *E*, | compound eye. |
| *e*, | invaginated roof of pharynx. |
| *Ephy*, | epipharynx. |
| *f*, | outer edge of protractor apodeme of first seta. |
| *Ft*, | front |
| *g*, | attachment of protractor apodeme of first seta to *C*. |




SNODGRASS—MOUTH PARTS OF THE CICADA.

| | |
|---|---|
| *Ge*, | gena. |
| *Gl*, | salivary glands. |
| *h*, | tip of bar from second seta attaching to occipital margin of head. |
| *Hphy*, | hypopharynx. |
| *Lb*, | labium. |
| *lb*, | base of detached labium. |
| *Lm*, | labrum. |
| *mb*, | neck membrane. |
| *Mcl*, | muscle of salivary pump. |
| *Md*, | mandible. |
| *md*, | site of detached mandible. |
| *Mth*, | mouth. |
| *mth*, | external aperture of functional mouth channel. |
| *Mx*, | maxilla. |
| *mx*, | stump of removed maxilla. |
| *o*, | ocelli. |
| *Œ*, | œsophagus. |
| *1PAp*, | protractor apodeme of first seta. |
| *Pge*, | postgena. |
| *Phy*, | pharynx. |
| *phy*, | supplementary pharynx, or bulb-like anterior end of œsophagus. |
| *1PMcl*, | protractor muscle of first seta. |
| *2PMcl*, | protractor muscle of second seta. |
| *1RAp*, | retractor apodeme of first seta. |
| *1RMcl*, | retractor muscles of first seta. |
| *2RMcl*, | retractor muscles of second seta. |
| $S_1$, | sternum of prothorax. |
| *SalD*, | salivary duct. |
| *SalPmp*, | salivary pump. |
| $T_1$, | tergum of prothorax. |
| *Ten*, | tentorium. |
| *ten*, | origin of anterior arm of tentorium. |
| *x*, | point on Locustid head corresponding with location of setal pouches of the cicada. |

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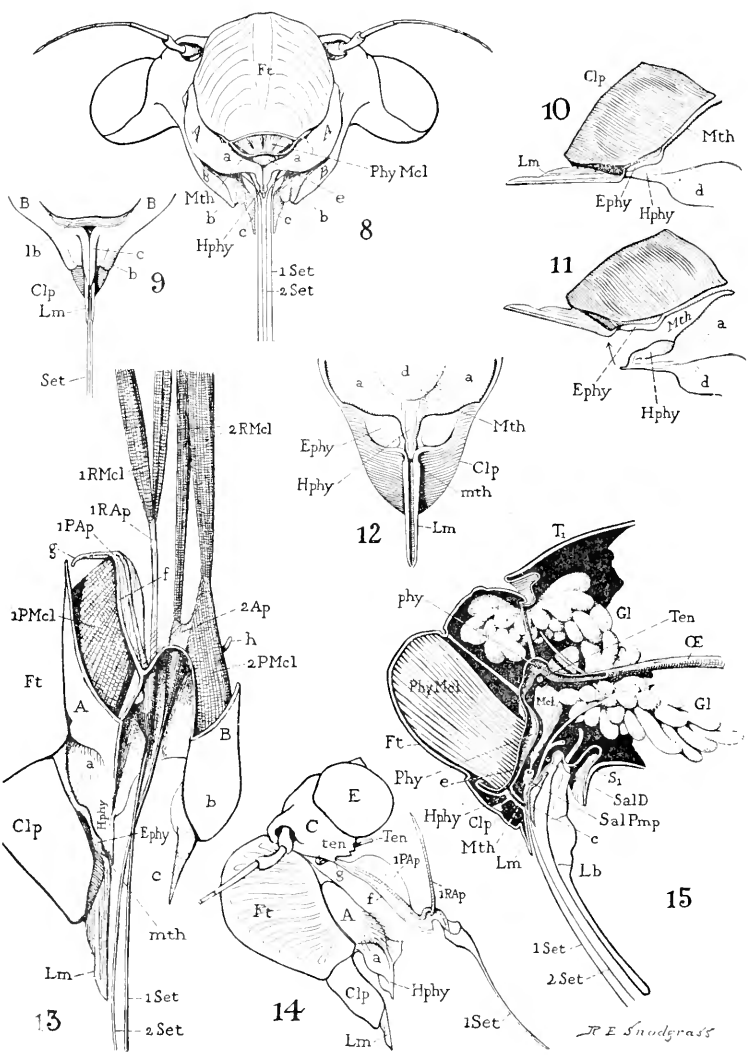


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## THE GENUS MATSUCOCCUS WITH A NEW SPECIES. (HEMIP-HOMOP.)

BY FRANK B. HERBERT, *Bureau of Entomology.*

### COCCIDAE, SUBFAMILY MARGARODINAE.

The Genus **Matsucoccus** Cockerell.

COCKERELL, T. D. A. In Can. Ent. XLI, 2, p. 56. (1909.)

*Type—Xylococcus matsumurae* Kuwana.

This genus was erected by Cockerell in 1908 to contain *Xylococcus matsumurae* Kuwana, from pine in Japan. He characterized it as follows:

"Female without marsupium; broad posteriorly, not elongated, antennae 10-jointed, close together; larva with antennae 7-jointed, and very peculiar crab-like legs, the femur large; male without whorls of long hairs on the antennal joints; caudal brush long, arising from apical segment; rudimentary hind wing with very large hooks. (Japan)."

With material of the type of the genus at hand together with two other species from pines in America, the genus may now be redescribed so as to include all of them, as follows:

Coccidae referable to the subfamily Margarodinae, i. e., adult female and first larva with legs and antennae, and at least one intermediate stage without these appendages.

Adult female elongate, broader posteriorly, with 9-segmented antennae, the latter transversely striated, except 1st and 2d segments. Legs well developed, also transversely striated. Tarsus attached at apex of tibia and strongly curved outward; with spines on inner margin of tibia, two hair-like digitules on tarsus and two knobbed digitules on tarsal claws. Without marsupium or anal tube. Mouthparts sometimes present.

Intermediate larval stage without legs, antennae or anal tube, the only conspicuous characters being mouthparts and spiracles. First stage larva with legs and 6-segmented antennae. All three stages possessing two thoracic and seven abdominal pairs of spiracles.

This genus is probably most closely related to *Kuwania*, *Steingelia* and *Stomacoccus*, all being without a marsupium or anal tube, but differs from them in several respects. The adult female, instead of bearing knobbed digitules on the tip of the tibia as in *Kuwania*, possesses a number of spines on the inner margin. The apodous larva of *Kuwania* also possesses only 4 pairs of abdominal spiracles, these on the first 4 abdominal segments. *Matsucoccus* differs from *Steingelia* and *Stomacoccus* in the number of antennal segments, the transversely striated legs and antennae and in having the anterior pair of legs normal in size. The tarsus and claw of the adult female bear only four digitules. The marsupium is lacking, in which respect this genus differs from *Callipappus* and *Xylococcus*. It also differs from the latter in that the anal tube is lacking. The mouthparts are sometimes present as is the case with several other genera referred to the Margarodinae.

It has been noticed that the antennae of those adult females which have not yet emerged from the skins of the apodous larvae, are retracted. That is, they are pulled back into the body, the distal half being within the basal half, the latter turned inside out.

In each of the species, the first exuvium is cast in a different manner, *matsumurae* rupturing on the ventor, *fasciculensis* on the cephalic end, and *acalyptus* on the dorsum.

*Key to the Species.*

A. Adult female with a pair of heavy spines on 5th to 9th antennal segments; apodous larva oval, with all spiracles forming an acute angle with the surface; first stage larva with bases of antennae approximate, and exuvium rupturing cephalically; occurring within fascicles of pine needles in California ........ *fasciculensis* Herbert.

AA. Adult female with a pair of heavy spines on 6th to 9th antennal segments only.

B. Adult female with 8-shaped pores on tip of abdomen surrounded with a compound ring; apodous larva circular, with only last 4 pairs of spiracles forming an acute angle with the surface; first stage larva with bases of antennae approximate, and exuvium rupturing ventrally; occurring in galls in bark of pine twigs in Japan and Eastern United States .......... *matsumurae* (Kuwana).

BB. Adult female with 8-shaped pores on tip of abdomen not surrounded with a compound ring; apodous larva oval, with all spiracles perpendicular to the surface; first stage larva with bases of antennae distant, exuvium rupturing dorsally; occurring exposed on needles of pine in Rocky Mt. Region .......... *acalyptus* n. sp.

**Matsucoccus matsumurae** (Kuwana).

KUWANA, S. I. In Insect World, IX, 3 (March, 1905), Figs.
——— Bull. Agr. Exp. Station, Japan, I, 2, p. 209 (1907), Figs.
COCKERELL, T. D. A. In Can. Ent. XLI, 2, p. 56. (1909.)

First stage larvae, adult males and females were found on pine in Japan by Mr. Kuwana at the time he described this species. It was placed by him in the genus *Xylococcus*, to which it is rather closely related, but later removed from that genus by Dr. Cockerell.

Lately Mr. Kuwana has found the intermediate stages of both the male and female on *Pinus thunbergii*. Realizing that the original description needed some correcting and that the intermediate stages should be described, he very kindly turned his material over to the writer, being too busy with other matters to describe them himself.

In the mean time, Mr. Harold Morrison, Coccidologist for the Bureau of Entomology, had received material from the Eastern United States and recognized that the specimens belonged to Matsucoccus, whereupon they were forwarded to the writer. Upon comparison, the writer was surprised to find that they were identical with *matsumurae*.

The Eastern material was collected by Mr. J. G. Sanders on twigs of scrub pine (*Pinus virginiana*) on Good-hope Hill, District of Columbia, in 1905, by Dr. A. D. Hopkins on pitch pine (*P. rigida*) in Pennsylvania in 1906, and from the same host by Mr. J. T. Morton on the R. W. de Forest Estate, Centerport, Long Island, New York, in 1919.

The following descriptions are taken from the Japanese material, augmented by the material from the Eastern United States.

*Adult female.*—2.5 to 4.5 mm. long and 1 to 2 mm. broad, in outline elongate oval, somewhat narrowed anteriorly. In life dark brown. Derm rough or crinkled. Antennae transversely striated (except 1st and 2d segments), 9-segmented (not 10-segmented as stated by Kuwana), bases approximate; first segment large, slightly longer than broad, 2d nearly as broad but shorter, the remaining segments becoming successively more slender, each being widest near the outer end. Each segment bearing three or more slender setae, segments 6 to 9 each also bearing 2 heavier spines. Legs are moderately large, transversely striated, trochanter bearing 1 long seta, the femur, tibia and tarsus each a number of small setae, particularly on inner margin. Tarsus bearing two hair-like digitules and the tarsal claw two knobbed digitules. Eyes present, mouthparts sometimes present. Spiracles occurring along the margin of body. Dorsum of abdomen bearing transverse rows of large, simple, circular pores; both dorsum and venter bearing internal ducts, which viewed from above have the appearance of 8-shaped pores; others at tip of abdomen having the appearance of 8-shaped pores, each surrounded by a compound ring. (Plate III J.) Small setae present on both dorsum and venter. Anal ring not discernible.

*Second stage* or apodous larva.—Body nearly circular in outline, about 1.3 mm. long when full grown and in life of a brownish black color. (Plate III C.) Without eyes, legs or antennae. Spiracles large and conspicuous. (Plate III.) Surrounded by large numbers (more than ten) of small ducts and set at inner end of rather short tubes, the latter perpendicular to the derm, except last 3 on 4 abdominal pairs which are at an acute angle. Derm slightly chitinized or dorsum. Anal tube absent, anal ring not discernible. Male apodous larva very similar to that of female except smaller.

*First stage larva.*—Body oval, acute at both ends, in life reddish brown, about .3 mm. in length when full grown. (Plate III B.) Eyes prominent, situated on margin of body, posterior to 6-segmented antennae, the latter with approximate bases. Segment 1 large and broad, 2, 4 and 6 long, 3 and 5 short; segment 4 bearing 2 broad stiff spines and 6 bearing 2 broad stiff spines and a large nipple-like process on its tip. Legs rather small, femur broad, tibia, tarsus and claw slender, the latter bearing 2 knobbed digitules, tochanter bearing 1 long slender seta. Segmentation of abdomen distinct. Spiracles resembling a row of buttons on each side of abdomen. Tip of abdomen rounded, bearing a short and a long slender seta on each side of the apex. Derm somewhat chitinized. First exuvium rupturing on the venter.

*Male prepupa* very similar to adult female except somewhat smaller. Antennae and legs similar in all respects. All 8-shaped pores simple, not surrounded with a compound ring; without large circular pores. Eyes present.

*Male pupa* possessing prominent wing pads, legs and antennae, the latter apparently 9-segmented. Caudal end bearing a blunt central lobe.

*Male adult*, typical male of the Margarodinae, with compound eyes, dusky wings and caudal brush, well described by Mr. Kuwana. Legs and antennae long and slender, transversely striated, the latter 9-segmented. Instead of always being 10, the number of tubes from which the caudal brush arises, varies somewhat, usually more than that number.

This peculiar coccid as observed in American material, occurs on the twigs of pine, yet is hardly discernible due to the fact that it lives in a pit or gall under the surface of the bark (Plate III A). No twigs from Japan have been observed by the writer, but Mr. Kuwana believes those live in similar positions. The only indication of its presence is a tiny black pin-hole in the bark and possibly a slight swelling at this point (Plate III A). In the mouth of the pin-hole can be found the cast skin of the first stage larva; under this and in a distinct cell under the surface of the bark can be found the second stage apodous larva or possibly only its cast skin. In emerging the adult female ruptures the skin of the second larva on its back and squeezes out through the tiny pin-hole, knocking away the skin of the first larva. From several hardened nearly dead twigs received from New York, the adult females were unable to emerge and were found still within the skins of the apodous larvae, in which they had secreted a mass of fluffy wax. According to Mr. Kuwana, they surround their eggs with this material when laid.

The only live forms found in the twigs collected in New York in October, 1919, were the apodous larvae, some of them containing immature female adults. These were found in the most recent season's growth. In Japan, Mr. Kuwana found apodous larvae, male prepupae and pupae in April, male and female adults early in May, and eggs and young larvae later in the same month.

There is probably but one generation per year, the larvae hatching in the spring and settling on the growing twigs, where they soon molt to apodous larvae. It is quite astonishing that they are able to form galls in the twigs. It is apparently done simply by the bark growing around and over the insect until it is finally covered in much the same way that a scar is covered up. For this reason it is necessary that they settle on the very young growing shoots.

The insect is doing considerable damage to the pines on the de Forest Estate on Long Island. Many of the small twigs are being killed. Probably spraying with a miscible oil in the spring as soon as the eggs hatch, would prove to be an effective remedy.

Having been described from Tokyo, Japan, in 1903 and collected in Pennsylvania and the District of Columbia in 1905 and 1906, it is a question as to which is its native haunt. There has been a considerable shipment of pines from Japan to America, which would indicate that it probably came from Japan. Also the fact that the insect is doing damage at Long Island would make it appear to be an introduced species, for native species are seldom noticeably harmful. However, its closest relatives, the other two species of this genus, are apparently native to the Western United States, which would be a strong indication that this species also is native to America. There is a slight possibility that this is native to both countries, being a relic of the preglacial period, when the countries were connected. Although scale insects seem to change slowly, one would expect some difference to have taken place during that time.

**M. fasciculensis** Herbert.[1]

HERBERT, F. B. In Proc. Ent. Soc. Wash., XXI, 7, p. 157. (Oct., 1919.)

This species was recently described from California, occurring within the fascicles of three-leaved pines. The antennae of the adult female bear pairs of heavy spines on segments 5 to 9. The apodous larva is oval in outline with all of the spiracles borne at an acute angle to its derm. This species seems to differ from the other two in that it has two larval stages instead of one preceding the apodous form, both of which are similar except for size. In the first larval stage the bases of the antennae are approximate. The antennae were considered to be 7-segmented in the original description, but comparison with the other species indicates that the last segment is in reality a nipple-like process occurring on the 6th. However, it is merely a matter of opinion as a slight lightening of the integument at the base of the former might be interpreted by some as indicating a 7th segment.

**M. acalyptus**, new species.

*Adult female.*—2 to 3 mm. long and .8 to 1.3 mm. broad, elongate oval in outline, somewhat narrowed anteriorly. (Plate III G.) Derm rough or crinkled. Antennae rather faintly transversely striated (except 1st and 2d segments), 9-segmented, bases approximate. 1st segment large, slightly longer than broad, 2d nearly as long and broad, remaining segments becoming successively more slender, each being widest near outer end. Each segment bearing 3 or more slender setae, segments 6 to 9 each also bearing 2 heavier spines. Legs moderately large, transversely striated, trochanter bearing 1 long slender seta, the femur, tibia and tarsus each bearing a number of small setae, particularly on inner margin. Tarsus bearing 2 hair-like digitules and the tarsal claw 2 knobbed digitules. Eyes present, mouthparts usually present. Tracheal system consisting of one main trachea paralleling the margin of abdomen, each spiracle being connected to it by a single smaller trachea; a number of auxiliaries also extending from the latter toward the center and appendages of body. (Pl. III G.) Dorsum of abdomen bearing transverse rows of large, simple, circular pores, both dorsum and venter bearing internal ducts, which viewed from above have appearance of 8-shaped pores. Small setae present on both dorsum and venter. Anal ring not discernible.

*Second stage* or apodous larva.—Body elongate oval in outline, about 1.5 mm. long and ½ as wide when full grown; in life of a brownish black color. (Pl. III F.) Without eyes, legs or antennae. Spiracles large and conspicuous, each surrounded by a number (3 to 10) of small ducts and set at inner end of a rather short tube, its outer end appearing as a dark chitinized circle. (Pl. III H.) All perpendicular to derm, the latter somewhat chitinized. Anal tube absent, anal ring not discernible.

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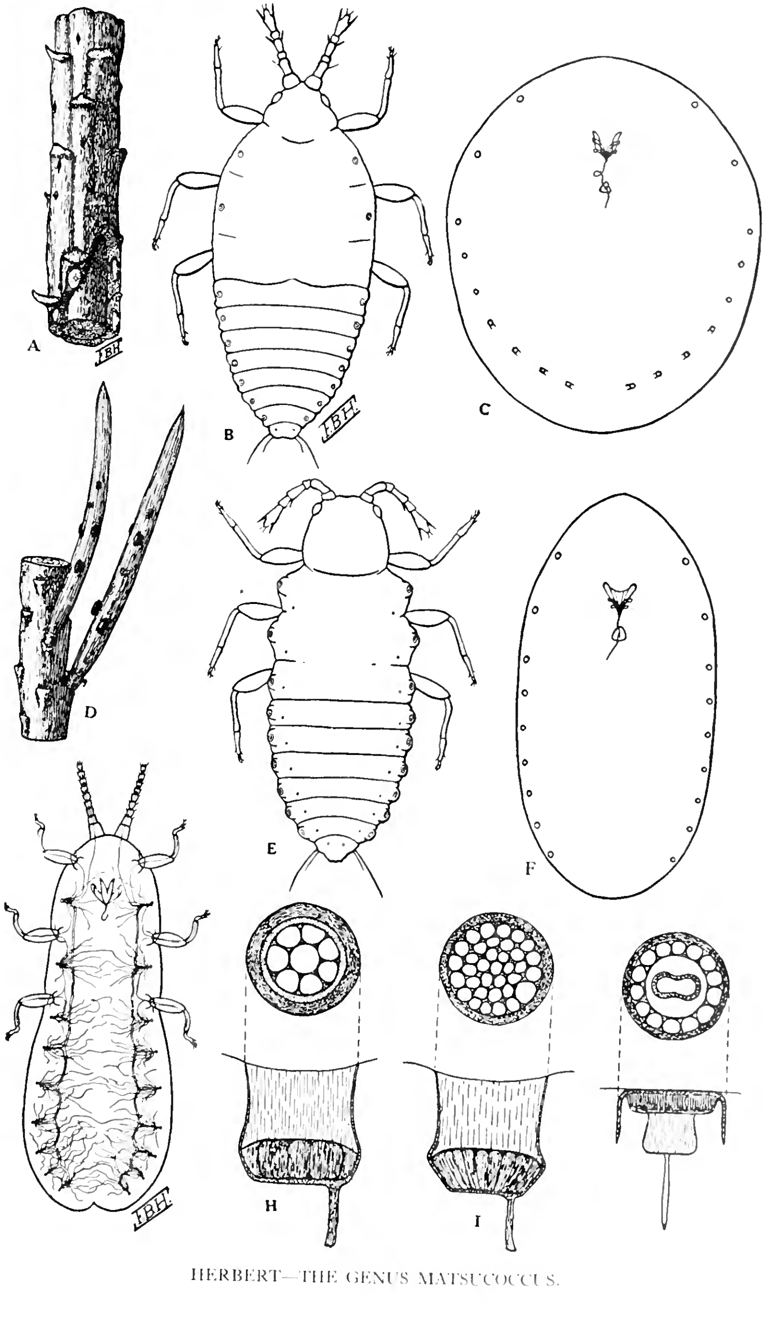
[1]This species has been made the type of the new genus *Americoccus* by MacGillivary, "The Coccidae," Jan., 1921, based on the described differences in the antennae.—Editor.




HERBERT—THE GENUS MATSUCOCCUS.

*First stage larva.*—Body elongate, .5 mm. in length when full grown, with sides nearly parallel and caudal end abruptly acute. (Pl. III E.) In life of a brownish color and surrounded with rays of wax. Head separated from and distinctly narrower than rest of body, and with prominent eyes. Antennae 6-segmented, bases well separated: segment 1 rather large and broad, 2 long without spines or setae, 3 very short, 4 long, bearing 1 broad stiff spine, 5 medium, 6 very long bearing 2 broad stiff spines and a small nipple-like process on its tip. Legs rather small, femur broad, tibia, tarsus and claw slender, the latter bearing 2 knobbed digitules. Trochanter bearing 1 long slender seta. Segmentation of abdomen distinct. Spiracles each on a raised process, together resembling a row of buttons on each side of abdomen; also a very small transparent pore dorsad of each spiracle. Tip of abdomen rounded, bearing a short and a long slender seta on each side of apex. Dorsum somewhat chitinized. First exuvium rupturing on dorsum.

*Male.*—Unknown.

*Types.*—Holotype, an adult female, and paratypes of adults and larvae from exposed portions of the needles of the single-leaf pinon (*Pinus monophylla*) from southern Idaho. Holotype and paratypes in the Entomological Collection at Stanford University. Paratypes also in the National Collection of Coccidae and the Forest Insect Collection at Los Gatos, California.

This material was received by Prof. R. W. Doane from Mr. P. J. O'Gara several years ago, simply with the information that it was apparently doing some damage in Idaho and requesting a determination. It was recently inspected by Mr. G. F. Ferris, who, upon finding it to be a *Matsucoccus*, kindly turned it over to the author to be described with the request that the type be deposited in the Entomological Collection at Stanford University. This has been done. To the above mentioned gentlemen the fullest thanks are due for the privilege of describing this species.

## EXPLANATION OF PLATE III.

A. Section of Pinus rigida twig showing pits or galls containing immature forms of M. mastumurae.

B. First stage larva of M. matsumurae.

C. Apodous larva of same.

D. Immature forms of M. acalyptus, n. sp., on needles of Pinus monophylla.

E. First stage larva of same.

F. Apodous larva of same.

G. Adult female of same showing tracheal system.

H. Top view and cross-section of spiracle of apodous larva of M. acalyptus.

I. Same of M. mastumurae.

J. Cross-section of internal duct of M. matsumurae and top view of same, showing 8-shaped pore surrounded with compound ring.

All greatly enlarged, the early stages more than the later stages. Drawn by F. B. Herbert. For illustrations of adult legs, antennae, etc., see Plates XIII and XIV, Proc. Ent. Soc. Wash., Vol. 21, No. 7 (Oct., 1919).

## A NEW GENUS OF BOMBYLIIDAE (Diptera).

By Charles T. Greene, *U. S. National Museum.*

This genus resembles *Ploas* but has only two submarginal cells instead of three as in *Ploas*. In Williston's Manual it runs to *Sparnopolius* but differs greatly in the antennae and shining scutellum.

Dr. J. McDunnough of Ottawa, Canada, called attention to the wing having only two submarginal cells.

### **Calopelta**, n. gen.

First joint of antennae dull gray, greatly enlarged on ventral, apical half; in profile, dorsal surface nearly straight; with very long, black, bristly hairs, sparse above, very thick below, especially dense towards apex on the ventral side; on the upper, outer surface are a few much shorter, yellowish-brown hairs; second joint dull gray, quite small, about as broad as long, faintly larger at apex than at base, with a circlet of long, black bristles on the apical half; third joint flattened dull black, slightly constricted near the base, broadest part at basal third from there tapering towards the apex, at the apex is a small two jointed, black style; first joint of style cylindrical about twice as long as its diameter, with small hairs at the apex; second joint cylindrical and its length is about five times its diameter. Thorax ashen gray covered with medium long yellow pile and very numerous long black hairs around the entire edge. Scutellum shining black with long yellow pile across the base and numerous long black hairs on the black surface. Abdomen ashen gray covered with yellow pile which is longer on the sides; apical edge of each segment and along the sides there are numerous long black hairs; venter clothed principally with long, dense, yellowish white pile with a few black hairs towards the apex. Tibiae with short, well defined black bristles arranged in rows. Wings with only two submarginal cells.

### **Calopelta fallax**, n. sp. Genotype (Fig.).

*Male.*—Eyes holoptic; orbital cilia long, black; frontal triangle small, black with a silvery dust. Face dull ashen gray with long black hairs above and whitish below. Proboscis black, reaching to the apex of the first antennal joint; palpi gray, nearly half the length of the proboscis, very slender with yellow hairs below, apical tuft black. Legs black; femora with long, golden yellow, hair-like scales lying flat and long, numerous, black hairs on under surface; tibiae with the same yellow hair-like scales and short, black, spine-like bristles arranged in rows; tarsi with a row of very fine black spines on under surface. Wings tinged with brown especially on the costal edge and at the base; both hind cross-veins with a faint cloud. Tegulae yellow with yellow fringe. Halteres yellow.

*Female.*—The same except as follows: Front broad, dull ashen gray with long black hairs and a few yellow, shorter hairs transversely above the base of the antennae.

Described from five specimens.

*Type, female*, Cat. No. 23086, U. S. N. M.

Ft. Garland, Colorado, June 8, 1883, Collection of C. V. Riley.

*Allotype, male*, Cat. No. 23086, U. S. N. M.

A male and female specimen labeled "Col." All three specimens in collection of U. S. National Museum. A male and female from Royal Oak, B. C., May 19, 1917, R. C. Treherne, are paratypes and were returned to The Canadian National Collection at Ottawa, Canada.

The two specimens from Royal Oak, B. C., have the knobs of the halteres blackish and the stems infuscated with a brownish-yellow.

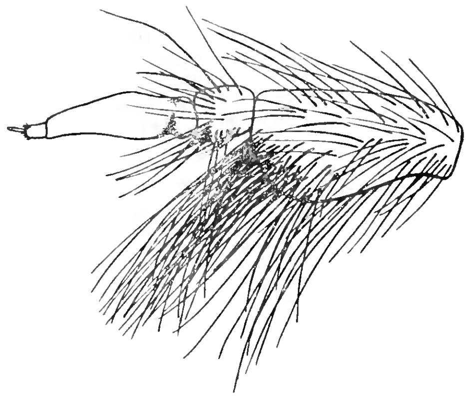


FIG. 1—*Calopelta fallax* Greene, antenna.

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# PROCEEDINGS

OF THE

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PROCEEDINGS OF THE
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VOL. 23 FEBRUARY 1921 No. 2

## REMARKS ON THE GENUS HYSTRICHOPSYLLA TASCH. WITH DESCRIPTION OF A NEW SPECIES. (SIPHONOPTERA.)

By EDWARD A. CHAPIN, *Washington, D. C.*

Through the kindness of Dr. Gordon F. Ferris, of Stanford University, I have received three specimens of a flea of the genus *Hystrichopsylla* Tasch. which appears to be undescribed. I describe it herewith as

### Hystrichopsylla mammoth, n. sp.

♂ *Head.*—The frontal notch is shallow and is quite low down on the anterior margin of the head. On the front part of the head there are many bristles. Of these bristles, seven are placed in a row from the base of the antenna forward to a point a little below the frontal notch. There are two strong bristles on the anterior edge of the antennal groove above the eye spot and one at the base of the maxillary palpus and there is one more at about the center of the space included by the bristles. In addition to these, there are many smaller hairs on the lower half of the frons. The eye is not pigmented but is indicated merely by a thickening of the chitin. The genal ctenidium is of six stout spines and occupies about the anterior half of the genal margin. The posterior angle of the gena is heavily chitinized and somewhat prolonged. The occiput bears two rows of bristles, the first (anterior) row of three and the second of five (with several much smaller bristles in the line). The marginal row of spines contains about thirteen on either side of the median line. The rostrum reaches almost to the apex of the fore coxa.

*Thorax.*—The pronotum bears on its posterior margin a ctenidium of about thirty-six spines or pairs of spines. That is, commencing with the fourteenth spine from either side, the dorsal spines are very irregular but appear to be grouped in pairs, one superimposed upon the other. The hairs on the meso and metathoraces are numerous. On the mesothorax, no order of arrangement is maintained but on the metathorax the hairs are in five rows. The metepimeron bears a vertical row of five large hairs directly below the metathoracic spiracle. There are many other and smaller hairs on the sclerite. On the mesosternum there is one very large hair.

*Abdomen.*—The tergites are thickly set with spinous hairs, the more posterior of which are in rows. On the second, third and fourth tergites, along the posterior margin there are rows of very short conical teeth, the numbers being in order 7, 2, 2. The antepygidial bristles are three on each side. Sternites III to VII are thickly set, toward their posterior borders with many hairs.

*Legs.*—The spines and hairs which adorn the legs of this species are similar in texture to those in the case of other species and their location is but slightly different. The longest apical spine on the posterior tibia is about two-thirds the length of the first tarsal segment. The plantar bristles of all the tarsi are arranged in five pairs, all lateral. The relative lengths of the tarsal segments are shown by the following table:

| Legs. | Segments 1–5. | | | | |
|---|---|---|---|---|---|
| I | 24 | 14 | 10 | 8 | 17 |
| II | 36 | 22 | 12 | 8 | 17 |
| III | 68 | 52 | 30 | 18 | 24 |

*Modified segments.*—The eighth sternite is produced posteriorly into a scoop-shaped process, thickly set with fine short hairs. The ninth sternite is club shaped and on the ventral margin toward the apex there are a number of stout teeth, mostly in pairs. The movable finger of the clasper is elongate, thickest slightly beyond the middle. On either side, toward the posterior margin there is a straight row of about fifteen hairs, reaching from the apex to about basal third. The fixed process is obliquely rounded above and bears a few hairs. The eighth tergite is trapezoidal in shape, with many long bristles and shorter hairs toward the upper portion.

♀ Essentially similar to the male in vestiture. Antepygidial bristles are four on each side. Compared with *H. schefferi* Chapin, its length is one-third greater, conical teeth of the abdominal segments are 7, 2, 2 instead of 8, 4, 3, and the body of the receptaculum seminis is nearly square (11:10) instead of rectangular (14:8).

Length: ♂ 7.38 mm.; ♀ 7.53 mm.

*Types.*—Type ♂, Allotype ♀ collected off *Aplodontia californica* Peters, at Mammoth, Mono County, California, July, 1917, by A. B. Howell. Paratype taken at Indian Canyon, Yosemite National Park, California, probably from *Aplodontia* sp. by Dr. G. F. Ferris. Type and paratype in Collection Ferris, allotype in my collection.

At this time it seems best to correct an unfortunate error in my description of *H. schefferi*. Owing to the contracted condition of the specimen it is almost impossible to determine the exact limits of the abdominal tergites. The small combs of short conical teeth do not occur on the third, fourth and sixth segments as stated but on the second, third and fourth as in the present species.

There are now four species of this genus known, of which one is palaearctic in range (*H. talpae* Curtis). The remaining three are found in western North America. For specimens of *H. dippiei* Rothsch., I am indebted to Mr. J. O. Martin of Berkeley, Calif., who has collected this species in the nests of *Neotoma fuscipes*. The following key will serve to separate the four species.

1. Ctenidia of abdominal tergites composed of small tooth-like spines which are in close-set rows; genal ctenidium of more than ten spines; palaearctic . . . . . *talpae Curtis*.

Ctenidia of abdominal tergites composed of small spines which are not in close-set rows; genal ctenidium of 6-7 spines; nearctic ... 2.

2. Pronotal ctenidium of 46 spines; body of receptacula seminis more than 210 $\mu$ long ... *schefferi Chapin.*

Pronotal ctenidium of 36-38 spines; body of receptacula seminis less than 210 $\mu$ long ... 3.

3. Body of receptacula seminis 184–199 $\mu$ long; nine bristles in upper row on frons ... *mammoth Chapin.*

Body of receptacula seminis 169 $\mu$ long; seven bristles in upper row on frons ... *dippiei* Rothsch.

For convenience, the exact dimensions of the receptacula seminis in the three species before me are given in the following table. As there are two receptacula in each female in the species of this genus, two columns of dimensions have been given. All measurements given in micra.

| Species | Anterior | Posterior |
|---|---|---|
| *H. schefferi* Chapin. | 215 x 123 | 230 x 138 |
| *H. mammoth* Chapin. | 199 x 138 | 184 x 154 |
| *H. dippiei* Rothsch. | 169 x 108 | 169 x 108 |

## SOME NEW ORTHOPTERA FROM MOKANSHAN, CHINA.

By A. N. Caudell, *Bureau of Entomology.*

Among a consignment of Orthoptera recently received for determination from Prof. N. Gist Gee, of Soochow, China, were several forms apparently undescribed. All of these are from Mokanshan, China, and descriptions of them are here given. Types and allotypes are retained in the collection of the U. S. National Museum and the paratypes are divided, some being retained in that collection and some returned to Prof. Gee.

### **Megaulacobothrus,** n. gen. (Truxalinae).

Agreeing closely with the characters given by Bolivar for his genus *Aulacobothrus* except that the inner calcaria of the posterior tibiae are equal. The species is decidedly larger however than any of those placed in the above genus by its author, and there is probably little relation between the two genera, in spite of the similarity of characters.

*Description, male and female.* Vertex moderately acute in both sexes, somewhat more so in the male; above slightly convex and without median carina; fevolae distinct, wholly visible from above, about three times as long as broad in the male and slightly less in the female; antennae filiform, those of the male more than twice as long as the head and pronotum combined, those of the female scarcely twice as long; frontal costa nearly flat, somewhat concave at the ocellus, the sides converging almost uniformly, sometimes more rapidly towards the vertex in the male, the point where it meets the vertex being narrower in the male than in the female, in the former not, or barely, broader than the basal segment of the antennae; face moderately declivous. Pronotum with distinct median and lateral carinae, the former cut at, male, or a little behind, female, the middle by the principal transverse sulcus, which also cuts the lateral carinae; lateral carinae converging in the anterior third and then diverging to the posterior margin of the pronotum, the broadest part of the disk being about twice as broad as at the narrowest point; anterior margin of pronotal disk truncate, posterior margin obtuse-angulate; lateral lobes quadrate. Organs of flight fully developed, the tegmina and wings of equal length, extending to, or barely beyond, the tips of the posterior femora; tegmina of the male with the costal area decidedly broadened, the transverse veins parallel and diagonal, growing more transverse towards the apex of the area; intercallary area subequal in width, about as broad as the ulner area at its widest point, intercallary vein absent; wings less than twice as long as broad, the margins evenly rounded, as a whole, but with moderate undulations between each radiate vein, a more decided notch at the terminus of the first one. Legs moderately slender; posterior femora flattened on the outer face, the carinae well elevated; posterior tibiae with the inner apical calcars equal in length and scarcely more than half as long as the inner ones, and similarly shaped. Abdomen moderately compressed; supraanal plate apically pointed, more so in the male, the sides somewhat rounded; subgenital plate of male apically pointed and directed upwards, that of the female flat and horizontal and apically narrowly cleft; cerci of both sexes conical, somewhat more elongate in the male; valves of ovipositor short, free, the margins smooth.

*Type.*—*Megaulacobothrus fuscipennis* Caudell.

In the key to genera of the Truxalinae given by Bruner[1] this genus falls under *Stenobothrus* on page 122. But it is amply distinct from that genus.

### **Megaulacobothrus fuscipennis**, n. sp.

*Description, male and female.*—Size large. Head as broad as the anterior portion of the pronotum; eyes elongate, apically pointed above, reddish brown, unicolorous; occiput without carina but with a mesial light stripe bordered on each side by a black one, and below that, on each side, with one or two more alternate black and lighter stripes, varying in distinctness in different specimens; antennae dark brown, often lighter basally, and consisting of about twenty-five or twenty-six segments in the male, all but the apical four or five, which are very small and short, being elongate; in the female probably of about the same number of segments, though in the only entire antenna of this sex examined the apical ones are fused into one long indistinctly divided segment. Pronotum light brown in color, the disk with the lateral carinae marked in yellow and margined outwardly along the middle and inwardly behind with fuscus; lateral lobes with some obscure light colored callouses. Abdomen blackish above and laterally at the base, the black giving way laterally along the middle to yellowish and the apical

[1] "Revision du Systeme des Orthopteres et description des especies rapportees par M. Leonardo Fea de Birmania" (Ann. Mus. Civ. Stor. Nat. Genova, Vol. xxxiii (2a, xiii), p. 1–230, pl. i–vi (1893).

half blood-red, especially above and laterally, beneath the yellowish cast continuing further towards the tip. Fore and middle legs brown, the tibiae only armed with small black teeth on each side below; hind femora brown on the outer face, sometimes with a little darker marking along the middle anteriorly, the geniculation blackish, the inner face light brown with one or two strongly diagonal black bands, and below merging into the color of the ventral surface, which is uniformly blood red; posterior tibiae blood red with black tipped spines, about a dozen to fourteen on each dorsal carina. Nymph without special features different from the adult except that the abdomen is not red and the hind tibiae are infuscated in the middle half.

Length, antennae, male, 15 mm., female, 14 mm.; pronotum, male, 5 mm., female, 6 mm.; elytra, male, 20 mm., female, 23 mm.; posterior femora, male, 16 mm., female, 18.5 mm.

Described from six males, type and paratypes A to E, four females, allotype and paratypes F to H, and one male nymph, paratype I.

Type, allotype and paratypes, A, B, C, F, G and I in Collection U. S. National Museum; paratypes D, E and H returned to Prof. Gee.

Catalogue No. 22971, U. S. N. M.

**Geea**, n. gen. (Truxalinae).

This genus runs in the keys of Brunner's 1893 paper to *Parapleuras* on page 121. But it is not very closely allied to that genus, which is now relegated to the synonymy under *Mecostethus* Kelch. The slightly expanded and parallel veined scapular area of the tegmina might lead one to the genus *Pnorisa* in Brunner's key. But there is little relation between the present genus and that African genus of smaller locusts.

*Description, female, the male unknown.*—Head with the face rather strongly retreating; fastigium of the vertex slightly acute-angulate apically, extending beyond the eyes a distance equal to about its own width, dorsally sulcate, without median carinae, the margins obtuse; fevolae absent; frontal costa with sides parallel above the ocellus, below which point they diverge moderately to the clypeus, which they barely reach; above the ocellus the costa is not at all sulcate, below and at the ocellus very moderately so; occiput moderately swollen, smooth; antennae triquetrous and slightly flattened basally, beyond becoming cylindrical. Pronotum scarcely longer than the head, without lateral carinae and with median carina distinct only on the metanotum, and there very slight; disk rounded, anterior margin roundly truncate, the posterior margin obtuse-angulate, the tip rounded; lateral lobes subquadrate, the lower-posterior angle rectangular; meso- and metasternal interspaces quadrate. Abdomen with the valves of the ovipositor well exerted, the scoop of the upper valves about as long as deep; supra-anal plate dorsally roundly convex, apically semicircularly rounded; cerci a little more than twice as long as basally broad. Organs of flight fully developed, exceeding somewhat the tips of the posterior femora; tegmina apically rounded without intercallary vein, scapular area very slightly expanded, the veins parallel; wings unicolorous, with veins not swollen. Legs moderately slender; all femora unarmed both above and below, the geniculations rounded; tibiae spined above only, the posterior ones with twelve to fourteen spines in the outer series, none next the apical spur.

*Type.—Geea conspicua*, Caudell.

### **Geea conspicua**, n. sp.

*Description, female, the male unknown.*—This is a large showy locust of a green and black, or dark brown, color in strong contrast. The entire body is blackish above, growing lighter laterally, the clypeus and lower part of the head greenish. the breast and lower surface of the abdomen brownish; antennae, of which all but 11 mm. of the basal portion is missing, entirely piceous and the eyes brown; pronotal disk with a moderately broad median stripe which continues slightly on to the occiput, vanishing before reaching the eyes; the eyes are narrowly margined with yellow and the anterior aspect of the vertex is of the same color, and a streak of yellow extends down each side of the face, from the base of the antennae to the outer margins of the clypeus; ocelli red. Tegmina almost entirely membranous, slightly coriaceous basally, dark brown in color except the anal margin, which is bright green for the entire length, reaching to near the tip of the tegmina, wings uniformly hyaline, the membrane made dusky by innumerable microscopic black specks, and a slight greenish tinge along the anal margin; the veins black. Fore and middle legs bluish green, the femora yellowish ventrally; hind femora green on the outer face, yellowish beneath and on the inner side, the apex black and with a preapical black band; hind tibiae dark blue with a broad subbasal greenish yellow band, the spines light in the basal half and piceous in the apical half; tarsi light yellowish with slight dark variegation.

Length, pronotum, 7 mm.; tegmina, 35 mm.; posterior femora, 22 mm.

Described from a single female, the type.
Type in Collection U. S. National Museum.
Catalogue No. 22975.

### **Phlaeoba brachyptera**, n. sp. (Truxalinae).

The abbreviated wings of this species will serve to distinguish it from the other members of the genus, to none of which it appears very closely allied.

*Description, male and female.*—General color wood-brown. Head about as long as the pronotum in the male, noticeably shorter in the female; vertex acuteangulate in male, rectangulate in female, extending beyond the eyes a distance a little greater than the interocular space, dorsally shallowly sulcate in front of the eyes, convex posterior of that point, the transition from the concave to convex being sudden and conspicuous; there is a distinct median carina extending for the entire length of the concave portion of the vertex and continued some distance back on to the convex portion; face very rapidly retreating in the upper part, more gradually below; frontal costa persistent and very narrow, expanding somewhat below, the sides about as elevated as the lateral facial carinae, with which they are subparallel; eyes about one and one-half times as long as broad, diagonally situated, when viewed dorsally, and brown in color, obscurely mottled with darker; antennae very moderately ensiform, longer than the head and pronotum together. Pronotum with median and lateral carinae, the latter parallel to near the anterior margin of the disk, where they diverge briefly; anterior margin of pronotal disk truncate, the posterior margin obtuse angulate; lateral lobes subquadrate. Organs of flight more abbreviated than in the other species of the genus, falling considerably short of the tips of the posterior femora, in male scarcely passing the middle of the hind femora, in the female attaining to about the base of the apical third; tegmina a little longer than the wings, the tips rounded, not accuminate, the costal margin moderately expanded subbasally; no distinct intercallary vein, though such is indicated by a disconnected median series of veinlets; wings hyaline with the longitudinal veins black, the costal and apical areas being somewhat infuscated. Legs slender, brown; hind femora moderately swollen in basal half, the dorsal margin carinate and with a few dark specks, unarmed both above and below, the geniculations blackish, the angles briefly angulate, a sharp median point terminating the femora apically; hind tibiae brown with a bluish tint, the spines ten or eleven on each side, and with the apical half piceous. Supraanal plate of male elongate rectangular, very slightly and briefly sulcate longitudinally above; subgenital plate narrowly pointed above; cerci simple and pointed in both sexes, more elongate in the male, where it is fully four times as long as basally broad; last dorsal segment of abdomen in female elongate, above basally flattened and laterally carinate, mesially shallowly concave; last ventral segment elongate, broader behind, with a barely noticeable median carina, the posterior margin truncate with a median brief obscure tooth projecting between the lower valves of the ovipositor, the lateral margins of this segment are posteriorly rounded; valves of ovipositor well exerted, unarmed, the scoop of the upper ones comprising about half the length.

The anal field of the tegmina and the disk of the pronotum in the male are lighter colored than the rest of the ground color, giving a general appearance of a broad dorsal stripe; this may probably be true also in some females, though in the single specimen of that sex now available for study it is not. The lateral lobes of the pronotum in two of the three males examined are blackish above, especially bordering the lateral carinae, while in the female and the third male this is true only to a lesser extent. There is a narrow and usually obscure postocular dark stripe present on the head, and there is sometimes a greenish tint on the sternum and on the lower surface of the fore and middle femora and tibiae.

Length, pronotum, male, 4 mm., female, 5.5 mm.; antennae, male and female, 12–13 mm.; tegmina, male, 10 mm., female, 12.5 mm.; posterior femora, male, 11 mm., female, 15 mm.

Described from three males, type and paratypes A and B, and one female, allotype.

Type, allotype and paratype A in Collection U. S. National Museum. Paratype B returned to Prof. Gee.

Catalogue No. 22973, U. S. N. M.

**Chrysochraon anomopterus,** n. sp. (Truxalinae).

*Description, male, female unknown.*—Very like *japonicus* Bolivar and *genicularibus* Shiraki, but does not agree with either sufficiently well to be considered identical. It differs from both the above mentioned species in lacking a longitudinal stripe of brown on the sides, the entire insect being an almost uniform brownish yellow color, faint indications of dorsal and lateral longitudinal stripes on the head, and the genicular arcs of the hind femora are barely darkened; the spines of the tibiae are black in the apical half; there are no spines on the femora; the hind tibiae slightly more clear yellow than the rest of the insect. The

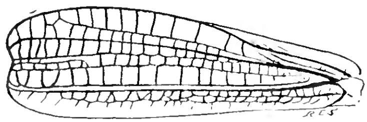

FIG. 1—Tegmen of *Chrysochraon anomopterus.*

antennae are noticeably flattened in the basal third and are longer than the head and thorax. The tegmina are much broadened in the apical half and the tip truncate and mesially notched, as shown in the accompanying figure; the hind wings are aborted, being decidedly shorter than the thorax. The cerci are simple, cylindrical and pointed, as long as the flat triangular apically pointed supraanal plate; subgenital plate with the tip broken off. Mesosternal interspace more than twice as long as broad, the metasternal lobes but little separated.

Length, pronotum, 4 mm.; antennae, about 10 mm.; tegmina, 12.5 mm.; hind femora, 13 mm.

Described from a single male, the type.
Type in Collection U. S. National Museum.
Catalogue No. 22974, U. S. N. M.

**Catantops viridifemoratus,** n. sp. (Acridinae).

This rather pretty grasshopper is placed in the above already unwieldy genus with considerable doubt. It runs to that genus in the keys of Brunner, however, and the specimens show no characters incompatible with those of *Catantops.*

*Description, male and female.*—General color brownish. Head greenish brown with broad black postocular bands and some small maculations on the occiput, varying in size, position and number, sometimes forming a rather uniform dorsal infuscation; eyes large and globose, especially in the male where they are but a little longer than broad while in the female they are almost half as long again as broad; frontal costa entending almost to the clypeus, sulcate only at and below the ocellus, the sides parallel, or converging slightly at the ocellus; interocular space approximately as broad as the frontal costa, slightly narrower in the male than in the female; vertex lightly sulcate above, without median carina, anteriorly meeting the face roundly, in the male with a scarcely perceptible angulation; antennae of female slightly compressed, yellowish brown in color and about twice as long as the pronotum, in the male absent from the single specimen seen. Pronotum yellow greenish brown on the sides and a little darker above, the sites of the lateral carinae marked by a broad black stripe continuous with the postocular stripes of the head; pronotal disk truncate anteriorly, roundly angulate posteriorly, rounding into the moderately elongate lateral lobes without forming lateral carinae except very bluntly so on the metazona; median carinae very slight, especially in the female, a little more distinct in the male; prosternal spine conical, apically broadly rounded; mesosternal interspace very slightly longer than broad in the male, a little broader than long in the female. Legs moderately slender, the hind femora moderately swollen basally; the color of the legs in general is greenish, the outer face of the hind femora very noticeably so, the tibiae with a bluish cast, those of the posterior legs being decidedly blue; the posterior femora apically and corresponding tibiae basally piceous, the femora marked dorsally by a broad medial and preapical band, sometimes somewhat obscured but usually very noticeable, even conspicuous; spines of hind tibiae black in apical half, yellowish basally, ten to twelve in the outer series, the basal two or three minute. Organs of flight fully developed, but barely or scarcely attaining to the tips of the posterior femora; elytra brown, the costal margin basally infuscated, intercallary area narrow and with a distinct intercallary vein; wings moderately and uniformly fuliginous, the veins black. Abdomen greenish yellow, with a few black markings apically; supraanal plate of male triangular, black on the greater part of the median portion, the tip and base only light and with a narrow median longitudinal stripe, broadly sulcate medially in the basal third and narrowly in the apical third, and more broadly so for the entire length on each side of the medial furrows; on each side of the narrow apical median sulcation is a pair of raised longitudinal carinae, short and black; subgenital plate with the upper margin thin and forming a brief, acute, depressed and posteriorly directed point, the apical half of this plate is mottled with blackish; ferculа mere rounded lobes shorter than the last dorsal abdominal segment from which they arise, but rather conspicuous from their color, which is black, in decided contrast to the yellowish color of the surface beneath them; cerci of male simple, apically clavate, shaped as shown in the figure (Fig. 2), the whole cercus extending slightly beyond the tip of the supraanal plate and is black on the apically expanded portion, except along the lower margin; just beyond the tip of the supraanal plate; between it and the tip of the subgenital plate, the integument of the abdomen forms an erect blunt tubercle; cerci of female about twice as long as basally broad, conical, usually tapering more rapidly in the basal half, apically narrowly rounded; valves of ovipositor well exerted, the margins without serrations, or with very rounded

FIG. 2—Cercus of *Catantops viridifemoratus*.

ones on the upper valves, where the scoop is about as long as the basal portion; last ventral segment of the abdomen of the female longer than broad, with a median apical angulation projecting between the lower valves of the ovipositor, and on each side of this median angle there are emarginations forming a flattened triangular lobe on each side, overlying the lateral apophystegal plates.

Length, antennae, male ? mm., female, 14 mm.; pronotum, male, 5 mm., female, 7.5 mm.; tegmina, male, 15.5 mm., female, 20 mm.; posterior femora, male, 13 mm., female, 16.5 mm.

Described from one male, type, and five females, allotype and paratypes A to D.

Type, allotype and paratypes A and B in Collection U. S. National Museum; paratypes C and D returned to Prof. Gee.

Catalogue No. 22972 U. S. N. M.

**Drymadusa mokanshanensis**, n. sp. (Tettigonidae, Decticinae).

*Description, male and female.*—Color almost uniformly yellowish green, probably green in life. Head as broad as the pronotum; fastigum of the vertex narrower than the basal segment of the antennae, from a front view triangular, the narrow point touching the fastigum of the front; basal segment of the antennae very broad, the second intermediate between the basal and the succeeding ones, which are cylindrical and very gradually growing smaller towards the tip of the antenna; the ends are broken from the antennae of the only two specimens known; eyes moderately protuberant, semicircular and brown in color. Pronotum with lateral carina roundly present only on the metanotum, where the disk is flat, the rest being rounded, the anterior margin truncate, the posterior margin broadly rounded; lateral lobes about as high as broad, the lower margin inclined anteriorly, the posterior-inferior angle rounded, the humeral sinus shallow; prosternal spines long and sharp; meso- and metasternal lobes pointed, the first more than twice as long as basally broad, the latter scarcely longer than broad. Abdomen plump, slightly compressed; supraanal plate of male with an apical u-shaped notch, the resulting points triangular, that of the female small, triangular and dorsally sulcate, with a black spot situated mesially; cerci of male sub-cylindrical, tapering, apically gently incurved, the whole five or six times as long as the basal width, a prominent broad triangular tooth situated on the inner side at about the basal fourth, the tip of this tooth being black, sharp and decurved; cerci of female simple, cylindrical, gradually tapering to a point and five or six times as long as basally broad; subgenital plate of male forming a long hollow, perpendicular sided scoop, verntrally concave with a low median carinae and more prominent margins, the tip triangularly notched mesially and bearing a pair of simple cylindrical tapering styles about six times as long as the basal width; subgenital plate of the female much smaller than that of the male, flat below, the apex broadly notched and turned outward so as to form a diagonal lateral furrow; ovipositor not quite three-fourths as long as the posterior femora, gently decurved and with the tip diagonally truncate. Legs slender; fore tibiae with four long dorsal spines on the outer margin in the male and three in the female; middle tibiae with several dorsal spines on each margin in both sexes; hind tibiae with many dorsal spines, all of the tibiae being armed below on both margins, all spines black at the tip and along the lower margins, those of the posterior ones more conspicuously black; anterior and intermediate femora with blunt blackish teeth on the anterior margins only, the posterior femora long and strongly swollen in the basal two-fifths, armed below on both margins with a few short piceous teeth; plantula of posterior tarsus free but short, about one half as long as the basal tarsal segment. Organs of flight fully developed, extending to or beyond the tips of the posterior femora; tegmina broader in the male than in the female, greenish in both sexes and with the main veins in the female blackish basally; tympanum of male about as long and broad as the pronotum; wings clear hyaline with a gree ish cast along a narrow costal strip in the apical half of the wing, the longitudinal veins mostly dark colored.

Length, pronotum, male, 8 mm., female, 9.5 mm.; tegmina, male, 47 mm., female, 42 mm.; posterior femora, male, 34 mm., female, 36 mm.; cerci, male, 4.5 mm., female, 2.75 mm.; anal stylets, male, 2.75 mm.; ovipositor, 23 mm.

Described from one male and one female, type and allotype.

Type and allotype in Collection of the U. S. National Museum.

Catalogue No. 22976.

The collection contained an adult male and a male nymph of another species of this same genus which seems allied to the one described above, except that the cerci and anal stylets are shorter and there are other characters, both structural and colorational, that indicate specific distinctness from *mokanshanensis*. The absence of all legs, except the right fore leg, from the only adult specimen makes determination difficult, and it is deemed best to leave this form unplaced until more and better preserved material is obtained.

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## NOTES ON THE ANCESTRY OF THE HYMENOPTERA.

By G. C. Crampton, Ph. D.,
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To any one who makes a study of a large number of structures from different parts of the body, in attempting to determine the origin and affinities of the various orders of insects, it very soon becomes apparent that it is utterly impossible to arrange the lines of descent of the insectan orders in a dichotomously branching tree drawn in one plane, since *several* orders are frequently connected by mutual bonds of relationship, and many lines of descent may converge toward a common ancestry, which is anatomically intermediate between two or more primitive groups, and is related to the one scarcely less closely than to the others. If we disregard the factor of time (*i. e.*, whether one order was derived from the common ancestral group sooner, or later, than certain others derived from the same ancestral group) and consider the ancestral group from which the others were derived as merely an anatomical "point of origin," the lines of descent drawn as though springing from such a point of origin would form a cone-like figure, solid at its base (where many annectant forms connect the various lines of development in all directions), but gradually splitting up into distinct lines of development as the connecting forms are lost. Some of these lines of descent parallel each other quite closely for a greater or less extent of their course, while others diverge more markedly as evolution progresses.

While a diagram of the lines of descent of the insectan orders, such as that described above, would represent the actual interrelationships of the orders much more accurately, there is great danger of making the figure so intricate that it is incomprehensible to any one save its author, thereby defeating its main purpose, which is to aid in visualizing the interrelationships and points of convergence of the lines of descent in question. I have therefore represented the lines of descent of the insects grouped about the Neuroptera (*i. e.*, those of the Diptera, Mecoptera, Trichoptera, Lepidoptera, Neuroptera, etc.) by a single line in the appended diagram, and I have used only the Neuroptera, with their immediate relatives the Mecoptera, to typify these lines of descent, since the Neuroptera and Mecoptera are the most important representatives of the group, and have retained many features exhibited by the other forms as well.

In this connection, it should be noted that although the Hymenoptera are represented in the diagram as a little lower down than the Neuroptera and Psocida, this fact has no phylogenetic significance, since the three lines originate at about the same level, and the Psocida (and probably the Neuroptera also) are if anything a little more primitive than the Hymenoptera are. On the other hand, the Mallophaga, Pediculidae, etc., which are descended from Psocida-like forebears advance much further along the road to morphological specialization than the Hymenoptera do, and similarly the higher Diptera, etc., which are descended from Neuroptera-like forebears, likewise travel further than the Hymenoptera do along the road to morphological specialization, so that it has seemed preferable to draw these two lines of descent somewhat longer that that of the Hymenoptera, in the diagram.

With regard to the often debated question as to which order of insects is the "highest," it would seem to the disinterested observer that such arguments are quite pointless unless one considers the order as a whole, and takes into consideration the character of its most primitive representatives, rather than the degree of specialization of its most modified representatives. Thus for example, the Crustacean *Sacculina* is much "higher" or more specialized than any known insect, yet no one would argue from this that the Crustacea are "higher" than the Diptera, or any other insects simply because one Crustacean has surpassed these insects in specialization! In any phyogenetic study we must consider the lowest representatives rather than the highly specialized members of a group, giving particular attention to the primitive characters retained in its lowest representatives, and when we consider the Hymenoptera taken as a whole from this point of view, they are seen to be a much more primitive group than they are generally supposed to be, and their line of development apparently arose at the point where the line of development of the Neuroptera began to diverge from that of the Psocida, as shown in the diagram.

The Hymenoptera are somewhat intermediate, anatomically, between the Psocida and the insects grouped about the Neuroptera (*i. e.*, Neuroptera, Mecoptera, Diptera, etc.), but their closest affinities are with the latter insects. This is shown by the similarity between the Hymenoptera and the "Neuropteroids" (*i. e.*, the insects grouped about the Neuroptera) in the type of metamorphosis exhibited by the two groups, and in the similarity between their pupae and larvae in particular, the larvae of Hymenoptera being very like those of the Mecoptera and Lepidoptera, for example. The head capsule in certain Hymenoptera is very like that of certain Mecoptera and Neuroptera, and the same is true of the mouthparts. The neck plates and thoracic terga of the Hymenoptera exhibit many points of resemblance to those of the Trichoptera, Mecoptera, and other insects related to the Neuroptera, and the genitalia of certain male Hymenoptera are very suggestive of those of the lower Diptera, Trichoptera and Mecoptera. These and many other features would indicate that the Neuroptera and Mecoptera (with their allies) are the next of kin to the Hymenoptera. On the other hand, the Neuroptera serve to connect the Hymenoptera with the Coleoptera, although there are many features aside from their mutual resemblance to the Neuroptera, which are clearly indicative of a rather close relationship between the Hymenoptera and the Coleoptera, and there are very good reasons for considering that the ancestors of the Hymenoptera were quite like the Coleoptera, on one side of their lineage. On this account, it is necessary to take into consideration the line of development of the Coleoptera also, in attempting to trace the genealogy of the Hymenoptera further.

As was pointed out in an article recently published in Psyche (Vol. 27, 1920, p. 112) if we take into consideration the character of the larvae (*i. e.*, the head capsule, mouthparts, etc.) the Coleoptera are remarkably similar to the Neuroptera, since it is possible to find but few characters which will serve to distinguish between the larvae of these two groups of insects; and the type of metamphorsis exhibited by the two orders is almost identical, so that if these features are of considerable importance in phylogeny, the Coleoptera should be placed in the same superorder with the Neuroptera, and occupy a position very close to the latter insects. On the other hand, the Coleoptera are extremely closely related to the Dermaptera, as is shown by the character of the maxillae, thoracic terga, "larval" cerci, and other structures, so that is is extremely difficult to determine whether to group the Coleoptera with the Dermaptera or with the Neuroptera. At any rate, the Coleoptera are anatomically intermediate between the Neuroptera and the Dermaptera, and if this fact has any significance (as every morphologist would claim that it does) it clearly indicates that on one side of their lineage, at least, the Hymenoptera, Neuroptera and Coleoptera were descended from ancestors very like the Dermaptera, and it is quite possible that the tendency toward the development of symmetrical genitalia exhibited by male Hymenoptera was inherited from this side of their ancestry.

While the Hymenoptera (and Neuroptera) may trace their lineage through Coleoptera-like forms to ancestors resembling the Dermaptera on one side of their ancestry, there is another side of their lineage of even greater importance, which leads back with the Psocida to ancestors resembling the Zoraptera and Isoptera. The head capsule of certain Psocidae is very like that of certain Hymenoptera, the wing venation in the two groups offers many points of similarity, and the same is true of the thoracic terga and the nature of the ovipositor. Similarly the head capsule of the Zoraptera (which are like the ancestors of the Psocida) is extremely like that of the lower Hymenoptera, the thoracic terga and wings exhibit many points of resemblance in the two groups, and the cerci (among other features of the terminal abdominal structures) are very much alike in the Hymenoptera and Zoraptera. In fact, it is quite probable that the inherent tendency toward the development of social life exhibited by the Zoraptera (and to a greater extent by their near relatives, the Isoptera) has passed on to the Hymenoptera from this source.

Thus, when we take into consideration a greater number of anatomical, developmental, and biological features, and also take into consideration the points of convergence of the lines of development on either side of the Hymenoptera as well, it becomes apparent that the line of development of the Hymenoptera, together with that of the Psocida and the Neuroptera, etc., leads back to ancestors resembling the Dermaptera (with the Coleoptera) on the one side, and the Isoptera (with the Zoraptera) on the other. Since the mutual resemblances which one finds in the groups in question would be inexplicable under any other view, and since all of the known facts are in perfect agreement with this view, there can be but little doubt that it is the correct one.

As was mentioned above, when we trace the ancestry of the Hymenoptera a step further, the line of development of their precursors would quickly merge with the lines of development of the Isoptera (with the Zoraptera) and the Dermaptera (with the Coleoptera), and since at this level of development, the different groups under discussion become connected together on all sides by mutual bonds of relationship in the form of annectant types linking them together in all directions, it would be more accurate to represent these interrelationships by a solid cone, instead of depicting the lines of descent as distinct at this level,

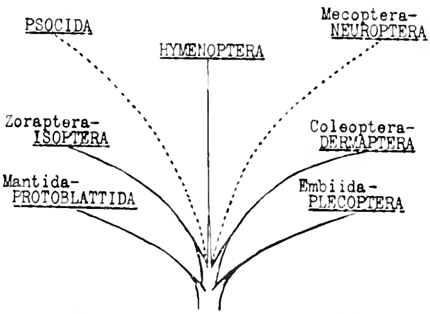


FIG. 1—Ancestry of the Hymenoptera.

as is done in the diagram. Furthermore, the similarities between the precursors of the Hymenoptera, Psocida, Neuroptera, etc., become so marked as we trace them back to their point of origin (where the lines of descent of the Dermaptera and Isoptera merge) that at this level, or a little below it, the differences between the ancestral types were doubtless no greater than the differences between the families of a single order of insects.

It is a comparatively simple matter to trace the lines of development of the Coleoptera, Neuroptera, Hymenoptera, Psocida back to ancestors anatomically intermediate between the Dermaptera and the Isoptera (with the Zoraptera), and these ancestral forms in turn quickly merge with the common ancestors of the Dermaptera and Isoptera. From this point on, however, the problem of finding the types ancestral to these forms in turn, becomes much more difficult. The ancestors of the Dermaptera were undoubtedly extremely closely related to the Plecoptera with the Embiida; and the Zoraptera are unquestionably intermediate between the Isoptera and Plecoptera so far as their morphological details are concerned. On the other hand, the Isoptera exhibit certain features clearly indicative of affinities with the Protoblattida, in addition to their undoubted relationship to the Dermaptera, Embiida and Plecoptera. This dual relationship of the common ancestors of the Dermaptera and

Isoptera to the Plecoptera (with the Embiida) on the one side, and to the Protoblattida (with the Mantida) on the other, is shown in the appended diagram, and simply indicates that the common ancestors of the Dermaptera and Isoptera (together with those of the other insects previously discussed) in turn lead back to precursors which exhibited many of the primitive characters of the Protoblattida and Plecoptera (with their allies) since they were doubtless anatomically intermediate between these two groups. These ancestral forms quickly merge with those of the Plecoptera and Protoblattida as we trace them still further back, and all of them were doubtless eventually derived from forms closely allied to the Palaeodictyoptera, which were among the first winged insects to be evolved from the Apterygota.

If the relationships as shown in the diagram were correct, we would expect that the Hymenoptera would exhibit a number of features in common with the Neuroptera and Psocida and nearly as many with the Zoraptera and Coleoptera, or with the Isoptera and Dermaptera; while the resemblances to the Protoblattida (with the Mantida) and to the Plecoptera (with the Embiida) would be somewhat more remote, and such is indeed the case. Furthermore, the fact that all of these forms exhibit some mutual resemblances, becomes readily comprehensible if we consider that the Psocida, Hymenoptera, Neuroptera, etc., were derived from ancestors like the Isoptera (with the Zoraptera) and the Dermaptera (with the Coleoptera), and that these in turn were derived from ancestors like the Protoblattida (with the Mantida) and the Plecoptera (with the Embiida), since some of the inherent tendencies of the primitive forms might be carried over into the successive ancestral types derived from them, thereby appearing in certain primitive representatives of even such higher types as the Neuroptera, Hymenoptera and Psocida. This view, which takes into consideration the undoubted mutual resemblances occurring in all of the forms discussed above, and which also takes into consideration the very primitive features exhibited by certain of the lower Hymenoptera, is clearly more in accord with the facts than is the case with that proposed by Packard, who would derive the Hymenoptera from Lepidoptera, or that proposed by Smith, who would derive the Hymenoptera from Trichoptera. Furthermore, the views that the Hymenoptera are derived from Neuroptera alone, as proposed by Haeckel, or that the Hymenoptera are derived from Mantida alone, as proposed by Handlirsch, do not take into consideration the fact that Hymenoptera exhibit affinities with *several* other groups, not with one alone, and in this respect they fail to set forth the true relationships of the Hymenoptera and the other forms under discussion.

## DIPTEROUS PARASITES OF SAWFLIES.[1]

By Charles T. Greene, *Bureau of Entomology*.

There are few published records of the Dipterous parasites of the sawflies.

In this paper I have endeavored to bring together all the records I could find on this subject and have added some new breeding records which are marked with an asterisk.

The material was reared by Messrs. S. A. Rohwer and Wm. Middleton at the Eastern Field Station, Forest Insect Investigations, Falls Church, Virginia. The number following each species refers to the Hopkins U. S. note system used in the Division of Forest Insects. The date, as here used, is the rearing date or the date on which the fly emerged from the puparium.

**Tachina rustica Fallén.** (of Coquillett.)

*Host.—*Macremphytus variana* Nort.

Collected at Plummer's Island, Maryland, by Wm. Middleton. Adult emerged May 26, 1916.

Hopks. U. S. No. 13635.

Collected at Cupid's Bower, Maryland, by T. E. Snyder. Adults emerged September 1 to 19, 1916.

Hopks. U. S. No. 13649 q.

**Tachina mella** Walker.

*Host.—*Macremphytus variana* Nort.

Collected at Plummer's Island, Maryland, by Wm. Middleton. Adult emerged May 29, 1916.

Hopks. U. S. No. 13635.

**Phorocera claripennis** Macq.

Host.—*Neodiprion lecontei* Fitch.

Collected at Tomahawk Lake, Wisconsin, by S. A. Rohwer. Adults emerged October 22 and 23, 1912.

Hopks. U. S. No. 10169 and 10170.

*Host.—*Neodiprion sp.*

Collected at Kanawha Station, West Virginia, by Dr. A. D. Hopkins. Adults emerged August 23, 1912.

Hopks. U. S. No. 10719 *b*.

**Phorocera** sp.

*Host.—*Neodiprion sp.*

Collected at Cardinal, Virginia, by W. P. Smith. Adults emerged July 31, 1915.

Hopks. U. S. No. 10737 *k*.

**Phorocera** sp. (near **macra.**)

Host.—*Neodiprion lecontei* Fitch.

Collected at Washington, District of Columbia, by L. Forman.

[1]Sawfly determinations by Mr. S. A. Rohwer, Custodian of Hymenoptera, U. S. Nat. Mus.

Adults emerged from August 17 to 28 and September 11, 1916.
Hopks. U. S. No. 13648 *b*.
Host.—*Neodiprion sp*.
Collected at East River, Connecticut, by Dr. C. R. Ely. Adults emerged September 24 to 26, 1914.
Hopks. U. S. No. 13675 *a1*.

**Spathimeigenia spinigera** Towns.

Host.—*Neodiprion edwardsii* Nort.
Collected at Redlands, California, by H. E. Burke. Adults emerged August 5, 1914.
Hopks. U. S. No. 12070 *j*.
Host.—*Neodiprion lecontei* Fitch.
Collected at Reading, Pennsylvania, by S. A. Rohwer. Adults emerged April 27, 1913.
Hopks. U. S. No. 10174.
Host.—*Neodiprion lecontei* Fitch.
Collected at Linglestown, Pennsylvania, by Wm. Middleton. Adults emerged May 29, 1914.
Hopks. U. S. No. 10724.
*Host.—*Neodiprion affinis* Rohwer.
Collected at Falls Church, Virginia, by J. N. Knull. Adults emerged May 19, 1917.
Hopks. U. S. No. 13648 *g*.
*Host.—*Neodiprion sp*.
Collected at Reading, Pennsylvania, by S. A. Rohwer. Adults emerged March 29, 1913.
Hopks. U. S. No. 10173 *c*.
Host.—*Neodiprion sp*.
Collected at Falls Church, Virginia, by S. A. Rohwer. Adults emerged August 14, 1916.
Hopks. U. S. No. 13648 *d*.
Host.—*Neodiprion sp*.
Collected at Falls Church, Virginia, by Wm. Middleton. Adults emerged August 9 to 22, 1917.
Hopks. U. S. No. 13662 *b*.

**Admontia hylotomae** Coq.

*Host.—*Arge sp*.
Collected at East River, Connecticut, by C. R. Ely. Adults emerged September 10 to 13, 1912.
Hopks. U. S. No. 10163 and 10163 *a*.
*Host.—*Arge sp*.
Collected at Falls Church, Virginia, by C. Heinrich. Adults emerged September 1 to 9, 1913.
Hopks. U. S. No. 11394.

Host.—*Neodiprion leconti* Fitch.
Collected at Falls Church, Virginia, by S. A. Rohwer. Adults emerged May 16, 1913.
Hopks. U. S. No. 10175.
*Host.—Sawfly. (No record, but probably a *Diprion sp*).
Collected at Snow Crack Canyon, Yosemite National Park, California, by J. M. Miller.
Hopks. U. S. No. 10825.

**Sturmia** sp.

*Host.—*Arge sp.*
Collected at East River, Connecticut, by C. R. Ely. Adults emerged August 11, 1914.
Hopks. U. S. No. 12081 *g*.

**Phorocera claripennis** Macq.

*Host.—*Neodiprion virginiana* Rohwer.
Collected at Kanawha Station, West Virginia, by Miss L. Hopkins. Adults emerged September 4, 1913, and June 25, 1914.
Hopks. U. S. No. 10722 *b*.

**Masicera** sp. (near **exilis.**)

Host.—*Neodiprion lecontei* Fitch.
Collected at Falls Church, Virginia, by S. A. Rohwer. Adults emerged May 22, 1914.
Hopks. U. S. No. 10716 *b*.

**Frontina armigera** Coq.

*Host.—*Neodiprion sp.*
Collected at Mt. Airy, Georgia, by T. J. McConnell. Adults emerged July 13 to 28, 1914.
Hopks. U. S. No. 10737 *l*.

**Exorista petiolata** Coq.

*Host.—*Neodiprion sp.*
Collected at East River, Connecticut, by C. R. Ely. Adults emerged September 10 to 12, 1917.
Hopks. U. S. No. 13675 *b*.

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## LARVA OF THE NORTH AMERICAN BEETLE SANDALUS NIGER KNOCH.

By F. C. CRAIGHEAD, *Bureau of Entomology*.

During the past July the writer spent several days at Doctor Hopkins' farm, Kanawha Station, West Virginia, investigating root borers of the genus *Prionus* on oak trees. On July 21, 1920, while digging at the base of an oak, a cicada pupa was unearthed that was intact in its burrow which had the exit hole completed to near the surface of the ground. The fact that it was dead and resembled a cast skin attracted attention and on attempting to pick it up, it fell to pieces, disclosing a large whitish pupa. This pupa was recognized as of some coleopterous insect and further search revealed the last larval skin intact in the abdomen of the cicada.[1] August 5, 1920, an imperfect adult of *Sandalus niger* Knoch emerged.[2]

The rearing of this beetle was very much of a surprise for several reasons. Before the adult emerged the unusual circumstances were related to several Coleopterists at the National Museum and all speculated as to what the beetle would be but no one thought of *Sandalus*. The writer was of the opinion that it might be a Meloid though the only basis for such an opinion was the parasitic habit and the form of the larva. The Meloid larvae also present considerable variation in structural details, so much so that they are exceedingly difficult to characterize as a family. None of the Meloids, however, have bifore spiracles and the maxillary mala is never bilobed, while this larvae has such structures well developed. The spiracles and other characters suggested to Doctor Böving and the writer that it belonged to the Cleroid[3] series of larvae including most of the families of Serricornia, and that it showed much in common with the Elaterids. The subsequent rearing of this beetle corroborates strikingly that much reliance can be placed in larval characters and further substantiates the contentions that no matter how much variation is exhibited in habits, even greatly modifying the form and many structures, the fundamental characters are little altered.

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[1]The fragmentary remains of this cicada pupa were sent to Mr. Wm. T. Davis, Brooklyn, New York, who replied that he regretted he was not able to determine it from the fragmentary condition of the specimen.

[2]Determined by Messrs. Schwarz and Barber.

[3]As defined by Böving and Craighead—Böving, A. G. and Champlain, A. B.: Larvae of North American Beetles of the Family Cleridae. Proc. U. S. Nat. Mus. vol. 57, 1920.

### Systematic Position of Sandalus Larva.[1]

*Sandalus* has been placed in the family Rhipiceridae together with *Zenoa* and *Callirrhipis* and other exotic genera. Larvae of both these latter genera have been studied and their association with Elaterid-like forms has been recognized. The larva of *Sandalus* presents so many structural differences from the two genera just mentioned that it can not be regarded as belonging to the same family. It might be contended that this parasitic larva, of which only the last instar is known, may have very different structures and appearance in the earlier instars. This of course may be the case in all such parasitic forms known (as in the families Staphylinidae, Carabidae or Meloidae) the fundamental structures, however, do not vary as much as is generally believed and the family characters usually are recognizable throughout the various stages. The form, reduction of legs, antenna and palpal joints can be regarded as adaptations to a parasitic habit, and a difference in these structures from allied genera are to be expected. The larva can be differentiated from Zenoa and Callirrhipis by the presence of a divided mala, which will also distinguish it from all other parasitic types of larvae known. The spiracles are identical with those of the Elateridae and Sandalus is possibly most closely related to this family. Many characters suggest, however, that it has developed from Malachiid or Dermestid types which are regarded as less specialized larvae than the Elaterids.

For the above reasons this genus is characterized as belonging to a distinct family, Sandalidae, based on *Sandalus niger* Knoch.

### Characterization of the Family Sandalidae.

*Larvae.*—White, fleshy, fusiform, provided with solid, chitinous, conical cerci; head globular, probably hypognathous; gula large, rectangular; labrum present; antenna large, conical, one-jointed; mandible of simple grasping type, conical and acute, without molar structure, retinaculum, prostheca or hairfringes; ventral mouth parts retracted, fleshy and somewhat swollen, fused into a unit through loss of maxillary articulating area and union of mentum and maxillary stipes; inner margin of maxillary stipes and region of cardo slightly chitinized; maxillary palp two-jointed; galea and lacinia present, conical, latter more obtuse; labial stipes conical, palp one-jointed; ligula small; hypopharyngeal bracon well developed but only lightly chitinized and united with large fleshy hypopharynx; occipital foramen posterior; legs weak, conical, no chitinous articulations, three-jointed, tarsus chitinized and hooklike, coxa widely separated; intersternal rings of mesothorax and metathorax well developed, no hypopleural chitinizations of thorax; abdominal and thoracic areas indistinct; spiracles bifore; tenth abdominal segment ventral, wart-like.

[1] The following taxonomic discussion is based on a joint study of the characterization of Coleopterous larval families undertaken by Dr. A. G. Böving and the writer.

**Description of the larva.**

In addition to the characters noted above, the larva can be described as follows:

Fusiform,[1] rather robust, creamy white, having the entire body surface sparsely covered with fine short hairs; length probably about 25–30 mm., widest about 5th and 6th abdominal segments. Head subglobular in form and lightly chitinized. having deep depressions on the front arising from the articulation of the mandibles and extending posteriorly, each forming an angle; labrum semicircular in outline, very thick and fleshy and fused with clypeus and triangular frons; frontal sutures and median epicranial suture well defined; no ocelli; mandible but little chitinized; gula well defined, broadly rectangular, bearing well marked tentorial pits at anterior lateral angles. Body folds but little differentiated (on larval skin) and no chitinizations; presternal ring of mesothorax and metathorax well defined and epipleural region of abdomen possibly swollen and protuberant; ninth tergum chitinized at tip and extended into a pair of chitinized, immovable, conical cerci. Spiracles rather large, lightly chitinized, bifore; nine pairs, first on mesothorax, bulla large and approximate to bifore fingers, latter pointing posteriorly.

The pupa was not carefully described while living as every precaution was taken to ensure its transformation. In form it was more slender than the adult, of a yellowish color and densely covered with a tawny soft velvety pubescence. The abdomen tapered posteriorly and was curled up under the thorax; when disturbed it would suddenly straighten with considerable force. It was this movement that probably scattered the pupal skin of the cicada when it was touched.

All that is known of the habits has already been given and it is hoped that this account may stimulate further search for more material especially of the earlier stages. It is altogether possible that the immature larvae may be more chitinized and resemble some Elaterid-like larvae, such as *Hemirhipus fascicularis* Fab., the larvae of which, in the later stages, is predaceous in the pupal cells of large Cerambycid wood borers and assume a fleshy, soft body form quite in contrast to the earlier heavily chitinized and free living stages.

In the summer of 1918 while collecting in Cumberland County, Pennsylvania, some half dozen adults of *Sandalus niger* were found slowly crawling up the trunk of an old sassafras tree in an open pasture. These beetles had probably emerged from the ground that day and were crawling up the trunk to take flight.

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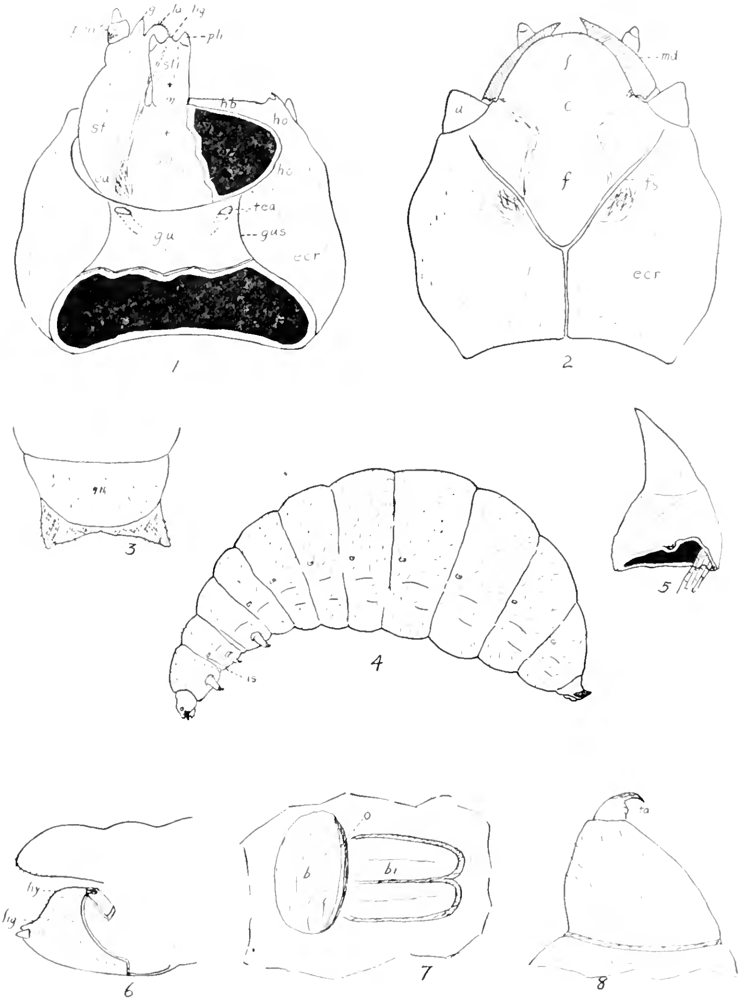
[1]The form and size of the larvae could only be approximately determined; by boiling in weak potash the skin was distended; the habitus figure was made with camera lucida.




CRAIGHEAD—LARVA OF SANDALUS NIGER

## EXPLANATION OF PLATE.

FIGURES DRAWN BY THE AUTHOR

Figure 1. Ventral view of head with right maxilla removed.
2. Dorsal view of head.
3. Ninth tergum showing cerci.
4. Reconstructed lateral view of body.
6. Lateral view of labrum and labium to show hypopharynx.
7. Abdominal spiracle.
8. Leg.

## ABBREVIATIONS.

| | | | |
|---|---|---|---|
| *a* | antennae | *is* | intersternal ring |
| *b* | bulla of spiracle | *l* | labrum |
| *bi* | fingers of bifore spiracle | *la* | lacinia |
| *c* | clypeus | *lig* | ligula |
| *ca* | cardo | *m* | mentum |
| *ecr* | epicranium | *md* | mandible |
| *epx* | epipharynx | *o* | opening of spiracle |
| *f* | frons | *pgm* | palpiger |
| *fs* | frontal suture | *pli* | labial palpus |
| *g* | galea | *pmx* | maxillary palpus |
| *ga* | gula | *sli* | labial stipes |
| *gus* | gular suture | *sm* | submentum |
| *hb* | hypopharyngeal bracon | *st* | maxillary stipes |
| *ho* | hypostoma | *ta* | tarsus |
| *hy* | hypopharynx | *tea* | tentorial arms |

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# PROCEEDINGS

OF THE

# ENTOMOLOGICAL SOCIETY

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## DESCRIPTION OF A NEW GENUS OF NEMOCERA. (Dipt.)

By W. L. McAtee.

Mr. D. W. Coquillett identified the fly here described as belonging to the genus *Eupeitenus*[1] Macquart, of the Bibionidae, relying, however, overmuch on "Macquart's well-known inaccuracy" to cover discrepancies between the characters of his specimen and those given in the original description and figure. As a matter of fact the fly not only does not belong to the genus *Eupeitenus*, nor to the family Bibionidae, but is so aberrant a genus that it is the type of a new sub-family characterized by Mr. Raymond C. Shannon in the appended paper.

### **Axymyia** new genus.

Second longitudinal vein long, extending into terminal fourth of wing, radial sector forking anterior to median crossvein, third vein forked, its upper branch joining second vein at its termination, fourth vein extending to apex of wing; no discal cell; fifth vein forked, a little beyond median crossvein; anal vein not reaching wing margin (venation well shown in Coquillet's figure); thorax somewhat humped and swollen, head inserted low; antennae 15-jointed about as long as height of head.

Genotype: *Axymyia furcata* new species.

### **Axymyia furcata** n. sp.

Female: General color fuscous, paler along sutures and incisures; eyes black, ocelli on a prominent tubercle which is rather darker than surrounding surface; basal joints of antennae and area about insertion of antennae pruinose; halteres pale fuscous; legs the same, terminal joints of tarsi darker; wings slightly fumose, veins brown.

Type a female, Germantown, Pa., April 26, 1908, H. S. Harbeck (U. S. N. M.). Paratype female, Great Falls, Va., April 20, 1916, W. L. McAtee (Biological Survey). The species has been collected also in Dead Run Swamp and near the mouth of Dead Run, Va., and at Ithaca, N. Y.

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[1] Rediscovery of the Bibionid Genus Eupeitenus. Ent. News, Vol. XX, No. 3, March, 1909, p. 106. fig.

## ANOTHER ANOMALOUS DIPTERON ADDED TO THE RHYPHIDAE.

By Raymond C. Shannon.

In connection with the preceding paper by Mr. W. L. McAtee in which the aberrant dipteron *Axymyia furcata* McAtee is newly described, it seems desirable to publish the following notes on its systematic position.

Under the title "Rediscovery of the Bibionid Genus Eupeitenus[1]" Coquillett records his identification of a dipteron as *Eupeitenus atra* Macq. He is evidently confident of its position in the Bibionidae as he states: "The head and its members, as also the body and legs, are essentially those of *Plecia*" (Bibionidae).

Critical examination of the same specimen shows that it is not a member of the Bibionidae and the characters given below show that it finds its natural position with the Rhyphidae. The genus *Plecia* possesses the following characters: Radial sector forking far beyond R-M crossvein; R2 and R3 fused and very short; antennae consisting of scape and an eight-jointed flagellum; scutellum very much reduced and not separated from mesonotum by a distinct suture; Cu2 recurrent at distal end, thus narrowing the anal cell. *Axymyia* differs in having the radial sector forking well before the R-M crossvein; branch R2+R3 long and R2 present as a distinct vein; flagellum of antennae composed of fourteen segments; scutellum well developed and separated from mesonotum by a distinct suture; anal vein evanesces some distance from wing margin, hence anal cell not narrowed at margin.

Mr. F. W. Edwards has proven that *Mycetobia* (formerly placed in the Mycetophilidae) is a member of the Rhyphidae.[2] The principal character used in both these cases, namely the forking of the radial sector basad of the R-M crossvein (originally discovered by Edwards), apparently is a fundamental one in the suborder Nemocera. Recently Alexander has added the Trichocerinae to the Rhyphidae. Dr. C. P. Alexander has very kindly examined this manuscript and approves of the position of the Axymyinae in the Tipuloidea, for which favor the author expresses his sincere thanks. The writer is much indebted to Prof. O. A. Johannsen for a number of points relating to the classification of the Nemocera and for some very timely advice.

Characters of the Rhyphidae: Radial sector forking anteriorly to R-M crossvein; anal cell widening towards wing margin; antennae with a many-jointed homomomous flagellum; no true macrochaetae present; ocelli present. This last named

[1]Ent. News, p. 106, 1909. Wing figured.

[2]Ann. Mag. Nat. Hist., ser. 8, vol. 17, 1916, p. 108–116.

character distinguishes the Rhyphidae from the other Tipuloidea.

*Table of Subfamilies of Rhyphidae:*

1. Discal cell present ........ 2.
— Discal cell absent ........ 3.
2. Two distinct anal veins; radial sector three-branched ........ *Trichocerinae.*
— One distinct anal vein; radial sector two-branched ........ *Rhyphinae.*
3. R2 fused with R3; vein R2+R3 short, entering wing margin short distance beyond R1; anal cell extending to wing margin ........ *Mycetobinae.*
— R2 present as a distinct vein; anal vein evanescent some distance from wing margin. (New subfamily, type genus Axymyia McAtee). *Axymyinae.*

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## THE LARVA OF POPILLIA JAPONICA, NEWMAN AND A CLOSELY RELATED UNDETERMINED RUTELINE LARVA. A SYSTEMATIC AND MORPHOLOGICAL STUDY.

By ADAM G. BÖVING, *Bureau of Entomology.*

*Popillia japonica* Newman belongs to the Scarabaeid tribe Rutelini. In his conspectus systematicus of the larvae of the series *Lamellicornia* Schiödte has characterized the larvae of this tribe.[1] Like the entire paper of which the conspectus systematicus forms a part that characterization is given in Latin. Translated and in a few places slightly modified it may be presented as follows, the footnotes and the textnotes in parentheses or brackets being by the present author:

### Characterization of the Rutelini.

I. Stridulating instrument formed by a dentate carina, on the dorsal side of the maxillary stipes, rubbing against a finely tuberculate area on the ventral side of the mandible (figs. 4 and 14). Antenna consisting of four joints. Legs all well developed, gradually increasing in length from first to third pair. Anterior abdominal segments dorsally with three transverse areas. Maxillary palp four jointed (Schiödte says, "three jointed," interpreting the basal joint as palpiger). No ocelli. Mandible with manducatorial portion (the portion with the molar or grinding structure) deeply separated from the scissorial portion (portion with the cutting edge) (m, s fig. 13); molar structure with posterior heel bearing a tuft of bristles (figs. 24, 25).

[By the given combination of characters the *Trogini*, *Geotrypini*, *Lucanini* and *Passalini*—sensu Schiödte—are excluded].

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[1] I. C. Schiödte: De metamorphosi Eleutheratorum observationes, Naturhist. Tidsskrift, series 3, vol. 9, 1874, pp. 227-376, pl. VIII-XIX.

A. Respiratory plate of spiracles surrounds the major part of bulla (R and B fig. 1). Legs with covering of fine hair.

[By these two characters the *Copridini*—sensu Schiödte—are excluded.]

1. Maxilla with both malae (=inner and outer lobes) completely fused (fig. 6). Anal opening transverse and terminal (fig. 15).

[By these characters the *Sericini*—sensu Schiödte—are excluded.]

b. [1]Scissorial portion of mandible depressed; apically obliquely truncate with terminal angle acute, posterior angle obtuse and by a short incision separated from a small tooth (figs. 8, 11). Labrum with lateral margins of the ventral side flattened and transversely striate (fig. 7). Length of antenna equal to length of head; subapical antennal joint distally and internally produced into a conical and pointed, incurved appendix. Claws (abbreviated expression for clawshaped tarsi) slender, subulate.

[By this combination of characters the *Cetoniini* and the *Dynastiini*[2]—sensu Schiödte—are excluded.]

†. Stridulating area of mandible, placed in the manducatorial portion, oblong, transversely ribbed with very fine and densely set ridges (figs. 4 and 13). Molar structure of right mandible with bicarinate crown (cr 1, cr 2 fig. 24). Maxilla with interior mala (=inner lobe=lacinia) bidentate and with [about] six acute, recurved stridulating teeth (figs. 14,17 and 21). Anal valvules not well defined, anal slit crescent shaped (figs. 15, 23). Abdomen clavate-cylindrical.

[By this series of characters the *Rutelini* are separated from the *Melolonthini*[3]—sensu Schiödte.]

The two forms described by Schiödte as typical Rutelini larvae on which his characterization of this tribe is based are

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[1]Under "a" Schiödte characterizes the Dynastiini and Cetoniini.

[2]The Dynastiine larva of *Cyclocephala immaculata* Olivier is mentioned by John J. Davis as one of those white grubs, which most likely could be mistaken for *Popillia japonica*. (John J. Davis: The green Japanese beetle, Circular No. 30, New Jersey Dept. of Agric., 1920, p. 20, fig. 11.)

[3]Some Melolonthine larvae of the genus *Phyllophaga* (=*Lachnosterna*), as *P. hirticula* Knoch and *P. tristis* Fabricius, are mentioned by John J. Davis as likely to be mistaken for *Popillia japonica* (l.c. in footnote 3). As another larva which can be mistaken for *Popillia japonica*, John J. Davis also mentions (l.c.) *Macrodactylus subspinosus* Fabricius. According to the character of the adult beetle, the genus *Macrodactylus* is placed among the *Melolonthini*. The larva, however, only approaches this tribe but can not be placed in it, differing in the following essential characters: 1. No stridulating area on mandible, no stridulating teeth on maxilla (the *Melolonthini* having a transverse stridulating mandibular area formed by irregularly distributed granules and twelve maxillary teeth). 2. Mandibular molar structure indistinctly bicarinate (the *Melolonthini* having tricarinate mola). 3. All claws of equal size (the *Melolonthini* have third pair abruptly abbreviated).

*Anomala aenea* Degeer, by Schiödte named *Euchlora frischii* Fabricius, and *Phyllopertha horticola* Linnaeus, both European species, common in Denmark. His brief characterizations of these larvae are as follows:

**Anomala aenea.**

"Epicranial suture with elevated margins. Antenna with length of subapical joint in proportion to basal joint as 3:4. Maxillary palp with length of postapical joint in proportion to prebasal joint as 2:4 (the Latin text has 'articulus secundus palporum maxillarium articulo primo duplo brevior,' our prebasal joint being identical with Schiödte's 'articulus primus' and our basal joint being his 'palpiger'). Length of tibia in proportion to femur as 3:4. Claws of third pair of legs abruptly shorter. Respiratory plate with oblong holes, placed in transverse series."

**Phyllopertha horticula.**

"Epicranial suture inconspicuous. Antenna with subapical joint as long as basal joint. Maxillary palp with length of postapical joint in proportion to prebasal joint as 3:4 (the Latin text has, 'articulus secundus palporum maxillarium articulo primo dimidio brevior'). Length of tibia in proportion to femur as 2:4. All legs with claws of about same size. Respiratory plate with angulate-rotundate holes, irregularly distributed."

The following definition of *Popillia japonica* Newman is given in exact conformity with Schiödte's formula.

**Popillia japonica.**

Epicranical suture with medianly slightly elevated margins (fig. 18). Antenna with subapical joint as long as basal joint. Maxillary palp with length of subapical joint in proportion to prebasal joint as 3:4 (fig. 6). Length of tibia in proportion to femur about equal (fig. 16). All legs with claws of about same size. Respiratory plate with angulate-rotundate holes, irregularly distributed (fig. 5).

The Popillia larva is more closely allied to the *Phyllopertha* larva than to the *Anomala* larva as these forms are defined by Schiödte, Popillia only differing from *Phyllopertha* in having slightly elevated margins of epicranical suture and proportionally somewhat longer tibia; from *Anomala* it differs, besides in the proportional length of the joints of the articulated organs mentioned, in having equally long claws and a differently constructed respiratory plate.

**Systematic and Morphological Description of Popillia Japonica Newman.**

(Mature larva; in U. S. National Museum; from Riverton, New Jersey, 5 Nov., 1917; coll. Wm. O. Ellis. Species reared.)

(Figs. 1–18, 21, 23 and 24.)

*Length of mature larva*, nearly 25 mm. (=one inch).

*Extreme width of head*, 3.1 mm.

*Cranium*,[1] narrower than prothorax, its extreme width in proportion to the extreme width of prothorax being 2:3; transverse with width to length as 2:1.5, widest immediately behind antennae; surface finely reticulate.

*Frons*, (fig. 18) indistinctly limited, wider than long, with width to length as 3:2; frontal suture with anterior half slightly convex, posterior half slightly concave; posterior frontal angle shortly accuminate. Anterior margin with four setae, two are exteriorly placed, between articulation of mandible and base of antenna; two are interiorly placed, between articulation of mandible and median line of frons; behind and close to the two exterior marginal setae is one seta; behind the interior marginal setae and towards the middle of frontal suture is a short series of three setae.

*Epicranial suture*, in proportion to length of frons as 1:3; elevation of margin along epicranical suture slight and dark colored; epicranical setae are about seven in series along the frontal suture and about ten in an irregular group laterally from antennal base to a point almost at the level with posterior angle of frons (figs. 12 and 18).

*Clypeus*, about two and a half times as wide as long, trapezoidal; in front with a transverse, slightly lighter colored, naked, ribbon shaped region, limited posteriorly by a low ridge; behind the ridge two lateral setae and one seta between anterior lateral seta and longitudinal middle line of clypeus.

*Labrum*, with length to width as 1:1.5, and with length to length of clypeus as 1:0.75, not much narrower than clypeus; laterally rounded, anterior margin irregularly and slightly crenulate, medianly somewhat obtusely produced; dorsal surface roughened with numerous small, rounded projections; posteriorly slightly elevated, flatly descendent forward; lateral border (fig. 7) ventrally flattened, with rather dense transverse striation; at apical margin (fig. 18) with one well developed and one rather small seta; at lateral margin dorsally with a series of about five setae and ventrally with a series of almost as many short, curved setae as striations; close to and parallel to posterior margin with a series of four setae; on disk with two setae, one placed anteriorly, one larger near the transverse middle line.

*Antenna*, almost as long as cranium, rather slender, four jointed; basal joint clavate, about one-fifth the length of entire antenna; prebasal joint clavate, about twice as long as basal joint; subapical joint about same length and proportions as basal joint, but anteriorly on the inner side produced into a well developed accessory process of pointed conical shape; apical joint somewhat shorter than first joint, twice as long as thick, elliptical, anteriorly pointed; a few setae on prebasal joint; thin, semitransparent sensorial area on apical joint of accessory process.

*Mandible*, slightly longer than cranium. *Scissorial portion* (s fig. 18) three times shorter and approximately half as wide as rest of mandible, depressed, above smooth, below rugose with longitudinal groove along exterior margin, and a shallow cavity at base (figs. 8 and 18); cutting edge thin with terminal angle pointed and posterior angle obtuse, separated by small incision from minute

[1]The term cranium is here used for the capsule, formed by the two fixed parts of the head, frons and epicranium.

tooth (t fig. 18). *Lateral exterior mandibular portion* (l figs. 13 and 18) subtriangular, flat, punctate and wrinkled, limited by two apically converging carinae from base of mandible to scissorial portion; with several setae. *Manducatorial* (=mola bearing) *portion* dorsally and ventrally somewhat convex, smooth and shining, separated from scissorial portion by oblique impression declining towards outside of mandible. Stridulating area elliptical, on right mandible twice, on left two and a half times as long as wide, densely set with minute asperities (figs. 3, 4 and 13), regularly arranged in fine, parallel lines. Right molar part oblique, anteriorly low, posteriorly prominently projecting, sloping gradually downwards from the upper part of crown to the heel; crown (=corona) (figs. 8 and 24) bicarinate, transversely trilobed with one small anterior (cr 1 fig. 24) and two large posterior lobes (cr 2 and cr 3); anterior lobe rounded, almost globular, limited by neckshaped narrowing; both posterior lobes fungiform and obtusely carinate; heel (=calx) (fig. 8 and ca fig. 24) strong, with flat, granulose surface, transverse, subtrapezoidal, about twice as broad as long, posteriorly truncate and emarginate with dorso-posterior angle (a fig. 24) developed as a short, broad, obtuse process about as long as wide, and only slightly projecting over a large, rounded, deeply excavate, dorsal portion of the bristle bearing base (bb fig. 24). Left molar part (figs. 9, 10 and 25) anteriorly prominent, posteriorly retracted; crown bilobed, anterior lobe (L 1 fig. 25) strong, fungiform, crenulate along free margin, shielding deep excavation, which receives posterior carinated lobe of right mola (cr 3 fig. 24); posterior lobe of left mandible frontally carrying an obtuse, transverse carina (L 2 fig. 25) between one strong dorsal and one less developed rounded ventral tooth; heel (Ca fig. 25) rather small, slightly concave, anteriorly limited by a low transverse carina, coming from a broad, dorsal, piliferous hook (=hamus) (H fig. 25) and disappearing towards ventral tooth of posterior lobe; bristle bearing base (Bb fig. 25) posteriorly with obtusely conical outline, and anteriorly almost contiguous with grinding surface of heel.

*Maxillary lobes* (=lacinia and galea) fused into a single, solid, conico-quadrangular, slightly depressed, setose structure; ventrally (fig. 6) with surface entirely plain, dorsally (fig. 14) with a rather deep, longitudinal sulcus, which is the limiting line between the areas of the exterior and interior lobes; exterior lobe (=galea) with single, terminal, curved and very strong tooth (=uncus) (gt fig. 17); interior lobe (lacinia) with two strong, conical teeth (lt 1, lt 2 fig. 17); long and strong, conical setae on dorsal side along bases of teeth; two strong conical setae (vs fig. 17) on the ventral side of bases of teeth; a single, short, strong seta (ps fig. 17) posteriorly to second lacinia-tooth.

*Stipes*, with stridulating teeth (figs. 14 and 21) on dorsal side, about six, slender, pointed and recurved; dentiferous carina apically curvilinear, with obtuse tubercle.

*Maxillary palp* (fig. 6), projecting beyond exterior maxillary lobe by half the length of the apical joint; four-jointed; basal joint short, obconical; second joint three times as long as basal joint; subapical joint three fourths the length of second joint; apical joint as long as second joint and obovate.

*Epipharynx*, (fig. 7) membranous, densely set with short spinules on each side of a nude, fleshy ridge along the middle line; four, pointed teeth asymmetrically placed near anterior margin.

*Glossa* (= *Lingua*, sensu Schiödte) (lin figs. 13 and 14) fleshy, cushioned, densely set with spines.

*Hypopharyngeal chitinization*, (fig. 14) obliquely transverse, asymmetrical, with right angle heavily chitinized and dorsally produced into a strong, obtuse process which together with upper part of right molar structure forms a hard strata against which upper portion of left molar part works; left angle triangular, dorsally semimembranous, interiorly limited by a longitudinal series of numerous spines; ventrally (hy fig. 13) both right and left angle with articulating fossa for hypopharyngeal condyle (hc fig. 13) of mandible.

*Legs* (figs. 12 and 16).—Rather long and slender, gradually and slightly increasing in length from first to third; third leg about as long as lengths of meso- and meta-thorax together; long, fine hairs scattered over entire surface of legs; coxae cylindrical, distal end near trochanter without conical prolongation; coxa of first leg twice, of third leg four times as long as thick; trochanter obconical, about twice as long as thick and almost as thick as coxa; femur clavate-cylindrical, slightly constricted at the middle inferiorly, about twice as long as thick; tibia ovate-cylindrical, about three times as long as thick, length in proportion to the length of femur as 4:5, thickness in proportion to thickness of femur as 2:3; claws subequal, all subuliform, somewhat incurved and about one third as long as tibia.

*Body form* (fig. 12).—Clavate-cylindrical, about six times as long as thick; hairs numerous and short, from seventh abdominal segment longer and scarcer.

*Color.*—Head testaceous, with heavily chitinous parts dark brown; body pale; legs pale flavescent; prothorax with an irregularly outlined, chitinous, testaceous impression in front of and almost as large as lower half of first dorsal area (prescutum) of mesothorax.

*Body areas* (fig. 12).—Prothorax with one dorsal area; meso- and metathorax with three dorsal areas (prescutum, scutum, scutellum); the first six abdominal segments with three dorsal areas (prescutum, scutum, scutellum).

*Tenth abdominal segment* (=annulus analis, figs. 12, 15 and 23).—Dorsally distinct, considerably longer than ninth abdominal segment; one and a half times as long as head (from tip of labrum to foramen occipitale); below with scattered, apically hook-shaped setae, and with two posteriorly diverging rows of about seven, short, straight, very pointed spines which are at a distance in front from the anal slit almost equal to the length of the rows.

*Anal slit*, transverse, terminal; upper anal lip (ua fig. 23) with rounded, concave margin; lower lip (loa fig. 23) with margin rounded and convex and with a slightly marked, straight, transverse impression between the two ends of the slit (ti fig. 23).

*Spiracles* (figs. 1, 2, 5 and 12). Orbicular; respiratory plate (R fig. 1) C-shaped almost surrounding bulla (B fig. 1), with width less than half the length of bulla; holes of plate (fig. 5) comparatively large, angulate-rotundate, irregularly distributed. Concavity of thoracic respiratory plate facing posteriorly; of abdominal plates anteriorly.

## An Undetermined Closely Related Ruteline Larva.

(Possibly *Strigoderma arboricola* Fabricius.)

(Mature larva; in U. S. National Museum; from Riverton, New Jersey, 4 October, 1920; coll. C. H. Hadley; among mixed material of various Scarabaeid larvae of same size. Species not reared.)

(Figs. 19, 20, 22, 26 and 27.)

*Length of mature larva*, nearly 25 mm. (=one inch).

*Extreme width of head*, 3.1 mm.

Larva close to *Popillia japonica* and identical with this species in every character mentioned in the "brief characterization" of that form (p. 5). Both have same size, same general proportions; however, the unidentified form differs in the following structural details from *Popillia japonica*.

*Frons* (fig. 19) with only two setae between the interior marginal seta and the middle of frontal suture.

*Labrum* (fig. 19) with posterior transverse elevation rather distinct and sculptured with closely set, rather large, obtuse, oval protuberances.

*Molar part of right mandible* (fig. 26) with heel (ca) almost square; dorso-posterior angle (a) slender, twice as wide and projecting over and entirely covering the bristle bearing base; small anterior lobe (cr l) of crown fusiform, with elongate elliptical outline.

*Last abdominal segment* (fig. 27) with two parallel rows of about ten spines; distance between posterior end of rows and anal slit somewhat shorter than length of rows.

The present larva probably belongs to the genus *Strigoderma*, being that North American genus which most closely approaches *Popillia*. According to the size of the mature grub and the fact that the only *Strigoderma* species which occurs in the locality in question is *Strigoderma arboricola* Fabricius, the larva must belong to this species, if it is a *Strigoderma* larva at all. That possibility, namely, can not be disregarded that the grub might be an *Anomala* larva. All the American species at present included in the genus *Anomala* may not be congeneric, and consequently the brief characterization given by Schiödte of *Anomala aenea* may agree only with part of the many *Anomala*-species. The larva of *Anomala binotata* Gyllenhal, which is reared from egg by Dr. F. C. Craighead (Hopk. U. S. 11872 x) corresponds exactly with Schiödte's characterization of *Anomala*. If, however, the grubs, mentioned by John J. Davis (l.c.) as *Anomala spp.*, really belong to that genus, it certainly will be necessary to separate those species from the rest of the genus, as they according to Davis are "distinguished by the angular anal split." It must at the same time be borne in mind that this character never, like the arrangement of the anal spines, has been considered one of specific or generic value, but always as a character of tribal value.

Serving as a summary the following key may express the systematic differences between those North American and European grubs which are closely related to or recorded as most likely to be mistaken for *Popillia japonica*.

All forms included in the key have: Four jointed antennae; all legs of approximately same length; a stridulating organ is never formed by special development of second and third pair of legs; ocelli are not present; cutting edge of mandible never tridentate.

*Key:*

1. Antenna shorter than headcapsule; antennal appendix obtuse; ventral margin of labrum without transverse striation; cutting edge of mandible without tooth; (North American) .......... *Cyclocephala*.
   Antenna as long as headcapsule; antennal appendix pointed conical; ventral margin of labrum transversely striate; cutting edge of mandible posteriorly with a small tooth .......... 2.
2. Stridulating structures absent on mandible and maxilla; (North American) .......... *Macrodactylus*.
   Stridulating structures present on mandible and maxilla .......... 3.
3. Stridulating area of mandible with granules irregularly distributed, of maxilla with about twelve teeth; anal slit transverse, medianly angular; (North American) .......... *Phyllophaga* (*Lachnosterna*).
   Stridulating area of mandible with granules in transverse fine lines, of maxilla with about six teeth; anal slit transverse, crescent-shaped .......... 4.
4. Claws of third pair of legs abruptly shorter than of first and second pair of legs; respiratory plate with oblong holes in transverse rows; (North American and European) .......... *Anomala*.
   Claws of third pair of legs same length as of first and second; respiratory plate with angulate-rotundate holes, irregularly distributed .......... 5.
5. Epicranical suture inconspicuous and without elevated margins; (European) .......... *Phyllopertha*.
   Epicranical suture with slightly elevated and medianly dark colored margins .......... 6.
6. Labrum coarsely granulate; mandibular mola with heel posteriorly concave and dorso-posterior angle shortly prolonged; with anterior lobe of crown globular; anal segment ventrally with two posteriorly diverging rows of about seven spines; (North American, introduced from Japan) *Popillia*.
   Labrum posteriorly with closely set, rather large, oval, obtuse elevations; mandibular mola with heel almost square and the dorso-posterior angle slender, twice as long as wide; with anterior lobe of crown fusiform; anal segment with two parallel rows of about ten spines; (North American) .......... *Undetermined grub;* possibly *Strigoderma*.

## EXPLANATION OF FIGURES.

Figures drawn by author.

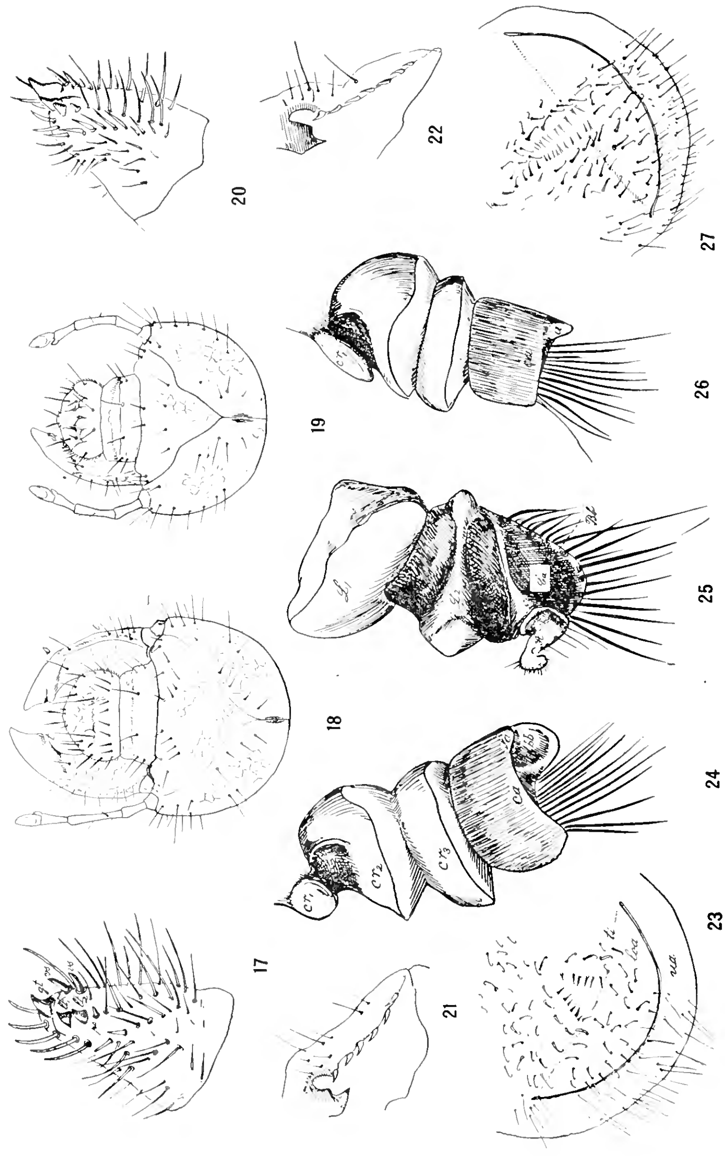
Plate V.

POPILLIA JAPONICA Newman.

Fig. 1. Abdominal spiracle: B, bulla with spiracular opening; R, respiratory plate with fine holes.

Fig. 2. Longitudinal section of spiracle: A, atrium; b, bulla; o, spiracular opening; r, respiratory plate; t, trabecula (one of those branched

BÖVING—LARVA OF POPILLIA JAPONICA




BÖVING—LARVA OF POPILLIA JAPONICA

supports of the spiracular plate which originate from the wall of the spiracular atrium); Trach, trachea.

Fig. 3. Small, highly magnified part of the stridulating area of mandible, showing the form and arrangement of the granules.

Fig. 4. Left mandible, ventral side, with stridulating area.

Fig. 5. Terminal part of respiratory plate, showing form and arrangement of the holes of the plate; highly magnified; external view.

Fig. 6. Right maxilla, ventral surface; showing sensorial area of apical joint of palp; completely fused lacinia and galea; the two lacinia teeth and the galea tooth; bidivided cardo; articulating area between maxilla and submentum.

Fig. 7. Epipharynx; four anterior asymmetrically placed small hooks; lateral margin with transverse striations.

Fig. 8. Right mandible.

Fig. 9. Left mandible.

Fig. 10. Diagram showing the way in which the molar parts of right and left mandibles fit together.

Fig. 11. Right mandible.

Fig. 12. Side view of larva.

Fig. 13. Ventral surface of mandibles and hypopharyngeal chitinization; hy, supplementary ventral condyle of mandible; fossa in hypopharyngeal chitinization receiving supplementary condyle of mandible; l, exterior and lateral part of mandible; lin, glossa; m, manducatorial (=mola bearing) part of mandible; o, stridulating, oval organ of left mandible; oo, same of right mandible; s, scissorial (=cutting) part of mandible.

Fig. 14. Dorsal surface of maxillae, glossa (lin), hypopharyngeal chitinization, pharynx and wide entrance to oesophagus (oe).

Fig. 15. Terminal portion of tenth abdominal segment.

Fig. 16. Second and third pair of legs.

Plate VI.

POPILLIA JAPONICA Newman and "STRIGODERMA ARBORICOLA Fabricius?"

Fig. 17. Popillia. Malae (=fused lacinia and galea) of left maxilla, innerside, viewed from buccal cavity: gt, galea-tooth; lt 1 and lt 2, lacinia-teeth; ps and vs, large setae.

Fig. 18. Popillia. Dorsal surface of head: s, scissorial part of mandible; 1, lateral part of mandible.

Fig. 19. "Strigoderma?" Dorsal surface of head.

Fig. 20. "Strigoderma?" Malae of left maxilla; view as fig. 17.

Fig. 21. Popillia. Posterior part of dorsal surface of right maxilla, exhibiting creaking teeth of stridulating organ.

Fig. 22. "Strigoderma?" Same view as fig. 21.

Fig. 23. Popillia. Posterior part of ventral side of tenth abdominal segment: loa, lower anal lip; ua, upper anal lip; ti, transverse impression between the two ends of anal slit.

Fig. 24. Popillia. Molar structure of right mandible: a, dorso posterior angle

of heel; bb, bristle bearing part of heel; ca, heel (=calx); cr 1, first lobe of crown (=corona); cr 2 and cr 3, carinated second and third lobes of crown.

Fig. 25. Popillia. Molar structure of left mandible: Bb, bristle bearing base of heel; Ca, heel (=calx); H, hook (=hamus); L 1 and L 2, first and second lobes of crown.

Fig. 26. "Strigoderma?" Same view as fig. 24.

Fig. 27. "Strigoderma?" Same view as fig. 23.

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## ANAPHOIDEA CONOTRACHELI GIRAULT (HYM.) AN EGG PARASITE OF THE APPLE MAGGOT.

By B. A. Porter and C. H. Alden.

In the course of studies of the apple maggot, *Rhagoletis pomonella* Walsh, carried on at Wallingford, Conn., it was noted by the junior author that a number of eggs dissected out of apples collected in the field were parasitized. Adults were reared, and determined by Mr. A. B. Gahan as *Anaphoidea conotracheli* Girault.

This Mymarid is very common as an egg parasite of the plum curculio, having been reared from that host on various fruits from many localities, including most of the Atlantic States from Connecticut to Georgia, and from Kentucky and Texas. It has also been reared from the eggs of the grape curculio, *Craponious inaequalis* Say, but so far as is known, no record has been made of this species as a parasite of the apple maggot. Individuals were reared by the writers from apple maggot eggs from two localities in the vicinity of Wallingford.

The life cycle from egg to adult for this parasite in the eggs of the curculio has been shown to be ten to eleven days, and is presumably not very different in that of the apple maggot. The egg-laying period of the second host follows shortly after that of the first, offering a very favorable succession of host material, enabling the parasite to breed almost without interruption from June until September.

The process of oviposition has not been observed. Parasitized eggs turn dark, especially in the middle portion, the part usually occupied by the parasite, the eyes showing through the shell as dark red. In emerging, the tiny parasite chews a hole in the side of the egg, and, instead of emerging through the egg puncture, it makes its way directly to the surface of the apple and chews its way through the skin, making an exit hole considerably smaller than the egg puncture and at a little distance from it. As has been noted with the eggs of the curculio, a few of the maggot eggs contained two parasites.

Counts made of material collected near Wallingford gave percentages of parasitism ranging from twenty-five to thirty percent, indicating that the parasite may prove of great importance in the natural control of the apple maggot.

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## REVISION OF THE GENUS LYGAEUS FAB. (HEMIPTERA-HETEROPTERA).

H. G. Barber, *Roselle Park, N. J.*

*Characters of the genus.*—Pronotum either without a median longitudinal keel or with a keel not reaching anterior margin; posterior margin straight before scutellum. Scutellum depressed, with a longitudinal median keel commonly joined to a median or premedian transverse ridge. Metapleura with posterior margin straightly or somewhat roundly truncate not oblique, the anterior and posterior margins of this nearly parallel.

Corium almost or quite impunctate; its posterior margin straight. Membrane not at all or usually narrowly but never with the apex more widely white margined; rarely entirely or for the most part clear of whitish. Head (except in Melanocoryphus Stål) with a red or pale spot or longitudinal fascia near base; eyes in contact with the anterior margin of pronotum. Species mostly black marked with red or sometimes with the latter color predominating.

*Key to Subgenera and Species.*

1. Pronotum black provided with a postmedian transverse red band or three red spots, remote from posterior margin. Venter most commonly red with fascia at anterior angles of segments 2–5 and all of sixth and genital segments black or most rarely (*formosus*) venter entirely black. Odoriferous orifices black. Head with red fascia at least at base. Larger species, 10–12 mm.
Subgenus (*Graptolomus* Stål) *Lygaeus* Fab., Van Duz. . . . 2.

— Pronotum unprovided with a transverse postmedian red fascia, remote from posterior margin. Species smaller . . . 6.

2. Clavus pale margined within, never furnished with a subapical black spot. Venter of abdomen entirely black. . . . *formosus* Blanch.

— Clavus never pale margined, either entirely black or anteriorly red; opposite apex of scutellum furnished with an opaque black spot. Venter red marked with black . . . 3.

3. Membrane in great part pale with fuscous veins. Broad margins of all pleurae posteriorly, propleurae anteriorly, bucculae and acetabulae pale fusco-reddish . . . *truculentus* Stål.

— Membrane either entirely black or most commonly pale margined with concolorous veins, with or without white discal spots. Bucculae, acetabulae and margins of pleurae not pale . . . 4.

4. Membrane entirely black without pale margins or white discoidal or basal spots. Clavus anteriorly red. Head with a Y-shaped red fascia, the anterior arms of which are extended beneath the antenniferous tubercles (=*trimaculatus* Dall.) *turcicus* Fab.

— Membrane pale margined, with or without white discoidal spots. Clavus either entirely black or anteriorly red. Red fascia at base of head most commonly reduced in size 5.

5. Clavus entirely black. Membrane variable, either only narrowly margined with white and occasionally furnished with less conspicuous white discal spots (Eastern forms) or broadly margined and furnished with conspicuous white discal spots (Western forms) *kalmii* Stål.

— Clavus anteriorly red. Membrane narrowly margined and most commonly furnished with white discal spots which are often reduced and sometimes wanting *reclivatus* Say.

6. Pronotum entirely black or sometimes only humeral angles red. Odoriferous orifices black. Head with red basal spot (sometimes obscured in *bistriangularis*). Corium and clavus bright red. Membrane very narrowly and evenly white margined. Sixth and genital ventral segments black Subgenus *Melanopleurus* Stål 7.

— Pronotum rarely entirely black (*pyrrhopterus*), if so then as in the other members of the subgenus *Ochrostomus* the odoriferous orifices are pale. Commonly the anterior, lateral at least in part and most frequently the posterior margin of the pronotum red or pale or the latter trimaculate with red 8.

7. Size larger, 8–9 mm. long. Bucculae variable but commonly higher and more semicircularly elevated. Bucculae, acetabulae, anterior margin of propleurae and posterior margins of pro- and mesopleurae rather broadly and conspicuously pale *belfragei* Stål.

— Size smaller, 5–6 mm. long. Bucculae lower, less semicircularly elevated. Bucculae, acetabulae, margins of pleurae, inconspicuously, narrowly pale bordered *bistriangularis* Say.

8. All margins of pronotum and hemielytra conspicuously bordered with red or yellow. Orifices black. Base of head with red spot. Bucculae, acetabulae, anterior margin of propleura and posterior margins of all pleurae broadly pale or yellow. Venter red with sixth and genital segments black. (*L. uhleri* Stål.) Subgenus *Craspeduchus* Stål.

— Rarely with entire margins of pronotum and hemielytra bordered with red or pale, if so then is the venter entirely black or margined with red or the head is without a red spot at base 9.

9. Head with a red or pale spot at base. Orifices pale. Coloration of venter variable, entirely black or margined with red or pale or only the sixth and genital segments black Subgenus *Ochrostomus* Stål. 10.

— Head entirely black. Orifices black, rarely pale (*mimulus*) in which case base of legs and apices of femora pale. Coloration of venter variable, most frequently entirely black or narrowly red margined, rarely for the most part red (*bicrucis*). Membrane with or without median white discoidal spot 14.

10. Venter red, sometimes more or less infuscated, sixth and genital segments

black. Pronotum black. Hemielytra red, more or less infuscated, apical margin pale. Membrane more broadly bordered with white along outer lateral margin. (= var. *melanopleurus* Uhl.) *pyrrhopterus* Stal.

— Venter either entirely black or fuscous or sometimes pale or red margined. Pronotum either with posterior margin trimaculate with red or entire pronotum reddish 11.

11. Venter entirely fuscous. Corium fuscous with apical angles only red. Membrane embrowned not margined with white *tripligatus* Barb.

— Venter black or fuscous, disk sometimes and margins pale or red. Corum either fuscous, margined with red or for the most part reddish. Membrane margined with white 12.

12. Pronotum ochraceous-red, provided with four short, premidian impressions. Corium ochraceous-red more or less infuscated, apical margin yellow. Membrane more narrowly pale margined in brachypterous forms. Pale spot at base of head often obscure *rubricatus* n. sp.

— Pronotum posteriorly trimaculate with red. Corium fuscous, costal. Commissural and apical margins and apical carina of scutellum red or pale. Membrane margined with white 13.

13. Pronotum with anterior margin red, fuscous markings form a T shaped fascia on each side of median line. Membrane rather narrowly and evenly bordered with white. Bucculae, acetabulae, anterior and lateral margins and posterior angles of prosternum broadly ochraceous-red. *lineola* Dall.

— Anterior margin of pronotum not bordered with red. Apical margin of corium and membrane except at apex rather broadly bordered with white. Bucculae, acetabulae, anterior margin of prosternum broadly and posterior margins of all pleurae narrowly white. (= *associus* Uhler ms.) *carnosulus* Van D.

14. Membrane with a median white discoidal spot or variegated with white. Species pilose, small *Lygaeospilus* new subgenus. 15.

— Membrane without median white discoidal spot, entirely fuscous or pale margined or rarely lacteus with fuscous veins (*nigrinervis*). Entirely nude or only slightly pilose. Larger species, over 5 mm. Subgenus *Melanocoryphus* Stal. 16.

15. Membrane fuscous, pale margined and provided with a rather clean cut transverse median white spot, often prolonged and continuous to middle base of membrane. Hemielytra red often more or less infuscated. Venter entirely fuscous or sometimes margined with red. (= *Lygaeus albulus* Dist. and *Lygaeosoma solida* Uhl.) *pusio* Stal.

— Membrane fuscous, variegated with white, discoidal spot more or less confused with pale variegations of surface; not pale margined, provided with triangular white fascia at outer basal angles. Hemielytra generally entirely fuscous or fusco-rufescent, rarely pale margined. Lateral margins of venter sometimes red or pale. (= *albulus* of various authors nec Distant and *obsuripennis* Stal.) *tripunctatus* Dall.

16. Posterior lobe of pronotum, corium, venter except genital segments and small vittae, red. Anterior margin of pronotum, clavus, posterior margins of corium, bucculae, acetabulae, anterior margin of prostern-

um and posterior margins of all pleurae conspicuously white or pale yellow ........ *bicrucis* Say.

— Posterior lobe of pronotum, corium, clavus and venter entirely or for the most part fuscous ........ 17.

17. Anterior lobe of pronotum and head between eyes and tylus ochraceous-red; posterior lobe bivittate with fuscous. Costal, apical, commissural margins of hemielytra, apical carina of scutellum, lateral margins and central disk of venter, pale yellow. Bucculae, antenniferous tubercles beneath, acetabulae, prosternum for most part and posterior margins of pleurae, pale yellow. Orifices, bases of legs and apices of femora pale. Membrane scarcely pale marginal ........ *mimulus* Stål.

— Anterior and posterior lobe of pronotum concolorous fuscous; sometimes the anterior or the posterior margin red or the latter trimaculate with red; sometimes the lateral margins bordered with red. Orifices, legs and venter black, the latter sometimes red or pale margined ........ 18.

18. Membrane lacteous with prominent fuscous veins and spot near outer basal angle ........ *nigrinervis* Stål.

— Membrane entirely fuscous or most frequently margined with white, sometimes in *lateralis* provided with a sub-basal white spot ........ 19.

19. Corium entirely fuscous, never margined with red or yellow. Membrane scarcely pale margined. Anterior and humeral margins and sometimes posterior median fascia, red. Venter not red margined ........ *rubicollis* Uhl.

— Corium with at least costal margins bordered with red or yellow. Pronotum with anterior, humeral or entire lateral margins and median posterior fascia red or yellow ........ 20.

20. Humeral red fascia not extended anteriorly beyond middle of pronotum. Anterior margin of prosternum, bucculae, and acetabulae very obscurely pale. Apical carina of scutellum not red. Membrane margined with white. Venter entirely fuscous or rarely margined with red ........ 21.

— Humeral red fascia extended beyond middle or entire edge of pronotum reddish. Anterior margin of prosternum, bucculae and acetabulae prominently and more broadly pale or yellow. Apical carina of scutellum red. Membrane with or without white margin. Margin of venter red ........ 22.

21. Margins of venter rarely red. Costal margin only of hemielytra red. Sunken disk of pronotum on either side of post median ridge closely and coarsely punctate. Larger species, about 8mm. Membrane sometimes with a lunate white spot near base ........ *lateralis* Dall.

— Margins of venter red. Costal, apical, commissural and inner claval margins of hemielytra red, sometimes entire apical angle of corium red. Disk of pronotum on either side of post median ridge finely or obscurely punctate. Smaller species, 5 mm. ........ *admirabilis* Uhl.

22. Membrane very obscurely, narrowly white margined. Costal margins of hemielytra prominently and sometimes commissural and inner claval margins very narrowly red or yellow. (=? *rubniger* Stål.) *facetus* Say.

Membrane plainly white margined. Costal, apical, commissural and inner claval margins of hemielytra plainly red *circumlitus* Stål.

**Lygaeus rubricatus**, n. sp.

Coloration.—Ochraceous-red, with antennae, head and sometimes more or less of the hemielytra infuscated; narrow apical margin of corium and frequently apical carina of scutellum pale yellow. Membrane fuscous, narrowly pale margined in brachypterous forms, more broadly pale in macropterous forms. Obscure pale spot at base of head. Beneath, head, rostrum, meso- and metasternum, venter and legs for the most part brownish. Prosternum reddish-ochraceous. Bucculae, acetabulae, sometimes the posterior margins of meso- and metapleura, disk and lateral margins of venter and frequently base of legs, pale ochraceous. Odoriferous orifices pale.

Head, lateral margins of pronotum and surface of hemielytra sparsely short pilose. Bucculae rather low, not extended much beyond middle of head. Tip of rostrum reaching between posterior coxae. Reddish-ochraceous pronotum impunctate, with anterior margin rather strongly concave, submargin impressed on either side; provided just before middle with four short pronounced transverse impressions, the two inner ones more narrowy separated; median longitudinal carina faintly indicated; disc on either side scarcely depressed. Hemielytra fusco-reddish with lightly elevated veins sometimes paler. Membrane frequently abbreviated, then scarcely reaching beyond apex of 5th abdominal segment and more narrowly margined with white.

Length, 5–6 mm.

Type.—♂ Tucson, Ariz., Apr. 21, Coll. by H. G. Hubbard (Type No. 24116 U. S. N. M.).

Paratypes.—♂ Tucson, Ariz., Apr. 29, 2 ♀'s Tucson, Ariz., 1 ♀ Ft. Yuma, Ariz., Jan. 28, 4 ♀'s "Ariz" (U. S. N. M.); 3 ♀'s Scottsdale, Ariz. (my Coll.).

This species belongs in the subgenus *Ochrostomus*, being most closely related to *L. carnosulus* Van D. from which it can easily be separated by color differences as given in the preceding Key. Eight of the twelve specimens mentioned above are brachypterous.

## SYNONYMY AND DISTRIBUTION.

Subgenus *Lygaeus* (Fab) Van Duzee.

*formosus* Blanchard—Fla., Neotropical.

*truculentus* Stål—Calif., Neotropical.

*turcicus* Fab (=*trimaculatus* Dallas). U. S. as far west as the Rocky Mts.

*kalmii* Stål.—U. S., Mexico.

subspecies *kalmii* (Stal) Parshley—Western U. S.

" *angustomarginatus* Parshley—Eastern U. S.

*reclivatus* Say—West and Southwest U. S., Neotropical.

var. *enotus* Say (=*costalis* H. S.)—Mexico.

Subgenus *Melanopleurus* Stål.
*belfragei* Stål—Western and Southwestern U. S.
*bistriangularis* Say—Southwestern U. S., Neotropical.
Subgenus *Craspeduchus* Stål.
*uhleri* Stål, Southwestern U. S., Neotropical.
Subgenus *Ochrostomus* Stål.
*pyrrhopterus* Stål (=*melanopleurus* Uhler)—Southwestern U. S., Mexico.
*tripligatus* Barber—Fla.
*rubricatus*, n. sp.—Ariz.
*lineola* Dallas—Southeastern U. S. to Texas.
*carnosulus* Van Duzee (=*associus* Uhler ms.)—Calif.
Subgenus nov. *Lygaeospilus*. [Genotype.—*Lygaeus (Lygaeospilus) tripunctatus* Dallas.]
*pusio* Stål (=*albulus* Distant, *Lygaeosoma solida* Uhler)—Southwestern and Western States, Mexico.
*tripunctatus* Dallas (=*obscuripennis* Stål, *albulus* of various authors nec Distant)—New England, N. Y., Fla., Tex., Calif. (Records uncertain confused with preceding.)
Subgenus—*Melanocoryphus* Stål.
*bicrucis* Say.—N. Y. to Fla., southern and western states.
*mimulus* Stål—Va. to Fla. and west to Texas.
*nigrinervis* Stål—Col.
*rubicollis* Uhler—Southwestern U. S., Mexico.
*lateralis* Dallas (= ? *californicus* Walker)—Western and Southwestern U. S.
*facetus* Say (= ? *rubniger* Stål)—Southeastern U. S. to La. and Texas. (Some records uncertain, confused with *lateralis*.)
*circumlitus* Stål—Ariz., Neotropical.
*admirabilis* Uhler—Col. and Southwestern U. S.

## CHARLES HENRY FERNALD.

MARCH 16, 1838—FEBRUARY 22, 1921

The Society regretfully records the death of the well known entomologist and teacher, Doctor C. H. Fernald. For twenty-four years, from June 2, 1892, until December 31, 1916, Doctor Fernald was a member of our Society.

*Actual date of publication March 25, 1921*

VOL. 23 APRIL 1921 No. 4

# PROCEEDINGS

OF THE

# ENTOMOLOGICAL SOCIETY

OF WASHINGTON



CONTENTS



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## OF WASHINGTON

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### PROCEEDINGS
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PROCEEDINGS OF THE
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VOL. 23 APRIL 1921 No. 4

## ENTOMOLOGICAL DRAWINGS AND DRAUGHTSMEN: THEIR RELATION TO THE DEVELOPMENT OF ECONOMIC ENTOMOLOGY IN THE UNITED STATES.[1]

By W. R. Walton.

I have chosen this title as the subject of my address, not because I felt especially competent to speak authoritatively upon it, but knowing that the society would expect a communication on some subject related to entomology, with which I might be supposed to be more familiar than most of you, I have selected one with which many were likely to be unacquainted, with the idea that you might be led to believe that I really knew something about it. Seriously speaking, however, I have been largely influenced in my selection of this subject by the feeling that many workers in entomological illustrative art have not received the notice, or the praise, which their efforts toward the advancement of entomology in this country have deserved. This, it has seemed to me, was particularly true of the earlier workers in this field, many of whom accomplished most remarkable work, but whose names, for the most part, have been allowed to lapse into unmerited oblivion. It has been the aim, therefore, in the preparation of the present paper, to collate the most easily available records regarding the personalities and accomplishments of these pioneers, together with certain relevant (and possibly some irrelevant) remarks on this and kindred subjects. In the preparation of this paper I have been greatly aided by suggestions and notes supplied by various members of the staff of the Bureau of Entomology, and especially those supplied by Dr. L. O. Howard, Dr. F. H. Chittenden and Mr. E. A. Schwarz. Dr. Henry Skinner has very kindly furnished a personal note regarding Mrs. Mary Peart, and in the bibliographical work my assistant, Mr. J. S. Wade, together with Miss Mabel Colcord and the Bureau Library staff, have been of the greatest assistance. I am greatly indebted also to Mr. Theodore F. Bolton of the Congressional Library staff for the use of manuscript notes which he generously contributed.

Psychology tells us that all sensory experiences in man somehow are mentally preserved; that in reality we never forget anything and that the question of whether a person be clever or

[1]Presidential address, presented at the January meeting, 1921.

stupid depends almost entirely upon his ability to extract from the storehouse of his subconscious mind the appropriate or necessary impression or thought at the psychological moment.

That illustrations are potent in evoking mental impressions must be obvious to all observant persons, and naturalists, especially, will readily admit the important part played in the natural sciences by well drawn illustrations. The most obvious function of such illustrations, of course, is their explanatory office. They aid the imagination in visualizing the subject treated. But illustrations have another equally valuable function regarding which we seldom think, namely: The fixation in our memories of the gist of the related text; in other words, they render available through the association of ideas those memory complexes containing all we know regarding the subject illustrated. Illustrations therefore must necessarily have played a most important role in the remarkable advance of applied entomology which has taken place in the United States during the past century.

In spite of the many mechanical and other refinements that photography has undergone during the past forty years, it has not yet reached a stage where it is possible by that means to produce truly satisfying representations of most insects, and especially where magnifications of more than a few diameters are required. Photography, of course, is an invaluable aid to entomology in many ways, especially for the purpose of showing pathological changes due to insect work or the environmental atmosphere of the species under discussion, but its limitations in recording the insects themselves are perfectly obvious. It is difficult, if not impossible, even in the case of large insects, to reproduce them by photo-engraving methods alone, in a manner approaching the crisp, clear image limned by the human hand with the aid of pen and ink, and pencil. The mental impressions left by the perception of most published photographic representations of insects may be compared with those produced by eating unsalted food. One immediately recognizes the fact that something is missing, but fails to perceive for the moment just what the missing element is. This feeling of dissatisfaction proceeds, I believe, from the absence of the vivid image as produced, in the line drawing, by the perfectly black line on the clear white paper; a sparkling effect which no other method of illustration has yet been able to equal. Another factor which tends to make drawings more acceptable than photographs, especially to entomologists, is the custom observed by the best draughtsmen of emphasizing, to just the right degree, those cardinal characters of the model which are recognized by the eye as constituting the habitus of the insect. This, of course, is the principle of caricature exercised in a modified degree. Photographs may indeed record habitus, but very often they fail to do so, probably because the important characters are lost to the eye among the multitude of halftones and non-essential details appearing in the photographic image.

Broadly speaking, entomological drawings may be said to comprise three general categories or classes: First, those intended solely for the amusement, or (as in the case of the newspapers), the horrification of the lay public. To this category belong the crude caricatures of insect life incorporated in certain cheap works of general reference, which it is unnecessary to name. To this class also must be referred the bizarre, and often impossible, representations of insects included in books designed for juvenile minds. Last and by far worst are those delirious night-mares sometimes spread in full-page prodigality over the Sunday supplements of American metropolitan newspapers. Superlative condemnation is assigned to the latter variety of incubus not only because of the great numbers of susceptible minds which it serves to infect, but also because often it is accompanied by an equally distorted and misleading text which serves to vivify the monstrosity suggested by the illustration. I do not refer here to the frankly humorous variety of entomological illustration which not only is harmless, but often contributes not a little to the gaiety of nations. I mean rather those pseudo-scientific revelations with which the papers are wont to regale an innocent and unsuspecting public. That the world would be the better for the elimination of such things is self-evident to the natural scientist. It is to be feared that the time is still far distant when such a reform may be expected to materialize; recently, however, an effort has become evident on the part of the better class of writers to present authoritative entomological matter in company with accurate illustrations and this movement may in time react favorably on the daily press.

The second class of entomological drawings comprises those illustrations prepared for the exclusive use of the scientist. They fill a useful and restricted sphere but have little or no general interest or educational value.

The third class includes a very large and important field and embraces all conscientiously drawn illustrations, showing insects in their entirety, either separated from or surrounded by their environmental atmosphere, and which are of value both to the laity and the professional entomologist. By far the greater number of entomological illustrations belong to this general purpose category and the following discussion is intended to apply to this class of figures. No mention has been made so far of colored illustrations which, when well done, are of the utmost importance and have the highest educational value. Unfortunately, the cost of good color print is still so high as practically to preclude its general use, and the poorer kinds of such work are far inferior in value to good line or stipple work. The recent appearance of a few good, colored illustrations in Federal entomological publications is an encouraging symptom which we hope will be followed by others in increasing numbers.

In surveying the work of the pioneers in American entomological illustrative art, one is apt to be impressed most forcibly by the excellent results achieved in spite of the optical difficulties and crude methods of reproduction under which most of the early draughtsmen must have worked. In these days of the perfected binocular microscope with its prisms for erecting the image of the model, its improved lighting facilities, its ample working distance, and of the intervention of photographic means of reproducing our drawings at any desired scale, it is difficult indeed for us to realize the almost disheartening obstacles that had to be overcome by these early draughtsmen. Many, if not most of the early worker were compelled to draw with the aid of simple magnifying glasses of comparatively low power, which gave a distorted image except in the center of the field. Even the best of microscopes in those days were comparatively crude affairs affording but a very short working distance and small field, and were designed almost entirely for slide work with transmitted light, and therefore of limited use in the preparation of drawings where direct illumination is necessary and it is desirable to have the entire model in the field of view at one time. Add to these difficulties the necessity of producing the drawing on the exact scale on which it was to be reproduced, that it must be drawn on or afterward transferred to wood, stone, or metal, and etched or engraved by a craftsman who possibly knew nothing of insects and had little sympathy for any one who did, and it seems wonderful that even a recognizable likeness of any insect could be produced by such methods. The fact that, in the face of such serious difficulties, illustrations of a very high character were produced, speaks volumes in praise of the patience, determination and skill of these early draughtsmen whose individual work will be mentioned later on.

Here and there among these men there occurred one whose physical, or rather whose optical deformity seems to have fitted him in a remarkable way for his chosen work. I refer to the intensely myopic vision of such men as Herman Loew and Townend Glover, whose otherwise defective vision permitted them to study and even to draw small insects with little or no artificial visual aid. Baron Osten Sacken has given us a very good account of Loew's powers in this way and Mr. Charles R. Dodge has mentioned Glover's abnormal vision as being of distinct advantage in his work. It would be of interest to learn just how greatly such visual defects may have influenced these men in the direction of entomological research.

Little, very little, is recorded in entomological literature regarding the personalities or achievements of the earlier draughtsmen. Too often their work has been absorbed or submerged without any, or with but scant mention, in the reputation of the entomologist who produced the text accompanying the illustrations. "Sunk without trace," as a notorious Teutonic diplomat has put it. There is no reason to believe that such occurrences were always intentional as doubtless this was not the case in many instances, but the fact that these oversights did occur with great frequency argues, to my mind, a lack of appreciation of the real and valuable service performed by the draughtsman and which it is my purpose to point out in the present paper. Here and there a few lines of biography regarding them have been penned in works of biography or entomological publications, to remind us that they were at least human beings, and a few of the most prominent men, such as John Abbot, T. R. Peale, and Townend Glover have received at the pen of some kindly writer like George Ord, the Rev. J. G. Morris, Charles R. Dodge, or Dr. Henry Skinner, a portion of the recognition which was due them. Dry and defective indeed would be most of the standard works on American entomology in the absence of the excellent illustrations which have served so well to fix them indelibly in our memories. Say, Harris, Packard, and others too numerous to mention would be poor indeed if robbed of the fine illustrations which adorn their pages, but nevertheless very little is included in most of these works to tell us aught of the persons who contributed this important part of the task. Compare, for instance, the early editions of Harris' "Insects Injurious to Vegetation," with the later editions of 1862-63, or better still, with the handsomely colored Flint edition, in which appear the fine plates drawn by Antoine Sonrel. The enhanced interest and value conferred by these illustrations is not merely obvious but truly astonishing. The Rev. J. G. Morris, in his History of Entomology (1846), remarks the absence of illustrations in the then existing editions of the book as a very serious fault in Dr. Harris' work.

As in the case of other branches of natural science, there are two very distinct types of intellect attracted to entomology. One of these is the purely investigational mind, actuated by a sense of curiosity or desire to know and to analyze or interpret what it discovers. The other has its origin principally in the emotions, that is to say, an appreciation of the beautiful in nature and art. Each struggles in its own way to tell what it sees; the one by means of that most artificial of all human conventions, the printed page; the other by the much more primitive but natural medium of a visual representation of the subject. Neither can be entirely successful without the aid of the other, but because of their fundamentally different viewpoints, neither understands fully the meaning or importance of the other's effort. Both, I believe, are equally important to the advancement of the science and therefore should share equitably in such glory as may accrue from the results of their labors. It is true, of course, that here and there in the vast field of the natural sciences is to be found a fortunate individual who seems to combine with considerable success the two faculties mentioned but, generally speaking, the great successes are achieved by men who specialize in one or the other provinces of the field, but who make an honest effort to appreciate each other's services.

Entomological draughtsmen, as well as other workers in art, have suffered under the stigma cast by that hoary delusion "the artistic temperament." In point of fact, however, we of the cult know that entomological draughtsmen as a class are "just folks" and are fully as stable, temperamentally speaking, as other workers in natural science—entomologists, for instance, and I think that musicians especially, among other classes of artists, have been largely responsible for the origin and growth of the current popular belief in the idea that artists of all varieties are creatures apart from all other classes of mankind in the possession of a "black beast," in the form of the "artistic temperament." There is no denying the fact that musicians, I mean professional musicians, from their earliest childhood have the emotional and motor elements of the brain stimulated and developed at the expense of other important functions of that complex organ, to the end that many of them, especially the virtuosi, become finally nothing more or less than emotional monstrosities. But this is not necessarily true of other branches of art and especially is it not true with regard to the illustrators of scientific subjects whose profession calls for the exercise of something more than mere emotion and even at times of the employment of something resembling pure reason. It is true, moreover, that a very considerable number of the most successful entomological draughtsmen have been entomologists as well and if some of them have exhibited peculiarities of temperament, doubtless this has been due more to their associations than to any inherent predisposition. Dr. Howard maintains that there is "no such thing as the entomological temperament," and says that "it is much easier to make an entomologist out of an artist than to convert an entomologist into an artist." I agree with the latter statement, and it all goes to prove the old adage that "you can't make a silk purse out of a sow's ear." In any event it seems true that a knowledge of entomology is an asset of the greatest value to the person who undertakes entomological illustrative work. Such knowledge not only permits him to perceive many details which otherwise would be overlooked but, what is of greater importance, it places him in rapport with his work and adds that seasoning of real interest, in the absence of which no truly successful work of any kind ever is accomplished. It must be admitted, however, that the path of the entomological draughtsman not seldom is bestrewn with conflict and trouble, especially if he be required to work under the direction of a specialist who knows little or nothing of drawing. Where the entomologist "knows that he knows not" and is content to permit the draughtsman to represent the insect as nature made it, all may be well. But when, as is sometimes the case, the entomologist "knows not that he knows not" and insists, for instance, that parts of the model actually seen in perspective, be projected as appearing in a single plane, or that appendages be twisted at impossible angles in order to reveal concealed anatomical peculiarities, etc., the results are likely to be painful as well as unfortunate. The skilled draughtsman is apt to be a self-respecting person who is in the habit of representing his model as seen from a single viewpoint, and who, when called upon to violate the laws of optics, is troubled immediately with an outraged sense of propriety which might be interpreted as an exhibition of the so-called "artistic temperament." In such a case, the greater the knowledge and skill of the draughtsman, and the larger the ego of the specialist, the louder the noise and the denser the smoke of the battle. It is to be regretted that such conflicts have in some cases caused the separation of skilled workers whose amicable association would have led to the most valuable of results. The well trained entomological specialist undoubtedly should be competent to criticise a drawing with respect to the representation of important morphological characters, but unless he have a thorough knowledge of drawing, it will be the part of wisdom for him to stop there and permit his draughtsman to follow the dictates of his own mind, in the strictly pictorial phases of the work. In my personal experience I have met with very few persons indeed, not themselves draughtsmen, who were able to criticise unfinished drawings properly and helpfully. The bare outline of a drawing, for instance, may seem to unskilled eyes badly proportioned or even misshapen, when, in point of fact, it may be quite correct and merely require skillful modeling to make it assume the proper appearance. It is obviously true, of course, that one who is devoid of technical knowledge as regards drawing may through reading, observation, and the study of pictures themselves, acquire a thorough appreciation of the good and bad qualities of a drawing and be able to recognize good finished work at sight; but such knowledge can not and does not enable him to criticise drawings in the making. Such powers are conferred only by personal experience with the pencil and only then on those having the requisite sense of form, mass, and color.

I mention these things not in a spirit of captious criticism, but rather with the hope that my remarks may lead to a better understanding regarding such matters, between the artist and the entomologist in their future relations. The subject is not a very agreeable one, and recalls to my mind the lines of an old song as follows:

> "Now if you don't like it, it's nothing to me,
> For I'm telling you things that I don't like to see."

Right at this point I should like to introduce another subject upon which something should be said, and this is the desirability of having all major drawings signed by the person who makes them. It seems to me quite as important that the author of a drawing be recorded with his work as the author of a text or even as the originator of a specific name in taxonomic zoology. If the identity of the draughtsman be known, this alone often will be sufficient to establish the accuracy of the work, and of course the converse is obviously true, for, sad to relate, people who do not realize their limitations *will* make drawings, and not all of such illustrations are either reliable or ornamental.

It is to be regretted that so little of an intimate biographic character has been published relating to the entomologists of America. It would, I believe, be difficult to name a profession which is richer in the possession of quaint and interesting human character (including, of course, the artist-entomologists) than is ours; but in spite of this fact, most of the published biographic sketches are largely devoid of purely human interest and deal principally, if not exclusively, with the scientific work or attainments of the persons involved. There is, as a rule, little included that conveys to the reader even an inkling regarding the human characteristics of the person who is the subject of the sketch. A notable exception to this rule is the intensely interesting and intimate picture of Townend Glover presented by Mr. Charles Richards Dodge (Bul. 18, Old Series), excerpts from which are given later on in this paper.

The brief obituary notice of Benjamin D. Walsh (AMERICAN ENTOMOLOGIST AND BOTANIST) written presumably by Dr. C. V. Riley, abounds in that human quality of which I speak, but leaves one with the feeling of having read the first chapter of a good story that never can be finished. We have here, restricted within the limits of four short pages, the mere outline of a delightful character to whom many pages of similar text might and should have been devoted. Would that we had more biographers such as Mr. Dodge to picture for us other prominent students of insect life who have gone before. Who of us, for instance, would not delight in similarly intimate and complete pictures of such celebrities as John Abbot, T. W. Harris, or indeed even of a personage so recently departed as Dr. C. V. Riley, whose personality has been but dimly delineated in any published work, but who, judging from current tradition, richly deserves, for many and various reasons, very much more extended biographic treatment than has yet been accorded him. It is to be hoped that some one of his contemporaries will yet record many significant facts and incidents bearing upon his career and its contact with the lives and the work of his associates which no one has yet been willing to place on record.

In a paper of so limited a character as the present one it has been possible to consider only those draughtsmen who have worked or are supposed to have worked, in this country in connection with illustrations of American insects. As a result of this plan we find included herein the names of many men of foreign birth who were among the foremost illustrators of insects in this country, but it also excludes a few distinguished men such as Herman Loew, for instance, who did much to advance the study of entomology in this country, but who never even visited the United States. However, this is scarcely to be avoided as time and space forbid the preparation of a book on this subject at present.

One of the earliest, if not the first, illustrator of North American insects was Mark Catesby, born in England in 1680, and who made his first voyage to America in 1712, landing in Virginia in April of that year. Catesby says he resided in America for seven years during this visit, returning to England in 1719, taking with him a collection of plants and products of the colonies which created such intense interest as to induce him to return to America for the purpose of making serious studies and collections of the fauna and flora of the "Carolina" region. Accordingly he returned to America in 1722 and during his subsequent explorations lived among the Indians, as he says, "hunting Buffaloes, Bears, Panthers and other wild Beasts," and engaged in painting objects of natural history. He spent four years in America on this occasion, returning to England in 1726, where he died in December, 1749. After his final return to Europe, Catesby published a work in two volumes, of which the following is an abridged title: "The Natural History of Carolina, Florida and the Bahama Islands, Containing Figures of the Birds, Beasts, Fishes, Insects, and Plants, etc., by Mark Catesby, F. R. S., Printed at the expense of the author, London, MDCCXXXI-MDCCXLIII." This is a quaint and interesting work of large folio size, the text of which is printed in both French and English, as was then the fashion with such publications. The dedication of Catesby's first volume to Queen Caroline is a fine example of what might appropriately be termed the anthology of natural history. It seems well worth reproducing here:

To the
QUEEN

MADAM:

As these Volumes contain an Essay towards the *Natural History* of that Part of Your MAJESTY'S Dominions, which is particularly honored by bearing Your

August Name CAROLINA, this and Your great Goodness in encouraging all sorts of Learning, have emboldened me to implore *Your Royal Protection* and *Favor* to my slender Performance. I hope Your MAJESTY will not think a few Minutes disagreeably spent in casting an Eye on these Leaves, which exhibit no contemptible Scene of the Glorious Works of the Creator, displayed in the New World; and hitherto lain concealed from the View of Your MAJESTY as well as of Your *Royal Predecessors* tho' so long possessed of a Country, inferior to none of Your MAJESTY's American Dominions.

Wherefore I esteem it a singular Happiness, after several Years' Travel and Enquiry in so remote Parts (by the generous Encouragement of Your MAJESTY's Subjects, eminent for their Rank, and for their being Patrons of Learning), that I am the first that has had the Opportunity of presenting to a QUEEN of GREAT BRITAIN a sample of the hitherto unregarded, tho' beneficial and beautiful Productions of Your MAJESTY's Dominions. I am

May it please Your MAJESTY,

Your Majesty's

*Most humble,*

*and most dutiful Subject*

M. CATESBY.

The plates accompanying Catesby's work were etched on copper by him personally from his own paintings and afterwards colored under his supervision. They are of large size, measuring about 10 by 13½ inches. There are represented in all some 27 figures of insects, of which the first volume contains 3 and the second 24, including one centipede. The insects proper are distributed according to order as follows: Lepidoptera 12, Orthoptera 4, Hymenoptera 4, Coleoptera 4, Siphonaptera 1, and Diptera 1. The latter for some reason has but four legs, perhaps because a fly catcher, which is pursuing it off the edge of the plate, has eaten the other two. The insects for the most part are introduced in the plates incidentally and at random, and often are associated with plants to which they bear no ecologic relation. In general, the illustrative work may be said to be rather crude as compared with that of contemporaneous illustrators of the better class, and does not approach the excellence of the artists of a slightly later period, such as that of Abbot, Wm. Wood Jr., or Peale. Catesby frankly acknowledges that he was not educated as a painter and apologizes for the "faults of perspective and other niceties" which are so plainly evident in his work.

The next illustrator of note of whom there seems to be any record is John Abbot, a man of most excellent attainments and admirable skill. John Abbot, according to his collaborator, Sir James Edward Smith, founder and first president of the Linnean Society, was born in London, England, about the year 1760. Dr. Smith says that he resided in Georgia for many years, where he collected insects for sale in England and other parts of

Europe. Evidently Abbot was a close and enthusiastic student of the biology and ecology of insects as his drawings and notes demonstrate this unmistakably. He was content to labor in this field of entomological research, leaving the taxonomic phases of the science entirely to others. Fortunately a competent and amiable collaborator appeared in the person of Dr. Smith, who has been fair and even generous in awarding Abbot full credit for his share in the fine work which was the result of their joint labors. Dr. Smith makes it perfectly obvious that the text of this work was written around the Abbot drawings and that without these admirable illustrations the taxonomic notes supplied by himself would have but little value. Regarding Abbot's work Dr. Scudder says "He was the most prominent student of life histories we ever had."

The work of Smith and Abbot was published under the title of "The Natural History of the Rarer Lepidopterous Insects of Georgia," printed in London in 1797, although some of the plates were engraved as early as 1793. It contains 104 plates of folio size, engraved intaglio on copper by Moses Harris from Abbot's drawings. The engraving is of excellent quality but some of the figures have not fared so well at the hands of the colorist whose identity is not revealed, but it certainly was not Abbot, who never saw the work until long after publication occurred. In most cases the figures are about life size or slightly enlarged, showing the larva, pupa and adult of each species associated with its favorite host plant. Where the sexes differ materially in appearance, both of them are figured. Abbot is said to have been still living in England in 1840, at the age of about 80 years, but the date of his demise does not seem to have been recorded in any of the publications to which I have access.

It is indeed most deplorable that very little is known regarding the personality of John Abbot. What is perhaps the best account of him is given by Dr. S. H. Scudder,[1] who says he quotes Swainson on the subject, but who also secured additional information from Dr. A. Oemler of Wilmington Island, Georgia. It is supposed that Abbot was an Englishman who was engaged, when about 30 years of age, by certain entomologists of England to undertake a collecting expedition to America. After considerable travel in this country he settled in the province of Georgia, where he lived for a period of nearly 20 years at or near Jacksonburgh, Scriven County, that State. All traces of this early settlement have now disappeared, although there were aged persons living in Georgia in 1885, but since deceased, who knew and remembered Abbot. None of these persons survived at the time Dr. Scudder's article was written in 1888. It has been said that Abbot returned to England in 1810 and that he was still

[1]Canadian Ent., Vol. XX, p. 153.

living there in 1840, but the accounts are somewhat conflicting. What is supposed to be a miniature portrait of John Abbot has been found in the 16th volume of a series of his drawings in the British Museum. This portrait was reproduced by Dr. Scudder as a frontispiece to the first volume of his work on American Butterflies. The portrait is a left profile bust, apparently done in water colors. It reveals Abbot as a man of spare figure, clothed in the lightest of attire, and therefore probably was executed during his residence in the warm climate of Georgia. The face is strongly featured, the nose being of the distinctly Roman type and quite prominent. The head is thickly clothed with what appears to be natural gray hair and the face is deeply lined and wrinkled beneath and around the corners of the eyes and the mouth, giving the countenance a distinctly humorous expression. The complexion is florid and apparently the eyes are blue. The forehead is deeply lined and in spite of the thick gray hair, the entire appearance of the portrait is that of a man far beyond middle age, but still retaining youthful vigor.

John Abbot's correspondent in England was one John Francillon, a silversmith in the Strand, London, who had a famous collection of insects and who made a business of supplying his correspondents with specimens and drawings of plants and insects, made or furnished by Abbot. The specimens were said to be of the very finest quality, as we may well imagine, and sold for sixpence a specimen, by the boxfull. He was also an expert in the art of inflating larvae and dealt in these inflated skins through his agent Francillon. In addition to the work edited by Dr. J. E. Smith, previously referred to, there are deposited in the British Museum no less than 17 quarto volumes of drawings similar to those of the Smith & Abbot publication. These are listed by Dr. W. F. Kirby as follows: 1–4 Coleoptera, 5 Orthoptera, Hemiptera, Homoptera and Heteroptera, 6 Lepidoptera, Rhopalocera, 7–11 Lepidoptera, Heterocera, 12 Neuroptera, Hymenoptera, 13 Diptera, 14 Arachnida, 15 Myriópoda, Mallophaga, Acarina, Crustacea, Lepidoptera, (transformations), etc., 16 Portrait, Orthoptera, Coleoptera (transformations), etc., 17 Lepidoptera (transformations). The drawings of the Lepidoptera are not duplicates of those published by Smith except rarely and there are nearly three times as many of them. About a dozen drawings of the transformations of the Coleoptera are given, many of which are believed to represent undescribed species.

Mr. Robert P. Dow has discussed the fragmentary records of Abbot's career in an interesting way. He concludes his article with a letter from Abbot addressed to Dr. T. W. Harris, together with his autograph signature, in a round flowing hand of most remarkable firmness and beauty for a man supposed to have been past 80 years of age at the time. The letter contains errors of grammar and for this reason Mr. Dow says "His education was limited. His grammatical blunders would be unpardonable in any grade above elementary school." I do not agree with Mr. Dow in his deductions from this evidence; in point of fact I have known college-bred men who could not or did not express themselves on paper nearly so well as Abbot has done in this communication. The errors noted may evince, in my opinion, the careless lapses of a fairly well educted person, and may possibly have been due to Abbot's lack of contact with educated persons for long periods of time, or even to the approach of senility. Witness, for instance, the following passages from this epistle: "I find it very difficult to know what insects are rare and what are common," * * * "Every year I have observed some very few kinds to be plenty," * * * and again, "There is a gentleman in Savannah who wanted me to make *an* Herbarium for him * * * but I was very seriously indisposed in the spring." This does not seem to be the language of illiteracy; the occasional capitalization of the nouns which may be noted in Abbot's letter is a relic of the middle English usage which at that time was fading out of the literature but which may be noted in the extracts from Catesby which have already been given. The records of the London Society of Artists show that John Abbot exhibited still life studies about the year 1770 and it seems quite probable that this was the work of John Abbot the entomologist of whom we have been speaking.

During the period of 27 years elapsing between the appearance of Abbot's work and the first edition of Say's Entomology, no illustrated work of importance dealing with American insects seems to have appeared (with the exception of the brief papers by W. D. Peck). The first edition of Say's work was published in 1824, and curiously enough the title page bears the following announcement: "Illustrated by Colored Figures from Original Drawings executed from Nature by Thomas Say." This amusing error was subsequently corrected in the Leconte edition of the work, and in view of the warm friendship known to have existed between Say and at least some of his illustrators, it must be viewed as a mere error of the types. The most prominent illustrator of Say's work was Titian Ramsey Peale, born in Philadelphia in 1800 and who died there March 13, 1885. Peale executed the first plates for Say's Entomology when but 16 years of age and these were printed in 1817, although the first edition of the work did not appear until 1824. T. R. Peale was later curator of the Philadelphia Museum and left a collection of Lepidoptera which is preserved in the Academy of Natural Sciences at Philadelphia. He was a distinguished naturalist as well as an artist and accompanied the Wilkes South Sea exploring expedition as naturalist in 1838-42. He was also the author of most of the plates for Bonaparte's American Ornithology and of many other drawings of natural history subjects.

Although T. R. Peale has generally been spoken of as the illustrator of Say's American Entomology, an examination of the published records fails to establish his authorship of more than 28 of the 54 plates contained in the work. Of the 26 remaining plates, 9 are credited to C. A. Lesueur, 9 to W. W. Wood, and 2 to H. B. Bridport. The remaining 6 plates are unsigned and there appears nothing in the text to inform us who prepared them. Titian R. Peale was a member of the well known Philadelphia family of that name, of which no less than 7 members were artists of greater or less renown in America. Several of them were interested in the natural sciences and did much to foster the science of entomology in the early days of its development in this country. The Peale family was a most remarkable one for the longevity of its members, as six of the artist members before referred to each lived to be more than 80 years of age. One lived to be 97 and the sum of the ages of the 6 amounts to no less than 522 years; here is evidence that the so-called "artistic temperament" is not nearly so wearing on the system as some persons would have us believe.

T. R. Peale's record bears but one stigma, in that he served as a "government clerk," having been employed as an Examiner in the Patent Office in Washington from 1849 to 1872. Perhaps it would have been more charitable not to mention this, in view of his otherwise exemplary life.

Charles Alexander Lesueur, who was a collaborator of Peale's in the illustration of Say's work, was a Frenchman by birth and was born in Havre-de-Grace, France, in January, 1778, where he died on December 12, 1846. Before his departure from his native country Lesueur was known as an artist of great ability and had been called "the Raphael of zoological painters." When Lesueur was in his 23d year, he shipped as a ship's apprentice for a voyage to Australia with what has been called the "Baudin Expedition." This was an exploring expedition fitted out at national expense and placed under the command of one Nicholas Baudin, who, judging from the account of the voyage given by George Ord, was as arrant a rascal as ever went unhung. He not only sold a large part of the stores that had been provided for the subsistence and safety of the members of the expedition, but reduced all hands to starvation rations, thus superinducing scurvy and other diseases from which a considerable number of the crew and scientific staff lost their lives.

Lesueur had not been long at sea before his remarkable talents as an artist were discovered with the result that he was promptly "transferred by the commander-in-chief from the humble position he occupied among the crew, to the honorable station of painter of natural history, and his appointments and privileges were made to correspond with his rank." Fortunately Baudin died during the voyage, otherwise it seems extremely doubtful whether the expedition would ever have returned to France. After three years of perilous adventure and almost indescribable hardship, the expedition returned, in March, 1804. Although Lesueur nearly lost his life from disease and the bite of a venomous reptile during the voyage, he found opportunity to execute no less than fifteen hundred drawings and paintings of the zoological collection which was said to have numbered more than one hundred thousand specimens. Some, but not nearly all, of these drawings appeared in the history of the voyage published in 1807. In the fall of 1815 Lesueur was invited by a wealthy Scotch-American, Mr. William Maclure, to accompany him as traveling companion on a voyage to the West Indies and thence to the United States. Maclure was a pioneer geological explorer who did much to advance the natural sciences in their early days in this country. Lesueur accepted and the party arrived at Barbadoes in December of that year. The winter was spent in collecting marine animals which afterwards formed the basis of Lesueur's admirably illustrated papers. In the spring of 1816 he arrived in the United States, and after considerable travel, settled in Philadelphia where he soon became a member of the American Philosophical Society and the Academy of Natural Sciences. Here he remained, according to Ord, for nine years, engaged in scientific pursuits and the teaching of drawing in the educational institutions of that city. It was during this time that Lesueur doubtless met Thomas Say, although it is not known exactly how they became associated. As Lesueur afterwards accompanied Say to New Harmony, they must have been on very friendly terms. Probably they met through the agency of the scientific societies to which they both belonged, Say having been elected to membership in the Academy in 1812. Dr. Morris says "It was during this period that Thomas Say came under Lesueur's influence and it is said that it was to him that Say owed his first acquaintance with marine invertebrates and other departments of zoology."

In 1825 Lesueur accompanied his friend Say to Indiana and took up his residence in the socialistic colony founded by Maclure and Owen at New Harmony. Of this event Dr. George Brown Goode says: "But for their sacrifice to the socialistic ideas of Owen, Say and Lesueur would doubtless be counted among the most distinguished of our naturalists, and the course of American zoological research would have been entirely different." Although American entomologists doubtless will agree with Dr. Goode regarding the unfortunate results of this venture, most of us will be slow to accept the idea that Thomas Say is not already enrolled among the "most distinguished" of early American naturalists.

The name of W. W. Wood appears as the author of nine of the plates in Say's Entomology; these are of equal quality with the plates drawn by either Peale or Lesueur. It seems possible that these plates may have been prepared by Mr. Wm. Wood, author of "Linnean Genera of Insects," and the beautiful plates of the "Illustrated Catalogue of the Lepidopterous Insects of Great Brittain," etc., who was a contemporary of Say and Lesueur and a most exquisitely skilful draughtsman and engraver. It was Mr. Wood's habit at that time, however, to sign himself "W. Wood, Junr.," whereas the plates in Say's work are signed "W. W. Wood." Mr. William Wood's skill with the pencil and graver amounted to real genius, and he was the author of literally thousands of beautiful figures of insects, many of which were drawn directly on copper with the graver. No evidence has been found, however, that Mr. Wood ever visited America. An examination of the city directories of Philadelphia from 1815 to 1835 discloses the name of but one W. W. Wood, who is recorded not an an artist but a stationer, located at 88 Walnut Street; however, perhaps he was the author of the plates in question. Who knows?.

There is a homogeneity of treatment about the entire set of illustrations in Say's work which leads one to suspect that some one artist supervised the reproduction of the original illustrations and managed to impart his personal touch to them, although it seems possible that the engraver may have been responsible for this rather stereotyped effect.

Plates 19 and 33 of Say's Entomology bear the name of H. B. Bridport. Mr. Hugh B. Bridport was born in London, England, in 1794, but emigrated to America in 1816, where he resided principally in Philadelphia. He was a painter of miniature portraits, having studied the art under Mr. C. Wilkin in London as well as at the Royal Academy, and followed this profession in various parts of this country. In 1817 Hugh Bridport established a drawing academy in Philadelphia in connection with his brother George, where he taught the arts of drawing and water color painting. Shortly afterwards he was associated with the English architect, John Haviland, in a school of architecture and drawing; Mr. Bridport is said to have engraved a very few good portraits in the stipple manner. While we have no positive evidence that Hugh Bridport was the author of the plates in Say's Entomology bearing that name, the information given above makes it practically certain that he should be credited with this work.

Among the early entomological illustrators, regarding whom little has been published, was Maj. Jno. Eatton Leconte, the father of Dr. J. L. Leconte, the famous Coleopterist. Jno. E. Leconte was born at Shrewsbury, N. J., Feb. 22, 1789, and died at Philadelphia, Nov. 21, 1862 (Appleton's Cyclopaedia), and is said to have left an extensive collection of water color paintings of American insects and plants, executed by himself. Unfortunately the drawings have never been published; they are said to be the property of the Missouri Botanical Garden at present. Dr. A. S. Packard states in the introduction to one of his volumes of the Monographs on the Bombycine Moths: "I have also copied in the plates a number of excellent colored drawings of caterpillars made by the late John E. Leconte which were loaned me for such purpose by his son, Dr. John L. Leconte." Unfortunately these drawings were incorporated in two plates with the drawings of other artists, so that it is not possible to identify those made by Major Leconte. It is certain that he did publish one very handsomely illustrated volume on the Lepidoptera in collaboration with Boisduval.[1] This volume, according to Dr. Goode, was almost solely the work of Major Leconte, although published under joint authorship. Boisduval states in the preface to the work that the drawings were colored by John Abbot and intimates that Leconte collaborated with Abbot in the preparation of the illustrations, although Leconte's name appears on but a single plate. All of the illustrative work is beautifully done and Abbot's name appears on 62 of the 78 plates. The choice and application of the pigments evinces the work of a consummate expert, as the colors to-day are as brilliant as though they had been applied but yesterday and there appears no trace of the oxidation which mars many of the older colored illustrations of insects where the pigments have been chosen without regard to their chemical affinity and possible reaction upon each other. In most cases the larva and pupa are shown as well as the adult insect.

In reviewing the work of the entomological illustrators of the United States, one can not omit, but naturally is reluctant to mention, that farcical volume on entomology which has been dignified by the title of "The Natural History of New York," published in 1854, under the authorship of the geologist Ebenezer Emmons. This absurd publication has received the unqualified condemnation of several competent critics such as our colleague, Mr. E. A. Schwarz, who says: "It is utterly worthless from whatever side it may be considered." This emphatic language from one who is ever inclined to speak in terms of charitable tolerance has led me to examine the work with more than usual care and interest in order to discover in what respects the illustrations have merited the strong terms used by our amiable friend. These illustrations consist of 50 lithographed plates, colored by hand. They bear the name of

[1]Entitled Historie Generale et Iconographie des Lepidopteres et des Chenilles de l'Amerique Septentrionale, par le Docteur Boisduval, et M. John Leconte de New York, Paris, 1833.

Emmons as draughtsman and that of R. H. Pease as lithographer. The mechanical work is of good quality and at first glance some of the plates, especially those of the Coleoptera, impress one rather favorably. But upon more careful examination this feeling is speedily dissipated because of the fact that, while some of the figures are recognizable, the drawing is execrable and inaccurate to a lamentable degree. The appendages often are unequal in number and different in shape on the two sides of the same insect; the outline of the subject is badly distorted and carelessly drawn, and in spite of the fact that a certain neatness of technique is apparent throughout, the work is an example of the possible results of sloppy, careless draftsmanship, coupled with a lack of competent supervision. What little merit the drawings may originally have possessed has been very effectively obscured by the colorist who might well have used his thumb in applying the colors, so far as it is possible to judge from the effects secured. The drawing and coloring of the Lepidoptera are especially atrocious and I feel sure there are plenty of talented children who could do better work. It is a relief to turn our attention from this absurdity to the work of such men as Antoine Sonrel, who was the chief illustrator of Harris' "Insects Injurious to Vegetation." All of the work which we have hitherto been discussing was in color, the outlines having first been printed either from engravings on copper or from lithographs, and afterward tinted by hand. They have consisted, for the most part, of Lepidoptera, but with the appearance of Harris' work we find for the first time in American books on entomology, with the exception of the short papers by W. D. Peck, a serious attempt at rendering in black and white the forms and true color values of insects in other orders, and it is a tribute to Dr. Harris' appreciation of good entomological illustrative work to remark the really wonderful success that was achieved. Not only have the plates been rendered with the very highest of artistic skill, but the wood engravings from which the text figures were printed are among the very best that ever have been produced in American works on entomology. The figures of the Bombycine moths, for instance, have never been equalled in any subsequent work. The figures of the Polyphemus and Cecropia moths are far superior to those of Riley's Missouri Reports and several of Riley's figures of the other larger moths, such as the Promethea and Luna moths, are rather inferior reprints of Harris' figures. The fact that Harris' Treatise on the Insects Injurious to Vegetation is still a standard work on entomology, is, I believe, due largely to the great excellence of its illustrations and constitutes strong evidence that honest, painstaking work in the natural sciences is practically imperishable.

According to Charles R. Dodge, Dr. Harris first requested

Townend Glover to make the illustrations for his work, stating at the same time that "Sonrel, a Swiss engraver, is the only person who can do such work at all well, and he, being a foreigner and not speaking English well, it will be difficult to get along with him." Glover afterwards declined to undertake this work and it was assigned to Sonrel with very happy results. Another admirable example of Sonrel's work are the plates accompanying Louis Agassiz' volume on Lake Superior, two of which, plates 7 and 8, depict specimens of Lepidoptera and Coleoptera respectively.

The illustrations for Harris' Insects Injurious to Vegetation consist of plates printed from steel engravings and text figures from engravings on wood. Charles Flint states that Antoine Sonrel made the drawings for the former and that Sonrel and John Burckhardt were the authors of those for the wood-cuts, but leaves us in doubt regarding the work with which each should be credited. The blocks for the beautiful wood-engravings were cut by Henry Marsh, whose work is beyond all praise. Except for Dr. Harris' brief mention of Sonrel nothing further seems to be on record regarding him. I have drawn on the resources of the Congressional Library as well as those of the U. S. Department of Agriculture without finding a trace of this artist. The standard reference works on artists and engravers are silent so far as Antoine Sonrel is concerned but, be this as it may, his work in connection with the Harris publication is sufficient evidence that he was a craftsman of infinite skill.

Of John Burckhardt who was Sonrel's colleague in this work, no record has been found.

The life of Townend Glover, first entomologist of the U. S. Department of Agriculture, is so well known through the excellent biography by Charles Richards Dodge (Bulletin 18, Old Series, Div. Ent., U. S. Dept. Agric.) that it seems hardly worth while here to mention many of the details of his career.

He was born at Rio de Janeiro, Brazil, Feb. 20, 1813, and died in September, 1883, at Baltimore, Md. When but an infant Glover was taken to Leeds, England, where he spent his boyhood and was educated in a private school. At the age of 20 he was apprenticed to a firm of woolen merchants in Leeds, but on reaching his majority, having been left a small fortune, went to Germany and took up the study of painting, paying especial attention to still-life work. As Glover was handicapped by intensely myopic vision, naturally he was unable to paint in a broad way, but this defect became actually advantageous in his afterwork with insects as it enabled him to study and to draw even small insects without artificial visual aid. After the lapse of about two years Glover decided to visit relatives in America and became so attached to this country that he remained here permanently. After much travel he settled at New Rochelle, New York, where he became well known as a sportsman. In 1840 he was residing at Fishkill-on-Hudson, now known as Mount Beacon, on an estate owned by his father-in-law. Several years later he became much interested in the study of pomology and made many admirable models of fruit for which he was awarded numerous prizes in the shape of cups and medals. This work was instrumental in securing his first appointment in the government service under the title of "Entomologist and Special Agent," this appointment being dated June 14, 1854. It was subsequent to this date that all of Glover's illustrative work on insects was accomplished. In 1859 he resigned his position with the department because of friction with his immediate superior and became a member of the faculty at the Maryland Agricultural College (now the Maryland University), as professor of natural sciences. Glover's largest publication known as "Illustrations of North American Entomology" was begun about this time. He states that his "Journal or Field Book" was written during this period for the use of the students of the Maryland Agricultural College. The text of this latter work is in Glover's chirography and was printed from lithographic plates while the illustrations, consisting of 23 plates, were etched on copper, intaglio. Only 45 copies were printed, in some of which the plates were colored by hand. As Glover himself says, the drawing in some of the illustrations is not all that could be desired, nevertheless, if these plates could be made easily available to beginners in entomology, they would still be valuable in filling the purpose of which they were made, especially if the nomenclature were modernized. His publication entitled "Cotton and the principal insects, etc., frequenting or injuring the plant," was published in the same manner and contains 22 plates, including illustrations, showing the diseases of the plant as well as insect pests. The little textual matter contained in the work is confined mainly to the legends for the plates, which are very well done, although a little stiff. This is especially noticeable in the attitudes of the caterpillars that have been illustrated. Glover's greatest work, however, was his "Illustrations of North American Entomology." The bound copy of this work in the Congressional Library at Washington, D. C., contains 275 copper plates averaging some 20 figures to the plate. The text consists of nothing but the names of the insects figured; there is not even an introduction or preface to explain the author's ideas or purpose in presenting the results of such enormous and painstaking labors in this unique and absurd form. The orders Coleoptera, Orthoptera, Neuroptera, Hymenoptera, Lepidoptera, Hemiptera and Diptera are represented. In the Coleoptera nearly 200 figures of larval forms are given and in the Diptera numerous larvae are figured. Not all the figures were drawn from life as many of them were redrawn from other works on entomology, mostly of the European authors. Glover's figures, while good, are by no means strictly accurate or of the highest quality. The perspective is often faulty, due to the fact that the several parts of the model have been drawn from distinctly different viewpoints. This fact becomes quite apparent when his figures are compared with actual specimens of the species represented. Many of the figures have a flat, poorly modeled appearance as if their author had intended them to be colored after they were printed. Nevertheless, if these illustrations could be made easily available to students, together with their modern names, they would fill a field not at present occupied by any other work on American entomology and would be of great value in this field. While Glover was serving as Entomologist for the Federal Government, he frescoed on the ceiling of a room in the northwest corner of the old Department of Agriculture building an oval or circular centerpiece. This unique design consisted of lepidopterous insects such as Papillio, Vanessa and some of the Sphingidae. The decoration remained for many years but finally became obliterated and no trace of it now is to be seen.

Mr. Dodge's admirable word picture of Townend Glover, with which all entomologists should be familiar, leaves the reader convinced that he was a genius but a most peculiar and eccentric character, and that this fact interfered seriously with his complete success in life. Had he been of a more companionable temperament, or even a little more fortunate, undoubtedly he would sooner or later have attracted the allegiance of some entomologist possessing complemental qualities of mind who could have furnished the steadying and directing force, which was all that was needed to render Glover one of the most momentous figures that has appeared in American entomology. He was the unfortunate victim of misdirected energies and talents of a very high order which could have been made entirely effective by proper management and assistance. Dipterists will understand what is meant if I say he was a Loew without his Osten Sacken.

It seems remarkable that following the time of T. R. Peale's activities a period of more than forty years elapsed before the appearance of a native born entomological draughtsman of any note. It was not until the appearance in 1869 of the first edition of "Packard's Guide to the Study of Insects," thus introducing to the entomological public the excellent drawings of Mr. James H. Emerton, that the pursuit of entomological delineation was resumed by persons of American bith. Lesueur, Bridport, Sonrel, Burckhardt, and Glover were of foreign birth, and even during Riley's time this field was occupied by natives of European countries; in truth it is only within comparatively recent years that this branch of art, in the United States, has fallen very largely into the hands of American born draughtsmen.

Although it is not my intention to discuss the work of living entomological illustrators it would be doing a great injustice to that grand old man among American illustrators of entomological subjects, Mr. James H. Emerton, to mention the work of his early contemporaries without paying tribute to his long and useful service in this field. Mr. Emerton was born at Salem, Mass., in 1847, and at this time is enjoying a vigorous old age in the environs of Boston. He it was who drew many of the line drawings and figures of larvae and pupae for Scudder's Butterflies of the Eastern United States and Canada, and also more than one hundred of the text figures for Packard's Guide to the Study of Insects. Mr. Emerton is the author and illustrator of a standard work on spiders, entitled "The Structure and Habits of North American Spiders," and has shown his versatility by the construction of many models of marine and other animals for the large museums of this country. It is remarkable that one of Mr. Emerton's colleagues in the illustration of Scudder's Butterflies, Mr. James Henry Blake, also survives. Mr. Blake was born in Boston July 8, 1845, and at present resides at West Somerville, Mass. He was educated at the Lawrence Scientific School, was Prof. Louis Agassiz' assistant at the time of his death and accompanied him on the Hassler Expedition and served as assistant paleontologist in the U. S. Geological survey for several seasons. Mr. Blake is also known as a public lecturer and especially as a zoological artist. He drew a large number of the very beautiful colored plates for Scudder's "Butterflies of the Eastern United States and Canada," and illustrated his "Tertiary Insects of North America," as well as other entomological publications of note. Mr. Blake has the honor of being dean of entomological illustrators in this country, as he is Mr. Emerton's senior by about two years. Two other artists contributed drawings to Packard's Guide regarding whom little or nothing appears on record; they are, L. Trouvelot and C. A. Walker. The former also executed some drawings for Scudder's Butterflies. The latter may have been Chas. A. Walker, a well known etcher of the period, who achieved an enviable reputation as an interpreter of famous paintings but this must apparently remain in doubt.

A distinguished colleague of Blake and Emerton in the work on "Scudder's Butterflies" was Edward Burgess, who was born at West Sandwich, Massachusetts, in 1848, and died at Boston, that State, in 1891. Mr. Burgess graduated from Harvard in 1871 and became secretary of the Boston Society of Natural History. He served as instructor in entomology at Harvard from 1879 to 1883, afterwards becoming a designer of sailing yachts. He was the creator of the Puritan, the Mayflower, and the Volunteer, the international cup-winners for 1885, 1886, and 1887 respectively. Mr. Burgess was an enthusiastic entomologist and specialized in the Diptera. Strange to say, however, he did little or no illustrative work in this order, in spite of the fact that a great need of such illumination existed in those days. Dr. S. H. Scudder states that Burgess not only made 173 drawings for his work on the butterflies, but also made the dissections and preparations from which these drawings were executed. Mr. Burgess was an insect anatomist of great skill and published several valuable papers on this subject.

Among the most beautiful and skillfully drawn illustrations of Lepidoptera that have appeared in any work relating to that order in North America are those published in William Henry Edwards' "Butterflies of Northeastern America and Canada." These wonderful illustrations were drawn by a woman, Mrs. Mary Peart, who has set a standard which it will be difficult for the human hand ever to surpass. Their excellence is, of course, due in part to the fine manner in which her drawings were reproduced, as the publication in which they occur is the most luxurious work on entomology that ever has appeared in this country. Mr. Edwards states in the prefatory remarks to his various volumes that Mrs. Peart's work began with plate VI, Part 2 of the work. That she supervised the drawing of all the plates on stone and made in all close to 1,000 figures for him in connection with his studies of the butterflies. He also states that Mrs. Peart aided in the rearing of the larval stages of the insects, which she afterwards drew, first on paper and afterwards on stone. Judging from the statement made by Mr. Edwards that Philadelphia in 1868 was four days' journey from his home in Coalburgh, W. Va., and that it was almost impossible to send material for drawing there for that reason, one is led to suppose that Mrs. Peart did her work in the former city. Dr. Henry Skinner of the Academy of Natural Sciences, Philadelphia, in answer to my letter of inquiry, has been kind enough to furnish the following information: "I can not tell you much about Mrs. Peart, although I knew her for many years. She lived near this institution, and the first time I met her she came in with Mr. W. H. Edwards, who remarked that 'the American Entomological Society should make her an honorary life member, as she had contributed more toward his work on American Rhopalocera than he had.' She was a delightful woman; cultured, refined and modest to a high degree. A good many years ago I visited her home with the late Dr. James Fletcher, who greatly admired her work and wished to meet her. She died in Philadelphia a few years ago and, if I remember correctly, was buried in some other place." Mr. Edwards states in the preface to his third volume that Mr. Edward Ketterer made the drawings for some 49 plates of that volume. No further information has been secured regarding this man.

Herman Strecker, who published an illustrated work on the Lepidoptera in 1872–1877, and who amassed a very remarkable collection in that order, was born in Philadelphia, March 24, 1836, and died at Reading, that State, November 20, 1901. The illustrations for Strecker's work consist of 15 quarto sized plates which were drawn by himself on stone and afterward colored by hand. Miss Emily Morton is said to have acted as his colorist in this work. The drawings are good but not of the very highest quality. They do not compare favorably, for instance, with those by either J. Henry Blake or Mary Peart. The coloring also is of mediocre quality and this is particularly noticeable in some of the larger moths, but, considering the difficulties under which Strecker labored, his work must be considered as quite remarkable.

Miss Emily Morton, born at New Windsor, New York, April, 1841, drew many larvae for A. S. Packard's "North American Lepidoptera," and colored many of the plates for Herman Strecker's work on the Lepidoptera. Miss Morton is quite an entomologist and has been especially active in the study of the biology of the Lepidoptera and has succeeded in hybridizing several of the larger Bombycine moths.

There is no doubt that the artist-entomologist best known to the general public in America was Charles Valentine Riley; born at Chelsea, London, England, September 18, 1843, and who died as the result of an accident at Washington, D. C., September 14, 1895. Dr. Riley holds preeminence in the public eye in this particular respect, not necessarily because he was actually the foremost exponent of this difficult art in this country, but rather because he was the best advertised draughtsman that we ever had. There is no doubt whatever that Dr. Riley was a most excellent draughtsman of the German school and that the earlier years of his career he did a large amount of very good work with the pencil. This period of activity in America was confined principally to the years 1868 to 1877 while he was engaged in the production of his famous Missouri Reports, which Riley himself considered the greatest achievement of his life. It is not generally known that Riley made several fine paintings of insects in oil colors for the Missouri Reports which were not included and still remain unpublished. After his arrival in Washington, Dr. Riley made practically no entomological drawings, doubtless because he was too busily engaged with administrative and other duties. The illustrations for his publications of this period were all made by other draughtsmen, excepting, of course, those which were reprinted from published works such as the "Missouri Reports," and even in the case of the latter papers Dr. Lugger is responsible for the statement that Lugger made some of the drawings in the rough, to which Dr. Riley simply contributed the finishing touches and his initials.

One of the draughtsmen who should be given first rank as regards the value of work accomplished, and honest, sincere effort in the delineation of insects, was Dr. George Marx, who acted as Dr. C. V. Riley's illustrator from 1878 to 1883 (excepting 1879–80, when J. H. Comstock was entomologist).

Dr. George Marx was born in Laubach, Germany, June 22, 1838, and died at Washington, D. C., January 3, 1895. He was educated at Darmstadt, where he became interested in botany and graduated in pharmacy at Giessen sometime previous to 1860, during which year he came to America. Upon the outbreak of the Civil War he enlisted as a private in the 8th New York Volunteers, but was soon afterward transferred to the medical corps as assistant surgeon, because of his pharmaceutical and medical knowledge. In 1862 he was wounded and disabled and after recovery engaged in the pursuit of his profession as a pharmacist in New York and at Philadelphia. In 1878 he was employed by the United States Department of Agriculture as a natural history draftsman, and began his work in Washington. Most of the very excellent plates and figures published by the Division of Entomology from 1878 to 1883 were the results of Dr. Marx' labors. These include several fine colored plates, such as those of the cotton worm, the boll worm, the army worm, etc., although many of these bear the initials of C. V. Riley. It will be a surprise to most entomologists to learn, for instance, that such admirable figures as that of the walking-stick insects, Plate III, of Riley's first report, the fine group figure of the clover leaf weevil of his report for 1882–83, and many other excellent illustrations, which have been reproduced again and again in later years, and credited to Dr. Riley, were in reality the work of Dr. Marx but which were calmly appropriated by Dr. Riley without a word of apology. It seems more than likely that this was done with perfect honesty on Riley's part who doubtless regarded the action as entirely within his rights.

Miss Lilly Sullivan, who was a protege of Dr. Riley's, after the death of Dr. Marx took up the work of illustrating the various reports and bulletins issued by the entomologist. What appears to be the first of Miss Sullivan's illustrative work appears in Dr. Wiley's Report for the year 1882, which contains two plates in color bearing Miss Sullivan's name. One of these shows a group of the Lepidopterous enemies of the cabbabge plant and the other, some of the principal insect enemies of the larch and spruce. A long series of drawings in black and white subsequently came from Miss Sullivan's pencil, among the most excellent of which are those contained in Howard and Marlatt's notable work entitled "The Principal House-hold Insects of the

United States," published as an Entomological Bulletin in 1902. Many of these illustrations have been widely copied and reproduced throughout the entomological literature of the world, and particularly those illustrations relating to medical entomology, such as the mosquitoes, the house flies, the roaches, etc. An amusing anecdote regarding Miss Sullivan is told by Dr. F. H. Chittenden, under whose direction Miss Sullivan worked at various times. Miss Sullivan came to him one day with a very troubled expression on her face, and asked the following question: "Doctor, what is to become of me after I have drawn all of the insects that are of economic importance?"

I have been unable to find that any notice of Miss Sullivan's death was published in any of the entomological periodicals of the time, but the records of the Department show that her services terminated on June 26, 1903, and as she died very suddenly it is probable that her death occurred about that date. It is needless to say that poor Miss Sullivan's worry over the narrowing field of illustrative work was groundless and that although thousands of drawings of insects have been made since her day, the limits of such work are still enshrouded in the mists of the dim and distant future. Mr. H. G. Hubbard, whose bulletin on the Orange Insects was one of the most popular publications ever issued by the old Division of Entomology, was a very good and painstaking draftsman. He made the drawings for plate XIV of that publication and also the single plate accompanying Hubbard and Schwarz' list of "The Coleoptera of Michigan."

The engraver who cut many of the blocks for illustrations in the various reports and bulletins of the old Division of Entomology was Otto Heidemann, who afterwards developed into one of the foremost authorities on the Hemiptera in this country. Mr. Heidemann was born in Magdeberg, Germany, September 1, 1842, and died at Washington, D. C., November 17, 1916. He learned the art of wood engraving in Leipzig and practiced his profession in southern Germany for about three years before coming to this country. Mr. Heidemann arrived in Washington some time during 1876 and was employed shortly afterward in making illustrations for government publications. In 1880 he was employed as a topographical draughtsman with Wheeler's Geographical Survey and in 1883 was appointed engraver for the Department of Agriculture. He remained in this capacity for about 12 years or until the development of commercial photography completely revolutionized the methods of illustration, when he took up the study of insects and became a very successful specialist in the order Hemiptera. While Mr. Heidemann's art work in connection with entomology consisted mainly of engraving the drawings made by George Marx, Miss Sullivan and others, he was a good draughtsman and made quite a number of entomological drawings, some of which were published, but there remain many others, made for the purpose of illustrating the work of the late T. H. Pergande, which still remain unpublished. Mr. Heidemann was an unusually obliging, gentle, courteous man, and even at an advanced age retained his vigor and activity to a remarkable degree.

Probably the most valuable feature of Dr. A. S. Packard's Monographs on the Bombycine Moths is their extensive series of fine illustrations in color of the early stages of these insects. The drawings for these plates were very largely the work of two men, namely, Mr. Joseph Bridgham and Mr. Louis H. Joutel. Mr. Joutel was born in Delaware County, New York, August 19, 1858, and died in New York City, September 6, 1916. He studied art at Cooper Union in New York City, where he resided for some 35 years. Mr. Joutel was a naturalist as well as an artist and took great delight in collecting and rearing the larvae of moths as well as those of amphibians, fish and other small animals. His most important contribution to entomological science no doubt are the drawings which he prepared for Packard's monographs and the fine monograph on the Coleopterous genus Saperda, published in collaboration with Dr. E. P. Felt, which was illustrated by Mr. Joutel in a most admirable manner. In addition to his art work, however, Mr. Joutel published many brief papers on the Coleoptera, principally relating to the longicorn beetles, regarding the biology of which he was very well informed. Most of Mr. Joutel's publications occurred in the Journal of the New York Entomological Society, with which organization he was long identified.

Mr. Joseph Bridgham, who was Mr. Joutel's colleague in the work on the Bombycine moths, and who was responsible for no less than 41 of the plates in that monumental work, also aided in securing many of the specimens from which the early stages of the moths were drawn.

## Conclusion

It would be a great pleasure to go on and tell in detail of the work of such men as the late J. H. Grossbeck, who made so many excellent drawings for Smith's studies of the "Mosquitoes of New Jersey"; of the fine line work of the late John F. Strauss, who did a great deal of work for the various branches of the Federal Bureau of Entomology, and especially of the beautiful, and indeed exquisite, wash drawings of the mosquitoes executed by our recently departed colleague, Mr. Fred Knab, and which were published in the monumental Monograph on The Mosquitoes of North and Central America and the West Indies in which Mr. Knab also participated as one of the authors.

It would be a still greater pleasure to extend the present remarks to include a survey of the living exponents of entomological illustrative art in this country, both veterans and recruits, but this obviously is impossible for several reasons, but especially because of the limitations imposed by time and space. A survey of that kind, however, would be interesting, and doubtless would reveal the names of many entomologists who, at one time or another, have wielded the pencil but who have relinquished it in favor of the pen, or perhaps one should say the stenographic clerk, in these strenuous days. For instance, who among the younger men remembers that Mr. C. L. Marlatt, even as far back as his student days, made some excellent drawings which were published by Professor Popenoe and that these works attracted the attention of Dr. Riley who induced Mr. Marlatt to come to Washington where his marked ability soon led him into other fields of entomological endeavor. Before this occurred, however, he had executed a considerable number of drawings such as those of the tree hoppers in Volume 7 of Insect Life, the mouth parts of mosquito larvae and the illustrations for his studies of the saw-flies. Who knows too that Professor R. H. Pettit was the author of a number of good drawings of the insects affecting domestic animals while serving as Dr. Lugger's assistant in Minnesota many years ago, etc. There are many other veterans of the pencil, such as Dr. Herbert T. Osborn, for example, whose work it would be a pleasure to review, but this must be left for the pen of some future writer. My purpose, as stated in the beginning of this paper, was to show the importance of the work of the draughtsman in advancing the science of entomology in this country and also to drag from unmerited obscurity the names of the earlier men whose work is in almost daily use but who, for the most part, have been utterly forgotten by those who participate in the results of their labors. If the present paper attains even the latter end I shall feel amply repaid for the slight labor of its preparation. It may be seen from what has been said that in some cases, even the name of the draughtsman has been disconnected from his work, and there is now no way of telling who was responsible for certain important drawings; in others the name of quite another person than the author has been substituted and it doubtless is true, also, that in many more cases very scant and altogether inadequate acknowledgment has been made the skillful and patient artist collaborator whose work contributed very greatly to the success of many a famous entomological publication.

Ruskin believed that "the greatest thing a human soul ever does in this world is to see something, and tell what it saw in a plain way." This is precisely what the skilled draughtsman does for the entomologist, and whether or not we agree with Ruskin, who will say that this service is not a great one?

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## A NEW SPECIES BELONGING TO THE GENUS GOODIA. (LEP.)

BY W. J. HOLLAND, *Carnegie Museum.*

In recently examining the collections of the *Saturniidae* in the Carnegie Museum I have found a species belonging to the genus *Goodia*, which I believe has not heretofore been described and a brief description of which is herewith presented together with a cut, which may enable it to be recognized. I take pleasure in naming it after my amiable associate, Mr. Hugo Kahl.

### Goodia kahli, sp. nov.

♂. The prevalent color of the wings on the upper side is fawn inclining to vinaceous. The fore wings are marked by a crenulated postbasal dark line, and by a postmedian, more strongly crenulated, dark line. These lines are furthest apart in the region of the end of the cell and come closer to each other as they approach the inner margin. The area between these two lines is darker inwardly and is outwardly marked by diffuse pale reddish spots, these being somewhat sharply defined externally by the post-median line. The transverse lines of the fore wings are continued upon the hind wings, the postbasal line on the hind wing being faint, except near the inner margin, where it is broad and diffuse; the postmedian line being complete from the costa to the inner margin. There are no hyaline spots on the fore wing. There is a minute hyaline spot, bounded by a fine dark annulus near the middle of the hind wing. The upper side of the thorax and the anterior portion of the abdomen above is darker than the ground-color of the wings. The collar is pale, inclining to whitish. On the under side the wings are marked as on the upper side, but the transverse lines on the fore wings are very feebly indicated or wanting. There is a rather conspicuous brilliant reddish spot beyond the end of the cell in the type. This spot is scarcely seen in the paratype. On the under side of the hind wings the crenulated postmedian line is distinctly marked, but not as conspicuously as on the upper side; the postbasal line is obscure, or obliterated.

The genitalia, which I have examined at the request of Dr. Karl Jordan, who is studying the insects of this group, are like those of *G. nubilata* Holl., the uncus of the prehensores being median in its position, and not terminal, as in *G. lunata* Holl.

The species in general appearances recalls *Goodia impar.* as described and figured by Aurivillius (*Cf.* Ent. Tidskr., XX, 1899, p. 246), but is very different, especially in lacking the hyaline spots near the end of the cell of the fore wing shown in the figure cited. It also somewhat resembles *G. vestigiata* Holl., but is quite distinct. Expanse of wing, 60–62 mm.

The description I have given is based upon two specimens, both males, one of which, the type, was taken at Efulen, Cameroon, May 21, 1914; the other, the paratype, was taken on October 24, 1913, at the same place.

The female, which is unknown to me as yet, is probably a much larger insect with broader wings, as is the case with the other species of which the female sex is known to me.

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*Actual date of publication April 16, 1921*

GOODIA (ORTHOGONIOPTILUM) KAHLI HOLLAND, SP. NOV.
(NATURAL SIZE)

VOL. 23 MAY 1921 No. 5

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OF WASHINGTON



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## ON THE FAMILY NAME FOR THE PLANT LICE.

By A. C. BAKER.

The origin of the word Aphis and the correct spelling of the family name based upon it have given rise to no little discussion among students of this group of insects. On the face of it the word appears to be Greek but it is found nowhere in the classical Greek writers. For bug Aristotle used *κόρις* and for lice he employed *φθείρ* but nowhere in his works, so far as I can find, does he refer to forms which might be considered aphids. One would naturally expect to find them under the discussion of lice for the Latin writers of the revival period treated them under Pediculus as the lice found on plants or in some cases those generated by plants. From Aristotle's word for louse we can have only Phthirius and other similar generic terms and from its Latin equivalent such generic names as Pediculus.

All modern students, seemingly, have believed that the word Aphis originated with Linnæus and our dictionaries (Murray's, Century, etc.) give this view and list Aphis as modern Latin. If this view is adopted we have a *d*-stem and the family name should be written Aphid-idae for Linnæus used aphides in the plural. Aphididae is generally employed to-day as the spelling for the family name of the plant lice.

But it is not with the meaning "louse" but rather in the sense of bug that we find the early use of the word. Aldrovandi[1] in his huge work wrote as follows:

> Cimex *κόρις*, ut dixi, Græcis nominatur, nonnunquam etiam *κόρυς*. Sed à Dioscoride *κόρεις οἱ α'πὸ κλίνης*, hoc est Cimices lectularii dicuntur: In glossario in plurali *κορίδες* etiam inuenio, & in Epigrammate Antiphanis *κόριες*. Recentiores Græci *κοριξα* nominant: reperio deniq; in veteri Lexico Α῎φις pro Cimice.

This passage is of considerable interest for it indicates not only our generic name Corixa and its Latin equivalent Cimex but it indicates also the original use of the word Aphis. The first thing proven is that the word is not modern Latin and that it did not have its origin with Linnæus. This granted, the derivation given in our dictionaries is, of course, incorrect. It must be remembered that Buckton was on the consulting staff

[1] Ulyssis Aldrovandi De Animalibus Insectis 1602, Lib. Quintus, 535.

of Murray's and Murray's simply gives as derivation the speculation he indicated in the first volume of his British Aphides. It is entirely a product of his imagination.

Aphis, then, as we find it, is a Greek word and upon the declension depends the spelling of our family name. As before mentioned it appears to have been used nowhere in classical Greek. If Linnæus had found it there he could scarcely have written aphides in the plural for the declension would be ἄφις, ἄφεως. As a matter of fact the word is not Attic but belongs to the Ionic dialect in which we have the genitive -ιος for ι-stems. This is indicated by the presence of the word in a Latin-Greek lexicon[1] dated 1554 in which I find the following entry:

Cimex, icis. f. g. ἄφις, ιος·

In an earlier lexicon by Gulielmus Mainus (1523) I also find the word aphis but no genitive is indicated. The word is here written ἄφις in one section and ἄφισ in another. In both of these lexicons I find the Attic word κόρις as well. Of the many examined, however, these two are the only ones in which the word aphis appears.

How did Linnæus come to write aphides in the plural? Several possibilities suggest themselves. It must be remembered that until a very late period with the Greeks Ionic was associated with medicine in much the same way as Latin has been with our biological sciences. In the island of Cos, for example, which was originally a Doric colony, Hippocrates and his school employed a form of Ionic and it was for long years afterwards the official medical dialect. The discussion of Cimex would in all probability be associated with medicine. Moreover the evidence seems to indicate that in Asia Minor words in ις like ἄφις were declined in the regular way with -ίος in the genitive and not with -ίδος.

Linnæus may have known the word as Greek and concluded without investigation that it should be ἀφιδος. This I think probable. On the other hand he may have found that it was actually used in the other Ionic form in some paper of which we have no record. Had this been the case, however, one would expect to find it in the lexicons. But it is possible that he simply wrote it in its present Latin form without much consideration.

The people of the East were well acquainted with many insects and they used the products of some of them in their industries. In view of the fact that the Attic people employed a different word it seems possible that Aphis in some form or

[1]Dictionarum Latino-graecum. In quo singulae dictiones ac locutiones latinae, graecis vocibus ac sententiis praemissae, magnu utriusque linguae comercium indicat. Huius aute plurima pars ex Budaei Vigiliaru reliquiis exerpta est . . . Lutetiae, apud C Stephanum 1554.

other reached the Greeks of Asia Minor from the Orient. This, however, is mere speculation. What we do know is as follows: The word is an ι-stem and can be traced only in the Ionic dialect. Linnæus used it as if it were declined with a δ stem. In all modern works it is considered Latin and credited to him.

From these facts and the foregoing we conclude that he made a mistake in using aphides in the plural and that the family name of the plant lice should be written Aphiidae and not Aphididae.

In preparing this paper I have to thank my father, J. J. Baker of Vancouver, B. C., and Prof. O. J. Todd of the University of the same place for suggestions.

## NOTES ON THE NESTING HABITS OF TACHYTES. (HYM.)[1]

By J. B. Parker, *Professor of Biology, Catholic University of America.*

These notes are based on observations of the nesting activities of two species of *Tachytes*, *T. dubia* Rohwer and *T. breviventris* Cresson, both of which prey upon *Conocephalus breviventris* Scudder, one of the long-horned grasshoppers. *T. dubia* was found nesting near Danville, Ohio, on August 22, 1917. The nesting site was located on a high bank of a creek bordered on either side by a fringe of trees. The site itself was not over ten feet square, sparsely covered with long, loose grass, and shut in by trees on three sides. The ground was an alluvial deposit of fine silt and sand. Some half dozen nests were found on this site but only two were opened. When I visited the site again in the summer of 1919, the whole bank had been carried away by the stream.

The first burrow opened was about eighteen inches in length, not straight in its course—the irregularities being due probably to the presence of roots in the soil—and at no point more than four inches below the surface. The tunnel was about the size of a lead pencil and the entrance to it was always left open. No lateral tunnels were formed, the brood chambers being in a line at the end of the main tunnel. Where a brood chamber is constructed the diameter of the tunnel is considerably enlarged. This nest contained three brood chambers separated from one another by partitions of soil solidly packed in. The chamber at the extreme end of the tunnel, the first one the wasp constructed, contained three grasshoppers with an egg in place. The second contained two grasshoppers with an egg in place, and the third one grasshopper and no egg. The second nest opened did not differ materially from the first in point of structure and arrangement; it contained two brood chambers of

[1]The two species of *Tachytes* were kindly identified for me by Mr. S. A. Rohwer and the grasshopper by Mr. A. N. Caudell. Specimens of all three species have been placed in the U. S. National Museum.

which the one at the extreme end was provided with three grasshoppers and an egg in place and the other, being incomplete, held only one grasshopper and no egg.

It appears that the wasp does not deposit her egg until the chamber has been completely provisioned. When this has been done and the egg placed the chamber is at once sealed up. The grasshoppers are placed upon their backs neatly arranged with their heads all pointing towards the closed end of the burrow. My limited observations on these two species indicate that the egg is always placed on the first grasshopper brought into the brood chamber but it is not deposited until the chamber has been completely provisioned. In the case of *T. dubia* the egg is placed on the sternum of the prothorax crosswise of the body between the head and the prothoracic legs. Owing to the circumstances under which these observations were made it was impossible to attempt any study of the development of the larva of this species.

Some idea of the activity of this species may be had from notes on movements of the wasp that constructed the nest first opened. She arrived at her nest with prey at 8:50 A. M. While she was inside the nest I removed the long grass that almost concealed the entrance to it. When the wasp came out at 8:52 she seemed confused by the change and spent the next five minutes buzzing about the entrance and popping in and out of it. She finally flew away at 8:57. She returned with prey at 9:20, left again at 9:21; returned at 9:45, left at 10:24; returned at 10:35, left at 10:36; returned at 11:00, left at 11:35; returned at 11:43 and was captured as she emerged at 11:44. By comparing this record with the number of grasshoppers found in the brood chamber of the first nest opened it will be seen that when the wasp remained for a considerable time within the nest, thirty-nine minutes the first time and thirty-five the second, this time was required for depositing the egg, sealing up the brood chamber and enlarging the tunnel for a new one.

In approaching the nest with prey the wasp makes a loud humming noise, poising in the air till the entrance of the nest is located when she settles directly into the opening of it. I may add here that in the case of the wasp that constructed the second nest opened, I removed the grass from about the entrance to her nest just as I had done with the first one, but this second wasp did not pay the slightest attention to the altered conditions nor did the change confuse her at all when she returned with prey.

A nesting site of *Tachytes breviventris* Cress. was discovered in a pasture on the grounds of the Catholic University of America, Washington, D. C., in September, 1920. On an area probably fifty feet in diameter eleven nests were counted while some dozen more were widely scattered about. The soil of the nesting site is sandy and at the level of the brood chambers it is almost wholly pure fine sand. The burrows were approximately three-eighths of an inch in diameter and extended downward vertically to a depth of from nineteen to twenty-four inches. From the bottom of the vertical tunnel lateral tunnels from four to eight inches in length were constructed at right angles to the vertical shaft and in radiate arrangement. In some cases the radiating laterals were at two levels one about four inches above the other. A brood chamber is constructed at the end of each lateral and when provisioned the lateral between the brood chamber and the main shaft is filled up with sand. I found no evidence of two or more brood chambers in any single lateral.

This species like the preceding species carries its prey to the nest in flight and like it makes a loud humming noise as it flies. The weight these wasps carry in flight is astonishing. Two wasps and their victims were weighed immediately after capture. One wasp weighed 160 mg and her prey 200 mg, the prey being in this case 1.25 times as heavy as the wasp; the other wasp weighed only 130 mg but her prey weighed 230 mg, the prey being in this case 1.77 times as heavy as the wasp that carried it. The first wasp carried her prey with little difficulty but the second found her task laborious. In searching for the entrance to her nest this second wasp was compelled to alight several times to rest, and the rapidity and violence of her respiratory movements plainly showed how great were the exertions required to enable her to carry her heavy load.

The entrance to the nest is always left open and when the wasp returns with prey she endeavors to alight in the opening, which, on the nesting site under observation, was a conspicuous hole in a pile of light sand. Consequently when she approaches her nest with her heavy load she circles about in the air or poises on the wing at about the height of a man's head until she locates the opening of the nest when she drops down directly into it. Frequently, perhaps because of fatigue, on coming down she lands a few inches to one side of the entrance. In such cases she invariably rises on the wing with her load, circles about and tries for the entrance again. I saw this performance repeated by one wasp no fewer than four times before she succeeded in landing in the entrance to her nest. I observed one wasp do this when she had missed the entrance less than two inches and with no obstacle whatever between her and the opening of the burrow.

In the brood chamber the grasshoppers are neatly arranged upon their backs lengthwise of the chamber with their heads pointing towards its outer end. The number of grasshoppers found in the different chambers varies from one to four. The usual number was four but I found in two instances a developing larva in a brood chamber that had been provisioned with only one grasshopper. This means that the mother wasp provides a more generous supply of food for some of her offspring than for others. Whether this is due to mere chance or whether those provided with a limited amount of food develop into males and those more generously supplied into females remains to be investigated. As in the case of the preceding species the wasp does not deposit an egg upon the first grasshopper brought into the brood chamber, at least not at the time she brings it in. I found several brood chambers not sealed up containing from one to three grasshoppers and in every case no egg was present. From this it appears that the wasp does not place an egg in a brood chamber until it has been provided with what the wasp considers an adequate supply of food for her offspring.

In the case of this species (*breviventris*) the egg is placed upon the ventral side of the thorax just behind the front leg. The anterior end of the egg rests upon the mid line of the thorax just behind the prothorax. In the case of one wasp the posterior end of the egg extended to the left side of the body of the grasshopper whereas in the case of another wasp it extended to the right. I did not succeed in finding a newly laid egg; all that were found were in a more or less advanced stage of incubation, so that the time required for the egg to hatch was not learned. An egg found on September 27, 1920, in a brood chamber provided with four grasshoppers, hatched on September 28. The larva moulted on September 29 and completed its feeding on October 1. I could find no evidence that the larva moulted more than once; but it may have done so. On October 2 it was trying to form a cocoon while lying on the surface of the sand in the breeding cell. I left it there until October 5 but it was unable to form a cocoon. I then filled a large vial with moist sand and after pressing the sand down firmly made a hole in it with a lead pencil. I put the larva into this hole and plugged the entrance of it with moist sand and laid the vial on its side. Thus enclosed the larva formed its cocoon successfully. Repeated experiments convince me that the larva can not form its cocoon unless surrounded with sand. If the larva fails to form a cocoon within a limited time after completing larval growth it dies.

The cocoon is formed of sand held together by a cementing substance furnished from the mouth of the larva. In beginning the formation of a cocoon the larva spins a loose network of silken threads about the body. This serves as a framework to hold the grains of sand, which, coated with the cement substance, the larva puts in place with the aid of its mandibles. When the wall of the cocoon is thus formed the larva inside, using its mouth parts in much the same fashion as a painter uses a brush, coats the inside surface of the cocoon with a substance that further binds the grains of sand together and gives the interior a smooth finish. While this work is going on the wall of the cocoon is flexible and the yielding of the wall to the pressure exerted in the coating process enables the observer to follow the movements of the larva as it proceeds with its work. In one instance when the larva had completed its cocoon I made a hole in it by removing a small part of the wall. I then placed the cocoon in the breeding vial with the hole in contact with the sand but the larva failed to repair the damage done and died after a few days. When first finished the cocoon is the same color as the sand composing it but later changes to a light chocolate color.

While feeding the larva passes no faeces. All faecal matter is retained in the posterior part of the alimentary canal until the cocoon is completely formed. It is then discharged in the posterior part of the cocoon to which it adheres in a dark, chocolate-colored, sticky mass. No part of this faecal matter is used in the construction of the wall of the cocoon.

The number of brood chambers a single wasp will provide was not learned since all the nests that were opened were incomplete. The largest number found was eight and of these, four contained only larvae of parasitic flies. In one brood chamber I found twelve mature fly larvae. In what way the fly introduces her eggs (or larvae) into the brood chamber of the wasp was not learned. The first act of these fly larvae, doubtless, is to devour the egg of the wasp. They then devour the grasshoppers. In every brood chamber in which I found one or more fly larvae, no egg or larva of the wasp could be found.

On December 24, 1920, I opened two more nests of *T. breviventris*. I found a number of cocoons of which four were removed without any damage, the others being crushed or cracked in digging. In every case these cocoons were empty. The four showed that the wasp had broken out of the cocoon and escaped in the usual way, for, as is the rule in such cases, the anterior end of the cocoon was open and the cocoon was packed full of sand, which had been forced back into it by the wasp as she digged her way out of the ground. Where do these wasps spend the winter, and how do they spend the time from spring to September while waiting for the grasshoppers to grow to a size that will make them suitable for food for the next generation of wasps?

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## FURTHER NOTES ON AMBOPOGON HYPERBOREUS GREENE. (DIPTERA.)

By Charles T. Greene, *U. S. Bureau of Entomology.*

When I described this species[1] I had but one male specimen and was unaware that it was not fully colored. At the present time I have four additional males and a female. Since I have

[1]A New Genus in Scatophagidae (Diptera), C. T. Greene, Proc. Ent. Soc. Wash., vol. 21, no. 6, June, 1919.

studied these specimens I find it necessary to make two corrections to my first paper and add the description of the male antennae.

*Female.*—Resembles the male. Front sub-shining, yellowish red, paler towards the antennae. Ocellar triangle shining black. Antennae short, pale yellow. First joint very short with a row of black bristles along the apical edge; second joint twice the length of the first with numerous black bristles on the outside reaching up to upper inner surface; bristles much longer on lower front edge; one large bristle on upper, apical edge; inner surface covered with numerous short, yellow hairs; third joint rounded apically, slightly infuscated and covered with short yellow pubescence; one and one half times longer than wide. Arista long, black, slightly thickened and reddish yellow at the base; located on dorsal basal third of third joint. Face short, broad, white, with the white extending upon the sides slightly above and below the base of antennae. Numerous, short black bristly hairs along the lower, lateral edge of the head. Dorsum of thorax and pleura shining yellowish red; dorsum of thorax clothed with numerous short, black, bristly hairs; in certain lights the middle and sides are narrowly blackish. Two pairs of dorso centrals. Scutellum yellowish red; two pairs of long bristles. Two sternopleurals, the front one sometimes quite weak and hair like. Abdomen shining black; five segments visible, the sixth very narrowly visible; first segment longer than any of the following segments, reddish at the base; second to fifth about equal in length; dorsum of abdomen with numerous short, black hairs and a very narrow, median, bare line or area. Fifth segment with one large bristle on each side at the apex. Venter with numerous short, bristly hairs. Front coxae long, robust, white pollinose; middle and hind coxae more normal and reddish yellow. Legs more normal, reddish yellow except the apical half of the front femora, tips of front and hind tibiae and front tarsi blackish brown; middle and hind tarsi with a brown infuscation. Length of front metatarsus equal to the remaining four joints; middle and hind metatarsi a little longer than the following four joints. Wings hyaline, a brownish infuscation along the costal edge; veins brown; yellowish at base of the wing. Halteres reddish brown at the base, knobs large, lemon yellow.

Length, 5 mm.

One specimen from Mt. Moscow, Idaho, July 25, 1920, R. C. Shannon, collector. Deposited in the collection of U. S. National Museum.

The male antennae are very much like those described for the above female with the following differences: Bristles on apical edge of first joint more yellowish; second joint with fewer black bristles on the outside surface and very few yellow hairs on inner surface; the bristle on upper, apical edge larger and located more towards the inside; third joint more rounded, whitish yellow and no infuscation. Arista same but paler at the base. The thorax may be variable from reddish to nearly black; pleura is generally darker than the dorsum. Two pairs of dorso centrals. In the type the front pair was so weak that I mistook them for the hairs covering the surface. Two sterno-pleurals, the front one sometimes very weak.

Four males from Mt. Moscow, Idaho, July 25, 1920, R. C. Shannon, collector. Deposited in the collection of U. S. National Museum.

The following note on the habit of this species was given to the author by Mr. Shannon: "Occurs near summit of Moscow Mountains (Cedar Mountain of government maps,—a name not in local use) where the slope is moist and there is a heavy growth of cedars. The females may be collected by sweeping the undergrowth but the males are found strutting about on the fallen logs, displaying their charms as proudly as the partridge on the log in the drumming season."

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## THE MALES OF THE ICHNEUMONID GENERA MYERSIA AND THAUMATOTYPIDEA, WITH DESCRIPTIONS OF NEW SPECIES. (HYM.)

By R. A. Cushman, *U. S. Bureau of Entomology*.

Among the undetermined Ichneumonidae in the National Collection I have recently found what I am confident are the males of these two anomalous genera together with an undescribed female *Myersia*, and another new species of that genus has been received from C. W. Johnson of the Boston Society of Natural History.

As pointed out in an earlier paper[1] these two genera should be referred to the Stilpnini.

### Genus MYERSIA Viereck.

The two new species of this interesting genus described below extend the known range of the genus to Maine and British Columbia, and double the number of known species. The females may be separated by the following key:

*Key to females.*

1. Temples broad, flat and nearly straight behind eyes; first tergite increasing gradually in width from base to apex, the spiracles not prominent; a large species, 6 mm. .......... *grandis*, new species.
   Temples narrow, convex and receding; first tergite increasing suddenly in width beyond the prominent spiracles; smaller species .......... 2.
2. Pale rufous .......... *pallida* Cushman.
   Black .......... 3.
3. Subapical flagellar joints fully as long as thick; postpetiole at apex little more than twice as wide as petiole .......... *johnsoni*, new species.
   Subapical flagellar joints thicker than long; postpetiole at apex nearly three times as wide as petiole .......... *laminata* Viereck.

[1]Proc. U. S. Nat. Mus., vol. 55, 1919, p. 521.

**Myersia laminata** Viereck.

What I am convinced is the male of this species is represented in the National Collection by ten specimens, one from Jackson's Island, Md. (P. R. Myers); one from Rosslyn, Va. (H. H. Smith); two from Dixie Landing, Va. (Ashmead); five from Langdale, Ala. (H. H. Smith); and one from Long Island, N. Y. The most striking difference between the male and female is in the possession by the male of a depressed and normally segmented abdomen, the second and third tergites being not at all fused. Other points of difference are in the relatively shorter (facial view) head; shorter malar space; more distinctly carinate anterior margin of cheek; nearly paralleled eyes; basally thickened and apically tapering antennae; less deeply concave propodeum with less prominent angles; and narrower and more roughly sculptured postpetiole. The color of the two sexes is the same except that the male has the antennae beyond the second joint of the flagellum and usually the posterior tibiae and tarsi fuscous. In some of the specimens, especially those from the south, the base of the abdomen is quite red.

**Myersia johnsoni,** new species.

*Female.*—Length 4 mm.

Differs from *laminata* Viereck in having the antennae somewhat more slender, the subapical joints being fully as long as thick; the abdomen less stout, the postpetiole at apex being but little more than twice as wide as the petiole and the rest of the abdomen nearly twice as long as wide; all coxae and the hind femora and tibiae fuscous.

The apical abscissa of radius in this and in *laminata* is basally slightly curved but otherwise straight, not sinuate as in *pallida.*

*Type-locality.*—South West Harbor, Mt. Desert Island, Maine.

*Type.*—Cat. No. 24143, U. S. N. M.

A single specimen taken by C. W. Johnson.

It is entirely possible that the differences noted between this and *laminata* are within the range of specific variation.

**Myersia grandis,** new species.

*Female.*—Length 6 mm.

Head in dorsal view transversely oblong, deeply concave behind, temples broad, flat, nearly straight, the occiput nearly as broad as eyes; in front view almost as long as broad, cheeks weakly convex, malar space more than twice as long as basal width of mandible; clypeus hardly twice as wide as long, broadly truncate at apex and with a narrow reflexed margin, weakly sculptured at base; face granular medially, subpolished laterally; eyes strongly divergent below; frons with deep, subpolished scrobes, separated by a low ridge; vertex granulated; cheeks and temples highly polished; antennae slightly more slender than in *laminata*, the subapical joints longer than thick, scape about two-thirds as thick as long. Thorax granulate dorsally, largely longitudinally striate laterally;

sternauli distinct; metapleurum granulate rugulose; propodeum mostly transversally rugulose opaque, areolopetiolar area subpolished, deeply concave, apophyses prominent; legs rather slender. Abdomen narrow fusiform; first tergite gradually wider from base to apex, where it is a little more than a third as wide as long, dorsal carinae highest just beyond spiracles, petiole striate, postpetiole striate except between the high carinae where it is shagreened; abdomen beyond first tergite barely half as wide as long; ovipositor sheath about as long as first tergite.

Black; abdomen piceous; antennae, clypeus, mandibles, palpi, legs, and tegulae ferruginous to testaceous; wings hyaline, venation brownish.

*Type-locality.*—Kaslo, British Columbia.
*Type.*—Cat. No. 24144, U. S. N. M.
One female captured June 5, by Dr. H. G. Dyar.

Genus **THAUMATOTYPIDEA** Viereck.

The male of this genus has heretofore been unknown. In the National Collection I have found a single specimen of this sex that I have no hesitation in referring to the genus. The sexual antigeny is so great that I do not attempt to associate it with either of Ashmead's species, which differ so little from each other that they may, with the study of more material, prove to be synonymous.

The male is almost exactly what one knowing the genus *Pezomachus* might expect it to be. It is, in fact, to *Myersia* what *Pezomachus* is to *Hemiteles:* with less completely areolated more sloping propodeum; slender, subclavate, normally segmented abdomen; and broad, rather weakly veined wings.

The male differs from the female of the genus in having the wings fully developed and the thorax normal; head shorter both from above and in facial view; eyes and ocelli larger; malar space much shorter; temples narrower antero posteriorly—in other words the head is normal as compared with that of the female exactly as is the case in *Pezomachus;* antennae slender, not subclavate, all flagellar joints (the apex is broken off) much longer than broad; thorax with all sclerites normally developed, but the propodeum with only the combined areola and petiolar area and the apical lateral areas defined, the other carinae entirely lacking; abdomen narrow, subclavate, depressed; second and third tergite not fused; first tergite less strongly curved and relatively shorter.

From the male *Pezomachus* it is at once distinguished by the very large and deep clypeal foveae; the posterior face of the propodeum extending medially much nearer to the base; the quite different venation, the stigma being narrow, the radial cell long with the radius broken at a nearly acute angle, the practically contiguous radius and cubitus (the intercubitus almost obliterated), the entirely wanting areolet and barely indicated apical abscissa of cubitus, the abscissula barely longer than intercubitella, and the straight nevellus with entirely lacking discoidella; the long, slender, and nearly parallel sided first tergite; and by the probably much less numerously jointed antennae.

**Thaumatotypidea koebelei,** new species.

*Male.*—Length 4.5 mm.; front wing 4.5 mm.

Head broad behind eyes, temples strongly convex; occiput concave; face granularly opaque, subpolished at sides; clypeus obscurely transversely striate; head otherwise polished; eyes slightly divergent below; malar space equal to basal width of mandible; temple slightly wider antero-posteriorly than eye; diameter of lateral ocellus slightly more than half as long as ocell-ocular line; antennae slender filiform, the thirteenth flagellar joint (which is the most distal one left) nearly twice as long as thick. Thorax largely polished; notauli weakly indicated in front, their position behind indicated by granular sculpture; meso pleurum striate above and in region of the scarcely indicated sternauli; metapleura punctate; propodeum subopaque coriaceous; combined areola and petiolar

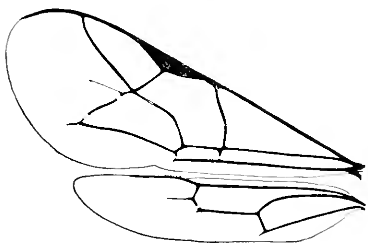

Fig. 1—Wings of *Thaumatotypidea koebelei.*

area reaching the basal third of propodeum, the apical carina not angulate at sides; legs slender; front wing as long as body, venation as indicated in figure. Abdomen narrow, widest near apex; first tergite very narrow, but little wider at apex than at base, with spiracles prominent, longer than second tergite, longitudinally striate; second tergite narrow at base, broad at apex, longer than apical width and nearly twice as long as third.

Black; mandibles and palpi yellowish; clypeus piceous; antennae fuscous; thoracic sutures and tegulae reddish; front and middle legs stramineous, hind legs testaceous, the femora slightly infuscate; wings hyaline, venation pale brownish gray; first tergite black; rest of abdomen piceous with second and third tergites at apex and the third medially yellowish.

*Type-locality.*—Easton, Washington.
*Type.*—Cat. No. 24145, U. S. N. M.
One specimen captured by Albert Koebele.

# REMARKS ON THE GENUS PLEUROTROPIS WITH DESCRIPTION OF A PARASITE OF TRACHELUS TABIDUS FABRICIUS. (HYMENOPTERA: CHALCIDOIDEA.)

By A. B. GAHAN, *Bureau of Entomology*.

The occurrence of the exotic sawfly, *Trachelus tabidus* Fabricius, in America as a possibly serious pest of wheat was brought to light during the summer of 1918. A paper by the writer treating of this sawfly has already been published by the U. S. Department of Agriculture.[1] Mention is made in this article of the rearing by Mr. W. R. McConnell of a parasite belonging to the genus *Pleurotropis* and apparently representing an undescribed species.

In view of the foreign origin of the host it is natural to suspect, though the conclusion does not necessarily follow, that the parasite too is exotic. It has proved impossible to reconcile the insect with the description of any exotic form, however, and as it does not conform to any described American species it seems desirable to describe it.

In the process of identifying this species the writer was led into making a more or less careful study of the characters, especially those of the antennae, appertaining to the genus *Pleurotropis*. The results of this study are discussed herewith.

## Family **EULOPHIDAE.**
### Subfamily **Entedoninae.**
### Genus **PLEUROTROPIS.**

*Pleurotropis* Foerster, Hymen. Stud. II, 1856, p. 78.

*Pseudacriasoides* Girault, Descriptiones Stellarum Novarum, 1917, p. 9.

*Epipleurotropis* Girault, Descriptiones Hymenopterorum Chalcidoidicarum cum Observationibus, 1917, p. 7.

The two genera listed as synonyms are based upon characters which, after examination of the types, I can not accept as generic.

*Pseudacriasoides* has as type *Pleurotropis utahensis* Crawford. The generic description by Girault is as follows: "Antenna 9-jointed, three ring-joints, the club 2-jointed; male antenna 10-jointed, three ring-joints, the club 2-jointed, the scape dilated. Scutellum with a median sulcus at base. Otherwise like *Pleurotropis*."

*Pleurotropis utahensis*[2] was described from four female and six male specimens of which the holotype was reared at Salt Lake City, Utah, from *Agromyza parvicornis* mining the leaves of corn, while the allotype and all paratypes were reared from

[1]Bul. 834, U. S. Dept. Agric., 1920, 18 pp.

[2]Proc. U. S. Nat. Mus., vol. 45, 1913, p. 316.

*Cephus sp.* (subsequently determined as *Cephus cinctus* Norton) boring the stems of wild grasses and grain at Salt Lake City and Kimballs, Utah. In addition to the type material there are now in the National collection eleven specimens reared from *Cephus cinctus* at Missoula, Montana, and determined by the writer as *Pleurotropis utahensis*.

The different host records for the holotype and the paratypes are ground for suspicion that the latter may represent a different species. If so, however, Mr. Crawford who compared them when describing the species failed to find characters to separate them. Apparently also Mr. Girault, who saw all of the material, accepted it as all belonging to the same species. Otherwise it is to be presumed that he would have proposed a new specific name for the paratypes. After a careful re-examination of all the material and despite the antennal differences discussed later, the writer is still of the opinion that all represent the same species. As in all such cases unsupported by careful biological studies the question of whether one or more species is represented in a given lot of material is merely a matter of personal opinion.

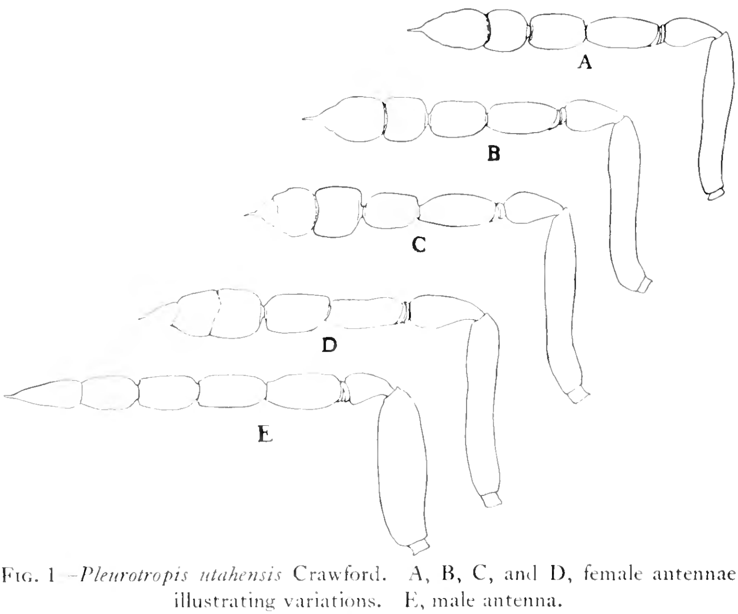


FIG. 1—*Pleurotropis utahensis* Crawford. A, B, C, and D, female antennae illustrating variations. E, male antenna.

As shown by the accompanying figures which illustrate antennae taken from four different females and mounted in balsam there is considerable variation in the antennal characters in this lot of material. Figure 1, A is from the holotype; B from a paratype; C and D from two of the Missoula, Montana, specimens. Except for the differences in antennae the specimens are inseparable, though differing somewhat in size. A glance at the figures will show that the differences lie in the relative closeness of the union between joints 8 and 9 of the antenna and the degree of development of a suture dividing joint 9 into two joints. The relative size and shape of the joints is practically the same for all four antennae. In figure 1–D, we have what appears to be a 2-jointed funicle and a 3-jointed club. In C, joints 8 and 9 are not nearly so closely united and the suture dividing the ninth is not so distinct. This antenna may be said either to have a three-jointed funicle and a two-jointed club, or a two-jointed funicle and a three-jointed club, the interpretation depending entirely upon the individual making the examination. Figures A and B are alike and differ from C only in the apparent absence of the suture dividing the ninth joint.

Although the greatest care was exercised in making these mounts there can be little doubt but that to some extent the apparent differences are to be accounted for by the imperfect definition of subopaque objects when mounted in balsam. Careful examination, before mounting, of the antennae from which figures A and B were made showed both to have a definite though very delicate constriction near the apex corresponding in position to the suture dividing the ninth joint in figures C and D. When mounted on a slide this suture was entirely invisible. The antennal mount made by Girault from the holotype specimen and upon which he based his description of the genus *Pseudacriasoides* was removed from the slide and it too showed a distinct constriction or shallow groove on the ninth joint. When remounted in balsam this groove again became invisible, corresponding in appearance to figure A which was drawn from the other antenna of the same specimen.

The pressure of the cover glass probably accounts to some extent for the greater separation between joints 8 and 9 in figures A, B, and C. Joint 8 is apparently more or less cup-shaped at apex, the base of joint 9 fitting into the aperture. The articulation between the two joints is free nevertheless, and not anchylosed as are the club joints.

Antennae from the same specimens are not always exactly alike in respect to the characters in question. For example, while figure B shows the ninth joint without a dividing suture the other antenna from the same individual when mounted in balsam shows a more or less distinct suture. Also the mate to the antenna from which figure D was drawn appears to have joints 8 and 9 more distinctly separated.

Whether one or more than one species is represented in this material, it affords a good illustration of the folly of basing genera upon such slight differences in the antenna. The material under consideration, as already pointed out, has been examined by three different students of Chalcidoidea and accepted by all three as a single species. Yet from an examination of slide-mounted antennae alone, the four individuals, antennae of which are figured, would probably be run in any of the existing generic keys to three different genera. The genera to which they would be assigned would depend largely upon whether the individual making the examination chose to call the eighth antennal joint a part of the club or a part of the funicle, upon how many of the minute ring-joints he was able to see, and upon whether or not the particular mount examined revealed the suture dividing the ninth joint. The determination of the generic position would depend to a considerable extent upon the individuality of the particular specimen from which the antenna for mounting was taken but more largely upon the accidents of mounting.

The antenna of the male allotype of *Pleurotropis utahensis* (Figure 1, E) is ten-jointed. The scape is only slightly more dilated than in typical species of the genus. The flagellum tapers from base to apex and the club is hardly differentiated from the funicle although joints 9 and 10 are more or less anchylosed and probably represent the club. If so the funicle is 3-jointed as in typical *Pleurotropis*. There are three distinct though minute ring-joints.

Most writers have credited the genus Pleurotropis with only one ring-joint. Waterston (Bull. Ent. Research, vol. 5, 1915, p. 343) considers the ring a single joint but states that this joint consists of two to three laminae which are distinctly separated only ventrally. With this conception I can not wholly agree. Mounts of antennae from many of the species in the National collection have been examined with the result that in most cases it has been possible to recognize three complete ring-joints. In some cases there are apparently only two, while in a few instances owing to the position in which the antenna was mounted it was impossible to determine the number. The ring-joints are always more or less telescoped into each other but are separated both above and below. When the flagellum is bent upward it tends to pull the ring-joints apart ventrally while pressing them more closely together dorsally and this may account for the impression gained by Waterston.

It is the writer's belief that while *Pleurotropis* normally has ten-jointed antennae in both sexes consisting of scape, pedicel, three ring-joints, a 3-jointed funicle and a 2-jointed club, the genus can not be limited to this antennal formula because one finds all degrees of separation and solidification of the apical two or three joints of the flagellum, it is not always possible to determine whether certain joints are a part of the club or a part of the funicle, and one can seldom be absolutely certain as to the exact number of ring-joints in a given antenna. While these antennal differences, within certain limits, are undoubtedly of importance as specific characters their use as generic characters can only result in adding confusion to a situation that is already tangled enough.

Disregarding in large part the antennae and recognizing as the essential features of the genus the medially bicarinate propodeum, together with those other characters ascribed to the genus by Waterston, will bring together a natural group of species which may be easily recognized and readily defined. The group will include species having widely different types of antennae, ranging from those having four ring-joints, a 2-jointed funicle and a solid club, as in the male of *clisiognathus* Waterston, to those having two ring-joints, four distinctly pedicellated funicle joints, and a solid club as in the female of *atamiensis* Ashmead. The fact that antennae of the two sexes of the same species not infrequently exhibit such widely different characters as illustrated by Waterston in the species *clisiognathus* is proof enough that antennal characters are not of generic value in this group.

The scutellar character referred to by Girault for the genus *Pseudacriasoides* is of even less value than the antennal characters. The alleged median groove on the base of scutellum is nothing more than a very slight longitudinal depression marking the line of convergence of the sculpture from the two sides of the scutellum. In some specimens it does not appear at all.

*Epipleurotropis* Girault is based on *Epipleurotropis longfellowi* Girault, the type material of which consists of a single male specimen the head of which was removed by the describer and crushed beneath a cover glass. The abdomen is missing. Judged by what remains of this specimen this is a distinct and well marked species but not sufficiently different to warrant separation from *Pleurotropis*. The scutellum is smooth medially and mostly so laterally but with a narrow longitudinal depressed line of sculpture on each side, appearing as a shallow groove. The propodeum does not differ from ordinary *Pleurotropis* except that the medial carinae are slightly less prominent than usual. The mandibles are bidentate with the inner margin exhibiting two or three fine serrations, a character common to a number of species of *Pleurotropis* as pointed out by Waterston. The antennae are of the same type as the male of *Pleurotropis utahensis*.

**Pleurotropis benefica**, new species.

Apparently closely related to *Pleurotropis nigritarsis* Thomson but differing from the description of that species principally in antennal characters. Also similar to *Pleurotropis utahensis* Crawford but is readily distinguished from that species by the dark tarsi, by the relatively longer and more hairy antennal joints, by the more strongly sculptured and differently colored front of the head, and by slight differences in the propodeum and abdominal petiole.

*Female.*—Length 3 mm. Head slightly broader than the thorax; vertex rather flat, separated from the occiput by a sharp carinate margin, and closely and strongly punctate; ocelli in an obtuse triangle, the lateral ocelli removed from the eye-margin about the long diameter of an ocellus; occiput concave, opaquely sculptured with a smooth line medially; eyes large, sparsely clothed with whitish hairs, deeply emarginate within and less strongly so behind; posterior orbits strongly punctate and clothed with rather coarse dark colored hairs; malar space short, about equal in length to the antennal pedicel; front of the head inflexed, above the transverse groove shining with shallow reticulations, between the transverse groove and base of antennae closely and deeply punctate and subopaque, just below the base of antennae weakly reticulated and shining, mouth-border finely opaquely punctate; antennae 10-jointed, inserted slightly

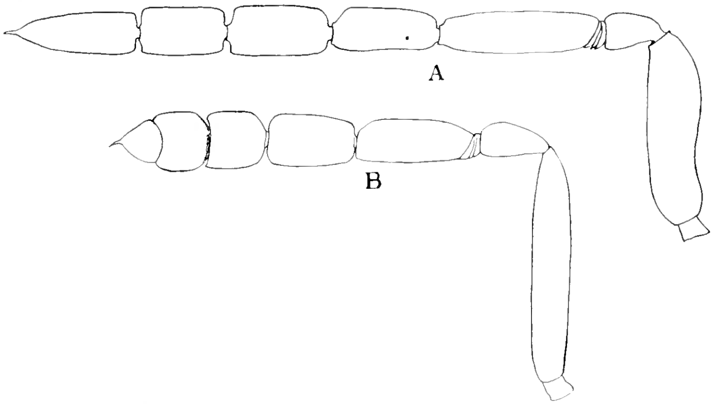


FIG. 2—Antennae of *Pleurotropis benefica* Gahan. A, male; B, female.

above the lower eyemargins and separated at base by a distinct ridge; scape slender, slightly curved and more or less flattened and shining metallic on the outer side, sculptured and darker on the inner side with seven to eight erect hairs on the ventral margin; pedicel about twice as long as thick; three small transverse ring-joints; flagellar joints all distinctly hairy; first funicle joint distinctly the longest, about three times as long as thick; second a little thicker than the first and approximately twice as long as thick; third about as long as thick and a little more closely joined to the following joint than to the preceding; club 2-jointed, about equal in length to the second funicle joint, the basal club joint subquadrate and as broad as the funicle, second or apical joint much narrower, conical, incompletely separated from the basal joint and terminating in a short but distinct spine; pronotum above with a narrow smooth posterior margin set off by a carina from the anterior declivous portion which is sculptured; mesoscutum strongly punctate, the parapsidal grooves complete and each terminating posteriorly in a large foveiform depression, the surface within the depression as strongly sculptured as the remainder of mesoscutum; scutellum much longer than broad, sculptured like the mesoscutum, except that on the anterior half of scutellum the punctures are somewhat smaller; axillae above sculptured like mesoscutum, below much more finely punctate; propodeum polished, the median carina forked a little behind the middle, the lateral folds straight and well developed, spiracular furrows deep; posterior lateral angles of the propodeum produced into a short triangular tooth-like process just above the attachment of the hind coxae; mesosternum nearly smooth, the median groove terminating anteriorly in a foveiform enlargement; abdomen not quite as long as the head and thorax, pointed ovate; petiole large, broader than long, opaque, carinately margined laterally, above and below, and with the anterior margin produced dorsally into a short flange which overlaps the posterior end of the propodeum; second segment comprising about one-third the length of the abdomen, smooth basally, the apical half weakly reticulated; third and following tergites all finely sculptured, subopaque, and distinctly though sparsely hairy; third tergite about one-third as long as the second; fourth to sixth subequal and each about two-thirds as long as the third; seventh approximately equal to the third; ovipositor concealed; submarginal vein of the forewing distinctly less than half as long as the very long marginal, with two or three upright black bristles above; proximal end of the marginal vein with a similar bristle, also; post-marginal and stigmal veins short and subequal. General color bright bluish-green; head darker than the thorax with the occiput black, and the face blackish, except that the area just below the insertion of antennae is coppery and the triangular area above the transverse groove is slightly more bluish; antennae entirely metallic black; legs concolorous with the thorax, their tarsi brownish black; second tergite bright blue-green; the petiole and segments beyond the second brownish-black; wings hyaline, the venation dark brown.

*Male.*—Length 2.2 mm. Antennae 10-jointed, scape slightly and nearly uniformly thickened, about four times as long as thick; pedicel not much longer than thick; three ring-joints transverse; flagellum longer but no more hairy than in the female; first funicle joint four times, second two and one-half times, and the third slightly more than twice as long as thick; fourth joint barely twice as long as thick; club solid, about as long as the second funicle joint and terminating in a distinct spine; abdomen short, the segments beyond the fourth retracted and mostly concealed; petiole longer than broad, almost as long as the hind coxae, and without distinct marginal carinae. Otherwise like the female except that the head is for the most part concolorous with the thorax, only the occiput and a transverse patch on the vertex embracing the posterior ocelli being black.

*Type-locality.*—Mount Holly Springs, Pennsylvania.

*Type.*—Cat. No. 24,166, U. S. Nat. Mus.

*Host.*—*Trachelus tabidus* Fabricius.

Eleven females and four males reared by W. R. McConnell, April 13 to 19, 1919, from hibernating prepupal larva of the black grain-stem sawfly and recorded in the Bureau of Entomology under Webster No. 18,700; one female paratype reared at Carlisle, Pennsylvania, by C. C. Hill, April 20, 1919, from the same host; and one male paratype reared by P. R. Myers, April 30, 1919, with the same locality and host. Antennae of type and allotype mounted on a slide.

Mr. McConnell states that the species is a primary parasite and that only a single individual is obtained from a host larva.

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## DISTRICT OF COLUMBIA DIPTERA: SCATOPSIDAE.

By W. L. McAtee.

These small to minute black flies have long been placed in the Bibionidae, but seem better grouped as a separate family. They breed in decaying vegetable matter and in excrement; in the adult stage they are most easily found in flowers and on windows. The most useful American paper on the family is that of Dr. A. L. Melander (Bul. 130, Washington Agr. Exp. St., April, 1916). It is based on a European revision of the genera by G. Enderlein (Zool. Anz. Vol. 40, pp. 261–282, October, 1912). In the last named paper genera are founded on trifling differences in venation which may not prove wholly satisfying; in fact one of them is synonymized on a subsequent page. Other genera of Enderlein's are used but it must be admitted that in certain cases only a little variation would link them up. The only genus here treated that has a distinct habitus is *Aspistes*.

*Key to the genera.*

A. Front tibia ending in a decurved sharp pointed process; thorax strongly elevated anteriorly, the declivity coarsely punctured; wing without apical cell, i. e., anterior branch of fourth vein interrupted basally. .......... *Aspistes*.

AA. Without the preceding combination of characters.

B. Anterior branch of fourth vein strongly angulate near base or emitting a crossvein which extends part way or entirely to third vein .......... *Scatopse*.

BB. Anterior branch of fourth vein neither angulate nor emitting a crossvein.

C. Apical wing cell present.

D. Apical cell much shorter than its stalk .......... *Swammerdamella*.

DD. Apical cell longer than its stalk.

E. Last vein of wing with a single curve; vein 3 remote from costa, section from radial crossvein to costal margin strongly curved into wing; radial crossvein near middle of second vein; subcostal cell usually larger than costal; halteres white; hind tibiae abruptly expanded distally .......... *Reichertella*.

EE. Last vein bent twice or thrice; vein 3 close to and nearly paralleling costa, in nearly a straight line from the radial crossvein to costal margin; radial crossvein nearer end of second vein; subcostal cell usually smaller than costal; halteres dark; hind tibiae not so expanded ........ *Rhegmoclema.*

CC. Apical cell lacking; i. e., anterior branch of fourth vein interrupted basally.

F. Last vein simply curved; third vein curved remote from costa; radial crossvein at about middle of second vein; subcostal cell much larger than costal ........ *Anapausis.*

FF. Last vein bent twice; third vein straighter, nearer costa; radial crossvein between 4th and last fifths of second vein; subcostal cell much larger than costal ........ *Aldrovandiella.*

## SCATOPSE Geoffroy.

The genus *Holoplagia* Enderlein (Zool. Anz. Bd. 40, No. 10–11, Oct. 18, 1912, p. 267), for the separation of which from *Scatopse*, the chief character is that the crossvein between veins 3 and 4 is complete, would appear untenable since all degrees of completeness of the vein may be found in a single species *Scatopse notata*. A new species is here described that has no part of a crossvein (in the specimens thus far examined) but only a hump at a point in anterior branch of fourth vein corresponding to the origin of the stump or crossvein of species having one.

*Key to the species.*

A. With a more or less complete crossvein between anterior branch of 4th vein and 3d vein; tibiae black usually with a brown annulus ........ *notata.*

AA. No crossvein, but anterior branch of 4th vein distinctly angulate at point corresponding to origin of crossvein in last species; tibiae and tarsi chiefly pale.

B. Joints 3–6 of antennae pale; tibiae with only narrow rings of dark color ........ *varicornis.*

BB. Antennae wholly black; dark annuli on tibiae broader on each succeeding pair of legs posteriorly, the hind tibiae about half dark ........ *tibialis* n. sp.

### Scatopse notata Linnæus.

One of the most common species; has been taken in Virginia near Plummers Id., Oct. 19, 1914, R. C. Shannon; Plummers Id., Md., Oct. 26, 1906, A. K. Fisher; Maryland near Plummers Id., April 28, 1914, on flowers of wild plum; Cabin John, Md., April 14, 1916, R. C. Shannon; Berwyn, Md., April 1, 1917, on flowers of *Salix capraea*, McAtee; Cleveland Park, D. C., April 14, 1918, H. L. Viereck; Washington, D. C., November 2, 1906, McAtee, April 2, 6, 1895 (U. S. N. M.). McAtee took numerous specimens also, on Matinicus Id., Maine, Oct. 29, 1915, from brine in hogsheads of pickled fish.

**Scatopse varicornis** Coquillett.

Originally described from a specimen collected in the District of Columbia by T. Pergande; no other seen.

**Scatopse tibialis**, n. sp.

Third vein chiefly paralleling costa, joining it at a point more than two-thirds of the distance from root to apex of wing, second vein joining costa a little more than half-way from wing-root to end of third vein; radial crossvein between 4th and last fifths of second vein; anterior branch of fourth vein distinctly angulate at a point somewhat more than one-fourth its length from origin; last vein bent at almost right angles once, then again at a slightly greater angle. General color black; face with bristly black hairs, the head including antennae opaque, the latter (.46–.52 mm. long) however, with hairs which appear pale in reflected light; thorax shining, somewhat greenish black, with sparse short pale reddish hairs; scutellum opaque dead black; abdomen opaque with vestiture of short pale hairs which in reflected light make the surface appear seal-brown; legs normal in shape, femora black, distal joints more or less pale; femora with fine white pubescence which shows in reflected light, the basal half of each tibia glistening white, this followed by a darker (fuscous to black) annulus broader on each succeeding leg posteriorly, the apex of each tibia and tarsus yellow-brown. Length 1.84 mm.

Type, a female, Falls Church, Va., June 21, 1914, F. Knab. (U. S. N. M.) Paratype, same sex, Great Falls, Va., May 19, 1915, McAtee. A damaged specimen probably also of this species Plummers Id., Md., August 11, 1907, McAtee.

**SWAMMERDAMELLA** Enderlein.

A. Apical cell very short triangular, about one-third the length of its stalk ........ *brevicornis*.

AA. Apical cell relatively longer, but much shorter than its stalk, its sides close together basally, but suddenly diverging apically ........ *pygmaea*.

**Swammerdamella brevicornis** Meigen.

A minute species, varying from slightly less to slightly more than 1 mm. in length. Washington, D. C., June 6, 19, 1912, on windows, McAtee; Plummers Id., Md., August 1, 1903, E. A. Schwarz, A. Busck.

**Swammerdamella pygmaea** Loew.

Originally described from District of Columbia material. The type was only .85 mm. long, but other specimens measure up to 1.5 mm. Maryland near Plummers Id., May 10, 1914, under bark of honey locust, R. C. Shannon.

**REICHERTELLA** Enderlein.

A. Femora swollen; antennae shorter than head *femoralis*.
AA. Femora slender; antennae as long as head *gracilis* n. sp.

**Reichertella femoralis** Meigen.

Virginia near Plummers Id., Md., May 20, 1914, R. C. Shannon.

**Reichertella gracilis**, n. sp.

First section of costa : second :: 2 : 1; subcostal cell broad; apical cell much longer than its stalk. Body black, mostly shining; legs somewhat brownish; slender, hind tibiae expanded apically. Length 1.8 mm.; antenna .34 mm.

Type, a female, Washington, D. C., May 24, 1916, A. Busck (U. S. N. M.).

**RHEGMOCLEMA** Enderlein.

A. Second vein joining costa at from one-half to two-thirds distance between wing-root and end of third vein.
B. Length 1.3–2 mm., color normally deep black; last male tergite tapered into a long process which is not expanded apically *atrata*.
BB. Length 1.1–1.3 mm., color in part or wholly brown; last male tergite tapering into a long process which is spatulate apically *barrus* n. sp.
AA. Second vein extending farther distally; second section of costa only about one-fourth length of first.
C. Apical cell about the same length as its stalk *floralis* n. sp.
CC. Apical cell much longer than its stalk *willistoni* n. n.

**Rhegmoclema atrata** Say.

Fairly common; Virginia near Plummers Id., Md., Nov. 2, to 15, bred from butternut (*Juglans cinerea*) hulls collected Oct. 10, 1914; Plummers Id., Md., Aug. 8, 1914, bred from fungus; Md., near Plummers Id., May 5, 1915, R. C. Shannon; Maywood, Va., April 21, May 26, 1916; Washington, D. C., June 4, 29, 1912, on windows, McAtee; May 21, 1915, H. S. Barber; June 7, 11, 1915, F. Knab; Woodridge, D. C., April 25, 1914, L. O. Jackson. Specimens are at hand also from Salmo, Wis., Aug. 11, 1919, McAtee.

**Rhegmoclema barrus**, n. sp.

First section of costa : second :: 5 : 3; apical cell more than three times as long as its stalk; last vein trisinuate, only the median bend very strong. Head and body blackish (sometimes brown), pleura, and legs brownish. Last male tergite shining pale brownish, cream colored at base, tapered apically into a long process which is more or less expanded apically. Length 1.1–1.3 mm.; antennae about .25 mm.

Type, a male, Washington, D. C., January 15, 1915, R. C. Shannon. Several paratypes with same data. (U. S. N. M.)

**Rhegmoclema floralis**, n. sp.

First section of costa : second :: 13 : 3; apical cell almost exactly as long as its stalk; last vein bisinuate. Black, thorax somewhat shining, abdomen rather opaque; last tergite brown, polished, the deflexed terminal portion a very short but broad triangle; legs paler distally, the tarsi yellow-brown. Length 1.3–1.6 mm.; antennae .19-.23 mm.

Type, a male, Plummers Id., Md., from flowers of *Staphylea trifoliata*, April 28, 1915, McAtee. (U. S. N. M.)

Paratypes Great Falls, Va., May 21, 1917, McAtee; and with same data as type. On this occasion the flowers of the bladder-pod shrub from which they were collected were literally filled with these little flies, many pairs of which were in copula.

**Rhegmoclema willistoni,** n. n.

The species published by Williston (Trans. Ent. Soc. London, 1896, p. 269, Pl. VIII, fig. 26) as *Scatopse pygmaea* Loew (Cent. V, 13) is not that species (Melander, Bul. 130, Wash. Agr. Exp. Sts., 1916, p. 14) hence the name *Scatopse pygmaea* Williston was a homonym from the beginning. So far as the writer is aware Williston's species has not yet been named, and he is pleased to be able to name it for the late Dr. S. W. Williston, who had in the highest degree that most admirable quality in a systematist, the conscious purpose of aiding others in the study of his specialty. What a contrast is this policy to the monopolistic tendencies characterizing the work of some taxonomists, but in the long run how much more profitable to science and vastly more creditable to its exponent.

A single specimen, now unfortunately lost, which seemed to agree perfectly with Williston's description and figure was collected at Dead Run, Va., May 5, 1915, by R. C. Shannon.

**ANAPAUSIS** Enderlein.

**Anapausis cismarina,** n. sp.

First section of costa : second :: 2 : 1; subcostal cell broad, anterior branch of fourth vein interrupted basally; last vein only slightly curved. Color black, shining, with a brownish cast especially on legs, halteres yellow brown. Length 1.98 mm., antenna .33 mm. Male genital segment with two hairy stylets, transversely grooved (hence appearing segmented); preceding segment divided, the ends produced posteriorly into prominent teeth, one each side of median line; claspers with a strong tooth externally, which is sinuate on its concave antero-exterior margin.

Type, a female, Great Falls, Va., May 19, 1915, in flower of *Liriodendron tulipifera*, W. L. McAtee. (U. S. N. M.) Allotype, same locality and date.

**ASPISTES** Meigen.

**Aspistes hartii** Malloch.

Beltsville, Md., May 2, June 9, 1915, May 25, 1919, McAtee.

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OF THE

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## TWO NEW SPECIES OF DIPTERA.

By Charles T. Greene, *Bureau of Entomology*.

The species treated below were referred to the author by Mr. W. R. Walton, in charge of the Cereal and Forage Insect Investigations of the U. S. Bureau of Entomology. Mr. Walton also made the drawing of the puparia showing how they are formed into a cluster or comb.

The social habit of the larvae of *S. sociabilis* is curious. The puparia are very firmly cemented together and it is impossible to separate them without fracturing several cells of the comb. The anal stigmata are unusually large in proportion to the size of the puparium which is thickly, though shortly pilose, excepting immediately surrounding the stigmal field. The species is new and may be characterized as follows:

### **Sturmia sociabilis**, new species.

*Male and female.*—Black, thickly covered with a pale gray pollen. Length, male 5 mm.; female 6 mm.

*Female.*—Front one-fourth the total width of the head at vertex; thickly dusted with a golden pollen which extends to the lower end of the sides of the face; the usual frontal bristles reach to the middle of the second antennal joint; two large orbitals directed forward; in addition to the usual bristles there are several very small, erect hairs, some are in the form of a straight line close to the eye margin; frontal stripe reddish brown, one fourth the width of the front before ocelli and extending on each side of the ocellar triangle. Ocellar bristles very small, converging forward. Facial depression dusted with silvery white; ridges with only three or four bristles above the vibrissae. Antennae black, reaching the lowest fourth of the face, faintly reddish on the outside near the base of third joint; arista about as long as the antennae, reddish, thickened on basal half. Vibrissae large. Palpi well developed; apex yellow, black on basal half or more. Thorax with four narrow, black vittae; four posterior dorso centrals. Scutellum black, faintly yellowish at the apex; one discal pair of macrochaeta; three marginal pairs and an additional smaller apical pair, decussate. Four sternopleurals. Abdomen all black; second segment with one pair median marginal, one pair lateral; also a very narrow median black stripe; third segment with four marginal pairs; no discals on either segments. Legs black; knees very narrowly reddish; middle tibia with one large bristle on front side near the middle. Hind tibiae evenly ciliated with one large bristle in the middle. Wing with one large bristle at base of third vein.

*Male.*—Same as female except the front is slightly narrower and there are no orbitals. Ventral surface of the third segment shining, having the appearance of being varnished.

Described from four (4) females and two (2) males. Specimens labeled—Rio Piedras, P. R. May 23, 1913, P. R. S. G. A. Ac. No. 473, 1913—J. R. Johnson, Collector.

Holotype, Female, Cat. No. 24,146 United States National Museum. Allotype, Male, Cat. No. 24,146.

This species runs to *S. inquinata* in Coquillett's Revision. It is undoubtedly related to *Sturmia distincta* Wied. a common parasite of the sphinx moths in North America. The latter species has the social habit in pupation as is evidenced by specimens reared by Mr. George W. Barber of the Bureau of Entomology at Charleston, Mo., October 24, 1914, from the larva of a sphingid (species undetermined). The puparia in this case are cemented together precisely as in *sociabilis* and form a disc nearly circular in outline. In the case of *S. sociabilis*

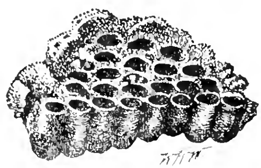

Fig. 1—Puparia of *Sturmia sociabilis*.

it was suggested to Mr. Jones that possibly the larvae were confined in so small a space that they were compelled to crowd each other in order to secure space in which to pupate but he stated that this was not the case.

**Phorocera meracanthae**, new species.

*Male and female.*—Back species covered with whitish pollen; in certain lights the apical edges of the abdominal segments are black and also have a broad black stripe on the third and fourth segment. Eyes hairy. Length, male 9 mm.; female 8 to 10 mm.

*Male.*—Front prominent, silvery, about one-fourth the head width and with numerous bristly hairs in addition to the frontal bristles; lowest frontals reach slightly below apex of second antennal joint; below these are four or five bristly hairs. Frontal stripe deep reddish brown. Ocellar triangle black with numerous long, bristly hairs; ocellar pair large, directed obliquely forward. Antennae long, reaching nearly the length of the face; third joint narrowly reddish at base and about five times the length of the second. Arista long, thickened on the basal fourth. Face strongly receding; ridges bristly almost to the lowest frontals. Vibrissae large, decussate. Palpi dull yellow, well developed. Thorax covered with white pollen forming four narrow, indistinct black vittae on anterior portion; four posterior dorso centrals. Scutellum concolorous; a discal pair of macrochaetae, also three pairs of large marginals and a small, decussate, apical pair. Abdominal segments with macrochaetae as follows: first and second segments with a median and lateral pair; third with four marginal pairs;

second and third segments with a discal pair. Sternopleura with three bristles. Middle tibiae each bearing one large and one small macrochaetae on the front side near the middle. Wing with the third vein bearing two bristles at the base. Length nine (9) mm.

*Female.*—Like the male except the following differences: Two large orbitals directed forward; several more large hairs below the lowest frontal. Scutellum reddish yellow on apical third to half. Wing with two or three bristles at the base of the third vein. Length eight (8) to ten (10) mm.

Described from six specimens. One male labeled as follows: Meyersville, Md., June 4, 1914; H254; J. A. Hyslop, Collector.

Holotype, male, Cat. No. 24,147 United States National Museum. Allotype, female, Cat. No. 24,147.

Reared at Hagerstown, Md., from the larva of *Meracantha contracta* Beauv. There were two other specimens in this lot of material but I did not think it advisable to include them because they are not fully matured.

Five females from the National Museum Collection labeled as follows: two specimens from Beltsville, Md., July 9, 1916, and one specimen from Mount Vernon, Va., July 4, 1917, W. L. McAtee, Collector. Two specimens from Hell Canyon, N. M., 7,200 feet; Manzano National Forest, 18,IX,16; C. H. T. Townsend, Collector.

This species is closely allied to *P. facialis Coq.*

All the material is in the United States National Museum Collection.

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## STUDIES OF ZENILLIA ROSEANAE B. & B. A PARASITE OF THE EUROPEAN CORN BORER. (Pyrausta nubilalis Hb.)

By W. R. Thompson, *U. S. Bureau of Entomology*, and M. C. Thompson.

### INTRODUCTION.

The present paper embodies a portion of the principal technical results obtained during the first year of work in southern France on one of the European parasites of the European corn borer, under the direction of the senior author of this paper, acting under instructions from the Chief of the Bureau of Entomology.

This paper contains the technical information necessary for the recognition of the parasite under consideration, in each of the successive stages of its development and for the elaboration of satisfactory methods of rearing and colonization.

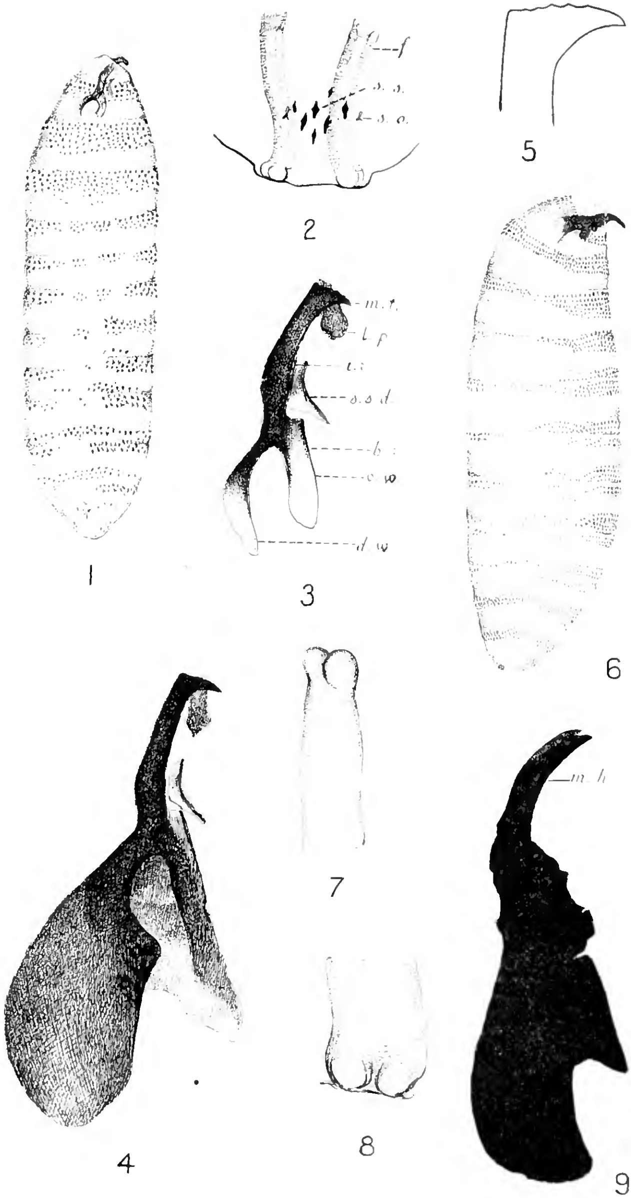
### Zenillia roseanae B. & B.

*Zenillia roseanae* B. & B. is a Dipterous parasite belonging to the family Tachinidae. The females of this species are larviparous, depositing upon the body of the host caterpillar thin-shelled eggs containing larvae ready to hatch immediately. The larva resembles in general structure the maggots of ordinary Muscids, such as the House-fly. Like the latter, it passes through three morphologically distinct stages separated by moults. The pupal stage is passed within the hardened skin of the last stage larva which forms the characteristic puparium.

## TECHNICAL DESCRIPTION.

The egg measures about 0.65 mm. x 0.175 mm. It is approximately cylindrical, tapering slightly anteriorly; the chorion is colorless and presents under high magnifications a fine punctuation.

The first stage larva measures about 0.65 mm. x 0.175 mm. It is moderately elongate (Fig. 1), cylindrical, tapering rather abruptly posteriorly, more gradually toward the anterior extremity; the cuticle is colorless and transparent; the body is composed of 11 segments and a minute head or pseudocephalon; the cuticle is colorless, transparent and unsculptured, bearing bands of minute dark spines. These bands of spines are broadest on the thoracic segments and particularly on segment II. On the abdominal segments they are narrower and here the dorsal part of each band is separated from the ventral part by a small pleural space in the middle of which there exists a small, isolated patch of spines. On segments I–VI inclusive, the bands of spines are situated on the anterior region of each segment, but on segment VII there appears, just in front of the dorsal extremity of the ventral spine-band of segment VIII, a small isolated group of spines situated near the posterior border of the segment. On segment VIII, below a similar patch, there sometimes appears a short ventral row and a similar dorsal one, running parallel to the band on the anterior border of the segment following and on segment IX there is a complete posterior band of spines, broadest in the pleural region. On the posterior border of segment X a similar band exists. As one passes toward the posterior extremity of the larva, the bands of spines on the anterior border of the segments become narrower and less important so that on segment X the pleural group has disappeared, while on segment XI only a few pleuro-ventral spines remain on the anterior border. The spines on the anterior border of the segments of the larva are directed forward while those on the posterior border are directed backward. The disposition of the spines on the last segment is rather unusual and serves to distinguish this species at once from the other Tachinid parasites of Pyrausta so far studied. On this segment there exists, in addition to the few ventro-lateral spines already mentioned, a ventral band traversing the middle of the segment, interrupted a short distance on either side of the median line, so as to isolate a median group, and, finally, between this band and the posterior extremity, a ventral patch of spines for the most part much heavier and darker than the other spines of the body and directed forward. Opposite the ventral group, on the dorsal surface, is a similar group (Fig. 2), which is slightly larger and situated between the pleural extremities of the median ventral band. These two groups of spines bear a functional relation to the posterior stigmata similar to that of

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the posterior hooks of such primary larvae as that of *Compsilura concinnata* Meig.

In this stage the larva is metapneustic; the posterior stigmata open a little to the dorsal side of the apex of the last segment; each stigma presents two respiratory papillae; the "felt-chambers" (Fig. 2) are about 6.5 as long as their diameter.

The mouth-hook or bucco-pharyngeal armature is represented by the Figures 3, 4 and 5 and it is therefore unnecessary to describe it in detail. In this stage it is without articulations; the median tooth presents 5 or 6 minute denticles (Fig. 5) on the cutting edge. In the newly hatched larva the armature has the form represented in the Figure 3, but at the end of this stage its aspect is superficially very different owing to a progressive chitinization which takes place in the pharyngeal cuticula surrounding the basal plates, and especially the dorsal wing (Fig. 4). This increase in the area of the basal portion of the armature corresponds to an increase during the first stage of the posterior part of the pharynx containing the elevator muscles and is doubtless due to the excitation of the pharyngeal epithelium by these muscles.

The sensorial organs of the larva are minute. The cephalic organs consist chiefly of a dorsal element, plano-convex in outline—the antenna—and a more ventral group of minute organs, constituting the maxilla. The sensorial organs of the body segments comprise a certain number of minute clavate hairs and more numerous minute circular pits. These organs are constant in number and distribution (Fig. 2).

The second stage larva (Fig. 6) measures about 4.0 mm. x 1.0 mm. (hibernating larvae). The larva is now more robust than in the first stage. The cuticula is colorless and transparent but the spine armature is relatively somewhat more conspicuous than in the first stage. On the first three segments there exists only an anterior band of spines which on segment II and III is broadened so as to form an oval plate in the ventral region. On segment IV a posterior band appears in the ventral region. On segment V a few curving rows of spines appear at the pleural extremity of this ventral band. The dorsal anterior band of segment VI is broken in the pleural region, and the pleural group above the posterior ventral band is larger. On segment VII the dorsal anterior band is feebly developed; the anterior pleural group is divided: and the anterior ventral band consists of only a few rows of small spines. On the posterior border a single short dorsal row appears. On segment VIII the dorsal anterior band is very feebly developed; there is a pleural group semi-circular in form, opposite the pleural group on the posterior border of segment VII; and the ventral anterior band is feeble and medially interrupted. On this segment the posterior band is now almost complete though still rather feeble in the dorsal region. On segment IX the dorsal part of the anterior band is absent and the pleural and ventral anterior groups are feeble; a continuous, moderately broad band of heavy spines exists on the posterior border. On segment X the anterior band is represented only by a few minute pleural spines and a single ventral row. The posterior band is like that on the preceding segment. On the last segment there exists a pleural group of curving rows of feeble spines, a median ventral group and dorsal and ventral groups of stigmatic spines as in the first stage.

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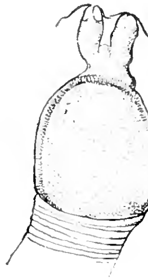

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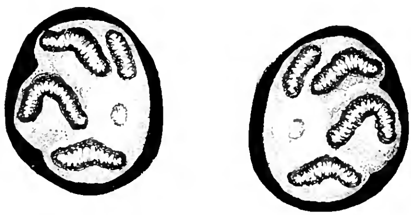

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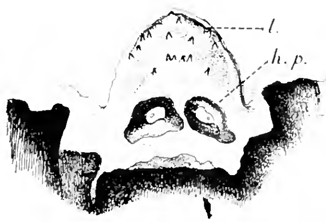


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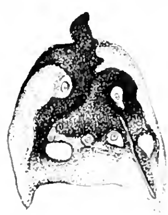

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The second stage larva is amphipneustic. The anterior stigmata are small and are situated just in front of the anterior border of segment III in the middle of the pleural region; each presents two respiratory papillae (Fig. 7); the felt-chamber is uniform in diameter throughout its length. The posterior stigmata (Fig. 8) open on the dorsal aspect of the apex of posterior extremity; each presents two respiratory papillae; the felt-chambers are more robust than in the first stage, the ratio of length to diameter being about 2 : 1.

The bucco-pharyngeal armature is represented in figure 9; in this stage there is no median hook, and it is replaced functionally by a pair of elongate curved lateral or mandibular hooks, which are the homologues of the small lateral plates of the first stage larva (Fig. 3); the base of the ventral wing of the basal plate is partly separated from the intermediate region by a short narrow incision but as in the first stage there are no articulations in the armature which forms a solid block.

The third stage larva (Fig. 10) measures 11.0 mm. x 3.0 mm. It is sometimes rather crescentic in form, the dorsal side being slightly concave, the ventral side convex. On the ventral side, the surface of the body presents a series of oval convexities, functioning as pseudopodia and situated in the region of the intersegmental conjunctivae IV–V, V–VI, VI–VII, VII–VIII, VIII–IX, IX–X, X–XI. These pseudopodia are slightly developed on the anterior segments but more prominent posteriorly. The one situated on the conjunctiva X–XI, surrounds the anal opening of the larva. In this stage, the cuticular spines, while perhaps as numerous as in the preceding stage, are relatively much less apparent so that under a low power the cuticle appears to be naked; the spines are arranged for the most part in curving rows separated by rather wide intervals. An anterior band exists on segments I–III, but on segments IV–VIII inclusive this band is broken in the pleural region, while on segments IX–XI, the dorsal part of the band, represented on segment VIII only by a few spines, is absent. The ventral part of the anterior band exists on all the segments to the Xth, where it is interrupted below the pleural region. On segment V there appears a posterior ventral band associated with a posterior pleural group on segments VI–IX. On segment X there is a complete and well developed posterior spine band. The XIth segment bears dorsal and ventral patches of stigmatic spines as in the preceding stages.

The third stage larva is amphipneustic; the felt-chamber of the anterior stigma is considerably swollen but diminishes rapidly in diameter distally where it terminates in the respiratory papillae (Fig. 11); these are generally two in number but not infrequently three are present and in some specimens as many as five exist; when such variations occur they are sometimes symmetrical but often not so. The posterior stigmata (Fig. 12) situated on the apex of the posterior extremity, are much larger than in the preceding stages and each possesses 4 respiratory slits of which the dorsal and ventral elements are generally short and straight while the intermediate pair are curved; the stigmatic area is surrounded by a well-developed, heavily chitinized, unbroken peritreme; the stigmata in the larva are separated by a distance equal to about one half the diameter of each stigma; the felt-chambers are very short and broad.

The bucco-pharyngeal armature (Fig. 13) differs greatly in form from that of the preceding stage; the lateral paired mandibular hooks are short, stout and straight with acute distal extremities; the ventral sclerite of the salivary duct, while not detached from the intermediate region, is very prominent; an articulation now exists between the intermediate and basal regions; the dorso-anterior angle of the dorsal wing of the basal plate is strongly produced anteriorly, while the posterior portion of this wing presents a deep narrow cleft; the hypopharyngeal plates (Fig. 14) are irregularly quadrangular in form and paired; each presents an oval or rounded sensorial unchitinized area; the inner surface of the labium bears a few rows of stout uncolored spines; the epipharyngeal plate (Fig. 15) is emarginate posteriorly and produced anteriorly into a short rounded tooth; it bears several sensorial areas as indicated in the figure.

The puparium measures about 6.5 mm. x 3.0 mm.; it varies in color from light to dark reddish brown; the surface is smooth without apparent rugosities or excrescences and moderately polished; the puparial wall is sufficiently transparent so that the cast third stage mouth hooks can usually be seen through the cap; the anterior extremity is rounded or hemispherical; the anterior stigmata are inconspicuous, not protuberant or elevated; the line of cleavage separating the two halves of the puparial cap passes posteriorly on the ventral side of the anterior stigmata and terminates just behind the anterior spine band of segment IV; the circular line of cleavage runs perpendicularly to this point around the puparium; the prothoracic cornicles traverse the puparial wall just in front of the posterior margin of segment IV, slightly postero-dorsad to the posterior end of the longitudinal line of cleavage of the cap; *the posterior end of the puparium* is rounded conical or sub-conical; the posterior stigmata are situated slightly dorsad of the posterior apex; they are inconspicuous and scarcely elevated above the surface of the puparium.

The respiratory apparatus of the pupa has the form shown in the figure 16; the internal spiracle is oval and presents 7 or 8 double rows of respiratory papillae; the terminal portion of the prothoracic cornicle is rather slender and only moderately chitinized, with a rather small number of spiracular openings (Fig. 17).

## The Adult.

According to the system of classification based on adult characters, this species belongs in the genus *Zenillia* R.-D. Dr. J. Villeneuve has very kindly supplied me with the diagnostic characters of this genus.

The genus *Zenillia*, writes Dr. Villeneuve, has replaced the genera *Myxexorista* B. B., *Tritochaeta* B. B.; the vibrissae become weaker as they approach the upper part of the facial plate and, especially in the female, cease to exist toward the upper half or third of the facial plate; eyes hairy; no orbital bristles in the male; front moderately broad; anterior claws of the male more or less elongate; posterior tibiae with regular or irregular ciliation; third longitudinal vein bearing bristles at its origin only; bend of the fourth vein without an appendage; second segment of the arista not perceptibly elongate; apical bristles present on the scutellum.

The synonymy of the genus *Zenillia*, according to the Catalogue of Palaearctic Diptera, of Bezzi and Stein, is as follows:

Zenillia R.-D. Myodaires, 152, I (1830).
syn. Atilia R.-D. 1863.
Clemelis R.-D. 1863.
Elpe R.-D. 1863.
Myxexorista B. B. 1891.
Nilea R.-D. 1863.
Sagaris R.-D. 1863.
Tritochaeta B. B. 1889.
Zelinda R.-D. 1863.

*Zenillia roseanae* was originally described by Brauer and von Bergenstamm in Denkschr. Akad. Wien. LVIII, 332, (1891) under the genus *Myxexorista*. As the original description is rather brief, I have prepared a new one from the specimens reared from Pyrausta which has been made sufficiently detailed for purposes of identification.

The adult (Fig. 18) is black, the calypteres brownish, the wings hyaline.

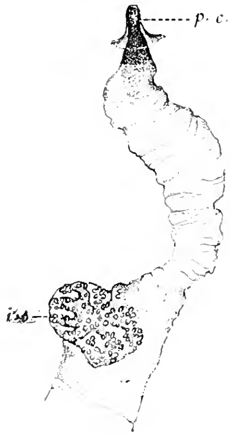
*Male.*—Front, seen from above about four-fifths as wide as eye; frontal vitta dark brown; pollen of para-frontals, para-facials and cheeks bluish grey; a single row of strong frontal bristles and outside this several rows of fine hairs; three to five frontal bristles below the base of the antennae, the row extending below the apex of the second antennal segment; para-facials bare; facial ridges ciliate on about the lower half; cheeks about one-fifth eye-height; eyes densely hairy; palpi black; occiput flat; antennae as long as the facial plate, the third segment about five times the length of the second; the arista thickened on its basal half.

Mesonotum black, thinly dusted with greyish-blue pollen, with one median and two pairs of lateral black vittae not very apparent from above; an irregular black vitta adjacent to the margin of the humeral callus; pleurae blue-black, very thinly dusted; 4 sterno-pleural bristles 1:2:1; 4 post-sutural and 3 post-acrostichal bristles; scutellum rather thinly pollinose, bearing 3 pairs of marginal bristles, a pair of cruciate, upwardly directed apical bristles and a pair of discal bristles.

Abdomen with segments II–IV greyish pollinose anteriorly, the bands of pollen interrupted by a dorsal median vitta; first segment with a pair of marginal bristles, sometimes feeble; second segment with a pair of discals and a pair of marginals; third segment with a pair of discals and a marginal ring; fourth segment with numerous scattered bristles; hypopygium not prominent, the visible portion polished black; hind tibiae regularly ciliate though one of the bristles toward the middle of the row is often larger than the others.

*Female.*—Two forwardly directed and one backwardly directed orbital bristles on each side; front, seen from above about as wide as eye; antenna not extending quite the full length of the facial plate, the third segment 3.5–4 times as long as the second.

The male genitalia have been represented (Fig. 19) as they present characters of value for the recognition of the species but it is not necessary for the purpose of this paper to describe them in detail. The female internal reproductive system corresponds in form to that of the species of Group VI in the system of Pan-

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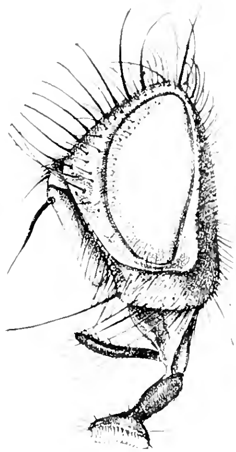

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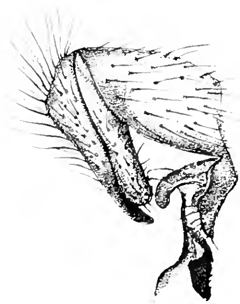

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tel; the terminal sclerites of the body of the adult female are simple and unspecialized.

## Biology.

The oviposition of this species has not been observed; but the structure of the reproductive system and of the primary larva indicates that the larvae are deposited directly on the body of the Pyrausta caterpillar during the period when the latter is feeding on the exterior of the plant or moving from place to place.

Immediately or at all events very shortly after entering the body of the host caterpillar, the primary larva enters one of the longitudinal bands of adipose tissue. The larvae of the autumn generation remain in the fat body during the winter (Fig. 20), which they pass in the second larval stage; during the initial period of its existence the larva has no connection with the tracheal system of the caterpillar and it must therefore obtain its supply of oxygen either from the ingested blood and adipose tissue of its host or from the fine tracheae which penetrate the fat body in which it lies; later on, however, the second stage larva applies its posterior extremity to a trachea of the caterpillar and forces an opening through which it secures a more abundant supply of oxygen; sometimes the larva attaches itself to one of the larger tracheal vessels, but more often to the finer branches which supply the fat body; in this stage it is thus surrounded by a sheath of mixed tracheal and fatty origin, in which, however, the adipose elements greatly predominate. Finally, after the second ecdysis, the parasite larva, which up to this time has fed only upon the blood and adipose tissue, begins to devour indiscriminately all of the internal organs of the caterpillar of which it leaves little but the skin.

The parasite larvae of the winter generation which we have had under observation have invariably emerged from caterpillars of the borer and this is also the usual habit of the larvae of the summer generation; but in one case a larva of the summer generation was observed to emerge from a chrysalid of the borer.

The larvae pupate in the gallery of the host beside the empty skin of the caterpillar from which they have emerged.

It is not necessary to consider in detail in this paper the changes produced in the structure of the adipose tissue of the host by the presence of the parasite larva; it may be noted, however, that the zone of adipose tissue immediately adjacent to the body of the Tachinid larva eventually takes on a light yellowish tinge, contrasting with the pure white color of the normal tissue in this species; in older larvae, the part of the adipose tissue forming the sheath becomes semitransparent owing to the disappearance of the fat globules from the cells composing it.

In the spring of 1920, most of the larvae of *P. nubilalis* collected in southern France were shipped to the corn-borer laboratory in Massachusetts. Consequently, few parasites were bred in the laboratory at Auch and the data secured in regard to the later phases of their life histories is somewhat fragmentary. From the information available it appears that the larvae of *Zenillia roseanae* emerge from the hibernating caterpillars of the borer about a month before the latter begin to pupate; but that the duration of the pupal and preoviposition periods in the case of the parasite are so much longer than in the case of the host, that the adult females of the Tachinid are not ready to oviposit until the young caterpillars of Pyrausta are present on the corn plant.

The first puparium found under outdoor conditions in 1920 was taken from a corn stalk in the laboratory garden on March 24; it was then freshly formed.

In caterpillars of the summer generation, larvae of *Zenillia roseanae* in stage II were first found on July 28 and last found on August 12, after which time no further dissections of the summer generation caterpillars were made in this region. The first puparium of the summer generation of this species was found in a flower stalk of the corn plant on August 3, the last on August 17, on which date a puparium from which the adult had already emerged was also collected. The duration of the pupal stage in the summer generation appears to be considerably shorter than in the hibernating generation but on this point we have not yet secured any exact information.

Few dissections of caterpillars of the autumn generation were made in 1920, but in a lot collected on October 3 a larva of *Z. roseanae* in the first stage was found in the fat body of a Pyrausta caterpillar.

The most important practical point determined by the investigations undertaken up to the present on the seasonal history of *Zenillia roseanae* is that *this parasite has a seasonal history synchronous with that of the host in southwestern France, having like the latter two generations a year of which the second is passed in the larval stage in the hibernating caterpillars of the borer.*

## Other Hosts.

In the work of Brauer and Von Bergenstamm already cited, *Zenillia roseanae* is recorded as a parasite of the well-known grape pest *Conchylis roseana* Hw. As we have had occasion to examine only a small number of the caterpillars of the host in question we are unable to confirm this record.

## Secondary Parasites.

On April 14, 1920, a puparium of this species was found which was filled with the larvae of a chalcid parasite; the puparium was unfortunately broken in collection and the parasites could not be reared; no other hyperparasites have since been discovered.

## Geographical Distribution.

*Zenillia roseanae* has been found in Pyrausta larvae in several of the departments of southwestern France (Gers, Hautes Pyrenees, Landes), and in the Mediterranean region at Hyeres (Var) and Menton (Alpes Maritimes). In material from southern Germany (southern Wurtemberg) and Belgium, it has not been discovered. It would thus appear to be a southern species; but so far it has not been found in material from Naples and it seems to be rarer along the Mediterranean littoral than in the region north of the Pyrenees.

## Importance as a Controlling Factor of the Corn Borer.

In order to determine accurately the status of this species as a controlling factor of the corn borer in Europe it will be necessary to carry on an investigation continuing over a considerable period. However from the data now available it would appear that *Zenillia roseanae* is a very important parasite of *Pyrausta nubilalis*. As it has two annual generations, both passed on the borer, its introduction into the United States offers much less difficulty than that of species with several generations which develop in different hosts. Having two broods a year it should be able to overtake and check the invasion of the host with comparative rapidity; and finally, the method of hibernation of the species, in the hibernating caterpillars of Pyrausta, enables the parasite to pass through one of the most difficult periods in its seasonal history with a much lower mortality than is caused by extreme unfavorable meteorological conditions and hyperparasitism in the case of species which pass the winter in the pupal or adult stages.

## LIST OF ILLUSTRATIONS.

Fig. 5. Anterior end of mouth hook of first stage larva.
Fig. 6. Second stage larva.
Fig. 7. Anterior stigma and "felt-chamber" of second stage larva.
Fig. 8. Posterior stigma and "felt-chamber" of second stage larva.
Fig. 9. Mouth hooks or bucco-pharyngeal apparatus of second stage larva; m. h.—lateral paired mandibular hooks.
Fig. 10. Third stage larva.
Fig. 11. Anterior stigmata of third stage larva.
Fig. 12. Posterior stigmata of third stage larva.
Fig. 13. Mouth hooks or bucco-pharyngeal apparatus of third stage larva.
Fig. 14. Hypopharyngeal plates and inner surface of labium of third stage larva; h. p.—hypopharyngeal plate; l.—labium.
Fig. 15. Epipharyngeal plate of third stage larva.
Fig. 16. Pupal respiratory apparatus; i. s.—internal spiracle; p. c.—prothoracic cornicle.
Fig. 17. Tip of prothoracic cornicle of the pupa.
Fig. 18. Head of adult male.
Fig. 19. External genitalia of adult male.
Fig. 20. Hibernating second stage larva in a lobe of the fat body of the corn borer caterpillar; tr.—tracheae of caterpillar.

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## SOME NOTES ON THE TERMINAL ABDOMINAL STRUCTURES OF SAWFLIES.

By William Middleton, *U. S. Bureau of Entomology*.

This paper, which was prepared under the direction of S. A. Rohwer, at the Eastern Field Station, East Falls Church, Virginia, and is a contribution from the Branch of Forest Insects, U. S. Bureau of Entomology, deals with some of the terminal abdominal structures of sawfly larvae and adults, and presents a terminology to be used in future taxonomic papers.

### Postcornu.

The larvae of the wood, stem and grass boring sawflies have long been known to possess a single, heavily chitinized, terminal appendage, or posterior horn, which until quite recently was unnamed. This structure was called the postcornu by Crampton[1] and the term is adopted by the author.

The postcornu in the internal feeding larvae is quite prominent, occurring at the apex of the abdomen above the anal opening upon a well defined fold which is distinctly separated from the dorsal plate, or epiproct, by lateral caudad grooves. In

[1] "The Genitalia and Terminal Abdominal Structures of Males and the Terminal Abdominal Structure of the Larvae of "Chalastogastrous Hymenoptera" by G. C. Crampton, Proc. Ent. Soc. Wash., vol. 21, No. 6, June, 1919, p. 137–8.

another group of the sawflies, the Pamphiliinae, there exists a smaller and less conspicuous, though undoubtedly identical structure. No special attention has been given to this structure in the Pamphiliinae, and because of this and its use in classification, the organ is herewith described. It consists of a small, obscure and somewhat S-shaped chitinized rod projecting from a posterior median plate, which occurs in a depression on the dorsad-caudad surface of the epiproct (see Plate I, Fig. A), and because of the position in which it is carried by the larva the postcornu can hardly be seen. (These observations were made upon dead larvae and the author has not yet had an opportunity to note the position or use of this structure in living larvae).

The character of, and the position occupied by, this appendage and the slight tendency for the formation of the lateral caudad grooves, as indicated by the depression at the lateral margin of the epiproct, seems to give ample grounds for believing it to be homologous with the postcornu of the other sawflies.

A comparative study of the postcornu of those groups of the Chalastogastra which possess this structure reveals certain similarities within families and differences between them, which may be described and tabulated as follows:

1. Postcornu small, inconspicuous, projecting anteriorly, S-shaped and unornamented (see plate I, figs. A and E). Larvae of four genera examined *Pamphiliinae.*

— Postcornu large, conspicuous, projecting posteriorly and more or less ornamented by spines, spurs or barbs 2.

2. Postcornu short, tube-like, circular in cross-section at apex, unornamented with spurs or barbs except on basal lobe (see plate I, fig. D). Larvae of four genera examined [1] *Cephidae.*

— Postcornu long, rod-like, compressed laterally or semicircular in cross-section at apex, ornamented on the dorsal or ventral margin with barbs or spurs 3.

3. Postcornu slightly curved, concave ventrally; semicircular in cross-section at apex, convex dorsally; ornamented on the ventral margin with spurs or barbs (see plate I, fig. C). Larvae of the genus *Xiphydria* examined *Xiphydriidae.*

— Postcornu straight; a vertical line in cross section at apex; ornamented on the dorsal margin with spurs or barbs (see plate I, fig. B). Larvae of five Nearctic genera examined *Siricidae.*

**Paired Terminal Structures**

Dr. G. C. Crampton in his excellent paper[2] on the terminal

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[1] "Notes on the Larvae of Some Cephidae," William Middleton, Proc. Ent. Soc. Wash., vol. 19, 1917, p. 174–179.

[2] The Genitalia and Terminal Abdominal Structure of Males, and the Terminal Abdominal Structure of the Larvae of "Chalastogastrous Hymenoptera"—Proc. Ent. Soc. Wash., vol. 21, No. 6, June, 1919, p. 137–8.

abdominal structures of sawflies, applies the term "cerci" to a larval and an adult appendage. In a paper recently submitted[1] the author indicated the existence of a homology between the larval postpedes and the adult cerci, thus disposing of the term cerci, as applied to larval structures other than the postpedes and leaving those protuberances of the larva designated as "cerci" by Crampton without a name. In the following paragraphs the writer, (1) treats somewhat more in detail his reasons for believing the larval postpedes and adult cerci to be homologous; (2) compares the styli, or arthrostyli, of the Pamphiliinae and Cephidae with the postpedes of other sawfly larvae and advances some reasons for considering them homologous; (3) suggests a new term for those larval structures designated "cerci," by Crampton; and (4) discusses briefly the cerci of the adult male *Tremex*.

*Postpedes and Cerci.*

The conclusion that the postpedes are homologues of the cerci was reached by means of a study of the ontogenetic development of *Pteronidea ribesii* supplemented by the position that the cerci occupy in relation to other parts of the adult.

In the formation of the pupa there are below the anus, and at the laterad caudad extremities of the venter of the tenth urite, a pair of rounded protuberances. (See Plate XI, Fig. I.) These lobes are formed from that area of the larva which gives rise to the postpedes and are the pads within which the adult cerci are developed, therefore they are undoubtedly homologous with these appendages (Plate XI, Figs. H and J). In the adult, the cerci do not spring from the chitin of the tergum, but are separated from that sclerite by a narrow strip of the membrane which constitutes the venter of the tenth urite. They are also below the anus and in one abnormal, adult, female of *Pteronidea ribesii* the cerci were fused together forming a single structure projecting below the anus. Thus, it would seem to the author that the cerci of the adult are not homologous with the so-called "cerci" of the larvae and that they are developed from the postpedes.

*Postpedes and Styli.*

The tenth, or terminal, abdominal segment has, in a number of sawflies, a pair of uropods or postpedes and in some of those sawflies (Cephidae and Pamphiliinae) not possessing what have been recognized as postpedes, there are a pair of laterad appendages on the sternum of this segment to which the term styli or arthrostyli, has been applied (Plate XI, Figs. A and G). Since these styli bear a very close structural resemblance to, and occupy a position similar to, the thoracic legs (in the Pam-

[1]To the Proc. Ent. Soc. Wash.

philiinae) and since it is a rather well recognized fact that the uropods are true limbs, the author can see no reason for not believing that the styli and postpedes are homologous structures (Plate XI, Figs. F and G).

That the styli should differ considerably in general appearance from the postpedes of an ordinary larva can not but be expected when the differences of use are borne in mind (Plate XI, Figs. A and H). In this respect it is to be remembered that the Cephidae live in grass stems and twigs and that they line their galleries with silk and that the Pamphiliinae make web nests, roll leaves and make silk and leaf tubes, while those sawflies possessing postpedes are usually free feeders, laying flat upon the surface of the leaf, or holding to the edge with the apex of the abdomen curled gripping the leaf or carried in the air curved S-shaped. The styliform thoracic legs of the Pamphiliinae, in which the claw is lost or changed in shape, resembles more closely the arthostyli, than the well-developed thoracic legs of the free feeding sawfly larva resemble the posterior uropods of these larvae.

*Cerci and Pseudocerci.*

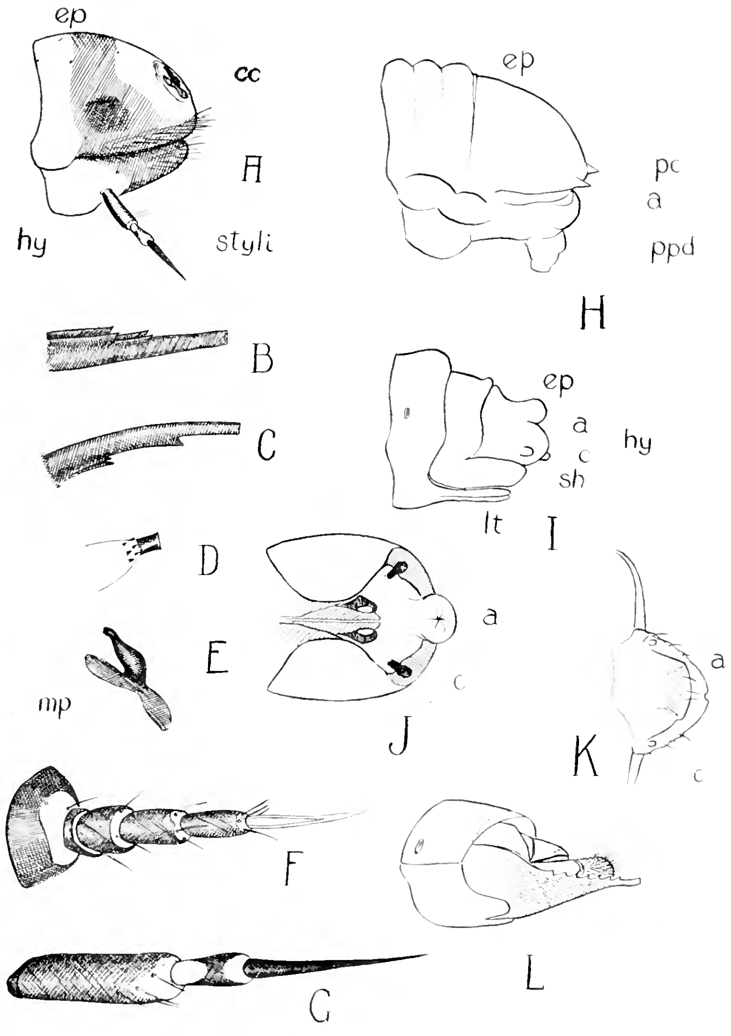
Since the so called "cerci" of the larvae are not homologous with the true cerci of the adult they should not bear the same name, and since the "cerci" of larvae are without a name the term "pseudocerci"[1] is suggested (Plate XI, Fig. H).

The pseudocerci of the sawfly larvae, are much less regular in presence, location and character than the cerci of the adult, a fact which in itself would tend to throw suspicion upon their being cerci. In the larvae of *Pteronidea* the pseudocerci are wanting in some species while in others they are present and well developed. In another Nematine genus (*Pontania*) the pseudocerci of the larvae of some species approach each other quite closely at the apex of the caudad margin of the epiproct and in the Siricidae structures, which appear to be sufficiently similar to bear at least for the present the same name, are found situated to either side of the dorso-median caudal groove and immediately above the basal lobe of the fold bearing the postcornu. The pseudocerci may easily be differentiated from the cerci because they are always found dorsad of the anal opening, and are always a continuation of the chitin of the epiproct (Plate XI, Figs. H and J).

*Cerci of Tremex.*

Certain authors (Rohwer, MacGillivray and Bradley) have remarked upon the absence of the cerci in the male of *Tremex* and some have considered the absence of these appendages to be of taxonomic importance.

[1]Pseudocerci is a name for these structures suggested by G. C. Crampton in a letter to S. A. Rohwer.




MIDDLETON—ABDOMINAL STRUCTURES OF SAWFLIES

In the studies made, by the author, on these appendages in sawflies, he found them present in *Tremex columba* (Linnaeus) but greatly reduced and inconspicuous (Plate XI, Fig. K). The cerci are quite small, but are present as distinct, cone-like, chitinous buttons on the membranous sternum of the tenth urite. They are situated at the cephalad laterad angles of the sternum of the segment in a position identical with that occupied by them in insects where they are larger.

The tenth tergite is arched, presenting a convex surface dorsally, and its posterior margin is curved to produce a projecting semi-circular disk of chitin. Beneath the tergum there is a membrane lying close to it and connecting its posterior margin with anus. Anus projects but slightly (never beyond the tenth tergite) and is carried compressed, close to the membrane (tenth sternite) below it, within the concavity made by the arching of the tenth tergite (Plate XI, Figs. K and L). Thus, the entire tenth sternum, including the cerci, is concealed beneath the epiproct.

## EXPLANATION OF PLATES.

A —Urite X of larva of Pamphiliinae, showing postcornu (cc) on epiproct (ep) and styli on hypoproct (hy).

B —Lateral view of postcornu of Siricidae, showing dorsal barbs.

C —Lateral view of postcornu of Xiphydriidae, showing ventral barbs.

D —Lateral view of postcornu of Cephidae, showing short, cylindrical, unornamented type with spines on basal lobe.

E —Lateral view of postcornu of Pamphiliinae, showing anterior projection from the posterior median plate (mp).

F —Leg of larva of Pamphiliinae.

G —Styli of larva of Pamphiliinae, appendages of the tenth urite.

H —Urites IX and X of larva of *Pteronidea ribesii* showing epiproct (ep) with pseudocerci (pc) above anus (a) and postpedes (ppd) ventrad.

I —Urites VIII–IX and X of pupa of *Pteronidea ribesii* showing epiproct (ep) above anus (a), hyproproct (hy) below anus bearing cerci (c), sheath (sh) and lancets (lt).

J —Urites IX and X of adult *Pteronidea ribesii* from venter showing cerci (c) below anus (a) and separated from tergum.

K —Ventral view X urite of adult of male *Tremex columba* showing membranous sternite below anus (a) with cerci (c) at lateral extremities.

L —Lateral view VIII, IX and X, urites of adult male *Tremex columba*.

### *Key to Symbols.*

| | | | |
|---|---|---|---|
| a | —anus. | lt | —lancets. |
| c | —cerci. | mp | —median plate. |
| cc | —postcornu. | pc | —pseudocerci. |
| ep | —epiproct. | ppd | —postpedes. |
| hy | —hypoproct. | sh | —sheath. |

## ON THE MALE GENITALIA OF THE MICROLEPIDOPTERA AND THEIR SYSTEMATIC IMPORTANCE.

By August Busck and Carl Heinrich.

In recent papers we have applied certain terms in defining the genitalia structure which it is our intention to use in subsequent treatment of the various Micro families. These are based on careful morphological studies of many forms and a homology of the parts in their various and often puzzling modifications. While we have considered mainly the Microlepidoptera our studies have included the Macro groups also and to them the nomenclature applies equally well. We have not conformed to strict priority in choice of names but have adopted the terms which seemed most appropriate and at the same time most generally accepted by Lepidopterists.[1]

In the structure of the genitalia are involved two segments of the abdomen (the 9th and 10th) aside from occasional modifications of the 8th.[2]

The exact defining limits of these two segments are not determinable; but the general structure, homologized with the locations of corresponding openings in the pupa, clearly indicate that the chitinized structures surrounding the genital opening are developments of sclerites of the 9th abdominal segment and that the chitinizations surrounding the anal opening are developed from the 10th.

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[1]Since John B. Smith has been the first to make extensive systematic use of the genitalia in Lepidoptera we have where possible used his terms in preference to others. For this reason we have not followed the suggestion of Dr. McDunnough in his excellent paper on the terminology of these parts (Can. Ent., vol. 43, 1911, pp. 181–189.)

[2]Different homologies have been suggested by other authors. Some following Berlese have included an eleventh abdominal segment in the genitalia. In a recent paper by Mr. John R. Eyer (Bul. Brook Ent. Soc., vol. 16, 1921, pp. 1–8) certain of the structure we refer to the 9th segment (harpes, vinculum and aedoeagus) are considered as belonging to the 8th and 10th respectively, while others which form their close association with the anal opening (socii) we consider as developments of the 10th segment are considered by him as belonging to the 9th. Such homologies do not seem to harmonize with the position of the genital and anal openings and armature of the pupa. Again we are unable to find any indication of an 11th abdominal segment in any Lepidopterous larva or pupa and the hypothesis of such an additional segment in the adult moth is at least unnecessary to a definition of the various parts of the genitalia structure and their homology within the Lepidoptera.

Our purpose, however, is not primarily the homology of the genital parts with particular sclerites or somites, but a homology of the structures as they are developed within the order Lepidoptera and a definition which will enable satisfactory application to Taxonomy.

In the lepidopterous genitalia all or most of the following nine external structures are present and can be differentiated and definitely homologized in the various groups however modified they may be.

**Vinculum** (Vm).

The vinculum is a ventral chitinized band articulating at its dorsal extremities with the tegumen. It is usually a simple narrow band but may be divided in the middle ventrally (ex. *Ellopia*) or extended into an anteriorly projecting process (ex. many *Gelechiidae* and *Plutellidae*). This and the following four structures are formed from sclerites of the ninth abdominal segment.

**Anellus** (An).

The anellus is a small, more or less triangular plate situated within the ventral angle of the vinculum and supporting the aedoeagus. This support may be affected in various ways; the anellus may be a mere plate with a hole (ex. *Hemerophila*) or sinuation in which the aedoeagus rests (ex. *Xyloricta*); or it may partially surround the aedoeagus as a chitinous cylinder (ex. *Cerostoma*) or semi-cylinder (ex. *Borkhausenia conia*) or from the plate an arm may be developed on which the aedoeagus is supported and pivoted (ex. *Olethreutidae*). In some forms the anellus develops various projections or lobes (ex. *Ethmiidae*, *Stenomiidae*). Sometimes the structures are not differentiated, the aedoeagus passing through the unchitinized membrane (ex. some *Helialidae*).

**Aedoeagus** (Ae).

The aedoeagus is normally a tube containing and protecting the penis, sometimes so modified as to be merely a ring with a thin extension (ex. many *Blastobasidae*) or more or less split and occasionally developed into finger or thorn-like projections from a tubular base (ex. *Gelechia natalis*). It articulates on the anellus when the latter is present. Sometimes, however, it is merely supported by the membrane of the 9th segment. It may be simple or prolonged into one or more spines or processes at apex (ex. *Gelechia* and *Stenoma*) or be laterally armed with tooth-like projections (ex. *Hystricophora*). Often the posterior end is produced beyond the entrance hole of the penis into a blind sack (ex. *Tortricidae*, *Plutellidae*, etc.). Some authorities have considered the aedoeagus to be but a chitinized part of the penis proper and therefore strictly speaking an internal structure; but we consider it a part of the external structure. As a chitinized part it has always a definite beginning and ending, is always rigid and serves directly as a protective armature and guide to the membranous penis.

Within and for part of its length connected with the aedoeagus lies the penis (P), a soft flexible tube which can be projected by blood pressure far beyond the mouth of the aedoeagus itself. It is usually armed near its tip by one or more spines or thorns, the so-called *cornuti* (Cn) (of Pierce) or "love thorns" (of Rothchild and Jordan). The number, size and shape of these is constant within the species and of great aid in specific differentiation.

**Harpes** (Hp).

The harpes are paired lateral clasping organs attached to the vinculum and frequently also articulated on the anellus, occasionally fusing at their base (ex.

certain *Geometridae*); hollow flattened structures of various and diverse shapes subject to extravagant modification; usually symmetrical but not seldom assymetrical (ex. many *Gelechiidae*, *Gracilariidae*, some *Oecophoriidae*). In most forms three distinct areas can be differentiated: a costal, an apical and a dorsal. These are sometimes defined by actual sutures (as in *Ethmidae*) indicating that the harpes are compound organs (modified pedal appendages). More often the areas are only defined by heavier chitinization, or inward folding of the edges, or by peculiarities of armature and hairs. These parts have been named respectively, costa (Ca), cucullus (Cs) and sacculus (Sc) (Pierce) which terms we have adopted. They are each subject to various modifications, and one is often developed at the expense of the others; the sacculus and costa having a tendency to develop into free extended arms. Occasionally one of these is so far separated from the rest of the harpes as to form a double harpe structure (Comp. Fig. 4). The so-called *clasper* of Smith prominently developed in the *Noctuidae* is a similar modification of the *sacculus*, being a free extension from the edge near the base. It takes various shapes in different families, is often forked and otherwise highly modified (ex. *Agrotinae*, *Pyraustinae*), and sometimes is represented by a mere thorn-like projection (ex. *Epiblema*, in *Olethreutidae*). Very often it is entirely absent. Similar clasper-like processes (Anl) may often be found arising from the annellus (ex. *Ethmiidae*, *Stenomidae*) and sometimes fusing into the harpes. These must not be confounded with the clasper of the harpes. All of these characters are constant within the species, and furnish excellent aid in the separation of higher groups. In a few groups the harpes are greatly reduced and hardly capable of functioning as clasping organs.

**Transtilla** (Ts).

The transtilla is a more or less band-like bridge connecting the harpes at their inner costal angles. Often merely a plain band. Often lobed or sinuated and ornamented with spine clusters. Sometimes attenuated or broken in the middle (ex. *Adoxophyes*) and appearing as free arms from the harpes. These arms may be reduced to mere knobs or spurs (ex. *Olethreutidae* and a few *Tortricidae*). Sometimes the transtilla is entirely absent (ex. *Oecophoridae*, *Blastobasidae* and *Noctuidae*).

**Uncus** (U).

This and the following two structures constitute the armature of the anus and therefore belongs to the 10th segment. The uncus is the posterior dorsal projections of the genitalia above the anal opening. It is normally more or less hook like (ex. *Sparganothis*), but may be broadened out (ex. *Gelechia*), spoon shaped (ex. *Pandemis*), trifid (ex. *Ethmia zelleriella*), bifurcate (ex. *Rhopobota*), or otherwise modified. It may be smoothed or haired. Often it is reduced or absent.

**Socii** (Si).

The socii are paired organs, normally soft, membranous and hairy; arising from the base of the uncus, more or less lateral to the anal opening. They are of very varied shape; commonly soft, papilla like and drooping (ex. *Eucosma*), sometimes erect (ex. *Harpypteryx*) or flattened or leaf-like (ex. *Sparganothis*), rarely strongly chitinized (ex. some species in *Epinotia*). They are occasionally more or less fused with gnathos (ex. some *Olethreutidae*) and are frequently rudimentary or absent (ex. *Laspeyresia*).

**Gnathos** (Gn).

The gnathos is a paired organ, ventral to the anus, arising near the base of the uncus below the soci if the latter are present and consisting in its completeness of two lateral arms and a ventral plate (Vp). The arms may be free, more or less tentile and hairy (ex. *Sparganothis*, *Synnoma*). Much more commonly they are fused at their tips into a strongly chitinized, smooth hook or beak-like structure (ex. *Cacoecia*, *Gelechia*), or into a variously modified and ornamented knob (ex. *Coleophora*, *Depresparia*). Occasionally the joined arms are reduced to a mere band (ex. *Holcocera*). The ventral plate (Figs. 2, 3) if present, is situated in a median line immediately below the anus and is more or less fused with the arms when these are present. It may be a broad shield-like structure (ex. *Peronea*) or a narrow chitinous strip along the under side of the alimentary canal (ex. *Pyrausta*, *Cerostoma*). It is sometimes greatly developed and apparently free lying against and covering much of the anal tube; in which case the arms themselves may be absent. It is often absent or not to be differentiated as a distinct part.

The gnathos is subject to very great modification. Rarely it is entirely absent (ex. *Amorbia*, *Coelostathma*).

**Tegumen** (Tg).

The tegumen is really the entire external covering of the 9th and 10th segments which have not been differentiated in the foregoing 8 parts and from which these 8 parts originate as specialized sclerite structures; but specifically it is recognized as the chitinized dorsal part, articulating at its lower extremities with the vinculum and from which arises the uncus, soci and gnathos, the other parts being normally membranous. This chitinized part of tegumen has been considered by many as the tergite of the 9th segment continued ventrally in the vinculum which is recognized as the sternite of the 9th segment. In certain isolated forms a suture just below the base of uncus would seem to substantiate this view; but the structure is normally so fused that it is impossible to differentiate two distinct parts, and we are inclined to consider the entire chitinized tegumen as part of the 10th segment; the 9th segment being greatly reduced and continued dorsally as membrane only.

In several groups the 8th abdominal segment is more or less modified and apparently a part of the genital apparatus, either as a specially chitinized covering (ex. *Gelechia*) or forming a lobed and strongly haired structure closely associated with the genitalia proper (ex. *Pandemis*).

In his presidential address before this society in 1914 the senior author gave in outline the progress of the classification of the Micro-Lepidoptera up to that time and showed how it had culminated in a comprehensive and natural system based fundamentally on venation as conceived and elaborated by Meyrick, who brilliantly utilized the foundations laid by Heirrich-Schaefer.

It was even then realized that while venation is the fundamental character upon which our classification must rest, it does not tell the whole story, nor is it alone always sufficient to determine natural groups. Characters of the pupa and larva and genitalia give an added light and a fuller understanding. In fact the seta arrangement in the larva is as fundamental as the venation. As an independent basis for classification it enables sure and accurate group definition and the results correlate with those obtained by venation.

Genitalia on the other hand are subject to such extreme modifications and the group characters are so subtle that unsupported by other characters in the insect, they would not be a safe guide except for specific differentiation; but as an additional factor in the classification they are of considerable significance, enabling clearer and sharper definition and finer division of families and genera.

For example, while the division between the families *Tortricidae* and *Olethreutidae* has always been clearly recognized and their species properly referred, no exact definition between them has been possible on venation or other hitherto considered adult characters. It is a curious coincidence that an attempt should have been made to employ genitalia in the separation of these very families by Fernald and Meyrick and unfortunate that these authors should have hit upon a superficial character—the presence or absence of uncus—which does not hold.[1]

The long standing confusion regarding the family *Xyloricitdae* and its present mistaken lumping with the family *Stenomidae* could have been avoided by a consideration of the genitalia. The two represent distinct geographical entities with but few stragglers outside their respective continents, Australia and America, and their genitalia in gross structure and detail (for example the split hairs on the harpes in *Stenomidae*) at once separate the two.

The genus *Setiostoma* Zeller described as a *Glyphipterygid* and always so considered on pterogostic characters is definitely proven by the genitalia to belong to the family *Stenomidae* (not equal *Xylorictidae* Meyrick). This fact is fully born out by a proper consideration of the venation though the venation alone might be—and has been—otherwise interpreted.

In the separation of genera the genitalia must be used with extreme caution, but here also they throw an additional light on the correlation of species and thereby enable a more natural grouping and a sharper division.

As a character for specific differentiation the genitalia are of

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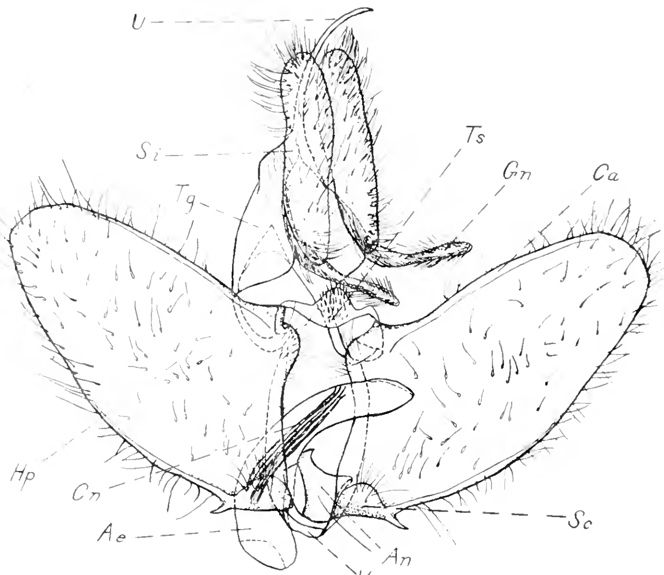
[1]Dampf: "Uber den Genitalapparat von *Rhopobota* Naevana," Iris, 1908, pp. 304-329.

Heinrich: "A Note on the Tortricid Genitalia," Proc. Ent. Soc. Wash., vol. 19, 1917, pp. 137-138.

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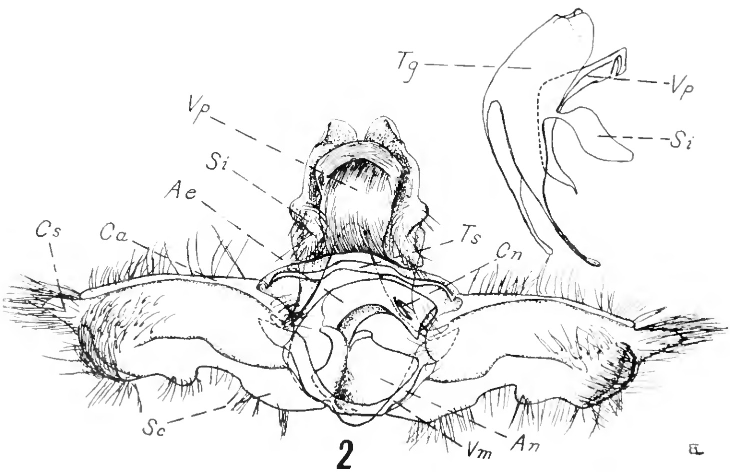


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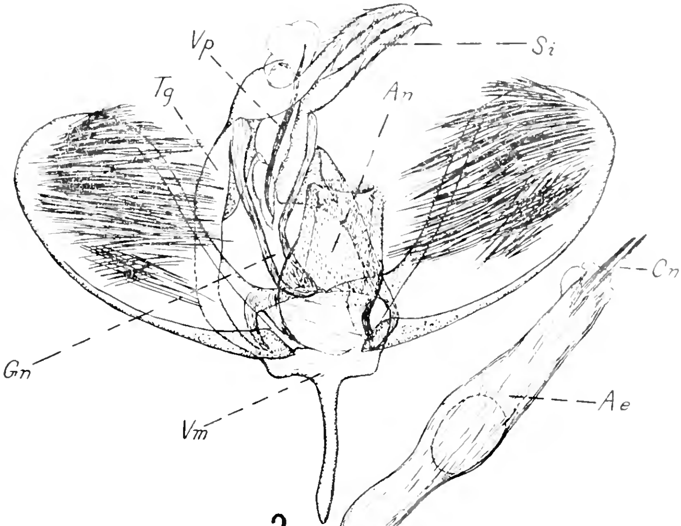
BUSCK AND HEINRICH—GENITALIA OF MICROLEPIDOPTERA

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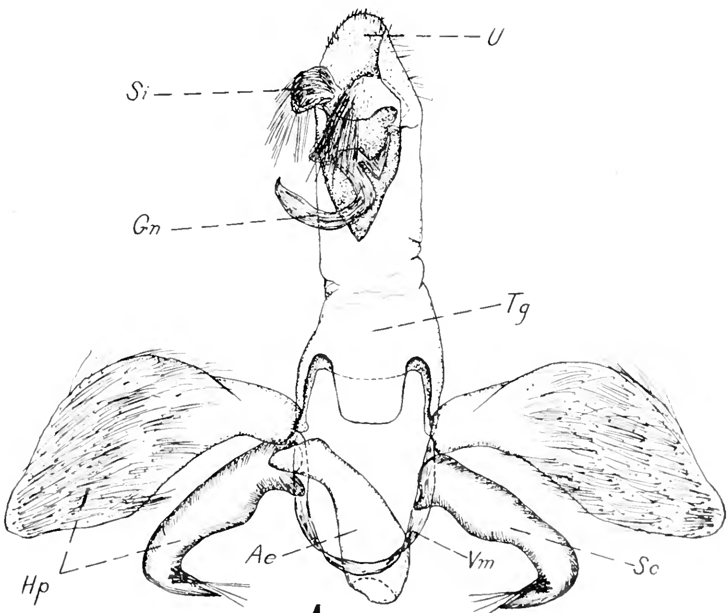


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BUSCK AND HEINRICH—GENITALIA OF MICROLEPIDOPTERA supreme importance, enabling the separation and definition of closely allied species that otherwise would be difficult or impossible to separate and also proving beyond dispute the specific identity of varieties, the superficial differences of which obscure their specific limits. With the aid of genitalia the identity or non-identity of a supposedly introduced species can be definitely ascertained, and a question of synonymy settled. No longer need it be a matter of personal opinion. It can be proven or disproven. For example, the identity of *Laspeyresia molesta* Busck with the Japanese and Australian Peach Moth is thus established while the hitherto accepted identity of the American and European pea moths (*L. nigricana* Stph. and *L. novimundi* Heinrich) is disproven. Except for the genitalia both of these cases and many similar ones would have remained debatable.

The introduction of the male genitalia into the classification of the Microlepidoptera does not in any way invalidate or revolutionize our present well-founded system. On the contrary, it gives us a better understanding and a surer confidence in this very system, substantiating it, enlarging upon its foundations and giving added light where venation is insufficient. The use of genitalia together with characters of the larva and pupa brings us nearer to that ideal of the systematist, a classification based upon the whole insect.

## EXPLANATION OF PLATES[1]

### Plate XII

Fig. 1—Male genitalia of *Sparganothis pilleriana* Schiffermuller.

Fig. 2—Male genitalia of *Peronsa cristana* Fabricius.

### Plate XIII

Fig. 3—Male genitalia of *Cerostoma vittella* Linn.

Fig. 4—Male genitalia of *Platyedra vilella* Zeller.

Ae —aedoeagus.
An —anellus.
Ca —costa.
Cn —cornuti.
Cs —cucullus.
Gn —gnathos.
Hp —harpes.
Sc —sacculus.
Si —socii.
Tg —tegumen.
Ts —transtilla.
U —uncus.
Vm —vinculum.
Vp —ventral plate.

[1]The drawings were made by Miss Eleanor T. Armstrong under the direction of the authors.

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# PROCEEDINGS

OF THE

# ENTOMOLOGICAL SOCIETY

OF WASHINGTON

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PROCEEDINGS OF THE

# ENTOMOLOGICAL SOCIETY OF WASHINGTON

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## THE THOMAS SAY SPECIES OF ICHNEUMONIDAE.

BY R. A. CUSHMAN AND A. B. GAHAN, *Bureau of Entomology*.

The Say types are no longer in existence and the only means of identification of the species are the original descriptions. These are usually short and incomplete. But careful study of a description will usually disclose some very characteristic feature that points unmistakably to a certain genus and frequently to a certain species.

Say described a total of sixty-one species of Ichneumonidae under the generic names *Ichneumon*, *Pimpla*, *Ophion*, *Anomalon*, *Acaenitus*, *Banchus*, *Peltastes*, *Cryptus*, and *Agathis*. He later removed his *Anomalon humeralis* to *Xorides*. He thus employed ten generic names.

Of the sixty-one species, forty-four have been identified, specifically or generically, and treated of by subsequent authors. Most of these first identifications have proved to be correct. In a few cases, however, the identifications are obviously wrong. Ashmead has pointed out one such instance and Cushman another and four more are indicated in the following pages. Thirty-eight of the first revisions, therefore, have been verified as have also the two corrections noted. Of the twenty-one species remaining unrecognized we have been able to positively identify fourteen. Six we have placed generically to our satisfaction, although we have been unable to determine the species in the available material. One species we have been unable to place even generically.

In listing synonymy we have in general listed references only to the first revision and to generic changes. Unless otherwise stated the published synonymy has been verified.

The species are treated alphabetically under the genera in which they were originally placed, and the genera are arranged alphabetically. In case the species is considered to belong to a genus different from the one in which it was originally placed the original genus is placed in parentheses followed by the proper genus.

For each of the species here positively identified for the first time and for each of the corrections in identification we have designated a neotype. These neotypes are all in the National Collection and each bears a red label with the word "Neotype."

### 1. (**Acaenitus**) **Arotes decorus** (Say).

*Acaenitus decorus* Say, Boston Journ. Nat. Hist., vol. I, 1835, p. 248 (Leconte ed., vol. 2, p. 702).

*Arotes decorus* Cresson, Trans. Am. Ent. Soc., vol. 4, 1872, p. 164; Rohwer, in Cushman and Rohwer, Proc. U. S. Nat. Mus., vol. 57, 1920, p. 516.

### 2. (**Acaenitus**) **Arotes melleus** (Say).

*Acaenitus melleus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 249 (Leconte ed., vol. 2, p. 703).

*Arotes melleus* Rohwer, in Cushman and Rohwer, Proc. U. S. Nat. Mus., vol. 57, 1920, p. 516.

### 3. (**Acaenitus**) **Xorides stigmapterus** (Say).

*Acaenitus stigmapterus* Say, Long's Second Exped., Phila., 1824, p. 325 (Leconte ed., vol. 1, p. 218).

*Xylonomus stigmapterus* Cresson, Trans. Am. Ent. Soc., 1870, p. 167; Walsh, Trans. Ac. Sci., St. Louis, vol. 3, 1873, p. 153 and 165.

*Xorides stigmapterus* Rohwer, Proc. U. S. Nat. Mus., vol. 57, 1920, p. 444.

### 4. (**Agathis**) **Ceratogastra ornata** (Say).

*Agathis ornata* Say, Boston Journ. Nat. Hist., vol. I, 1835, p. 226 (Leconte ed., vol. 2, p. 684).

*Ceratosoma fasciata* Cresson, Proc. Ent. Soc., Phila., vol. 4, 1865, p. 283.

*Ceratosoma rubyata* Davis, Trans. Am. Ent. Soc., vol. 24, 1897, p. 366.

*Ceratogastra* (*fasciata*) Ashmead, Can. Ent., vol. 32, 1900, p. 368.

*Ceratogaster fasciata* Dalla Torre, Cat. Hym., 1891, p. 62.

*Ceratogaster rubyata* Dalla Torre, *loc. cit.*

The color and color pattern of the head, thorax, and propodeum in this and the following species point unmistakably to *Ceratogastra.* Davis's name is based on a cyanide stained specimen.

*Neotype.*—A female without data.

### 5. (**Agathis**) **Ceratogastra polita** (Say).

*Agathis polita* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 226 (Leconte ed., vol. 2, p. 684).

Possibly an unusual variant of *ornata* but since we have no specimen that agrees in all particulars with Say's description, we hesitate to synonymize the two species. If synonymy is proved *polita* will be the name to apply to the species since it has line precedence.

### 6. (**Anomalon attractus** Say) = **Diplazon laetatorius** (Fabricius).

*Ichneumon laetatorius* Fabricius, Spec. Ins., vol. 1, 1781, p. 424.

*Bassus laetatorius* Panzer, Krit. Revis., vol. 2, 1806, p. 74.

*Anomalon laetatorius* Jurine, Nowr. Meth. Class. Hym., 1807, p. 116.

*Anomalon attractus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 241 (Leconte ed., vol. 2, p. 696).

*Bassus tripiticrus* Walsh, Trans. Ac. Sci., St. Louis, vol. 3, 1873, p. 85.

*Diplazon laetatorius* Vireck, Hym. Conn., 1917, p. 303.

There are in the National Museum several specimens of *laetatorius* that have the white markings of mesopleurum and mesosternum described by Say in varying degrees of completeness. In some cases these spots are confluent and in others represented only by white dots behind the front coxae. Certain of these specimens agree almost perfectly with Say's description, one female differing only in having the entire fourth tergite black. This tergite, however, varies in a series of specimens all the way from all black to all red.

*Neotype.*—A female collected April 18, 1911, at Dallas, Texas, by H. Pinkus.

The above synonymy is not complete but includes only generic changes and North American synonyms.

### 7. (**Anomalon**) **Neleopisthus densatus** (Say).

*Anomalon densatus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 243 (Leconte ed., vol. 2, p. 698).

*Neleopisthus similis* Cushman, Proc. U. S. Nat. Mus., vol. 56, 1919, p. 379.

The type of *Neleopisthus similis* Cushman agrees almost perfectly with Say's description, so nearly perfectly that the discrepancy in the length of the "oviduct" must be explained by the supposition that in Say's specimen the ovipositor proper was free of the sheath and it was this to which Say referred.

*Neotype.*—The type of *Neleopisthus similis* Cushman.

It should be noted that in the first line of the description as reprinted in the Leconte edition the word "orbits" occurring in the original description before "above with a white line" is omitted.

### 8. (**Anomalon**) **Glypta divaricata** (Say).

*Anomalon divaricatus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 244 (Leconte ed., vol. 2, p. 699).

*Glypta divaricata* Cresson, Trans. Am. Ent. Soc., 1870, p. 153. Possibly (=*pulchripes* Cresson).

Undoubtedly a *Glypta* but apparently not *pulchripes* as suggested by Cresson, for Say says nothing of red pleura, white clypeus and mandibles or hind tibiae. His description is more like *tuberculifrons* Cresson. Say's specimen was from Florida, from which State Cresson had no specimens of *Glypta;* nor are there any in the National Museum. We suspect that Say's species is distinct from any that Cresson knew.

### 9. **Anomalon ejuncidus** Say.

*Anomalon ejuncidus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 241 (Leconte ed., vol. 2, p. 697).

*Trachynotus texanus* Cresson, Trans. Am. Ent. Soc., vol. 4, 1872, p. 169.

*Trachynotus ejuncidus* Cresson, Trans. Am. Ent. Soc., vol. 4, 1872, p. 169.

*Trachynotus canadensis* Provancher, Nat. Can., vol. 11, 1879, p. 119.

*Nototrachys canadensis* Cresson, Synop. N. Am. Hym., 1887, p. 200.

*Nototrachys ejuncidus* Cresson, loc. cit.

*Nototrachys texanus* Cresson, loc. cit.

Sixty North American specimens of *Anomalon* in the National Collection have been examined. Included in this number are a paratype of *texanus* Cresson and a homotype (Gahan) of *canadensis* Provancher. Notwithstanding the fact that in this material there are to be found considerable differences in color as well as slight structural differences, we are unable to find any characters of either color or structure that appear to be constant. We are therefore in doubt as to whether the material represents one species or more than one. The paratype of *texanus* and the homotype of *canadensis* are in our opinion the same species, however, and since they agree in every way with Say's description of *ejuncidus* we are constrained to believe that Say's species is the same.

### 10. (**Anomalon**) **Thyreodon flavicornis** (Say).

*Anomalon flavicornis* Say, West. Quart. Rept., vol. 2, 1823, p. 73 (Leconte ed., vol. 1, p. 163).

This species was confused by Norton[1] and subsequent authors with *Anomalon flavicornis* Brullé, a species now referred to *Heteropelma*. The color of the wings as described by Say is sufficient to show that his species is not the same as Brullé's. This color immediately suggests *Thyreodon flammipennis* Ashmead and *T. fernaldi* Hooker, species from the same general region as that recorded for *flavicornis* Say, and although we have seen no specimen that agrees exactly with Say's description we are strongly of the opinion that the species should be referred to this group.

### 11. (**Anomalon**) **Xorides humeralis** (Say).

*Anomalon humerale* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 74 (Leconte ed., vol. 1, p. 378).

*Xorides humeralis* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 223 (Leconte ed., vol. 2, p. 682).

*Xylonomus lavalensis* Provancher, Nat. Can., vol. 6, 1874, p. 59.

*Xylonomus humeralis* Provancher, Nat. Can., vol. 12, 1880, p. 100.

*Xorides humeralis* Rohwer, Proc. U. S. Nat. Mus., vol. 57, 1920, p. 434.

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[1] Proc. Ent. Soc. Phila., vol. 1, 1863, p. 360.

### 12. (Anomalon) Aplomerus lineatulus (Say).

*Anomalon lineatulus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 244 (Leconte ed., vol. 2, p. 699).

*Aplomerus foutsi* Rohwer, Proc. U. S. Nat. Mus., vol. 57, 1920, p. 454.

Say's statement that "This has some resemblance to *mellipes*" at once suggests *Aplomerus*, the male of which has not as yet been described. A male of *foutsi* Rohwer, unfortunately without the head, but reared by J. C. Bridwell with the female at Baldwin, Kansas, has recently been received from Mr. Bridwell. This specimen agrees perfectly with Say's description and is undoubtedly his species.

*Neotype.*—The above male specimen.

### 13. (Anomalon) Odontomerus mellipes (Say).

*Anomalon mellipes* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 74 (Leconte ed., vol. 1, p. 378); Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 242 (Leconte ed., vol. 2, p. 697).

*Odontomerus mellipes* Walsh, Trans. Ac. Sci. St. Louis, vol. 3, 1873, p. 164.

*Odontomerus errans* Rohwer, Proc. U. S. Nat. Mus., vol. 45, 1913, p. 360.

*Odontomerus mellipes* Bradley, Bull. Brooklyn Ent. Soc., vol. 13, 1918, p. 104; Rohwer, Proc. U. S. Nat. Mus., vol. 57, 1920, p. 458.

### 14. (Anomalon) Clistopyga recurva (Say).

*Anomalon recurvus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 243 (Leconte ed., vol. 2, p. 698).

*Clistopyga annulipes* Cresson, Trans. Am. Ent. Soc., vol. 3, 1870, p. 150.

The only ways in which any of the National Museum specimens of *annulipes* disagree with Say's description are in size and in the color of the mesosternum and mesopleura. Both of these characters are very variable, several of the specimens being fully as small as Say's type and some almost lacking the red on the thorax.

*Neotype.*—A female captured at Ocean View, Virginia, by A. N. Caudell.

### 15. (Anomalon) Cylloceria sexlineata (Say).

*Anomalon sexlineata* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 74 (Leconte ed., vol. 1, p. 378).

*Lampronota sexcarinata* Davis, Trans. Am. Ent. Soc., vol. 22, 1895, p. 30.

Davis's species agrees so exactly with Say's description that it seems that the length (three twentieths of an inch) given by Say must be a misprint for three tenths of an inch.

*Neotype.*—A female taken June 28, 1918, at Kanawha Station, West Virginia, by S. A. Rohwer.

### 16. (**Banchus**) **Acroricnus aequatus** (Say).

*Banchus aequatus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 247 (Leconte ed., vol. 2, p. 701).

*Atractodes cloutieri* Provancher, Nat. Can., vol. 6, 1874, p. 150.

*Linoceras cloutieri* Provancher, Nat. Can., vol. 11, 1879, p. 110.

*Agathobanchus aequatus* (Say) Ashmead (name but not description), Proc. U. S. Nat. Mus., vol. 23, 1900, p. 97.

*Exetastes* (?) *aequatus* (Say) Viereck, Trans. Kans. Ac. Sci., vol. 19, 1905, p. 303.

Ashmead's determination of *aequatus*, and probably the specimens from which he drew his description of *Agathobanchus*, is obviously wrong when these specimens are compared with Say's description of *aequatus*. From Say's description of the areolet his specimen was obviously cryptine.

A male of *Acroricnus clouteri* (Provancher) in the National Museum agrees except in minor details with the description, and we have no hesitation in synonymizing *cloutieri* with *aequatus*.

*Neotype*.—A male specimen without data.

*Agathobanchus* Ashmead, although based on a mistaken determination of Say's species, still has that species as type and is synonymous with *Acroricnus* Ratzeburg, the synonymy of which is as follows:

#### Genus **Acroricnus** Ratzeburg.

*Acroricnus* Ratzeburg, Ichn. d. Forstins., vol. 3, 1852, p. 92. Genotype—(*Acroricnus schaumi* Ratzeburg) = *Cryptus macrobatus* Gravenhorst.

*Macrobatus* Holmgren, Svensk. Vet.—Akad. Handl., vol. 75, 1854, p. 50. Genotype.—*Cryptus macrobatus* Gravenhorst.

*Xenodocon* Foerster, Verh. naturh. Ver. preuss. Rheinland, vol. 12, 1855, p. 237. Genotype.—*Xenodocon ruficornis* Foerster.

*Linoceras* Taschenberg, Zeitschr. Gesammten Natur., vol. 25, 1865, p. 105. Genotype.—*Cryptus macrobatus* Gravenhorst.

*Osprynchotus* Kriechbaumer, Ent. Nachr. Heft 4, 1878, p. 221 (not Spinola).

*Agathobanchus* Ashmead (of genotype, not of description), Proc. U. S. Nat. Mus., vol. 23, 1900, p. 97. Genotype.—*Banchus aequatus* Say.

The specimens that Ashmead left in the National Museum determined as *Banchus aequatus* Say and apparently the ones from which he drew his description of *Agathobanchus* are banchine. Bradley redescribed both genus and species, but did not note the differences between it and the *aequatus* of Say. Viereck, however, noted the differences and renamed *aequatus* Ashmead as *bradleyi*, but retained it in *Agathobanchus*. Morley has synonymized *Agathobanchus* (of the description, not of the genotype) with *Agathilla* Westwood, in which he is undoubtedly correct, and also doubtfully synonymized *aequatus* with *fulvopicta* Westwood. There can be no doubt of the specific distinctness of the two species.

The synonymy of *Agathilla* Westwood and of *Agathilla bradleyi* (Viereck) are therefore as follows:

### Genus **Agathilla** Westwood.

*Agathilla* Westwood, Tijds. Ent., vol. 25, 1881–1882, p. 24, Pl. 6, figs. 1–7. Genotype.—*Agathilla fulvopicta* Westwood.

*Agathobanchus* Ashmead (of description, not of genotype), Proc. U. S. Nat. Mus., vol. 28, 1900, p. 97; Bradley, Ent. News, vol. 14, 1903, p. 144; Viereck, Trans. Kans. Ac. Sci., vol. 19, 1905, p. 303.

*Agathilla* Morley, Rev. Ichn. Brit. Mus., part 4, 1915, p. 140.

### **Agathilla bradleyi** Viereck.

*Agathobanchus aequatus* Ashmead (of description), Proc. U. S. Nat. Mus., vol. 23, 1900, p. 97; Bradley, Ent. News, vol. 14, 1903, p. 144 (not Say).

*Agathobanchus bradleyi* Viereck, Trans. Kans. Ac. Sci., vol. 19, 1905, p. 303.

*Agathilla aequatus* Morley, Rev. Ichn. Brit. Mus., part 4, 1915, p. 140. [Doubtfully synonymizes *aequatus* with *fulvopicta* Westwood.]

## 17. (**Banchus**) **Hyposoter fugitivus** (Say).

*Banchus fugitivus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 247 (Leconte ed., vol. 2, p. 701).

*Campoplex fugitivus* Riley, 1st Ann. Rept. Ins. Mo., 1869, p. 139 (parasite on *Euchaetes egle*).

*Limneria fugitiva* Riley, 4th Ann. Rept. Ins. Mo., 1872, p. 41.

*Limneria guignardi* Provancher, Addit. Faun. Can. Hym., 1886, p. 87.

*Limneria oedemasiae* Ashmead, Proc. U. S. Nat. Mus., vol. 12, 1890, p. 436.

*Ameloctonus fugitivus* Ashmead, Smith: Ins. of N. J., (1899) 1900, p. 582.

*Hyposoter fugitivus* Gahan, Proc. U. S. Nat. Mus., vol. 48, 1914, p. 156.

The specimen recorded by Say as having come from "a very pretty cocoon which is somewhat cylindric, white, with two maculated black bands" is not *fugitivus* as here recognized, since the cocoon of *fugitivus* is spun inside the skin of the host and is not banded with black. The cocoon that Say refers to may be that of (*Limneria*) *Hyposoter annulipes* (Cresson), a very similar species.

## 18. (**Banchus**) **Exetastes nervulus** (Say).

*Banchus nervulus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 246 (Leconte ed., vol. 2, p. 700).

A male specimen captured by C. W. Johnson at Princeton, Maine, that agrees perfectly with Say's description is in the National Museum. There are also a female from Savoy, Massachusetts, and two females from Mt. Desert Island, Maine. The species is closely allied to *suaveolens* Walsh, but is at once distinguishable by its black hind tibiae and uniformly infuscate wings.

*Neotype*.—The above male.

### 19. (Cryptus) Compsocryptus calipterus (Say).

*Cryptus calipterus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 234 (Leconte ed., vol. 2, p. 690); Cresson, Trans. Am. Ent. Soc., vol. 4, 1872, p. 158.

*Compsocryptus calipterus* Ashmead, Proc. U. S. Nat. Mus., vol. 22, 1900, p. 43.

*Cryptus fletcheri* Provancher, synonymized by Provancher himself with *calipterus*, is apparently distinct. This opinion is based on notes on the type by S. A. Rohwer as well as on the original description.

Cresson's statement that the antennae of *calipterus* are without an annulus is not in agreement with the original description. A large series of *calipterus* from Mexico, Texas, and New Mexico shows that this character is, however, not constant.

*Cryptus calipterus* as restricted by us does not agree in all respects with Ashmead's description of *Compsocryptus*. Ashmead included under the name, several very similar species, some of which do agree with the generic diagnosis, and in our opinion these are all obviously congeneric.

### 20. (Cryptus) Compsocryptus ? cestus Say.

*Cryptus cestus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 234 (Leconte ed., vol. 2, p. 691).

We are not able to identify this species in the National Collection. It is similar to *calipterus* and is very likely a *Compsocryptus*.

### 21. (Cryptus) Itoplectis conquisitor (Say).

*Cryptus conquisitor* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 232 (Leconte ed., vol. 2, p. 689).

*Cryptus pleurivinctus* Say, loc. cit., p. 235 (Leconte ed., vol. 2, p. 691).

*Pimpla conquisitor* Walsh, Can. Ent., vol. 2, 1869, p. 12. (First synonymizing of *pleurivinctus* with *conquisitor*).

*Ephialtes (Itoplectis) conquisitor* Cushman, Proc. U. S. Nat. Mus., vol. 58, 1920, p. 347, fig. 1, Pl. 21, fig. 2.

Further synonymy is given in the last reference.

### 22. (Cryptus) Mesochorus discitergus Say.

*Cryptus discitergus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 231 (Leconte ed., vol. 2, p. 689).

Say's description of the abdomen of *discitergus* is so suggestive of some species of *Mesochorus* that there seems little doubt that it belongs to this genus. An undetermined specimen of *Mesochorus* in the National Collection comes very close to Say's description, differing only in the extent of black on the thorax and in having the basal joints of the antennae (the flagella are gone) reddish.

### 23. (**Cryptus ductilis** Say) = **Campoplex** (**Nemeritis**) **canescens** Grav.

*Campoplex canescens* Gravenhorst, Ichn. Eur., vol. 3, 1829, p. 1118.
*Cryptus ductilis* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 233 (Leconte ed., vol. 2, p. 690).
*Campoplex frumentarius* Rondani, Bull. Soc. Ent. Ital., vol. 6, 1874, p. 134.
*Nemeritis canescens* Thomson, Opusc. Ent., fasc. 11, 1887, p. 1120.
*Omorga frumentaria* Chittenden, U. S. Dept. Agr., Bur. Ent. Bull. No. 8, n. s., 1897, pp. 41 and 43.
*Omorga columbiana* Ashmead (MS), Chittenden, U. S. Dept. Agr., Bur. Ent. Bull. No. 20, n. s., 1899, p. 67.
*Idechthis oahuensis* Ashmead, Faun. Hawaiiensis, vol. 1, pt. 3, 1901, p. 355.
*Amorphota ephestiae* Cameron, Proc. Linn. Soc., N. S. Wales, 1912, p. 187.
*Nemeritis canescens* Morley, Brit. Ichn., vol. 5, 1914, p. 133.

This is a well-known cosmopolitan parasite of lepidopterous larvae in stored grains, etc. The synonymy of *ephestiae* and *oahuensis* with *canescens* was demonstrated by Morley, and there can be no doubt that *frumentarius* is also synonymous since both the description and the host relations agree. Specimens in the National Museum labelled in Ashmead's hand *Omorga columbiana* are the same species as those determined by Gahan as *frumentarius* and as the paratypes of *oahuensis*. There is considerable variation in the color of the legs and abdomen, and many specimens agree with Say's description of *ductilis*.

*Neotype.*—A female taken in a flour mill at Hillsdale, Michigan, by D. B. Whelan.

We do not believe that *Nemeritis* Holmgren, *Omorgus* Foerster, and *Idechthis* Foerster are generically distinct from *Camoplex*.

### 24. (**Cryptus**) **Labena grallator** (Say).

*Cryptus grallator* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 236 (Leconte ed., vol. 2, p. 692).
*Mesochorus fuscipennis* Brullé, Hist. Nat. Ins. Hym., vol. 4, 1846, p. 250.
*Labena grallator* Cresson, Proc. Ent. Soc. Phila., vol. 3, 1864, p. 399; Walsh Trans. Ac. Sci. St. Louis, vol. 3, 1873, p. 162. (First synonymizing of *Mesochorus fuscipennis*.)

### 25. (**Cryptus micropterus** Say) = **Aptesis pterigia** Bradley.

*Cryptus micropterus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 238 (Leconte ed., vol. 2, p. 694).
*Brachypterus* [*Cryptus*] *micropterus* Walsh, Can. Ent., vol. 2, 1869, p. 11.
*Aptesis micropterus* Cresson, Syn. and Cat. No. Am. Hym., 1887, p. 199.
*Aptesis pterygia* Bradley, Bull. Brooklyn Ent. Soc., vol. 13, 1918, p. 100.

Finding the name *micropterus* preoccupied in *Aptesis*, Bradley renamed this species.

If Viereck has described correctly the material characterized in Hym. Conn., p. 328, it probably was not this species for he says "exserted portion of ovipositor about as long as the abdomen."

### 26. **Cryptus (Spilocryptus) nuncius** Say.

*Cryptus nuncius* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 237 (Leconte ed., vol. 2, p. 693); Riley, Amer. Ent., vol. 2, 1870, p. 100. (Synonymizes *extrematis* Cresson with *nuncius*); Riley, 4th Ann. Rept. Ins. Mo., 1871, p. 110–111. (Recognizes *extrematis* Cresson and *nuncius* as distinct).

None of the species listed in the synonymy with *nuncius* by Dalla Torre is correctly so placed. With the possible exception of *sordidus* Provancher, which its author says has the second tergite medially aciculate, all of these specimens are apparently synonyms of *extrematis* Cresson. Provancher's *extrematis* is not the same as *extrematis* Cresson, for the face, clypeus, mandibles, and tegulae are said to be white, while the true *extrematis* has all of these parts black.

### 27. (**Cryptus**) **Crypturopsis orbus** (Say).

*Cryptus orbus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 231 (Leconte ed., vol. 2, p. 688).

*Hemiteles orbus* Walsh, Can. Ent., vol. 2, 1869, p. 9–10.

*Mesostenus diligens* Cresson, Can. Ent., vol. 10, 1878, p. 207.

*Lymeon annulicornis* Ashmead, Ins. Life, vol. 7, 1894, p. 243.

*Crypturopsis annulicornis* Cushman, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 521. (Possibly synonymous with *diligens*.)

The male of *diligens* agrees in every way with Says' description. Examination of more specimens since the publication of Cushman's paper convinces us of the identity of *diligens* and *annulicornis*.

*Neotype*.—A male reared by August Busck near Twining City, Maryland, from a spider egg-cocoon.

### 28. (**Cryptus pleurivinctus** Say) = (**Cryptus**) **Itoplectis conquisitor** (Say), which see.

### 29. (**Cryptus**) **Stylocryptus subclavatus** Say.

*Cryptus subclavatus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 237 (Leconte ed., vol. 2, p. 693).

*Phygadeuon rotundiceps* Provancher, Nat. Can., vol. 9, 1877, p. 12.

A homotype (Rohwer) of *rotundiceps* agrees in every way with the description of *subclvatus* except that the abdomen is not blackish at the apex, but this is variable, some specimens showing a distinct infuscation. The bifoveate prescutellar groove with its distinct margin, the stout, subclavate antennae, depressed thorax, and nearly parallel intercubiti are characteristic and are exactly as described for *rotundiceps*. The species is extremely closely allied to the genotype, *Stylocryptus brevis* (Gravenhorst).

*Neotype.*—A female from province of Quebec, Canada.

### 30. (**Cryptus**) **Hemiteles tenellus** Say.

*Cryptus tenellus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 233 (Leconte ed., vol. 2, p. 690).

*Hemiteles tenellus* Walsh, Can. Ent., vol. 2, 1869, pp. 9–12.

*Hemiteles nematívorus* Walsh, Can. Ent., vol. 2, 1869, p. 11,

*Hemiteles utilis* Norton, Trans. Am. Ent. Soc., vol. 2, 1869, p. 326.

*Hemiteles melitaeae* Ashmead, Proc. U. S. Nat. Mus., vol. 12, 1890, p. 399.

*Hemiteles coleophorae* Ashmead, loc. cit., p. 400.

*Hemiteles variegatus* Ashmead, loc. cit., p. 400.

*Otocuates orgyiae* Ashmead, Trans. Am. Ent. Soc., vol. 23, 1896, p. 209.

*Otocuates periliti* Ashmead, loc. cit., p. 210.

*Hemiteles (Orthizema?) areator* subspecies *tenellus* Viereck, Conn. Hym., 1917, p. 337.

*Hemiteles tenellus* Timberlake, Proc. Haw. Ent. Soc., vol. 3, 1918, p. 400.

The above synonymy, except of *nematívorus* Walsh, is that proposed by Timberlake, who, however, admits that there may possibly be more than one species. Walsh's description is of an insect entirely within the range of color variation of *tenellus*.

### 31. (**Ichneumon**) **Exetastes bifasciatus** (Say).

*Ichneumon bifasciatus* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 73 (Leconte ed., vol. 1, 1859, p. 377).

*Cryptus? bifasciatus* Cresson, Trans. Am. Ent. Soc., vol. 6, 1877, p. 209.

Further discussion of very suggestive character descriptive of this species is given by Say in his description of *Cryptus calipterus*. This leaves no apparent doubt that the species is an *Exetastes* allied to *fascipennis* Cresson.

An unnamed species heretofore confused in the National Collection with *fascipennis* agrees very well with Say's description. It differs from *fascipennis* principally in having the face relatively shorter; the malar space shorter than basal width of mandible; clypeus nearly twice as broad as long; ovipositor fully as long as first tergite; and the wings more distinctly fasciate.

*Neotype.*—A female from Washington, District of Columbia, taken by T. Keleher.

Other specimens are from Georgia, Florida, and Texas.

### 32. (**Ichneumon**) **Amblyteles brevicinctor** (Say).

*Ichneumon brevicinctor* Say, Am. Ent., vol. 2, 1825, 1. 49, Pl. 22, fig. 1 (Leconte ed., vol. 1, 1859, p. 49, Pl. 22, fig. 1); Boston Journ. Nat. Hist., vol. 1, Pt. 3, 1835, p. 228 (Leconte ed., vol. 2, 1859, p. 686).

*Ichneumon extrematis* Cresson, Proc. Ent. Soc. Phila., vol. 3, 1864, p. 149.
*Phygadeuon niger* Provancher, Nat. Can., vol. 6, 1874, p. 280.
*Ichneumon brevicinctor* Cresson, Trans. Am. Ent. Soc., vol. 6, 1877, p. 150, no. 140.
*Ichneumon extrematatis* Cresson, loc. cit., p. 150, no. 141.

In a series of both sexes reared from pupae of *Bleptina* sp. under apple bark at Vienna, Virginia (Quaintance Nos. 7922 and 14419), all the females are *extrematis* and the males *brevicinctor*. There is no female in the National Collection having the black trochanter of *brevicinctor*, while most of the males have. There are three males in which the trochanter is partly white.

### 33. (**Ichneumon**) **Amblyteles centrator** (Say).

*Ichneumon centrator* Say, Am. Ent., vol. 2, 1825, p. 49, Pl. 22, fig. 3 (Leconte ed., vol. 1, 1859, p. 49, Pl. 22, fig. 3).
*Ichneumon fortis* Provancher, Nat. Can., vol. 7, 1875, p. 79.
*Ichneumon flavicornis* Cresson, Proc. Ent. Soc. Phila., Vol. 3, 1864, p. 140.
*Ichneumon centrator* Cresson, Trans. Am. Ent. Soc., vol. 6, 1877, p. 144.
*Stenichneumon centrator* Roman, Ent. Tidsk., 1910, p. 192.
*Stenichneumon flavicornis* Roman, loc. cit.

There is a large series of both *centrator* and *flavicornis* in the National Collection. There can be no doubt that they are sexes of the same species.

### 34. (**Ichneumon**) **Amblyteles comptus** (Say).

*Ichneumon comptus* Say, Boston Jour. Nat. Hist., vol. 1, 1835, p. 229 (Leconte ed., vol. 2, p. 686); Cresson, Trans. Am. Ent. Soc., vol. 6, 1877, p. 165.

### 35. (**Ichneumon**) **Plagiotrypes concinnus** (Say).

*Ichneumon concinnus* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 68 (Leconte ed., vol. 2, 1859, p. 374).
*Amblyteles ? concinnus* Cresson, Trans. Am. Ent. Soc., vol. 6, 1877, p. 194. (Excluding female.)
*Plagiotrypes concinnus* Ashmead, Proc. U. S. Nat. Mus., vol. 23, 1900, p. 20.

Cresson has expressed the opinion that the female described by Say is a Cryptine. We are unable to confirm or disprove this opinion. It may possibly have been a Mesostenine, although the exserted ovipositor is not sufficient evidence to exclude it from the Joppinae.

### 36. (**Ichneumon**) **Amblyteles devinctor** (**Say**).

*Ichneumon devinctor* Say, Am. Ent., vol. 2, 1825, p. 48, Pl. 22, fig. 2 (Leconte ed., vol. 1, 1859, p. 48, Pl. 22, fig. 2); Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 230 (Leconte ed., vol. 2, 1859, p. 687).
*Ichneumon tibialis* Brullé, Hist. Nat. Ins. Hym. vol. 4, 1846, p. 301.

*Ichneumon monticagus* Cresson, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 255.
*Ichneumon devinctor* Cresson, Trans. Am. Ent. Soc., vol. 6, 1877, p. 174.

The above synonymy is by Cresson.

### 37. (**Ichneumon**) **Amblyteles duplicatus** (Say).

*Icheumon duplicatus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 230 (Leconte ed., vol. 2, p. 688).
*Ichneumon signatipes* Cresson, Trans. Am. Ent. Soc., vol. 1, 1867, p. 308.
*Ichneumon lobatus* Provancher, Nat. Can., vol. 7, 1875, p. 77.
*Ichneumon duplicatus* Cresson, Trans. Am. Ent. Soc., Vol. 6, 1877, p. 180.
*Ichneumon signatipes* Cresson, Trans. Am. Ent. Soc., vol. 6, 1877, p. 180.

A series of six females (*signatipes*) and two males (*duplicatus*) reared by A. B. Champlain from the same host at various localities in Pennsylvania shows these two to be sexes of the same species. The antigeny is much the same as in the closely allied *W-album* (Cresson).

### 38. (**Ichneumon**) **Theronia? hilaris** Say.

*Ichneumon hilaris* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 71 (Leconte ed., vol. 1, 1859, p. 376).

The form of the areolet would exclude this species from the Joppinae and suggests *Theronia*. The male of *Theronia melanocephala* Brulle comes very close to the description, but the face is not distinctly yellow but rather reddish in the middle and black at the sides. The specific name is a primary homonym, being preoccupied in *Ichneumon* by *hilaris* Gravenhorst.

### 39. (**Ichneumon inquisitor** Say [not Scopoli]) = **Epiurus inquisitoriella** (Dalla Torre).

*Ichneumon inquisitor* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 71 (Leconte ed., vol. 1, p. 375).
*Cryptus inquisitor* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 233 (Leconte ed., vol. 2, p. 690).

The true status of this species has already been pointed out by Cushman;[1] as has also that of *Cryptus inquisitor* var. *α*. The latter is *Iseropus coelebs* Walsh. The synonymy of both is given in detail in the reference cited.

### 40. (**Ichneumon**) **Amblyteles malacus** (Say).

*Ichneumon malacus* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 72 (Leconte ed., vol. 1, 1859, p. 376); Boston Journ. Nat. Hist., vol. 1, 1835, p. 227 (Leconte ed., vol. 2, 1959, p. 685).
*Ichneumon afer* Cresson, Proc. Ent. Soc. Phila., vol. 3, 1864, p. 137.
*Ichneumon maurus* Povancher, Nat. Can., vol. 7, 1875, p. 75 (not Cresson).

[1]Proc. Ent. Soc. Wash., vol. 20, 1918, p. 10–12.

*Ichneumon malacus* Cresson, Trans. Am. Ent. Soc., vol. 6, 1877, p. 143.
*Stenichneumon malacus* Roman, Ent. Tidsk., 1910, p. 192.

### 41. (Ichneumon) Hoplismenus morulus (Say).

*Ichneumon morulus* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 73 (Leconte ed., vol. 1, p. 377); Boston Journ. Nat. Hist., vol. 1, 1835, p. 227 (Leconte ed., vol. 2, p. 685).
*Ichneumon calcaratus* Provancher, Nat. Can., vol. 7, 1875, p. 49.
*Hoplismenus morulus* Cresson, Trans. Am. Ent. Soc., vol. 6, 1877, p. 186.

### 42. (Ichneumon) Amblyteles navus (Say).

*Ichneumon navus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 229 (Leconte ed., vol. 2, p. 687).
*Ichneumon cinctipes* Provancher, Nat. Can., vol. 7, 1875, p. 51.
*Ichneumon navus* Cresson, Trans. Am. Ent. Soc., vol. 4, 1877, p. 51.
*Coelichneumon navus* Roman, Ent. Tidsk., 1910, p. 152.

### 43. (Ichneumon) Amblyteles otiosus (Say).

*Ichneumon otiosus* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 69 (Leconte ed., vol. 1, 1859, p. 374); Say, Boston Journ. Nat. Hist., vol. 1, Pt. 3, 1835, p. 686; Cresson, Trans. Am. Ent. Soc., vol. 6, 1877, p. 155.
*Stenichneumon otiosus* Roman, Ent. Tidsk., 1910, p. 192.

### 44. (Ichneumon) Amblyteles paratus (Say).

*Ichneumon parata* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 68 (Leconte ed., vol. 1, p. 373) [not 1835].
*Ischnus paratus* Cresson, Proc. Ent. Soc. Phila., vol. 3, 1864, p. 156.
*Ichneumon paratus* Cresson, Trans. Am. Ent. Soc., vol. 6, 1877, p. 168.

Cresson was undoubtedly correct in synonymizing *parata* Say 1835 (not 1828) with *laetus* Brullé.

### 45. (Ichneumon) Amblyteles pectoralis Say.

*Ichneumon pectoralis* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 72 (Leconte ed., vol. 1, 1859, p. 376).

Cresson failed to recognize this species, merely remarking that it is apparently allied to *scitulus* Cresson, which disposition of it seems to us to be the logical one. From the pale front and middle legs Say's specimen was apparently a male.

### 46. Ichneumon pterelas Say.

*Ichneumon (Pimpla) ptereles* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 71 (Leconte ed., vol. 1, 1859, p. 376).
*Pimpla pterelas* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 224 (Leconte ed., vol. 2, p. 683).

This is not the *Pimpla pterelas* Say of Cresson, Provancher, and others, which was first described by Walsh, under what name is not known, for Cresson substituted Say's name in the manuscript of Walsh's paper. It was redescribed many years later by Ashmead as *Pimpla pterophori*.

The Say species is obviously a true *Ichneumon* as indicated by the very long ovipositor and the coloration of the legs. Support of this idea was given by Say in his second reference to the species when he stated that *Pimpla humida* is similar in size and form to *pterelas*. There is no specimen of this genus in the National Museum that exactly agrees with the description.

### 47. (**Ichneumon**) **Amblyteles residuus** (Say).

*Ichneumon residuus* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 73 (Leconte ed., vol. 1, p. 377); Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 231 (Leconte ed., vol. 2, p. 688); Cresson, Trans. Am. Ent. Soc., vol. 6, 1877, p. 184.

The writers have accepted Cresson's interpretation of this species. The specimen at hand appears to differ slightly in some minor details from Say's description but the description is so indefinite that it is doubtful if it would be possible to associate any species with it which would more nearly fit it.

### 48. (**Ichneumon**) **Amblyteles suturalis** (Say).

*Ichneumon suturalis* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 226 (Leconte ed., vol. 2, p. 685).

*Amblyteles suturalis* Cresson, Trans. Am. Ent. Soc., vol. 6, 1877, p. 193.

Cresson[1] synonymized his *propinquus* with *suturalis*, but a paratype of the former in the National Collection seems to be sufficiently different to warrant retaining the name *propinquus*.

*Amblyteles superbus* Provancher, placed in synonymy with *suturalis* by Davis,[2] is also a distinct species as indicated by notes on the type made by Mr. Gahan.

### 49. (**Ichneumon**) **Amblyteles unifasciatorius** (Say).

*Ichneumon unifasciatorius* Say, Am. Ent., 1825, p. 48, pl. 22, fig. 4 (Leconte ed., vol. 1, p. 48, pl. 22, fig. 4); Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 228 (Leconte ed., vol. 2, p. 686). [Mentioned in comparison with *I. otiosus*.]

*Ichneumon niger* Brullé, Hist. Nat. Ins. Hym., vol. 4, 1846, p. 302, male only.

*Ichneumon unifasciatorius* Riley, 3d Ann. Rept. Ins. Mo., 1871, p. 71; Cresson, Trans. Am. Ent. Soc., vol. 6, 1877, p. 155.

The female of *niger* is apparently a different species since it is not described as having the white-markings of hind tibia, pronotum, mesoscutum, scutellum, and first tergite, while the wings are fuscous with black or blue-black venation. The description

[1]Trans. Am. Soc., vol. 6, 1877, p. 193.

[2]Can. Ent., vol. 27, 1895, p. 287.

is so brief that it is impossible to fix on any of the species described by Cresson or others as the same, although it might be either *viola* Cresson or *malacus* Cresson or even a small specimen of *maurus* Cresson.

### 50. (**Ichneumon**) **Itamoplex vinctus** Say.

*Ichneumon vinctus* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1878, p. 70 (Leconte ed., vol. 1, 1859, p. 375).

*Cryptus americanus* Cresson, Proc. Ent. Soc., Phila., vol. 3, 1864, p. 297.

*Itamoplex americanus* Ashmead, Smith's Ins. N. J., (1899) 1900, p. 570.

Cresson failed to recognize this species and simply included it under "Desiderata" in his "Classification of the North American Ichneumonides."

The male of *Itamoplex americanus* (Cresson) usually has a blackish line on each side of the middle of the face, but the distinctness of these lines varies greatly, and the National Collection contains two specimens which lack them and agree perfectly with the description of *vinctus*.

*Neotype*.—A male collected May 29, 1895, by Hugo Kabl at Lawrence, Kansas.

Further synonymy is given in Dalla Torre's "Catalogus Hymenopterorum" under *Cryptus americanus* Cresson.

### 51. (**Ophion**) **Labrorychus analis** (Say).

*Ophion analis* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 75 (Leconte ed., vol. 1, p. 379).

*Anomalon analis* Norton, Proc. Ent. Soc. Phila., vol. 1, 1863, p. 361.

*Erigorgus analis* Viereck, Conn. Hym., 1917, p. 281.

Norton was certainly correct in placing this in the (Anomalini) Therionini, and specimens determined by Ashmead as *analis* and confirmed by Gahan by comparison with Norton's specimen run to *Labrorychus*.

### 52. **Ophion bilineatum** (**Say**).

*Ophion bilineatus* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 75 (Leconte ed., vol. 1, p. 378); Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 240 (Leconte ed., vol. 2, p. 695).

For synonymy see Hooker.[1] This has not been verified by the writers.

### 53. (**Ophion**) **Viereckiana brachiator** (Say).

*Ophion brachiator* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 240 (Leconte ed., vol. 2, p. 695).

*Campoplex xanthogaster* Brullé, Hist. Nat. Ins. Hym., vol. 4, 1846, p. 159.

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[1]Trans. Am. Ent. Soc., vol. 38, 1912.

Hooker[1] places this among the "Misplaced and Unrecognized Species, etc.," and no other writer appears to have recognized it.

A female in the National Collection determined, we believe correctly, by Ashmead as *Campoplex xanthogaster* Brullé agrees in every respect with Say's description and is undoubtedly this species.

*Neotype.*—The above mentioned female specimen.

### 54. (**Ophion**) **Exochus emarginatus** (Say).

*Ophion emarginatus* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 76 (Leconte ed., vol. 1, p. 380).

*Anomalon emarginatus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 245, (Leconte ed., vol. 2, p. 699).

Davis[2] referred this species to the Orthocentrine genus *Tapinops* Foerster and synonymized with it *Exochiscus pusillus* Walsh, *Alomyia abdominalis* Provancher, and *Orthocentrus californicus* Ashmead. Ashmead[3] called attention to Say's second reference to the species and showed that Davis was in error in his synonymy, the areolet being absent in Say's species, which would exclude it from *Tapinops*. Ashmead also states "I have recognized Say's species; it does not even belong to this tribe (Octhocentrini) but belongs to a genus in the next tribe or the "Exochini." The present writers had arrived at the same conclusion independently. Ashmead did not indicate by further statement or by labelled specimen what he recognized as Say's species. Nor have the writers been able to determine exactly the species to which Say's name should be assigned, but that it is an *Exochus* resembling *Exochus laevis* Cresson there appears to be no room for doubt.

### 55. (**Ophion**) **Paniscus geminatus** (Say).

*Ophion geminatus* Say, Contrib. Maclur. Lyc. Phila., vol. 1, 1828, p. 76 (Leconte ed., vol. 1, p. 379).

*Paniscus geminatus* Norton, Proc. Ent. Soc. Phila., vol. 1, 1863, p. 364.

Norton remarked that there appeared to be two sizes of the species which he was unable to separate. Aside from the question of size there appear to be several species of true *Paniscus*, not to mention the genus *Parabatus*, confused in the National Collection under this name. In order to fix the species it seems advisable to designate a neotype combining at least the apparently most nearly constant characters mentioned by

[1] Trans. Am. Ent. Soc., vol. 38, 1912, p. 159.

[2] Trans. Am. Ent. Soc., vol. 24, 1897, p. 222.

[3] Proc. Wash. Acad. Sci., vol. 4, 1902, p. 230.

Say, leaving for a later time the revision of the genus. These characters are: "antennae somewhat shorter than body" and "vertex with a black spot." In addition to these the neotype designated below has the antennae brownish with scape paler, head yellow, discocubital vein without a ramulus, and color of venation and size as described. The pleura are not noticeably yellow, but this character is extremely variable.

*Neotype.*—A male taken June 14, 1918, at Falls Church, Virginia, by R. A. Cushman.

### 56. (**Ophion**) **Eremotylus glabratus** (Say).

*Ophion glabratus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 239 (Leconte ed., vol. 2, p. 695); Riley and Howard, Ins. Life, vol. 3, 1890, p. 155.
*Eremotylus arctiae* Ashmead, Trans. Am. Ent. Soc., vol. 23, 1896, p. 192.
*Ophion glabratus* Viereck, in Smith's Ins. of N. J., 1909, p. 620 and 621.
*Eremotylus arctiae* Viereck, loc. cit.

Hooker[1] synonymized this with *macrurus* (Linné), but it appears to us that Say's description applies better to *arctiae* Ashmead, especially in the size and the glabrous area of the discocubital cell. The latter is much more conspicuous and elongate in *arctiae* and thus agrees better with Say's "longitudinally ovate spot" than does the small spot of *macrurus*. Moreover, Riley and Howard and Viereck had previous to Hooker recognized *glabratus* as a parasite of *Hyphantria cunea*, which is also commonly a host of *arctiae*.

### 57. (**Ophion mundus** Say) = **Therion morio** Fabricius.

*Ichneumon morio* Fabricius, Spec. Ins. 1, 1781, p. 436, n. 100.
*Ophion morio* Fabricius, Suppl. entom. System. 1798, p. 237, n. 8.
*Ophion mundus* Say, Boston Journ. Nat. Hist., vol. 1, 1836, p. 239 (Leconte ed., vol. 2, 1859, p. 695, n. 3).
*Anomalon flavipes* Brullé, Hist. Nat. Ins. Hym., vol. 4, 1846, p. 170.
*Exochilum mundus* Norton, Proc. Ent. Soc. Phila., vol. 1, 1863, p. 360, n. 10.
*Anomalon nigripenne* Provancher, Nat. Can., vol. 6, 1873, p. 173.
*Exochilum morio* Morley, Rev. Ichn., Pt. 2, 1913, p. 73.
*Therion morio* Viereck, Bull. 22, Conn. Geol. & Nat. Hist. Surv., 1916, p. 286.

This species has become well known in American literature under the name of *Exochilum mundum*. The synonymy of Say's species with *morio* Fabricius was first pointed out by Morley in 1913 after an examination of the Fabrician type. The genus *Exochilum* Wesmael is a synonym of *Therion* Curtis as pointed out by Rohwer, Cushman, and Gahan.[2]

[1] Trans. Am. Ent. Soc., vol. 38, 1912, p. 148.
[2] Proc. Ent. Soc. Wash., vol. 17, 1915, p. 149.

### 58. (Ophion) Enicospilus purgatus (Say).

*Ophion purgatus Say*, Boston Journ. Nat. Hist., vol. 1, 1835, p. 238 (Leconte ed., vol. 2, p. 694).

*Ophion lateralis* Brullé, Hist. Nat. Ins. Hym., vol. 4, 1846, p. 141.

*Ophion purgatus* Norton, Proc. Ent. Soc. Phila., vol. 1, 1863, p. 358. (Synonymizes *lateralis* with *purgatus*.)

*Enicospilus purgatus* Ashmead, in Dimmock's "Notes on Parasitic Hymenoptera," Proc. Ent. Soc. Wash., vol. 4, 1898, p. 153.

Szeplegeti[1] and Morley[2] accredited this species, under Brullé's name, to the Australian Region, evidently under the mistaken idea that "la Caroline" referred to the Caroline Islands. That this is wrong is shown by the locality given under *Ephialtes irritator* Brullé, "l'Amerique du Nord (la Caroline)." Both of the species were collected by the same person, one L'Herminier.

### 59. (Peltastes) Metopius pollinctorius (Say).

*Peltastes pollinctorius* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 245 (Leconte ed., vol. 2, p. 700).

For synonymy see Dalla Torre's Catalog.

### 60. (Pimpla) Rhyssella humida (Say).

*Pimpla humida* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 224 (Leconte ed., vol. 2, p. 683).

*Rhyssa (Pararhyssa) humida* Walsh, Trans. Ac. Sci., St. Louis, vol. 3, 1873, p. 109.

*Rhyssella humida* Rohwer, Proc. U. S. Nat. Mus., vol. 57, 1920, p. 423.

### 61. Pimpla ? petiolata Say.

*Pimpla ? petiolatus* Say, Boston Journ. Nat. Hist., vol. 1, 1835, p. 224 (Leconte ed., vol. 2, p. 683).

We are unable to recognize this insect, but are of the opinion that it probably belongs to the subfamily Tryphoninae.

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## A NEW SPECIES OF THE CHALCIDID GENUS ZATROPIS. (HYM.)

By J. C. Crawford.

To this genus must be referred *Catolaccus hunteri* Crawford, *C. incertus* Ashmead, *C. nigroaeneus* Ashmead, *C. coeliodis* Ashmead, *C. perdubius* Girault, and *Meraporus bruchivorus* Ashmead.

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[1]Gen. Ins., Fasc. 34, 1905, p. 27.

[2]Rev. Ichn., Pt. 1, 1912, p. 49.

The genus must, I think, be kept distinct from *Neocatolaccus* from which it differs in lacking the transverse ridge on the propodeum (which makes the propodeum of *Neocatolaccus* appear areolated); in having a broad band back of marginal vein without ciliae; the area between postmarginal and stigmal almost destitute of ciliae; and the under side of wing back of marginal with a row of long large curved ciliae.

**Zatropis tortricidis**, new species.

*Female.*—Length 3 mm. Head and thorax bronzy, abdomen greenish bronzy; head and thoracic dorsum with timble-like punctures; face with striae converging towards mouth, laterad extending almost to eyes, medially extending over two-thirds distance from apical margin of clypeus to insertion of antennae; scape and first two ring joints testaceous, pedicel brown with testaceous apex, last ring joint and rest of antennae dark brown, first joint of funicle distinctly longer than wide and longer than either pedicel or second joint of funicle; propodeum with fine thimble-like punctures, a distinct median carina which does not extend to apex of neck, foveae at base of neck bounded laterally by a carina; metapleura smooth polished, the anterior margin reflexed; coxae metallic, femora dark brown with a metallic lustre, tibia brownish-testaceous with whitish apices, tarsi whitish; abdomen somewhat larger than head and thorax combined.

*Male.*—Length 1.75 mm. Similar to female except in secondary sexual characters, but the tibia much more brown; antenna with two ring joints, the first joint of funicle shorter than second.

*Type-locality.*—North East, Pennsylvania.

*Type.*—Cat. No. 24,589, U. S. N. M.

*Host.*—*Polychrosia viteana* Clemens.

Described from six females and four males.

Differs from *incertus* in having foveae at base of neck of propodeum bounded laterad by carinae; from *catalpae*, *coeliodis* and *nigroaeneus* in having the front edge of metapleura recurved and projecting above plane of mesopleura; from *perdubius* and *bruchivorus* in having first joint of funicle distinctly longer than wide and distinctly longer than second or than pedicel.

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*Actual date of publication, October 15, 1921.*

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OF THE

# ENTOMOLOGICAL SOCIETY

OF WASHINGTON



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PROCEEDINGS OF THE
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# SOME SUGGESTED HOMOLOGIES BETWEEN LARVAE AND ADULTS IN SAWFLIES.

By WILLIAM MIDDLETON, *Bureau of Entomology.*

## Introduction.

The following paper, which is a contribution from the Branch of Forest Insects of the Bureau of Entomology, was prepared under the direction of S. A. Rohwer and presents some of the results of a study of the metamorphosis of the gooseberry sawfly, *Pteronidea ribesii* Scopoli. The homologies, between the larval areas and the adult sclerites here indicated are only suggested as the author does not believe they are founded on sufficient evidence to be considered as conclusive. The chief value of these suggested homologies lies in the fact that they summarize a series of observations on the external appearance of the larval areas of a sawfly secured by a study of its metamorphosis and that they form a small part in the controversy of the composition of the insect segment and origin of postscutellum. Their chief weakness lies in the fact that as yet they are not supported by definite anatomical and histological evidence.

The composition of the tergum of the segments of the larva of *Pteronidea ribesii* Scopoli was given considerable attention, especially the limits of the segments and the relations that the areas bear to each other, segment to segment and abdomen to thorax. The results obtained by these studies are supported by successful application to other sawfly larvae representing well separated groups.

For the time being, the author does not adopt for the tergal areas of the larva the names of the adult parts to which they apparently give rise, but prefers to use a system of lettering and numbering. Such a method of referring to the various parts of the larval tergum makes it possible to describe it and in this paper has the added advantage of not making it necessary to repeat the words "of adult" and "of larva."

## Method of Study.

The insect chiefly under observation was *Pteronidea ribesii* Scopoli (the Gooseberry Sawfly) which was chosen because it is well known, widely distributed, very abundant, of fair size and has several generations in a year.

The data for this paper were chiefly obtained directly from the study of living larvae, prepupae, pupae and adults of *Pteronidea ribesii.* Large numbers of these insects were examined every day, and the progress of metamorphosis was recorded by notes and drawings. Specimens showing changes in areas or folds, were preserved for confirmation of the observations and to aid in the final preparation of the notes. Dissections of living larvae and prepupae were occasionally made.

The body folds of the larval skin were studied from both the exterior and interior; and the arrangement and points of attachment of all of the larger muscles were determined. The arrangement of the areas of the larva and the newly formed prepupa were found to be identical. But as there are great differences between the prepupa and the pupa, and since it is in the prepupal stage that profound changes occur, the areas of the prepupa were followed to the pupal stage by frequent observations on living specimens which had been removed from their cocoons. Changes of body contour together with the relaxation of the mandibles and the gradual movement of the optical centers inwards and dorsad in the head served as an index to the progress of the prepupa in its development. The relation of the sclerites of the pupa to the prepupal areas and the changes in body contour caused by the formation of the pupa within the prepupal skin has suggested the homologies herein described. The removal of the skin of the prepupa, before the pupa had developed sufficiently for shedding lent further weight to these suggestions. The evidence obtained by this last method was often very satisfactory, because on the sclerites of the incomplete pupa there were indications of divisions corresponding with the folds and areas of the enclosing prepupal skin.

The pupa skin seems merely a sack within which the adult is developing and while in general structure it is sufficiently similar to the adult, as to make unnecessary any such elaborate method as is necessary to trace homologies between prepupa and pupa, considerable attention was given to the development of the sclerites and abdominal appendages.

The interpretations of the body folds as thus determined in the larva of *Pteronidea ribesii* have been successfully applied to several other sawfly larvae belonging to well separated groups, the principal of which are: *Neodiprion lecontei* (Fitch), *Cimbex americana* Leach, *Arge salicis* Rohwer.[1]

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[1]A few drawings showing the satisfactory way in which these interpretations can be applied to larvae belonging to well separated groups have been included in this paper. (See Plate XIV, figs. 2, 4, 7 and 8.)

## Limitation and Composition of Larval Segments.

The larva of a sawfly is distinctly divided into a head and body. The body is further divided, more or less distinctly, into prothorax, mesothorax and metathorax and ten abdominal segments and it is readily observed that in the abdomen each segment excepting the ultimate is subdivided into a constant number of areas and that the areas of one segment are recognizable duplicates of the areas of any other abdominal segment. Hence between any two abdominal spiracles on the same species there is a constant number of areas (see Plate XIV, figs. 2-5 and 6). In each of the first nine larval abdominal segments of *Pteronidea ribesii* there are four tergal areas; three ornamented with spots and hairs, and one, plain without markings or hairs. The thoracic segments (see Plate XIV, figs. 1 and 2) are somewhat similar to the abdominal ones especially in containing four tergal areas but differ chiefly as follows:

1. The position occupied by the spiracle.
2. The possession of but two spiracles for the three segments, one very large within and apparently belonging to the prothorax and one very small and obscure, situated between the mesothorax and metathorax.
3. Some change in the proportion and spotting of the areas.
4. A considerable constriction of the anterior area of the prothorax where it unites with the head.
5. The division of the pleural zone into four more or less distinctly defined areas termed preepipleurite and postepipleurite and prehypopleurite and posthypopleurite.

Thus, in *Pteronidea ribesii*, the segments, exclusive of the head and the anal segment, are composed dorsally of four areas each. It will be seen from a study of the drawings illustrating the composition of the body areas for both thorax and abdomen of sawflies belonging to different groups, that the number of folds per segment is not the same for all sawfly larvae, but that although some annulets may be divided, homologies do exist between these areas from abdomen to thorax and from species to species. (See Plate XIV, figs. 2, 4, 7 and 8.) The homologies between the different segments of an individual larva are readily seen if a definite area be followed throughout the segments from abdomen to thorax. The homologies between widely different larvae can be determined by comparison although it may sometimes be necessary to assure oneself by an examination of the muscles.

It now becomes necessary to decide with which of the transverse tergal folds segments begin. In this connection the musculature offers some suggestions and since the infoldings of the skin, which determine the annulets, are used for muscle attachments these muscle attachments undoubtedly add weight to the value of these infoldings as intersegmental and segmental divisions. Before proceeding with the following short account of the musculature of *Pteronidea ribesii* it is necessary to accurately indicate the limits of each of the tergal areas. The four areas are accordingly designated by the letters A, B, C and D (see Plate XIV, figs. 2 and 5) and are defined as follows:

A—the anterior of the three ornamented areas. In the abdomen it is the area preceding that above the spiracle.

B—the area posterior of A. It is the second of the three oranamented areas and the one which in the abdomen lies above the spiracle. (In some sawfly larvae this area is large and subdivided. See B1 and B2 in drawings of *Cimbex americana*. Plate XIV, fig. 7.)

C—the area posterior of B. It is the posterior of the three ornamented areas and lies above the alar[1] area. (In certain sawfly larvae area C is large and is subdivided, see C1, C2, C3, in drawings of *Neodiprion lecontei*, plate XIV, fig. 4.)

D—The area which is unarmed and posterior of C or anterior of A. (In certain sawfly larvae this area is infolded and not visible as a distinct and separate division of the segment, see drawing of *Arge salicis*, Plate XIV, fig. 8.)

An idea of the musculature of *Pteronidea ribesii* may best be had by an examination of the accompanying diagram (Plate XIV, fig. 3) in which the principal muscles of the mesothorax, metathorax, and first abdominal segment are pictured. It will be observed that all of the stronger infoldings marking areas A, B, C and D are used to a certain extent as ridges for muscle attachments for the majority of the large muscles. Both the anterior and posterior margins of area A bear many muscles and either margin more than both margins of all the other areas. Furthermore all the long, longitudinal muscles, that (are segmental) go from one segment to another attach only to the margins of this area always uniting area A of one segment with area A of the preceding and following segments. Thus we have in each segment one area which bears on its anterior and posterior margins the great majority of the muscle attachments, and to either its anterior or posterior margin is attached at least one end of all longitudinal muscles. This indicates area A as either the first or last area of the segment.

[1]In a paper recently published by the author ("Leconte's Sawfly, an Enemy of Young Pines," Jour. Agri. Research, Vol. XX, No. 10, pp. 741–760, see footnote 1 on pages 742–3 and fig. F, plate 91) he adopts certain names for longitudinal regions of the sawfly larval body and figures them. Under the tergum he recognizes supraspiracular and spiracular regions (IV & V). Since the spiracle does not always retain the same position on the body wall, i. e., within the so called spiracular region, he proposes to substitute supraalar and alar for the names supraspiracular and spiracular respectively and believes that in so doing he increases the usefulness of the plan making it adaptable to other groups where the spiracle is less fixed in its position than in the sawflies.

Superficial examination of any sawfly larva immediately suggests that area A is at the cephalic end of any abdominal segment but more substantial indications that the anterior margin of this area marks the cephalic limit of each tergum are obtained from certain features of the musculature and from the construction of the prothorax and the tenth abdominal segment.

An examination of the musculature of the larva of *Pteronidea ribesii* (Plate XIV, fig. 3), as well as that of such other sawfly larvae as have been studied shows that there is a greater number of muscles extending *posteriorly* from the *anterior* margin of area A, and linking it with the segment *caudad* than there are muscles extending *anteriorly* from the *posterior* margin of the same area A, and serving to unite it with the *cephalad* segment. Area A is also closely linked to the three posterior areas by the small, short, intrasegmental muscles which extending caudad always start from margin D A, and which extending cephalad start at the same margin. The significance of these two points of musculature can be more readily understood by an examination of accompanying illustration (Plate XIV, fig. 3), and they seem to the author to indicate quite clearly that the infolding D A is the line of intersegmental division and that area A belongs to the segment caudad of the line.

The anal segment (Plate XIV, fig. 6) is not of the same construction as the other abdominal segments, and seems to be dorsally composed of a single, fused, segmental plate named the epiproct. This plate extends from the posterior margin of the unarmed area D of the ninth abdominal segment to the anus at the apex of the abdomen. In those larvae in which the anal segment retains traces of the ornamentation of the preceding segments, this ornamentation is aborted and the portion of the segment on which it occurs, although occupying the same relative position as the ornamented parts in preceding segments, is not separated from the remainder of the epiproct by any such constriction or infolding of the skin as marks the posterior margins of similar areas in the preceding segments. The areas of the anal segment are never distinct but are occasionally indicated by the vestiges of ornamentation mentioned above, and when thus indicated they occupy the same relative position as in any preceding abdominal segment. The unarmed, narrow area (D) immediately preceding the unified anal segment can not be considered as part of the last segment, but must be looked upon as the terminal fold of the ninth abdominal segment. The sharp, well defined infolding or constriction separating this area (D) from the anterior of the anal segment adds proof to the muscular indications that area D is the posterior subdivision of the segment.

Viewing the larva from the exterior there seems to be a reduction in the number of areas in the prothorax (Plate XV, fig. 9).

However, when the skin is examined from the interior, the four tergal areas are to be found (Plate XIV, fig. 1). The anterior area is a constricted, unarmed, narrow band partly (or entirely) covered by the head and connects the head with the first area of the prothorax which is visible from the exterior (B). This unarmed band I have considered as the aborted first area (A) of the prothorax thereby completing that segment.

Thus we see, that to limit the segment of a larva of *Pteronidea ribesii* in any other manner than that described above makes it necessary to (1) ignore the neck-like membrane of the prothorax or to explain its presence by deriving it from the head or to consider it as a distinct and separate development; (2) to separate as belonging to the ninth abdominal segment a portion of the epiproct which is never a distinct area and which is frequently indistinguishably fused with the remainder of the anal segment or to connect with the anal segment area D of the ninth abdominal segment which is never as distinctly separated from the ninth segment as it is from the anal segment; and (3) to consider many small, short, weak muscles as intersegmental, *i. e.*, arising in one segment and attaching to an infolding in another.

To summarize: the segment of *Pteronidea ribesii* is composed tergally of four areas and begins with the area preceding that above the spiracle. These areas are here designated by the letters A, B, C and D with the anterior being known as A. The first three (A, B, and C) of these areas are ornamented with spots and hairs while the posterior one (D) is plain and entirely without spots or hairs. That other sawfly larvae agree with this limitation and composition of a segment may be demonstrated by the following examples:

*Nediprion lecontei* (Plate XIV, fig. 4). The thorax and tenth abdominal segment of *Neodiprion lecontei* is practically of the same construction as *Pteronidea ribesii* but in the first nine abdominal segments area C is twice subdivided forming three subareas (C1, C2, C3) of which only the middle one (C2) is ornamented. Hence the construction of the tergum of *Neodiprion lecontei* is: Thorax—A, B, C and D. Abdomen—(urites 1–9) A, B, C1, C2, C3 and D; (urite 10) epiproct.

*Arge.* (Plate XIV, fig. 6.) In the larvae belonging to the genus *Arge* the thoracic and abdominal (1–9) segments appear to consist dorsally of only three areas (A, B and C). The fourth area (D) is present however, but infolded under C. This may easily be demonstrated by splitting a larva longitudinally along the back, or by injecting a living larva with alcohol, which expands the body.

*Cimbex.* (Plate XIV, fig. 7.) The larva of *Cimbex americana* is in respect to A, C, D similar to *Neodiprion lecontei* but B is divided B1 and B2, in both the thorax and the abdomen. The construction of the tergum of this species is: Thorax—A, B1, B2, C, D: Abdomen—(urites 1–9) A, B1, B2, C1, C2, C3, D—(urite 10) epiproct.

Thus, in all sawfly larvae the segments are divided into four areas, three of which are usually armed, and always distinct and prominent, for which reasons and others which will follow I have called them segmental areas and a fourth, unarmed area which is occasionally infolded or not found unless sought for. The first area is recognized by bearing on its anterior and posterior margins the greatest number of muscles. The second is above the spiracle in the abdomen and the third is above the alar area. All three of these areas are always present and usually ornamented more or less conspicuously but the fourth area is never ornamented, not infrequently reduced in size or appearing wanting and occurs between the third area of the segment of which it is a part and the first area of the following segment. Because the fourth area is unlike the segmental areas in never being ornamented and in not always possessing a similar prominent, easily seen position, and because it is apparently used chiefly to connect the segment of which it is a part with the segment following, I have called it a connective area.

## Composition of Adult Thorax.

Having thus briefly characterized the composition and defined the limitation of the larval segment of *Pteronidea ribesii* the salient parts of the segments in the adult may be called to mind before entering into a discussion of the possible homologies existing between larval and adult areas. The three thoracic segments of adult sawflies are not equal in size or composition (Plate XV, fig. 20). The mesothorax is much larger than either of the other thoracic segments and is the part usually considered as the typical thoracic segment. It is divided into four parts: the prescutum, scutum, scutellum (including posttergite) and postscutellum. The three anterior parts are fused together and constitute the most conspicuous part of the segment. The posterior plate is rather distinct, being separated from the anterior part by a membrane, although laterally it usually fuses with the pleurum. The prothorax differs remarkably from the mesothorax and is much smaller. The metathorax while much smaller than the mesothorax differs from it chiefly in the lack of a prescutum.

Comparing the construction of the thorax of the adult with that of the larva two striking differences are evident: 1—The mesothorax of the adult is composed of four, dorsal, segmental areas and a connective membrane, while in the larva there are only three dorsal segmental areas and a connecting area. 2—The thoracic segments of the adult are of unequal construction, while in the larva each thoracic segment has an equal number of divisions. These differences in themselves seem to indicate that no homology exists between the adult and larva; however, through a study of the transformation of the thorax of the prepupa into the thorax of the pupa indications are found suggesting the existence of a relation in development, or homology, between the larval segmental elements and the adult segmental elements.

**Metamorphosis** (See drawings Plate XV, Figs. 9–10).

The larva is ornamented on areas A, B, and C with prominent black spots and when the larva sheds, the skin of the prepupa is of the same shape but with the spots lacking color though rather more prominent or elevated than in the larva. As the prepupa develops these spots become more distinct, not in prominence, however, for they lose to a considerable degree their elevation, but in a difference of texture from the surrounding skin. In the larva the skin of areas A, B, and C seems much the same in thickness and rigidity, although perhaps the black shininess of the spots does differentiate them rather markedly from the surrounding tissue. In the prepupa as development advances the skin between these spots seems to become considerably less rigid and thick, and has somewhat the appearance of a membrane connecting the toughened areas. As the pupa is formed within, this membrane seems to occupy considerable of the surface and enables the prepupal skin to accommodate itself to the forming pupa. The spots seem to be in their relation to the parts of the pupa formed below, the latent imaginal discs[1] from which the adult form develops.

The development of the prepupa is accompanied by two evident changes other than reduction in size and consequent wrinkling of the skin. These changes are: the relaxing and opening to some extent of the mandibles and a gradual movement of the optical centers. The relaxing of the mandibles occurs rather early in the prepupal stage and does not seem to be especially indicative of the immediate approach of pupation. The mandibles although open are capable of closing as was determined by inserting objects between them. The movement of the sensory parts of the eye is, however, considered of importance as indicating the beginning of the greater changes incidental to the development of the pupal stage.

The prepupa up to the apparent beginning of the formation of the pupa has a black eye in a black eyespot but when this stage is attained the eye assumes a translucent whitish appearance in the black eyespot. A close examination will now reveal that the eye or the sensory part, is being withdrawn from the old

[1]Korchelt—Heider Text book on Embryology, Invertebrates, Part III, Insecta, footnote p. 296 (Burger).

larval and prepupal location and moves slowly dorsally and inwards, while, as this progresses the facets of the compound adult and pupal eye become slowly and indistinctly visible close to the head capsule and in approximately their normal adult position, extending from the old eye about half way up the side of the head.

This withdrawing of the eye is accompanied, and followed, by a gradual development of the pupa. The head capsule of the prepupa wrinkles and changes its surface in conformation with the new and somewhat differently shaped structure within. The thorax lengthens and the legs lay stretched straight posteriorly. The first abdominal segment is constricted giving the prepupa a characteristic "waistlined" appearance. The abdomen as a whole is somewhat contracted and shortened and the spiracles of the prepupa are connected with those of the forming pupa by whitish narrowing bands or tubes.

The dissections of the prepupa during these critical changes and the attempts made to remove the skin of the prepupa from the pupa indicate that during the early formation of the new stage the two skins are practically identical in the closeness of their association and that the pupal skin is very delicate. Indeed no attempts to separate the two skins are successful until the contraction of the pupa has advanced considerably and the insect has begun a natural separation, with the pupa considerably resembling the adult in form. This complicates the work by making all the observations on the early pupal development indirect and dependent upon observations of the changes denoted by the prepupal skin and contour and the association of these changes with steps in pupal development. However, since the same insect can be observed through the entire course of its development and by removing the skin of the prepupa when it has separated from the pupa, pupal areas can be connected with prepupal areas, it is possible to understand to some extent the development of the pupa by the effects it produced upon the skin of the prepupa. As the pupa is formed and its divisions become sufficiently distinct for interpretation through the prepupal skin it is found that the pronotum of the adult is formed below areas B and C of the prepupal prothorax (area C lies above the anterior margin of the prescutum of the mesothorax of the adult but is empty and folded flat posteriorly, probably due to the longitudinal lengthening of the prescutum and the consequent withdrawing anteriorly of that portion of the pronotum formed beneath). The prescutum is narrow, long, medianly divided and extends cephalad from under area A, mesothorax of prepupa. Scutum is formed under B, and the latero-dorsal and supraalar discs of C (in a specimen of a prepupa the skin of which was removed to disclose the pupa beneath, scutum was transversely and longitudinally divided)

(Plate XV, figs. 16, 17 and 18). Scutellum (including posttergite[1]) is formed under the subdorsal pair of discs of C, and area D is above the posterior of scutellum and the membrane separating postscutellum from the anterior portion of the mesothorax. Postscutellum is found under area A of the prepupa's metathorax which occurs in the depression between the mesothorax and the metathorax. The metathoracic scutum and scutellum are below areas B and C. The scutum being found below area B and the latero-dorsal and supraalar discs of area C and the scutellum being found below the subdorsal discs of area C which are rather distinct from the remainder of C. Metathoracic area D is very narrow and area A of the first abdominal tergite is above the postscutellum of the metathorax.

The phragmae seem to be the prolongations of the infolded margins of areas used for attachment of the muscles which have been enlarged. In their development, the particular muscles enlarged, for the accomplishment of the new duties or activities required of the insect upon reaching its adult stage, are the controlling guide. Area A in bearing on its posterior and anterior margin all the attachments of intersegmental muscles (Plate XIV, fig. 3) is the natural base for these structures as evinced by the following text figure and the illustration showing the longitudinal section of the adult mesothorax (Plate XV, fig. 22). An examination of these drawings will show the anterior margin of the prescutum (or A larval mesothorax) and the posterior margin of the postscutellum (or A larval metathorax) produced to form phragmae and connected by a large muscle. An examination of the drawing of *Pteronidea ribesii* musculature will reveal that there exists already in the larval thorax (T III—Plate XIV, fig. 3) three muscles having these points of attachment in common.

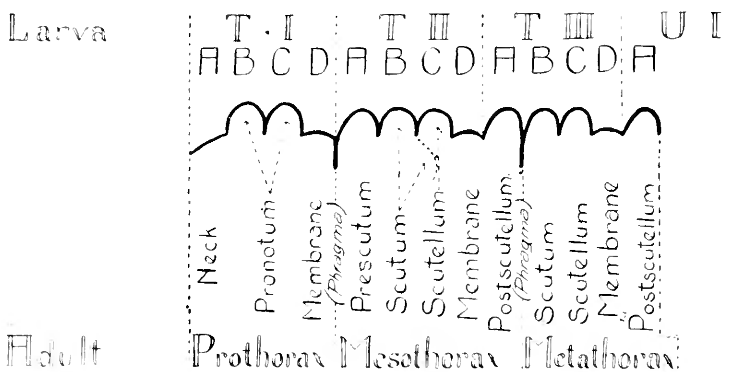
From the above comparison, which describes the position occupied by the tergal sclerites of the adult in relation to tergal areas of the prepupa, it would seem that the adult tergal sclerites are developed from the larval areas indicated in the following table and figure.

**Suggested Homologies.**

| *Adult* and *Pupa* | from | *Prepupa* and *Larva*. |
|---|---|---|
| Pronotum | " | B and C prothorax |
| Membrane between pronotum and prescutum | " | D prothorax. |

[1]The posttergite is the "lobe on posterior margin of scutellum" recognized by Snodgrass ("Thorax of Hymenoptera," Proc. U. S. N. M., Vol. 39, pp. 37–91. See o, page 88 and Plate I, fig. 3) and designated "posttergite" by Crampton ("The Ground Plan of a Typical Thoracic Segment in Winged Insects," Zoologischer Anzeiger, Vol. 44, 1914, pp. 56–67. See page 60.)

| | | |
|---|---|---|
| Anterior mesothoracic phragma | " | margin D A (mesothoracic side). |
| Mesoprescutum | " | A mesothorax |
| Mesoscutum | " | B and latero dorsal and supraalar discs C. |
| Mesoscutellum | " | subdorsal discs C. |
| Membrane between scutellum[2] and postscutellum[2] | " | D mesothorax. |
| Mesopostscutellum | " | A metathorax. |
| Posterior mesothoracic phragma | " | margin A B (metathorax). |
| Metascutum | " | B and laterodorsal and supraalar discs C. |
| Metascutellum | " | Subdorsal discs lobes C. |
| Membrane between scutellum[3] and postscutellum[3] | " | D metathorax. |
| Metapostscutellum | " | A first abdominal tergite. |




## Conclusion.

The foregoing observations on the structure of the larvae of sawflies supports the findings of Doctors A. D. Hopkins and A. Boving on Coleoptera. Dr. Hopkins, in his fine monograph on "The Genus Dendroctonus,"[1] recognized four transverse segmental divisions in adult, larva and pupa. Of these four transverse segmental divisions Dr. Hopkins finds clearly represented in the tergites of the larval thorax, two, the prescutal and scutellar divisions with evidence of a third, the scutal division, on the sides and in the abdominal tergites 1–6, three, the prescutal, scutal and scutellar divisions.

[1]"The Genus Dendroctonus." U. S. Department of Agriculture, Bureau of Entomology. Technical Series, No. 17, Part I, 1909, pp. 24–26.

In his monograph, Dr. Hopkins does not discuss the homology of the larval with the adult areas and explains his use of the adjective form of adult sclerite names to designate larval areas as follows:

"Whether or not these divisions or lobes are homologous with divisions occupying relatively the same positions in the pupa and adult may be a subject for difference of opinion, but the names here applied to what appear to be corresponding parts should serve as a reliable guide to their recognition and accurate definition and description in comparative studies and identification of species."

However, in the discussion of a paper by Dr. Boving,[1] Dr. Hopkins[2] makes the following statement: "The essential features in the development from the egg to the adult in the insects with a so-called incomplete metamorphosis is not so very different from those in insects with a so-called complete metamorphosis. Therefore much of the terminology, as applied to the primary elements of the adult, is applicable to all stages, such as the tergum with its prescutum, scutum, scutellum and postscutellum; the sternum with its presternum, sternum, sternellum and poststernellum; the pleurum with its epipleurum and hypopleurum; the epipleurum with its epimeral area, lobe or sclerite and its spiracular area, lobe or membrane; the hypopleurum with its episternal area, lobe or sclerite and its coxal area, lobe or coxa—and so on as applied to all body segments of all stages."

The present observations and interpretations made, also, in part, substantiate the conclusions of Berlese[3] in which he considers the part here called the postscutellum as the "acrotergite" or anterior portion of the segment posterior. Berlese found the adult mesothorax and metathorax to consist of four parts exclusive of the intersegmental skin; these he called "acrotergite," "protergite," "mesotergite," and "metatergite." In the mesothorax: the acrotergite was the anterior phragma ("Profragma (partim)"); the protergite, the prescutum ("Prescuto (partim)"); the mesotergite, the scutum ("Mesoscuto"); the metatergite, the scutellum ("Scutello"). In the metathorax: the acrotergite was that part here called the postscutellum and the posterior phragma of the mesothorax as

[1]"On the Abdominal Structure of Certain Beetle Larvae of the Campodeiform Type. A study of the Relation between the Structure of the Integument and the Muscles." Dr. A. G. Boving. Proc. Ent. Soc. Wash., Vol. XVI, No. 2, June, 1914, pp. 55–61.

[2]Dr. A. D. Hopkins in discussion of above paper. Proc. Ent. Soc. Wash., Vol. XVI, No. 2, June, 1914, pp. 61–63.

[3]1906–1909 Gli Insetti, loro organizzazioni, sviluppo, abidiedini e rapporti coll' uomo.

recognized in adults and which he called "Mesofragma (partim)"; the protergite, the prescutum ("Prescuto (partim)"); the mesotergite, the scutum ("Metascuto"); and the metatergite, the scutellum ("Metascutello").

The chief objection to this interpretation of Berlese's is that as noted by Snodgrass, in his excellent paper on "The Thorax of Insects and the Articulations of the Wings,"[1] Berlese (see Plate IV of the preceding reference) has drawn some purely arbitrary lines across the notum in some figures to support his interpretation, and that this interpretation necessitates the presence of the mesothoracic postscutellum and the metaprescutum in the same insect. I have not been able to recognize a metaprescutum in the sawfly adults studied and the following quotations from Snodgrass' "The Thorax of Insects and the Articulation of the Wings"[2] lead to the conclusion that in the Hemiptera and Coleoptera where the mesopseudonotum (mesopostscutellum) is absent a metaprescutum is present and in the Hymenoptera where a mesopseudonotum is present the metaprescutum is absent.

In the Lepidoptera, however, Snodgrass has recognized a metaprescutum and a mesopseudonotum (see "The Thorax of Insects and the Articulation of the Wings," Plate LX, figs. 150 and 151), while Berlese in his figure of Sphinx (Plate IV, fig. 6 of the preceding reference) shows an arbitrary division into

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[1]Proc. U. S. Nat. Mus., 1909, Vol. 36, pp. 511–595.

[2]P. 561, 24th line—speaking of Hemiptera:

"Scutellum of mesonotum forms a large triangle between the bases of fore wings. *Mesopseudonotum absent. Metanotum* distinctly divided into three transverse parts by transverse lines (87, *psc*, sct, scl). A pseudonotum (87, 88, PN) present, very narrow mesially, expanded laterally where fused with epimera (epm.).

First abdominal tergum (87, 88, 1T) a narrow bar fused with metapseudonotum, expanded laterally, bearing the spiracles (1 sp.) and phragmal arms (1 PH)."

P. 563, 29th line—speaking of Coleoptera:

"*Mesopseudonotum lacking unless represented by two small plates* (127, 128, 131, q) *connecting mesonotum and metanotum.*

*Metanotum* in lower families with Carabidae (132) and Dytiscidae (136) distinctly divided into three transverse parts (*psc*, sct, scl)."

P. 567, 24th line—Hymenoptera:

"Mesopseudonotum (160, 161, 163, 169, 170, PN²) carries large potsphragma (161, 163, 170, Pph) projecting downward and backward into metathorax.

Metathorax well developed and of normal shape in Cimbex (164) presenting all the principal pleural and tergal parts (Eps, Epm, sct, scl, (PN)[3]."

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[3]Note no psc present.

"protergite" (metaprescutum) and "mesotergite" (metascutum). The writer is uncertain as to what the real significance of this condition may be. There is room for considerable speculation but inasmuch as it does not absolutely disprove the homologies he suggests and since these homologies are founded upon observations on metamorphosis he has refrained from discussing the situation.

Snodgrass dismisses the derivation of the postscutellum from a succeeding segment on the ground that it is "most frequently" "continuous laterally with the epimerum" although he states that, "often there is a line between the two and sometimes they are only articulated or merely contiguous."[1] He derives the postscutellum as a "secondary tergal chitinization in the dorsal membrance behind the notum," and the following quotations[2] from his 1910 paper give his views in brief on the origin of this plate and the phragma:

P. 45, 5th line:

"The posterior transverse postalar sclerite of the mesotergum and the metatergum (figs. 1, 4, and 5 PN) developed best in those segments that have the wings best developed as organs of flight, though not present in either segment of the Isoptera. It is absent in the mesothorax of Orthoptera, Euplexoptera, and Coleoptera, and is greatly reduced or absent in the metathorax of species having the hind wings reduced. That of the metathorax is generally fused with the first abdominal tergum in Orthoptera, Euplexoptera, and Hymenoptera. The postnotum is ordinarily called the 'postscutellum' since it lies immediately behind the scutellum of the notum. However, it is not one of the divisions of the notum, since it is formed independently as a secondary tergal chitinization in the dorsal membrane behind the notum."

P. 45, 39th line—speaking of phragmas:

"The first, when present, is always fused with the front edge of the mesonotum. The second is likewise fused with the front of the metanotum in Orthoptera, Euplexoptera and Coleoptera, but when present in the other orders it is connected with the postnotum of the mesotergum. The third is always connected with the metapostnotum even when this plate is fused with the first abdominal tergum."

C. W. Woodworth[3] in his review of three papers by R. E. Snodgrass recognizes the significance of the muscular and morphological conditions in the adult insects in the following statements:

"The interpretation of the origin of the postscutellum or pseudonotum, as he (Snodgrass) calls it, was suggested by myself in the paper previously referred

[1] "The Thorax of Insects and the Articulation of the Wings," p. 523.

[2] Snodgrass, R. E., "The Thorax of the Hymenoptera," Proc. U. S. Nat. Mus., 1910, Vol. 39, pp. 37–91.

[3] Science, Vol. XXX, No. 764, Aug. 20, 1909, pp. 243–244.

to, though I can not agree in considering this region belonging more to the segment in front than to the segment behind, particularly when the phragma is considered as part of this interpolated sclerite.

"The great dorsal muscle of flight for which the phragma was developed is probably only a dorsal intersegmental muscle. These extend from the anterior edge of one segment to the corresponding part of the next. The anterior phragma is mesoprescutal, the posterior is a part of the first abdominal segment. The hymenoptera appear to be an exception in regard to the position of the first abdominal segment, only because of the great constriction between the first and second segment.

"It may be impossible on anatomical grounds to locate the division between segments after the articular membrane has become wholly chitinized. The phragma may be, as this author says, a 'chitinization of the infolded intersegmental membrane,' but if so, why is not the deepest point of the fold the point of demarkation between the segments?

"A more reasonable position would seem to be that the infolding for the attachment of intersegmental muscles marks the posterior boundary of the prescutum that the phragma belongs therefore entirely to the following segment and that with the completion of the chitinization of the articular membrane, the division is lost somewhere immediately anterior to the phragma.

"The region designated by this author as pseudonotum developed as a chitinization of the articular membrane is probably therefore made up of two elements, one of which is continuous with the prescutum of the following segment."

The present studies on the larva and adult support a conception of the insect segment as composed of four primary parts, three plates, prescutum, scutum, scutellum, and an intersegmental membrane, and tend to lead to the conclusion that the postscutellum, in being derived from the segment posterior, is homologous with the prescutum.

In view of the lack of anatomical and histological support for the suggested homologies, the author has not adopted the adult sclerite names for the larval areas from which they appear to originate but expects to use the letters as assigned under "Limitation and Composition of Larval Segments."

## LIST OF ABBREVIATIONS.

A —first division of segment.
a —anus.
ab —infold between divisions of segment A and B.
ant —antenna.
B —second division of segment.
$B^1$ —first subdivision of B.
$B^2$ —second subdivision of B.
C —third division of segment.

$C^1$ —first subdivision of C.
$C^2$ —second subdivision of C.
$C^3$ —third subdivision of C.
cen —cenchri.
cl —connecting ligament.
cx —coxa.
cxl —coxal lobe.
cy —compound eye.
D —fourth division of the segment—a connecting membrane.
ep —epiproct—dorsal portion of terminal abdominal segment.
epm —epimeron.
eps —episternum.
H —head.
hy —hyproproct—ventral portion of terminal abdominal segment.
hyp —hypopleurite.
id —imaginal discs—embryonic tissue from which adult sclerites and appendages develop.
im —intersegmental muscles.
lsm —large segmental muscles.
ly —larval eye or ocellus.
lys —larval eye parts within the head.
m —muscle.
mb —membrane.
mdm —mid dorsum.
P —pleurum.
par —parapterum.
pca —postcallus—prominent lobe between anus and postpedes.
peps —preepisternum.
phrg —phragma.
pn —pronotum.
ppd —postpedes—legs of the terminal abdominal segment.
prep —preepipleurite.
prhyp—prehypopleurite.
prsc —prescutum.
psctl —postscutellum.
psep —postepipleurite.
pshyp—posthypopleurite.
pspa —alar area.
pt —posttergite.
sct —scutum.
S —sternum.
sctl —scutellum.
sp —spiracle.
spa —spiracular area.
ssm —small segmental muscles.
T —thorax.
ter —tergum.

tg —tegula.
U —urite—abdominal segment.
upd —uropod—leg. of abdominal segment (proleg).
w —wing.

## EXPLANATION OF PLATES.

Plate XIV—Larval Structure.

fig. 1—*Pteronidea ribesii* Scopoli; larva; skin from interior, showing folds; head, prothorax and mesothorax.

fig. 2—*P. ribesii;* larva; skin from interior, showing folds; mesothorax, metathorax and first abdominal segment.

fig. 3—*P. ribesii;* larva; skin from interior, showing folds and muscles; mesothorax, metathorax and first abdominal segment. The only muscles indicated on the drawing of the mesothoracic tergum are small, short, close to the body wall, attached to infoldings defining the subdivisions of the segment and always attached within the limits of the segment. Those indicated in the metathorax are only the large segmental and intersegmental muscles. The first urite shows muscles of all three types in the one segment.

fig. 4—*Neodiprion lecontei;* larva; skin from the interior, showing folds; mesothorax, metathorax and first abdominal segment.

fig. 5—*Pteronidea ribesii;* larva; skin from the interior showing folds; third and fourth abdominal segments.

fig. 6—*Pteronidea ribesii;* larva; skin from the interior, showing folds; seventh eighth, ninth and tenth abdominal segments.

fig. 7—*Cimbex americana;* larva; skin from interior, showing folds; mesothorax, metathorax and third abdominal segment.

fig. 8—*Arge salicis;* larva; skin from interior, showing folds (area D extended); mesothorax, metathorax and third abdominal segment.

Plate XV—Metamorphosis and Adult Structure of *Pteronidea ribesii.*

fig. 9—Larva; from exterior; head, prothorax, mesothorax, metathorax and first abdominal segment.

fig. 10—Early prepupa; from exterior; head, prothorax, mesothorax, metathorax and first abdominal segment.

fig. 11—Prepupa in first stages of transformation to pupa (eye spot moving and compound eye just discernible as forming); head, prothorax, mesothorax, metathorax and first abdominal segment.

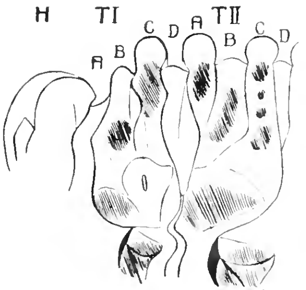
fig. 12—Same prepupa (as figure 11) two days later; head, prothorax, mesothorax, metathorax and first abdominal segment.

fig. 13—Prepupa, transformation to pupa advanced; head, prothorax, mesothorax, metathorax and first abdominal segment.

fig. 14—Same prepupa (as figure 13) one day later; head, prothorax, mesothorax, metathorax and first abdominal segment. (Note: Wing forming in mesothorax).

fig. 15—Same prepupa (as figure 14) one day later; head, prothorax, mesothorax, metathorax and first abdominal segment. (Dorsal view).

fig. 16—Same prepupa (as figure 15) one day later. Skin partially removed; head, prothorax, mesothorax, and metathorax. (Dorsal view.)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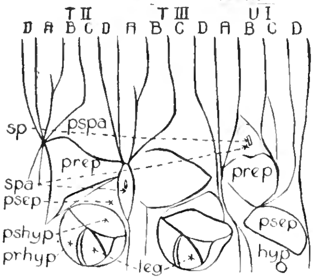
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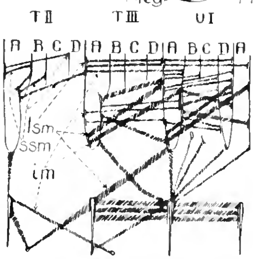
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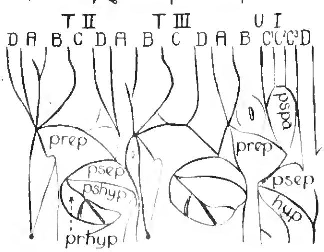
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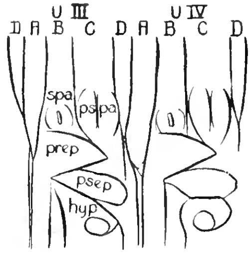
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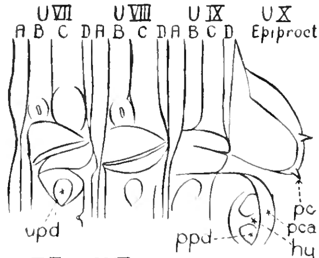
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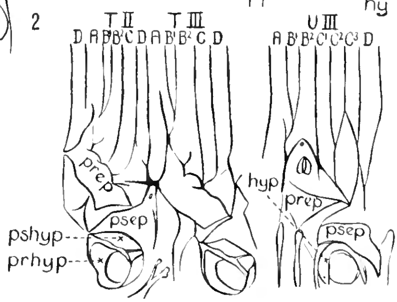
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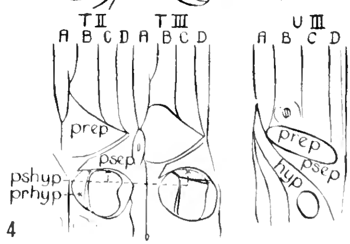
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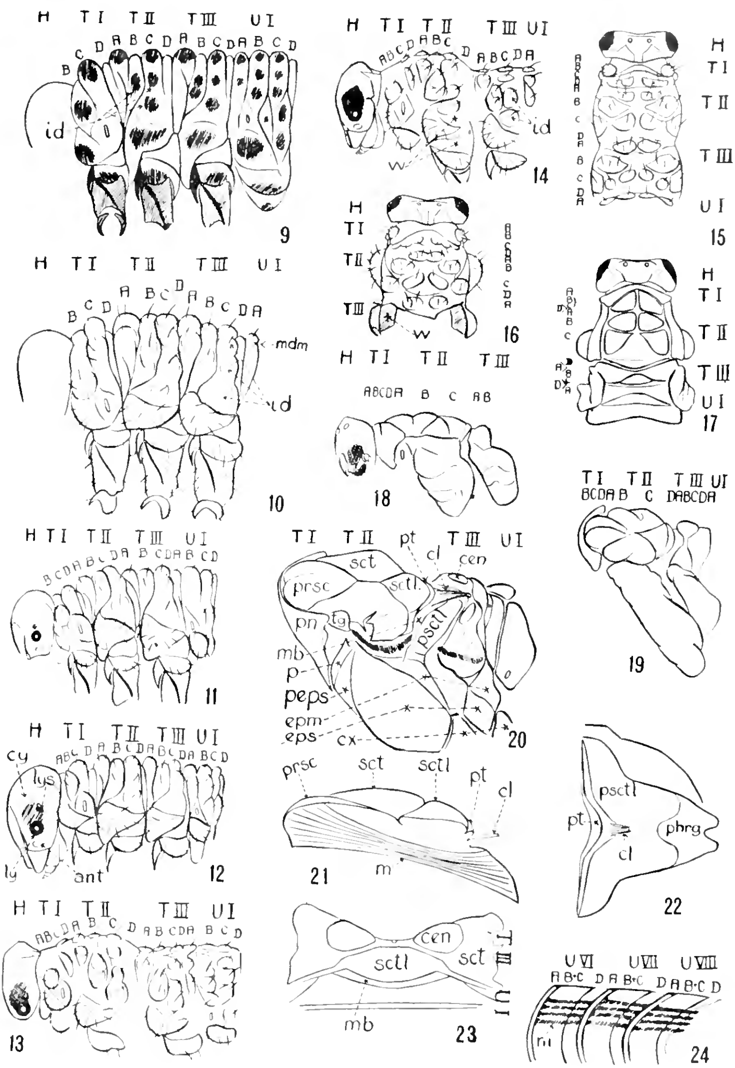
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fig. 17—Same prepupa same day (as figure 16) but with skin entirely removed showing formation of pupa; head, prothorax, mesothorax, metathorax and first abdominal segment. (Dorsal view).

fig. 18—Same as figure 17; lateral view.

fig. 19—Pupa which had shed its prepupal skin naturally, prothorax, mesothorax, metathorax and first abdominal segment.

fig. 20—Adult; thorax and first abdominal segment.

fig. 21—Adult; longitudinal section through mesothorax including postscutellum and the anterior and posterior phragmae, showing large dorsal longitudinal muscle and connecting ligament.

fig. 22—Adult; posttergite, connecting ligament, postscutellum and phragma and longitudinal section of postscutellum and phragma.

fig. 23—Adult; metathorax including metapostscutellum.

fig. 24—Adult; longitudinal section from tergum of abdomen, showing divisions of segment and large longitudinal muscles.

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# PROCEEDINGS

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# NEW GENERA AND SPECIES OF PROTURA.

By H. E. Ewing, *U. S. Bureau of Entomology.*

At the March meeting of the Entomological Society of Washington Mr. Barber and I reported the finding of Proturans in the vicinity of Washington, D. C. At that time they had been found only on a very few occasions and in numbers, only in one situation. Since then the writer has taken them in several local situations at Takoma Park, Maryland, and in some instances in large numbers.

The first specimen reported from the vicinity of Washington, which was accidentally found by Barber in some leaf mold in which he was rearing beetle larvae, and the two subsequent specimens taken near Plummer's Island, Maryland, have been found to be of the same species which is new. This species has been named *Acerentulus barberi* by the writer, and is described in a short paper which has been sent to the Entomological News for publication.

Since the finding of these primitive insects at Takoma Park, Maryland, large numbers of them have been taken there. Up to the present no less than twelve species have been found, and more than this, all of these twelve species are represented in collections from a single deposit of decaying leaves, twigs and other organic material situated only a few rods from the writer's home. It should be stated, however, that at no other place have Proturans been found in such diversity or numbers as at this particular spot where they were first located, almost by accident, one evening last February.

In reporting from a single locality as many as twelve different species, which number is only four less than have been described from the world, it is realized that some critics may be inclined to discredit the specific determinations of the same. To these the desire is expressed that they examine for themselves the types of these species which are deposited in the United States National Museum. If asked to explain the occurrence of such a large number of species in a single locality I can only state that it is my opinion that an unusually good sample of the North American species occurring in the Upper Austral Life Zone has been obtained. Certainly this collection can be nothing more and it may be much less than this; which fact causes one, upon reflection, to conclude that the Nearctic Proturan fauna must be much richer in species than would be supposed if we should base a conclusion upon what has been known in the past of the species occurring in Europe or reported from the world.

In presenting the descriptions of these new species the writer wishes to acknowledge his indebtedness to Mr. H. S. Barber of this society for the many helpful suggestions he has made in regard to the method of studying living specimens and the preparation of mounted material.

## *Descriptions of Genera and Species.*

The ten new species described in this paper fall into three genera recognized by Berlese or into the new genera here created, of which there are three.

### **Eosentomon** Berlese.

Species of the genus *Eosentomon* differ from all the other Proturans in possessing tracheae and in having all pairs of the abdominal appendages large and two-segmented.

### **Eosentomon vermiforme**, n. sp.

A medium sized but very long species. Head long, being fully twice as long as wide; pseudoculi entirely lateral in position and in the form of irregular pits; mouth-parts conspicuous; rostrum present, reaching the tips of extended maxillary palpi. Exposed portion of prothorax about twice as broad as long. Meso-, and metathorax of about the same length but in the latter slightly the longer; spiracles conspicuous, ventro-lateral. Abdomen very long, broadest at the fourth segment and all tergal plates distinctly yellowish; tergal apodemes slightly thickened toward the center, not antero-posteriorly arched and unbranched laterally; seventh abdominal segment equal to the eighth in length, the latter slightly narrower than the former and considerably narrower at its posterior margin than at its anterior margin. Abdominal appendages very slender, those of the first pair being about one-third as broad as long. Legs moderate; first pair extending beyond the rostrum by the full length of the tarsi and about one-half the length of the tibiae, and each leg ending in a tarsal claw which is of about the same length as those on the other legs but is less strongly curved. Total length, slightly extended, 1.32 mm.; width, 0.16 mm.

*Type.*—Cat. No. 24,578 U. S. N. M.

Described from a single specimen, a female, collected at Takoma Park, Maryland, from decaying leaves. This species differs from all the described species in being more slender and worm-like. It is rare at Takoma Park.

### **Eosentomon pallidum**, n. sp.

A small, white species. Head broad, about two-thirds as broad as long; pseudoculi lateral, inconspicuous; rostrum minute; maxillary palpi when extended long, conspicuous, in this state equaling in length one-half the width of the head. Exposed part of prothorax about two-thirds as long as broad. Meso-, and metathorax subequal; their stigmata small and lateral. Abdomen very whitish in front becoming more yellowish toward the tip; tergal apodemes not thickened toward the middle, not antero-posteriorly arched and not branched laterally; seventh abdominal segment slightly longer and slightly broader than eighth. Legs moderate; anterior pair extending beyond the tip of head by the full length of the tarsi and by about one-half the length of the tibiae, claws about as long as those on other legs but not so strongly or evenly curved. Total length, maximum extension, 1.14 mm.; width, 0.13 mm.

*Type.*—Cat. No. 24,579 U. S. N. M.

Described from a single female which was one of many specimens taken at Takoma Park, Maryland, from among decaying leaves. This species is very much smaller than *E. wheeleri* Silvestri, the only American species known in the past, and *E. vermiforme* just described. The species appears to be common in the smaller and finer-fibered leaves of decaying masses at Takoma Park.

### **Eosentomon minimum**, n. sp.

A minute, yellowish species. Head long, being nearly twice as long as broad; pseudoculi either rudimentary or wanting; rostrum present, almost as broad as long. Prothorax as usual. Meso-, and metathorax subequal; spiracles, large, conspicuous and entirely lateral. Tergal plates of abdomen well developed and equally conspicuous on all the segments; tergal apodemes conspicuous, very slightly thickened toward the middle, not antero- posteriorly arched and not branched laterally; seventh and eighth abdominal segments similarly shaped, but the seventh is slightly the larger. Claws of anterior legs considerably longer and stouter than those on the other legs. Length with segments somewhat telescoped, 0.54 mm.; width, 0.12 mm.

*Type.*—Cat. No. 24,580 U. S. N. M.

Described from the type specimen, a male, taken at Takoma Park, Maryland, from decaying leaves. This species is closely related to *pallidum* but differs from it in several particulars, especially in having the more anterior segments of the abdomen as well chitinized as the posterior ones and in having a much longer head. It is rare at the locality where taken.

### **Protentomon**, n. gen.

Tracheae and spiracles wanting. First and second abdominal appendages large, conspicuous and two-segmented; third abdominal appendages much smaller, one-segmented. Apodemes wanting. A single transverse row of dorsal setae on each abdominal segment.

*Type.*—*Protentomon transitans* Ewing.

This species, which is here to be described and which is made the type of this new genus, is by far the most important taxonomically of any of the American forms thus far discovered.

This is because it unites the two quite distinctive families of the Protura that have been recognized in the past; the Eosentomidae, which have tracheae and the Acerentomidae, which do not. The abdominal appendages of *P. transitans* are very similar to those of Eosentomidae, but on the other hand the absence of the tracheae and the presence of but a single transverse row of dorsal setae on each abdominal segment are characters of some of the species of Acerentomidae. The writer expects to make a more detailed study of this species later.

**Protentomon transitans**, n. sp.

Living specimen white; mounted specimen entirely hyaline. Head short; pseudoculi circular in outline, dorso-lateral; mouth-parts inconspicuous and hyaline except for the minute labial palpi which are yellowish. Prothorax large, exposed part being fully two-thirds as long as the mesothorax. Meso-, and metathorax subequal, without chitinous plates and with a few very minute setae. Abdomen long; dorsal setae minute except for segments seven to twelve where they are fairly conspicuous; segment nine about two-thirds as long as eight and eight two-thirds as long as seven. First and second abdominal appendages large, conspicuous and of the same size and constitution, each is noted for having an intersegmental plate at the junction of proximal with distal segment; last abdominal appendages one-segmented yet conspicuous, shaped as those of *Acerentomon*. Legs short, stout and similar; front pair only slightly larger than the others and with a similar claw. Length when moderately extended, 0.74 mm.; thickness, 0.08 mm.

*Type.*—Cat. No. 24,581 U. S. N. M.

Described from a single male, taken from decaying leaves at Takoma Park, Maryland. This species is in some respects probably the most generalized of any of the Proturan species yet described. The anterior legs are but little specialized, the prothorax is much more comparable to the mesothorax than in any other of our American species, and the seventh, eighth and ninth abdominal segments are remarkably similar except for size.

**Acerentomon** Silvestri.

This is the genus erected by Silvestri for the first species of the Protura to be described, the much studied *A. doderoi*. It is usually differentiated from the other genera of the family Acerentomidae as recognized by Berlese upon variations in the number of segments found in the maxillary and labial palpi. An investigation into the composition of these structures by the writer has caused him to doubt the occurrences of such differences as are supposed to exist, hence it appears best for the present to use other characters.

*Acerentomon* is distinguished from the other genera that should be recognized in its family by two good characters: First, in this genus some of the tergal apodemes are broadly branched laterally and, second, the second and third abdominal appendages are by no means all but invisible vestiges, but are fully one-half as long as the large first segments of the first pair of appendages.

**Acerentomon americanum,** n. sp.

Species medium-sized, uniformly yellowish. Head long, pointed and almost completely concealing the prothorax from above; pseudoculi lateral, pit-like; rostrum conspicuous. Dorsal part of prothorax about three times as broad as long. Mesothorax slightly smaller than metathorax and both with convergent sides. Abdomen long, unicolored; segment seven larger than eight, slightly swollen at the level of tergal apodeme, the latter with a stout posterior horn which reaches the pleuron and a more slender anterior horn which does not reach the pleuron, tergal plate with a single transverse line. Legs rather stout; anterior pair extending beyond the tip of rostrum by three-fourths the length of their tarsi; tarsi of anterior legs each ending in a long, slightly curved claw. Length when much extended, 1.17 mm.; width, 0.14 mm.

*Type.*—Cat. No. 24,582 U. S. N. M.

Described from the type specimen, a female collected in decaying leaves at Takoma Park, Maryland. This species differs from *doderoi* and *microrhinus* in several minor details and markedly in the shape of the rostrum and of the tergal apodemes, especially the seventh tergal apodeme. Only a single specimen of this species has been obtained.

**Acerentomon conurus,** n. sp.

Species undersized for its genus, pale yellow and almost uniform in coloration. Head very long, being over twice as long as broad; pseudoculi pit-like, lateral; rostrum very small and short. Prothorax about as broad as mesothorax and mostly concealed above by the superplaced head. Meso-, and metathorax about equal, the latter slightly the broader. Abdomen with sides almost parallel from the base to the end of segment six; segment seven a truncate cone, as is eight; apodeme of seventh tergal plate twice forked laterally and squarishly thickened near its middle; eighth abdominal segment with transversely striated band. Anterior legs extending beyond the tip of rostrum by the full length of the tarsi; the latter armed with claws that are longer, stouter and less curved than those on the other legs. Length with segments neither extended nor telescoped, 0.81 mm.; width, 0.12 mm.

*Type.*—Cat. No. 24,583 U. S. N. M.

Described from the type only, a female taken at Takoma Park, Maryland, from decaying leaves. This species is considerably smaller than the others found in the genus and is at once separated by the peculiar shape of the seventh abdominal segment. An examination of the mouth-parts shows the maxillary palpi to be three-segmented, instead of four. The reason for the apparent discrepancy between the number of segments in this pair of appendages in this species and the number apparently found in others will be found only by further investigation. The species is abundant in moist decaying leaves at Takoma Park.

### **Acerentulus** Berlese.

In this genus, *sensu restricto*, the following distinguishing characters may be given: Tergal apodemes never twice forked laterally; both tergal plates and apodemes present on the meso-, and metathorax and first eight abdominal segments; tarsi of front legs without row of spines. This genus is richest by far in number of species of all the genera of Protura.

### **Acerentulus oculatus**, n. sp.

A medium-sized species which has the thorax and first abdominal segment somewhat paler than the rest of the body. Head about twice as long as broad and strongly arched in front; pseudoculi (or ocelli?) dorso-lateral, conspicuous and provided each with a hemispherical cornea-like structure; rostrum absent; in front of eyes four transverse striations are present. Exposed part of prothorax about two-thirds as long as wide. Meso-, and metathorax similar, the latter broader than the former. Segments one to six inclusive of the abdomen quite similar in shape; seven narrower and slightly longer; eight much smaller than seven and with both striated band and pair of pectines. Some of tergal apodemes,—two to seven inclusively,—but slightly antero-posteriorly arched, squarishly thickened at the middle and branched laterally; most of tergal plates with two transverse lines, only one of which is conspicuous. Tarsi of first pair of legs about one and a third times as long as tibiae, and each terminated by a long, stout claw which is curved only beyond its middle. Length, with segments slightly telescoped, 0.89 mm.; width, 0.20 mm.

*Type.*—Cat. No. 24,584 U. S. N. M.

Described from type specimen, taken at Takoma Park, Maryland, from decaying leaves. This species is most nearly related to *A. confinis* (Berlese) of the described species but differs from *confinis* in having the head about twice as long as broad instead of about one and one-half times as long as broad, as well as in other characters. It is a common species at Takoma Park.

### **Acerentulus tenuiceps**, n. sp.

A good sized, well chitinized, yellow species. Head very long, over twice as long as broad, somewhat squarish behind and cone-like in front; pseudoculi not conspicuous, slightly dorsal of lateral in position; rostrum in the form of a chitinous tubercle. Exposed part of prothorax not one-half as long as the mesothorax. Meso-, and metathorax large. Abdomen large, broadest at the fourth or fifth segments; some of tergal apodemes thickened near their middle and branched near their extremities, none of them strongly antero-posteriorly arched; seventh abdominal segment similar in shape to the eighth but much larger; eighth segment with transversely striated band and pair of pectines. Anterior legs much larger than the others; tarsal claw of anterior legs very long, curved only beyond its middle and without accessory spur at or by its base. Length with segments slightly telescoped, 0.85 mm.; width, 0.15 mm.

*Type.*—Cat. No. 24,585 U. S. N. M.

Description based on the type, a female taken from decaying leaves at Takoma Park, Maryland. This species is most nearly related to *A. oculatus* just described, but differs from it in having small pseudoculi, which are more lateral in position, in having the head more slender and in minor details. The species is very common at the locality where it was taken.

**Acerentuloides**, n. gen.

The thorax and at least first abdominal segment without tergal plates and tergal apodemes; tergal plates present on some of the posterior abdominal segments, without transverse lines. Most of other characters similar to those of *Acerentulus*.

*Type.*—*Acerentuloides bicolor* Ewing.

The type species of this genus is minute and has the anterior part of the body hyaline and but little chitinized but the posterior part well chitinized. It differs from the species of *Acerentulus* known to the writer in many characters, but at present it can not be stated how many of these should be regarded as generic.

**Acerentuloides bicolor**, n. sp.

Minute species with head, thorax and anterior parts of abdomen whitish, while the posterior part of the abdomen is yellow. Head long; pseudoculi lateral; rostrum short, minute. Exposed part of prothorax about three times as broad as long. Meso-, and metathorax about equal, hyaline without tergal or sternal plates. First two abdominal segments without tergal plates, the remaining segments showing a progressive increase in the development of these plates from the third segment backward; seventh abdominal segment about one and a half times as broad as long and with two transverse rows of dorsal setae composed of seven setae to the row; eighth abdominal segment shaped similarly to the seventh but smaller, with transversely striated band. Anterior legs extending beyond the head by the full length of the tarsi and by about one-fourth the length of the tibiae; claws slightly longer and less curved than those on the other legs. Length when much extended, 0.82 mm.; width, 0.10 mm.

*Type.*—Cat. No. 24,586 U. S. N. M.

Description based on the type specimen, a female taken from a decaying mass of organic matter at Takoma Park, Maryland. This species is common at Takoma Park, but because of its small size is easily overlooked.

**Microentomon**, n. gen.

Differing from previously described genera of Acerentomidae in having but a single transverse row of dorsal setae to each abdominal tergum. Tergal plates very poorly developed; tergal apodemes broadly rounded and not thickened near their middle.

*Type.*—*Microentomon minutum* Ewing.

In this genus also should be placed the *Acerentulus perpusillus* of Berlese, described from Italy in 1910. Berlese's species is said by him to be rare, and he possessed but a single example. The members of this genus are exceedingly small. When well extended they are about .5 mm. in length, but in a contracted state are much less. Being flattened and almost as slender as a nematode, they probably are the smallest insects known, although some others are shorter, *e. g.*, minute beetles and some of the parasitic Hymenoptera.

**Microentomon minutum**, n. sp.

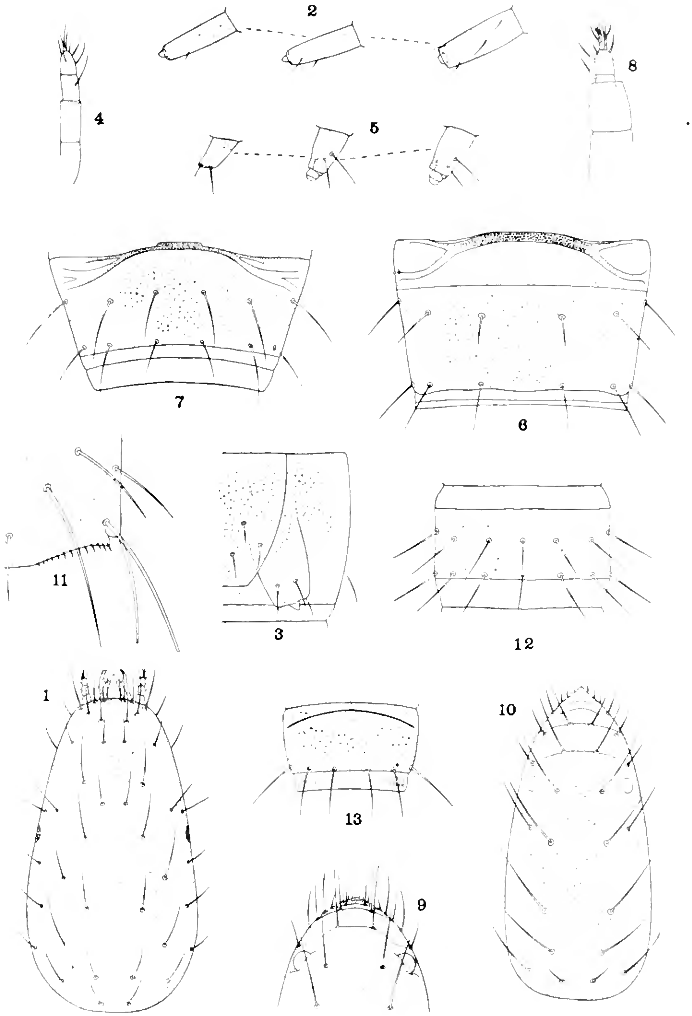
When living not seen by the unaided eye except when on a dark background and then appearing only as a minute white speck. Head about three-fifths as broad as long; pseudoculi inconspicuous, lateral, pit-like; rostrum in the form of a tubercle. Exposed part of prothorax about twice as broad as long. Meso-, and metathorax subequal. Abdomen with sides parallel for most of its length; tergal apodemes very slender, extending from pleuron to pleuron and unbranched laterally; seventh abdominal segment about twice as broad as long, with its single transverse row of dorsal setae situated at the posterior margin of the tergal plate and composed of six setae. Anterior legs, although larger and differently conformed from the others, yet not so much so as in most all other Proturans. This pair extends beyond the anterior margin of the head by about four-fifths the length of the tarsi. Length, well extended, 0.61 mm.; width, 0.09 mm.

*Type.*—Cat. No. 24,587 U. S. N. M.

Described from type specimen taken from decaying leaves and twigs at Takoma Park, Maryland. This minute insect normally inhabits moist decaying twigs, being found under the bark of the same. The species is probably very common, but is not usually observed because of its minute size and habits. Three mounted specimens are at hand, all of which lack the complete number of segments and the genital papilla hence are not mature. The generic characters of these specimens agree exactly with those of the single female found by Berlese. Because of its common occurrence it appears desirable to make this species the type of the genus, notwithstanding the fact that the mature form has not yet been taken. I have frequently observed live specimens of the species and studied them alive in the laboratory.

*A Comparison Between the Palearctic and Nearctic Protura.*

The number of Proturan species now known from the Nearctic Region is twelve, which number happens to be exactly the same as reported from the Palearctic Region. Of the more generalized forms which breathe through tracheae and constitute the family Eosentomidae, four species are known from each of these two zoogeographical regions. Of the forms without tracheae, the Palearctic is represented by four genera, one of which has not been found yet in the Nearctic; of these same atracheate forms the Nearctic is represented by five genera, two of which are yet not known to occur in the Palearctic. Most of the Palearctic species thus far described are over one millimeter long and are well chitinized; on the other hand most of the twelve

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species so far reported from the Nearctic are less than one millimeter long and are very poorly chitinized. This apparent difference between the two faunas is probably due to the fact that the writer has employed specialized methods of collection which has revealed better the microproturans than have those methods that have been used in Europe. Finally it should be stated that the study of our Nearctic Proturans shows that the group as a whole, at least as far as the Holarctic is concerned, is one of marked unity; a unity in fact not found in the case of the two other major groups of Apterygota, the Thysanura and the Collembola.

## EXPLANATION OF PLATES.

Fig. 1, *Eosentomon vermiforme*, n. sp., dorsal view of head, x 333; fig. 2, *Eosentomon vermiforme*, n. sp., ventral abdominal appendages on left side, x about 267; fig. 3, *Eosentomon pallidum*, n. sp., ventral view of left appendage of second abdominal segment, together with a part of same segment, x 333; fig. 4, *Eosentomon minimum*, n. sp., left labial palpus from below (camera lucida drawing with oil immersion lens); fig. 5, *Protentomon transitans*, n. sp., abdominal appendages of right side, lateral view, x 333; fig. 6, *Acerentomon americanum*, n. sp., dorsal view of seventh abdominal segment, x 333; fig. 7, *Acerentomon conuris*, n. sp., seventh abdominal segment from above, x 333; fig. 8, *Acerentomon conurus*, n. sp., left maxillary palpus from outside (camera lucida drawing with oil immersion lens); fig. 9, *Acerentulus oculatus*, n. sp., dorsal view of anterior part of head, x 333; fig. 10, *Acerentulus tenuiceps*, n. sp., dorsal view of head, x 333; fig. 11, *Acerentulus tenuiceps*, n. sp., dorsal view of dorso-lateral part of eighth abdominal segment (oil immersion lens); fig. 12, *Acerentuloides bicolor*, n. sp., dorsal view of seventh abdominal segment, x 333; fig. 13, *Microentomon minutum*, n. sp., dorsal view of seventh abdominal segment, x 333.

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# OBSERVATIONS RELATIVE TO RECENT RECOVERIES OF PLEUROTROPIS EPIGONUS WALKER. (HYM.)

By J. S. Wade and P. R. Myers, *U. S. Bureau of Entomology*.

It is the purpose, in the compilation of the data here submitted, to recapitulate very briefly the more essential facts regarding the introduction into this country from England of *Pleurotropis epigonus* Walker, a well-known Chalcidoid parasite of the Hessian fly *Phytophaga destructor* Say. It also seemed desirable to collect the records of distribution, and to assemble chronologically all available citations to the literature on the insect. Acknowledgment is gratefully made to Mr. A. B. Gahan of the Bureau of Entomology for much information furnished.

The original description of the species by Francis Walker appeared in 1839 under the name of *Entedon epigonus* Walker. This later was found by Dr. Riley (who compared specimens with Walker's type in the British Museum), to be synonymous with *Semiotellus nigripes* Lindemann described in 1887. Subsequently the species was placed by W. R. McConnell at the suggestion of A. B. Gahan in the genus *Pleurotropis*.

The great abundance of the Hessian fly in England in 1886 and 1887 enabled Dr. Riley, who was then abroad, to study its parasites in some detail. The most abundant of these parasites proved to be the species under discussion, and it was at that time that the idea was conceived that the artificial introduction of the parasite might prove of the greatest practical value to the wheat growers of the United States. The idea was based on the well-recognized fact that European insects often increase in excess of their normal abundance when introduced into foreign countries. With this idea in view, a quantity of parasitized Hessian fly puparia were sent by Mr. Frederick Enock of London in 1891, and were received and released by Prof. F. M. Webster at Lafayette, Indiana, by Prof. S. A. Forbes at Champaign, Illinois, and by Prof. A. J. Cook at Agricultural College, Michigan. Later a supply, sent by Prof. Forbes from Champaign, Illinois, was released by Dr. James Fletcher, Dominion Entomologist, Ottawa, Canada.

The material sent to Prof. Forbes was placed in an enclosed plat experiment and rearings therefrom were released by him. There are published records of recoveries of this species and hints of the ultimate success of the experiments conducted by Prof. Forbes, but there do not appear to be any reports from Prof. Webster, Prof. Cook, and Prof. Fletcher. Additional material received from Mr. Enock in 1894 was released at Cecilton, Md., and Fredericktown, Md. Mr. William H. Ashmead, in May, 1895, collected one specimen at Cecilton, Md , but we have no record of its successful introduction at Frederick, Md., until April 19, 1917, when the junior author reared a male from Hessian fly puparia secured at that locality. The records of two other males and three females from that locality were also secured between May 26, 1917, and March 26, 1921. All other specimens appear to have been liberated, as Dr Riley quaintly says: "Under such conditions as to warrant the expectation of continuous breeding."

For many years the results were not marked, and, as indicated, only two positive reports as to the establishment of the parasite, those from Prof. Forbes, and Mr. Ashmead were received. The lack of evidence from the other points of introduction seems due almost entirely to lack of proper examinations by those having trained eyes for minute forms, and to lack of familiarity with this and allied species. No further records of recoveries were found until 1915, when rearings were made by Mr. W. R. McConnell and the junior author from material collected at Hagerstown, Md., Andersonburg, Pa., Ford City, Pa., Greenville, Pa., Warfordsburg, Pa., and Montoursville, Pa. A brief resume of the introduction of the parasite and records of rearings to 1916 inclusive, was published in the Journal of Economic Entomology, February, 1916, by Mr. McConnell, who adds: "We know practically nothing of its life history and I have never succeeded in inducing it to oviposit. Adults have emerged in cages from April to June inclusive, and from September to December inclusive. Most of the specimens reared were males."

Mr. McConnell's statement that there was a predominance of males in this species apparently was based on the 19 specimens which had been reared at that time. Since then over 1,400 specimens have been reared, of which 529 were males and 929 were females. This shows the females predominate by nearly 2 to 1.

This species has become one of the common parasites of the Hessian fly throughout Maryland, Pennsylvania, New Jersey, and New York, but apparently is more abundant in New York than in any of the other States mentioned. The rearing records of this species would indicate that the climatic conditions of the more northern latitudes of the Middle Atlantic States are more adaptable for its development. Nearly 1,500 emergence records have been secured from 151 localities and of these only seven emergence records from three localities are from south of the Potomac River. Hundreds of puparia have been reared from various localities in the Shenandoah Valley of Virginia, but so far we have secured but one record of its occurrence in that State.

In view of subsequent developments, it seems quite obvious that the insect eventually has obtained a secure foothold in at least part of the country as a result of the efforts at introduction. All things considered, it is not remarkable that it has taken many years for the presence of this parasite to become manifest, and it now appears certain that it has now become adapted and increased in numbers sufficient to rank in value with other important parasites of the Hessian fly.

The following list comprises all known records of distribution down to date:

*Delaware:*

Dover, Townsend. C. C. Hill.

*Illinois:*

Campaign, S. A. Forbes; Freeport, Grand Ridge, Hollowayville, Minooka, Morris, Princeton, Seneca, Toulon, W. P. Flint.

*Indiana:*

Logansport, W. H. Larrimer.

*Maryland:*

Braddock Heights, Boonsboro, W. R. McConnell; Cecilton, W. H. Ashmead; Frederick, P. R. Myers; Funkstown, P. R. Myers and W. R. McConnell; Hagerstown, W. R. McConnell, P. R. Myers and E. M. Craighead; Middletown, P. R. Myers; Myersville, W. R. McConnell and P. R. Myers;

New Windsor, P. R. Myers; Williamsport, W. R. McConnell and P. R. Myers.

*Michigan:*

Battle Creek, W. H. Larrimer.

*New Jersey:*

Frenchtown, P. R. Myers; Hightstown, P. H. Hertzog.

*New York:*

Akron, Alabama, Albian, Alden, Alexander, Waldwinsville, Barker, Batavia, Bergen, Berne, Borodino, Bristol Center, Brockport, Brocton, Brookview, Byron Center, Caledonia, Canandaigua, Canawaugus, Chafee, Charlotte, Churchville, Clifton Springs, Conewango, Coopersville, Corfu, Cuylerville, Eagle Harbor, East Hamlin, Elba, C. R. Crosby; Evans Mills, W. R. McConnell; Fairport, Fancher, Fayette, Fishkill, Freedom Plains, Gasport, Genesee, Greigsville, Genoa, Hall, Hamburg, Hamlin, Hilton, Holley, Indian Falls, Indian Fields, C. R. Crosby; Ithaca, W. R. McConnell; Knowlesville, LaFayette, LeRoy, Lincoln, Lima, Lockport, Macedon Center, Medina, Marilla, Mumford, North Rose, Oakfield, Ontario, Pultneyville, Retsof, Rhinebeck, Rochester, Sanborn, Romulus, Scottsville, Skaneateles, Skaneateles Falls, Slingerlands, Sodus Point, South Sodus, South Wales, Stafford, C. R. Crosby; Theresa, W. R. McConnell; Tonawanda, Tully, Unionville, Vernon, Wallington, Walworth, C. R. Crosby; Waterport, W. R. McConnell; West Henrietta, Wolcott, C. R. Crosby.

*Ohio:*

Franklin, Highland, Jefferson, Marion, Miami, Trumbell and Wood Counties, W. H. Larrimer.

*Oregon:*

Centralia, M. M. Reeher; Forest Grove, M. C. Lane and M. M. Reeher.

*Pennsylvania:*

Alinda, C. C. Hill; Andersonburg, P. R. Myers and C. C. Hill; Boiling Springs, W. R. McConnell and C. C. Hill; Butler, W. R. McConnell; Carlisle, P. R. Myers, W. R. McConnell, P. H. Hertzog and C. C. Hill; Carlisle Springs, W. R. McConnell; Danville, P. R. Myers and P. H. Hertzog; Dover, P. R. Myers; East Texas, C. C. Hill; Fairfield, P. R. Myers; Ford City, W. R. McConnell; Gettysburg, P. R. Myers; Greensburg, Greenville, W. R. McConnell; Hanover, Hellertown, Herndon, P. R. Myers; Hunters Run, W. R. McConnell, P. R. Myers and C. C. Hill; Indiana, Johnstown, W. R. McConnell; Lancaster, P. H. Hertzog; Landisburg, C. C. Hill; Landsdale, P. R. Myers, C. C. Hill; Lewisburg, W. R. McConnell, P. H. Hertzog and P. R. Myers; Linden, P. R. Myers; Macungie, P. R. Myers and C. C. Hill; Marysville, P. R. Myers; Middleburg, P. R. Myers and P. H. Hertzog; Milheim, W. R. McConnell; Montoursville, P. R. Myers and P. H. Hertzog; Mt. Holly Springs, P. R. Myers; W. R. McConnell and C. C. Hill; Muncy, P. R. Myers and P. H. Hertzog; New Castle, Needmore, New Wilmington, W. R. McConnell; Northumberland, P. R. Myers and P. H. Hertzog; Palmyra, P. R. Myers and C. C. Hill; Penbrook, P. R. Myers; Perkasie, P. R. Myers and C. C. Hill; Red Lion, P. R. Myers; State College, Saegerstown, W. R. McConnell; Springtown, C. C. Hill; Terre Hill, P. R. Myers; Vicksburg, W. R. McConnell; Warfordsburg, P. R. Myers and W. R. McConnell; Wernersville, C. C. Hill; York, P. R. Myers; West Chester, C. C. Hill.

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*Washington:*

Chehalis, Kelso, M. C. Lane.

*West Virginia:*

Charleston, Martinsburg, P. R. Myers.

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## A NEW CERAMBYCID BEETLE FROM CALIFORNIA.

By W. S. Fisher, *U. S. Bureau of Entomology.*

In working over a collection of beetles submitted by Mr. J. S. Wade, Cereal and Forage Insect Investigations, Bureau of Entomology, for determination, the following new species was found. This is the sixth species to be described in the genus *Desmocerus*, five of these belong to the Pacific fauna, and one is found throughout the eastern and southern states.

**Desmocerus dimorphus**, new species.

*Male.*—Elongate, moderately convex and strongly attenuate posteriorly, head, antennae, pronotum, underside and legs black; elytra dull orange colored in pinned specimens (bright orange when living); each elytron with an oblong oblique bluish-black space just behind the humeral umbone.

Head rather large, strongly obliquely narrowed behind the eyes and deeply, longitudinally grooved on the vertex, the groove extending between the antennae to the front; surface coarsely, deeply and confluently punctate and sparsely clothed with long cinereous hairs; antennae with joints three, four and five considerably enlarged at the inner apical angles. Pronotum one and one-half times as wide as long, distinctly narrower in front than behind, strongly transversely constricted along the anterior margin and with a feeble transverse depression in front of scutellum; sides strongly obliquely diverging from anterior angles to a feeble, round tubercle at middle, then strongly sinuate and nearly parallel to posterior angles, which are acute and somewhat projecting; base nearly truncate with a broadly rounded lobe in front of scutellum; surface coarsely, deeply and confluently punctate and sparsely clothed with inconspicuous cinereous pubescence, the hairs becoming much longer towards the sides. Scutellum oblong, black and densely clothed with velvety black pubescence. Elytra wider than pronotum at base, humeral angles rounded, strongly, regularly attenuate to apical sixth, then broadly rounded to the apex, which is feebly truncate; each elytron strongly bilobed at base; humeral umbones well developed; surface deeply and densely punctate, the punctures becoming smaller and more confused towards the apex, sparsely clothed with short inconspicuous hairs; intervals smooth. Beneath rather strongly punctate, somewhat rugose and rather densely clothed with long recumbent cinereous pubescence.

Length 15 mm.; width at base of pronotum 5.5 mm.

*Female.*—Elongate, moderately convex and parallel, head, antennae, pronotum, underside and legs black; elytra dull black with the margins of a dull orange color in the pinned specimens (bright orange when living).

Head and pronotum similar to the male; antennae with joints three, four and five regularly enlarged at both apical angles. Elytra distinctly wider than pronotum at base, humeral angles rounded; sides parallel to apical sixth, then broadly rounded to apex, which is very feebly truncate; surface opaque, more densely punctured than in the male; intervals finely granulated. Body beneath similar to that of the male.

Length 18 mm.; width 6.5 mm.

*Type Locality.*—Sacramento, California.

*Type, allotype and paratypes.*—Cat. No. 24678, U. S. Nat. Mus.

Described from four specimens, two males and two females, received from Mr. J. S. Wade and collected by Mr. B. G. Thompson at Sacramento, California, during May and June,

1921. Mr. Thompson states that the "specimens were collected on Elderberry (*Sambucus* sp.), and borings in the stems indicated that they breed in the stems of this host." Paratype A is a male, and is similar to the type except that each elytron has an additional oblong bluish-black spot near the apex. Paratype B is a female, and is similar to the allotype except that it is smaller, measuring only 16 mm. in length and 5 mm. in width.

This species belongs to the section of *Desmocerus* in which the sexes differ in color. It is allied to *D. piperi* Webb, but can be distinguished, however, from that species by the elytra being smoother, with the tips more truncate; females with the elytron opaque black and intervals finely granulated; males with the elytron marked with bluish-black spots and more strongly attenuate posteriorly. It resembles *D. californicus* Horn very closely in the punctation of the elytra but can be separated from that species by the sexes being differently colored.

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## A NEW ASILID FLY FROM THE MADEIRA ISLANDS.

By T. D. A. Cockerell.

In the Museum of the Seminario at Funchal is a considerable collection of Madeira Diptera, determined by Becker. In it I found only one Asilid, *Machimus madeirensis* of Schiner. My wife took a specimen of this species at Canical, Madeira, January 5, 1921. One other Asilid is recorded from Madeira, *Tolmerus novarensis* Schiner. The Canary Islands possess a much richer Asilid fauna, with four species of *Promachus*, six of *Epitriptus*, two *Stictopogon*, and one each of *Heligmoneura*, *Tolmerus* and *Habropogon*. There are many indications that the Canaries, or at least the more eastern ones, were united with the African continent during part of Tertiary time. The Madeiras, on the other hand, appear far more isolated, and in general have the biota of oceanic islands. If there was ever any land connection with the continent, it was as far back as the Mesozoic

In the island of Porto Santo, 23 miles from Madeira, there is an extremely distinct snail-fauna, and a considerable number of endemic insects, particularly Coleoptera. On the southern slopes of the Pico de Castello, in January, I collected two males and a female of a *Machimus* which at first sight seems identical with that of Madeira. It is, however, rather smaller, and close inspection shows that it is certainly distinct, with the following characters:

### **Machimus portosanctanus**, n. sp.

*Female* (Type).—About 13 mm. long, wing 9 mm.; black, with the tibiae suffusedly dusky reddish basally; face narrow, white with a faint yellowish tint;

face-beard long, mainly composed of black hairs, but lower part with slender white hairs; lower part of cheeks, behind eyes, with long pure white hair; occiput with erect black hair; proboscis shining black, about as long as the antennae; antennae black, the style not much shorter than the third joint; thorax dorsally with a faint median stripe, obsolete posteriorly, sublaterally with narrow shining ochreous bands, broadest in front; sides of thorax yellowish gray, with black spots, the mesopleura with two small round spots in front, and a broad bar behind, the whole like a grotesque face; thoracic bristles (posterior to the suture) long and black; wings pale grey, distinctly more dusky apically; legs with coarse black bristles, hind tibiae and basitarsi with fine ochreous hair on inner side; halters purplish at base, with a white stem and orange knob; abdomen compressed, the segments viewed laterally showing white apical bands rapidly broadening ventrad, so as to make elongate triangles, becoming continuous with the greyish-white venter; end of abdomen more produced, with terminal lamallae, than in *M. rusticus* Meigen.

Compared with a female *M. madeirensis*, this is readily distinguished by the anterior part of thoracic dorsum, which has only extremely short inconspicuous pubescences, and no dorsal bristles anterior to the insertion of the wings, though there are three notopleural bristles, the anterior one short. The front is distinctly narrower, and the face-beard seems less extensive. The long bristle on under side of hind femora is creamy-white; in *madeirensis* it is black. In *madeirensis* the apex of the discal cell, if produced upward, would reach the extreme base of the second submarginal; in *portosanctanus* it would reach a point well beyond the base. In other respects the two species are essentially alike, and are evidently very closely related.

*Male.*—Length about 13 mm.; similar to the female except for the sexual characters. The eyes are redder; the hind tibiae are dusky red except the middle third posteriorly, but the color is obscure; the hind tarsi are reddish. The genital armature is similar to that of *M. atricapillus* Fallén, but the forceps seem to be more slender, and more distinctly truncate in lateral view.

*Type and Allotype.*—Cat. No. 25049 U. S. National Museum. The paratype sent to the British Museum.

The genus *Machimus* has 34 Palearctic species, including five from Spain and one (*M. micropygus* Becker) from Morocco. Eastward, it extends as far as Persia (*M. armipes* Becker, *M. thoracicus* Lw., *M. cingulifer* Becker), and Speiser has described two species from the Kilimandjaro region in Africa. Great Britain has two species. Aldrich's Catalogue cites one species (*M. avidus* V. d. Wulp) from Wisconsin.

A mosquito and Tipulid I collected at Villa Baleira, Porto Santo, were found by Mr. F. W. Edwards to be "tramp" species, *Culex pipiens* L. and *Trimiera pilipes* Fab.

## MELANOTUS HYSLOPI N. SP. (COLEOP.).

BY R. H. VAN ZWALUWENBURG.

The species herein described has been found so often in material submitted for determination that it has seemed advisable to publish this description in advance of a monographic revision of the genus.

### Melanotus hyslopi, n. sp.

*Male.*—11.5 mm. long, 3.0 mm. wide. Slender elongate; dark chestnut brown. Pubescence grayish white, moderately thick, coarse, short, recumbent. Free margin of frons rather acutely rounded, slightly convex and very precipitous along its median portion. Parantennal foveae very deep, entering strongly sideways into the cranium behind the anterior face of the parantennal area. Parantennal area prominent, and on a plane distinctly anterior to that of the rest of the fronto-clypeal region; median height of parantennal area about equal to its median width. Mandible with a deep fovea entering sideways near the base of its exterior face.

Third antennal joint about one-third longer than the 2d; both together about as long as the 4th (1.0–1.33–2.33). Tip of 8th antennal joint attaining the posterior angle of the prothorax.

Prothorax about as long as wide. Sides of prothorax, including posterior angles, straight and diverging slightly backwards from about the anterior one-third; gently narrowed from anterior one-third to the anterior angles. Punctuation of notum of prothorax simple on disc, where it is rather coarse and sparse. Posterior angles unicarinate, the carina strong and diverging slightly from the lateral margin, attaining nearly midway to the anterior angle. Notum of prothorax somewhat depressed, with a posterior, median, impressed line. Sulci well marked, subparallel with lateral margin.

Scutellum longer than wide. Elytral striae consisting of a single series of well impressed, sublinear punctures. Interspaces nearly flat, sparsely and finely punctate. Elytra as wide at base as posterior angles of prothorax; sides subparallel to about middle, thence conjointly narrowed to the apex. Humeral carina not prominent; base of elytron without prominent knob opposite base of 4th stria. Sternites of abdomen coarsely and subconfluently punctate.

*Female.*—Slightly more robust than male. Tenth antennal joint attaining to about apex of posterior angle. Prothorax more transverse than in male. Elytra with sides parallel to beyond middle, thence conjointly narrowed to the apex. Otherwise similar to the male.

The color varies from light castaneous to deep chocolate brown. The males vary in length from 11.3 mm. to 12.0 mm., the females varying within the same limits. The relative length of the 2d, 3d and 4th antennal joints also varies, the 3d varying from one-fourth to one-half longer than the 2d, and the 4th from slightly less than the combined length of the 2d and 3d to slightly more than their combined length. In some males the antennae exceed the posterior angles by only 2 or 2½ segments.

Described from 9 males and 2 females: (Males—South

Mountain, near Hagerstown, Md., July 6, J. A. Hyslop; Hagerstown, Md., June 20; Harpers Ferry, W. Va., May 19, Hubbard and Schwarz; Landisburg, Pa., June 30, J. N. Knull; Bear Swamp, near Ramsey, N. J., Aug. 28, Amer. Mus. Nat. Hist.; New Baltimore, N. Y., July 10, E. B. Southwick; Portland, Conn., May 25 on white pine, F. W. Harris; Beverly, Mass., Cornell Univ., lot 200, Crew; Toronto, Ont., May 22, R. J. Crew. Females—North Saugus, Mass., June 15, D. H. Clemons; Amherst, Mass., June 1, Mass. Agr. Coll.).

*Type.*—Male, allotype and 2 male paratypes, Cat No. 24561, U. S. N. M.

*Type locality.*—South Mountain, Md.

This species, which is named in honor of Mr. J. A. Hyslop, runs to *sagittarius* Leconte, in Candèze's key (Mon. des Elaterides, vol. 3) and is often found in collections labelled as that species. The two are similar in habitus, but show the following differences: (1) as a rule *sagittarius* Lec. is larger (12.5–13.5 mm. long); (2) has the posterior angles more divergent than the side of the prothorax; (3) has the free margin of the frons more broadly rounded and less precipitous medianly; (4) has the prothorax relatively broader, and (5) each lateral lobe of the male aedeagus has a prominent acuminate angle on its outer margin near the apex, whereas in *hyslopi* the lateral lobes (see Fig. 1) are entire and have their sides subparallel. The aedeagus of *pertinax* Say resembles that of the present species very closely, but in *hyslopi* the lateral lobes are apically broader and more robust than in pertinax. The very prominent parantennal area and deeply incised parantennal foveae easily distinguish *hyslopi* from all other known American species except *sagittarius* Lec.

The species seems to be confined to the northeastern part of this country, and southeastern Canada. In addition to the localities given above, specimens have been seen by the writer from Marion, Mass., Mastic, L. I., and Trenton, N. Y., Jackson's Id., Plummer's Id., Wolfsville and Meyersville, Md., Washington, D. C., and Black Mountains, N. C.

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## THE PERIODICAL CICADA, 1919; BRIEF NOTES FOR THE DISTRICT OF COLUMBIA REGION.

By W. L. McAtee.

Perusal of two papers[1] relating to the 1919 occurrence of Brood X of the Periodical Cicada suggested to the writer the

[1] Allard, H. A., Am. Nat., Vol. 54, pp. 545–551, Nov.-Dec., 1920, and St. George, Raymond A., Proc. Ent. Soc. Wash. Vol. 22, pp. 227–231 (Dec., 1920). Feb. 10, 1921.

desirability of putting on record a few of his own observations made in the vicinity of the District of Columbia. Both of the articles referred to record nocturnal singing by this cicada; testimony agreeing with the writer's experience, but disagreeing with the statement in our most complete publication[1] on the seventeen-year "locust." During the height of abundance of the insect in the Washington region the nights were very warm especially for the period May 29 to June 4 inclusive. On these dates not only were the insects singing as I retired and when I arose, but whenever I waked at night I did not fail to hear the cicada chorus. Perhaps nocturnal singing occurs only when the temperature surpasses a certain and probably rather high minimum.

It does not seem that the general ring of cicada music can be produced by the notes one hears made by individual cicadas close at hand. The most common solo note, in my experience, is perhaps the "Pha-r-r-r-aoh" note. To me the first part of it sounds like the distant cry of Fowler's toad; the latter part passes from a cooing to an "o" sound, this phrase descending rapidly both in pitch and volume. The end of the abdomen of the insect is depressed each time these falling notes are given.

Another common note produced by the cicadas is a clicking sound. It is given rapidly and the end of the abdomen of the insect is depressed with each click; one individual I noted lifted the wings and swiftly depressed them at each emission of the sound. This note is quickly taken up by nearby cicadas and a clicking chorus is soon under way.

A note that I have not seen described is a zip, zip, z-e-e-e-e-a-a-ah, of quite orthopteran quality. This note also is quickly taken up by a number of individuals and in such a chorus, as well as in the case of the clicking note, a considerable degree of synchronism is apparent.

It was observed at Laurel, Md., that a large number, and apparently a high percentage, of cicadas which had been compelled to make their exit holes through a compact gravel walk, were so injured in the process that they either did not win free from the pupal shell, or having accomplished that failed to complete their metamorphosis. The most common defect was that the wings did not fully expand, being more or less crumpled and withered in appearance; probably this was caused by undue pressure on the wing pads occurring while the nymphs were tunneling through the very hard sidewalk.

The following observation on a dragon-fly feeding upon the Periodical Cicada is offered as a contribution to knowledge of the predatory enemies of the insect. On May 30, 1919, near Laurel, Md., I flushed a *Tachopteryx thoreyi* from near the

[1]Marlatt, C. L., Bul. 71, U. S. Bur. Ent. p. 85, 1907.

ground, and found that the prey which it dropped was a periodical cicada; about half of the head of the cicada had been eaten away.

The foregoing notes all refer to the larger seventeen-year "locust" (*Tibicena septendecim*). The smaller form also was locally abundant, and renewed observation of the very distinct character of its song was made. A review of the literature brings out the following points bearing on the specific character of the dwarf form. This smaller insect seems never to interbreed with the larger, and notwithstanding ordinary variability is distinct in size, color and genital characters as well as in song. There seems no good reason therefore why it should not be considered a full species (*Tibicena cassinii*). *T. cassinii* does seem to be rather a camp-follower of *T. septendecim*, varying with it in periodicity (in response to temperature no doubt) from 13 years for the southern to 17 years for the northern broods, but this should not militate against its recognition as a species. Doubtless one form was derived from the other, but it certainly is not more difficult to consider them distinct, than two species of *Phyllophaga*, for instance, which may have identical habitat, food and life cycle. Geographic or seasonal isolation is no longer regarded as essential to distinctness of species, it being recognized that just as effective isolation may be due to more subtle factors.

## WILLIAM H. FOX.

Doctor William H. Fox, a former member of the Entomological Society of Washington, died at his home in Washington, D. C., November, 1921. Doctor Fox was elected a member of our Society November 3, 1887. From 1888 until 1893 he was a member of the Executive Committee; during the year 1889 was Recording Secretary; he was a member of the Editorial Committee for volume I. He took an active part in the earlier meetings of the Society, presenting many notes and papers. Most of these dealt with spiders although some presented new facts about habits of insects. He described a number of new species of spiders and was especially interested in their habits. The collection which he prepared was sold to Cornell University when it became necessary for Doctor Fox to discontinue his avocation in favor of his vocation. Doctor Fox was a graduate of Yale, and for many years a member of the medical profession in Washington, D. C. He was a kind and thoughtful man and loved by all who knew him.

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# LIFE HISTORY OF ETHMIA MACELHOSIELLA BUSCK. (LEP.)

By August Busck and Carl Heinrich.

*Ethmia macelhosiella* was described in 1907 (Proc. Ent. Soc. Wash., vol. 8, p. 93) from a single male specimen collected late in September, 1904, near St. Louis, Mo., by Mr. H. A. McElhose. The species was considered rare and remained unknown except for this unique type in the National Museum until the fall of 1916. On November 8, 1916, Mr. E. A. Schwarz brought from Plummers Island, Maryland, a vial containing half a dozen moths with the remark: "What is that common thing? There are *a hundred thousand millions* of them on the island." The moths were our rare *Ethmia*. The authors went the same day to the island and found the striking black and white moth abundant everywhere on the tree trunks as reported. Plummers Island had probably been explored entomologically more than any other American locality and the reason of our missing this conspicuous species during all these years is partly explained by the fact that it is not equally abundant every year, but more so by the unusually late appearance of the moths, at a season when the collecting of Lepidoptera is normally abandoned. There was no clue to be discovered at that time of the year as to its food plant and it was not before early last spring that we gained further knowledge of the species.

On May 5th last year (1920) Mr. Herbert Barber brought in a small, prettily striped caterpillar found on a tree trunk at Plummers Island.

An examination of the setal arrangement proved the caterpillar to be an *Ethmia*. The authors immediately accompanied Mr. Barber to the island in search of more material. Such we found quite abundant on or near tree trunks. Apparently the caterpillars were full grown and in search of suitable quarters for pupation. Diligent search of the plants growing in the immediate neighborhood was for a long time without result and about to be abandoned when Barber discovered one of the larvae on the leaf of a *Phacelia*. Renewed search on this plant on a lower and more shaded, undisturbed part of the island soon resulted in additional specimens. The brightly striped larvae are quite conspicuous and feed exposed in full view, but drop to the ground when disturbed and are easily lost sight of. They were all full grown at this date and on the point of leaving their foodplant. A search for the larvae a week or even a day later would have been futile. When full-grown the larva wanders from the foodplant in search of a suitable log or tree trunk in which to pupate. There they sometimes find accidental holes or cracks to satisfy them, but much more often they bore into the sound bark, chewing their way with the mandibles and leaving the chips behind as tell-tale evidence of their presence, an evidence quickly effaced by rain or wind. About a quarter of an inch or more from the surface the larva makes a snug chamber, lining it with silk. Here it pupates a few days later, remaining as pupa all through the summer and fall.

Many larva were taken home for rearing and they were observed boring their way laboriously into solid bark of Cork Elm taken along for the purpose. Others were given the ingenious, ready made pupation blocks covered with isinglass, invented and employed by the economic workers of the Bureau of Entomology in Dr. Quaintance's Division. The *Ethmia* larva at once adopted these, thus saving themselves the hard work of boring their own holes. They merely lined and closed the small chambers with silk, pupating head outwards to enable successful issue of the adult.

On a sunny day late in October or early in November the adults appear and copulate on the tree trunks, flying rather sluggishly when disturbed. An effort was made to keep moths over winter under various conditions, but it was unsuccessful. All of them died within a few weeks without laying eggs. It is probable that in nature the moths live over winter, at least the females, and that they deposit their eggs on the foodplant in the spring. The foodplant has only a very short season in April and early May. Then it disappears and there is no evidence of it above ground. If the eggs of *macelhosiella* are laid on the foodplant, which is the most reasonable supposition, then the adult female must hibernate until early spring. But the possibility that the eggs may be laid in the fall on the ground or on the tree trunk and that the young larvae go in search of their foodplant when it appears in the spring is not excluded by our present observation.

However this may be, the active life of this insect is confined to a very short larval period in early spring and to an adult period of a few days in early winter during which copulation takes place. Through the entire summer it remains inactive as pupa within the bark and during the winter it hibernates inactively as adult (or possibly as egg). The eggs were not obtained and it is not definitely known where and how they are deposited. Dissection of the abdomen of several fertilized females disclosed only some 20 to 40 rather large eggs in each female, but it is possible that additional eggs may be formed before egglaying begins.

A technical description of the known stages follows:

*Larva.*—(Plates 1, 2, Figs. 1, 2, 3, 4, 10) full grown 18–20 mm. long by 2–2.5 mm. wide. Ventral and ventro-lateral surface of body pale smoky grey white; lateral area white, more or less suffused with pinkish and with occasional slight suffusion of yellow, the white area extending in a continuous, clearly defined, longitudinal band the length of the body and including the areas of the spiracle, thoracic setae III, IV and V and abdominal setae IV and V; above the spiracle a broad subdorsal longitudinal band of smoky black including all the setal areas above the spiracles; along mid dorsum a rather narrow, sharply defined longitudinal yellowish white strip faintly suffused with pink and dividing both the thoracic and anal shields; chitinized areas about tubercles large, round or oval, deep dull black; legs strongly chitinized with chitinized areas shiny jet black; crochets of prolegs black, 26 to 30; chitinized attachment of proleg muscles in prolegs black, conspicuous; thoracic and anal shields deep, dull black; body setae moderately long, black; setae group VII on 9th abdominal segment consisting of a cluster of several minute hairs; spiracles small, round, with chitinized rim black. Head and chitinized areas of trophi shining jet black; an irregular transverse white band extending across the top of the head and including in its area setae A2, A3 and Adf1; ocellar lenses whitish.

The presence of secondary hairs on some part of the body coupled with the normal micro arrangement of three setae (III, IV and V) on the prespiracular shield of prothorax and of the close approximation of setae IV and V under the spiracle on the pro-leg bearing abdominal segments appears to be characteristic of the family *Ethmiidae*. In *E. macelhosiella* the secondary hairs are limited to a small cluster in group VII on the 9th abdominal segment.

*Pupa.*—(Plate 2, Figs. 7, 8, 9) 9.5 mm. long by 3 mm. wide at widest part; dark brown, rather stout; somewhat flattened; abdomen laterally swollen between abdominal segments 4 and 6, widest at abdominal segment 5. Without spines or hairs of any kind, entire surface however finely and irregularly corrugated (see Fig. 7a). Cephalic end rounded; vertex distinct, rather narrow; labrum prominent; labial palpi very small; mandibles rather large; maxillary palpi not reaching proximo-lateral angles of maxillae; maxillae less than half the length of the wing cases; prothoracic and mesothoracic legs half the length of the wing cases; antennae reaching to tips of wings; no femora exposed; wings extending to anterior margin of fifth abdominal segment; spiracles minute, round, not produced; caudal end of abdomen bluntly rounded, bent under and appressed for last three segments; sutures between abdominal segments 5–6 and 6–7 wide and deep; segments 8, 9, 10 narrow; abdominal 10 entirely ventral and flatly appressed. *Anal prolegs* (apl) *with their crochets present;* anal and genital openings slit-like, the latter lying between the prolegs; cremaster absent.

The most striking and characteristic features of the pupae in this family are: the retention of anal prolegs from the larval stage; the even flattening of the entire pupa and the laterally swollen abdomen with its bent under appressed terminal segments.

*Moth.*—(Plates 1, 2, 3, Figs. 5, 6, 11, 12, 13, 14, 15). Male antennae blackish brown very indistinctly annulated with white and with undersides of first joint white; second joint of labial palpi black with white base; terminal joint white with a few black scales. Face white with black edges towards the eyes. Head white with a small central black dot on vertex. Thorax white with a central longitudinal, black line and two small posterior black dots. Patagia white with black base. Forewings white with a slight roseate tinge and sparsely sprinkled with black scales; from base to just below apex a conspicuous black longitudinal streak, partly interrupted at the end of the cell by a round pure white dot, the black streak narrowly edged below and partially above by a thin more or less interrupted line of bright orange scales; the black scales in the upper part of the wing tend to form longitudinal streaks; a row of ill-defined black dots before the cilia along the terminal edge. Cilia white. Hindwings light fuscous. Abdomen dark fuscous, each joint tipped with white and anal tuft yellowish white. Venation typical of the genus.

The females are considerably smaller than the males and much darker (Comp. figs. 5 & 6), the forewings more sprinkled with black scaling and the central longitudinal line broader than in the males; hindwings blackish fuscous with light fuscous cilia. Male genitalia (Pls. 2, 3, Figs. 11, 12, 13, 14) with uncus broad, hood-shaped, slightly bilobed; soci absent; gnathos a large, strongly chitinized bulging central plate, heavily spined at apex; vinculum simple; annullus large, semi-cylindrical, fused with transtilla and partly fused with harpes, with two large flaring lobes; aedoeagus large with stout, strongly curved "blind sack" below the entrance hole of the penis, mouth bilobed; cornuti consisting of two long slender spines; harpes broadly fused at base with anellus and a broad undifferentiated transtilla; costa separated by distinct sutures from the rest of the harpes; sacculus large, apex sharply pointed, cucullus armed with a few long costal spines.

The female genitalia with strongly chitinized dorsal and genital plates; ductus bursae with a spiraled, strongly chitinized median part; bursae copulatrix large, oval, with oblong triangular spined *signum* (Plate 3, Fig. 15).

*Alas expanse* males: 26–28mm.
females: 22–24mm.

The male genitalia are typical of the largest group of *Ethmia* to which *macelhosiella* belongs (*discostrigella* Chambers, *geranella* Busck, *umbrimarginella* Busck, *semitenebrella* Dyar, etc.) but are at once differentiated by the acutely pointed apex of the harpes.

TERMS USED IN FIGURES HEAD OF LARVA (Figs. 1–2).

A1, A2, A3 . . . . . . . . . . . anterior group of setae.
Aa . . . . . . . . . . . . . . . . . anterior puncture.
A D F R . . . . . . . . . . . . adfrontal ridge of frons.

| | |
|---|---|
| A D F S | adfrontal suture. |
| E1, E2 | epistomal setae. |
| F1 | frontal setae. |
| Fa | frontal puncture. |
| Fr | frons. |
| G1 | genal seta. |
| L1 | lateral seta. |
| LR | longitudinal ridge of frons. |
| O1, O2, O3 | ocellar setae. |
| Oa | ocellar puncture. |
| P1, P2 | posterior setae. |
| SO1, SO2, SO3 | subocellar setae. |
| SOa | subocellar puncture. |
| X | ultra posterior setae and punctures. |

## TERMS USED IN SETAE MAP OF LARVA (Fig. 3).

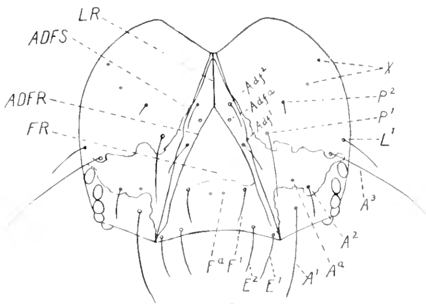
| | |
|---|---|
| TI, TII | first and second thoracic segment. |
| AIII, AVIII, AIX | third, eighth and ninth abdominal segments |

## TERMS USED IN FIGURES OF PUPA (Fig. 7–8).

| | |
|---|---|
| a | antenna. |
| ao | anal opening. |
| ge | glazed eye. |
| go | genital opening. |
| l1 | prothoracic leg. |
| l2 | mesothoracic leg. |
| lb | labrum |
| lp | labial palpi |
| md | mandible. |
| mp | maxillary palpi. |
| ms | mesothorax. |
| mt | metathorax. |
| mx | maxilla. |
| se | sculptured eyepiece. |
| v | vertex. |
| w | wing. |

## TERMS USED IN FIGURES OF GENITALIA (Figs. 11, 12, 13, 14).

| | |
|---|---|
| Ae | aedoeagus. |
| An | anellus. |
| Cn | cornuti. |
| Gn | gnathos. |
| Hp | harpes. |
| Tg | tegumen. |
| Ts | transtilla. |
| U | uncus. |
| Vm | vinculum. |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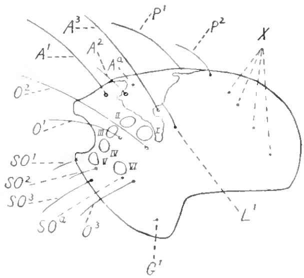
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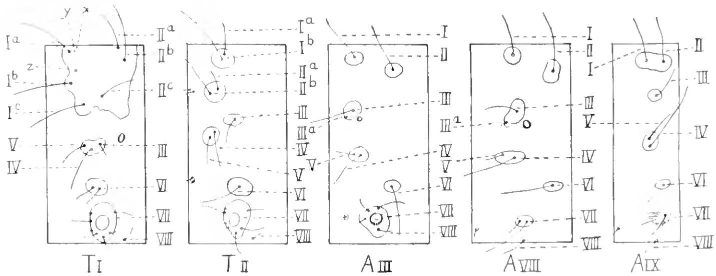
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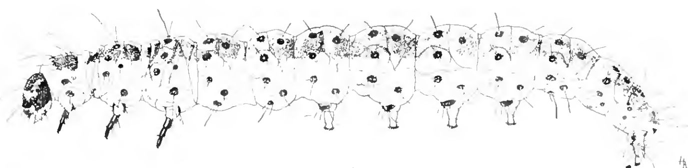

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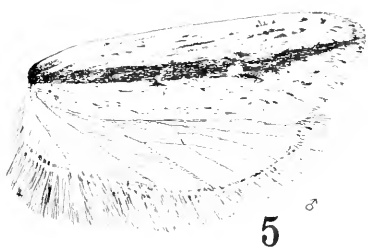
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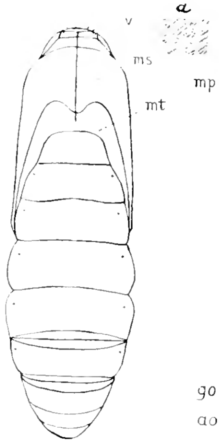
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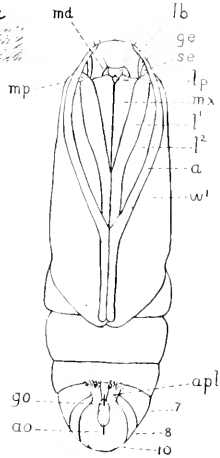
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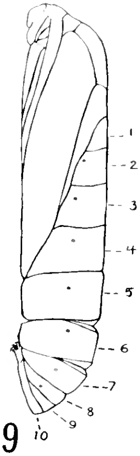
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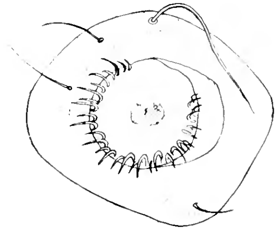

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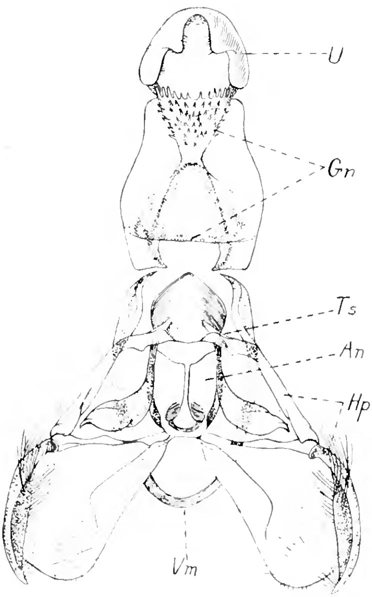
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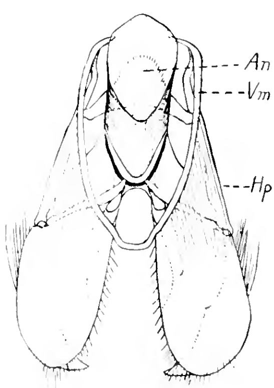
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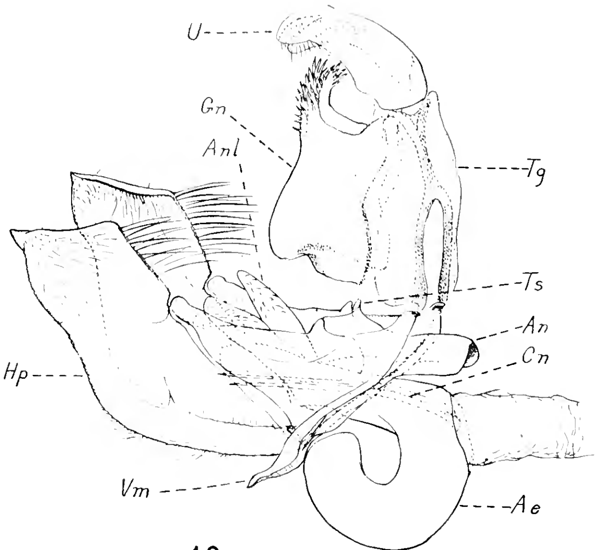


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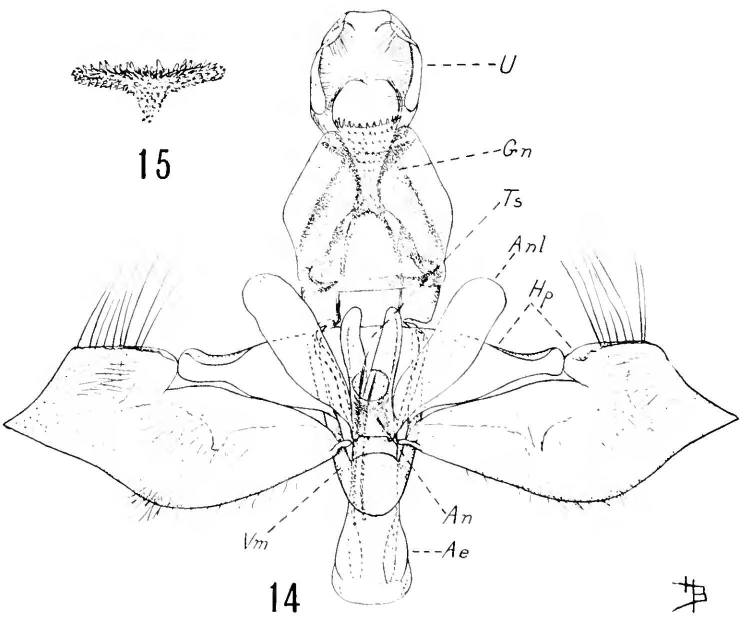


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EXPLANATION OF PLATES.

The drawings were made by Mr. Harry B. Bradford under the direction of the authors.

*Plate* 1.

Fig. 1. Head capsule of larva, front view.
" 2. Head capsule of larva, side view.
" 3. Setal map of body segments of larva.
" 4. Larva.
" 5. Wings of male.
" 6. Forewing of female.

*Plate* 2.

Fig. 7. Pupa, dorsal view.
" 7a. Section of pupa skin, showing sculpture.
" 8. Pupa, ventral view.
" 9. Pupa, side view.
" 10. Abdominal proleg of larva.
" 11. Male genitalia of moth, front view; aedoeagus removed.
" 12. Male genitalia of moth, back view; aedoeagus removed.

*Plate* 3.

Fig. 13. Male genitalia, side view.
" 14. Male genitalia, front view.
" 15. Signum of female bursa copulatrix.

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## THE LARVA OF THE NORTH AMERICAN BEETLE ZENODOSUS SANGUINEUS SAY OF THE FAMILY CLERIDAE.

By Adam G. Böving and A. B. Champlain.

The description of the following form adds another genus to those previously described by us.[1]

**Zenodosus sanguineus** Say.
(= *Thaneroclerus sanguineus* Say.)
(Plate 4, figs. 1–11.)

U. S. Nat. Mus., Wash., D. C.; four specimens of which one specimen is dissected and mounted on two slides; labeled: *Zenodosus sanguineus* Say, Harrisburg, Pa. In mines of Ptinids and Calandrids in dead scar on living Betula. Larvae collected and adults reared by A. B. Champlain.

Total length of body, about 10 mm.; extreme width, about 2 mm.; extreme thickness almost 2 mm.; anterior width of prothorax about 1½ mm. Head capsule with length to width as 5 : 4. Chitinous parts shiny. Head capsule dark Indian red; mandibles dark brown, almost black; prothoracic shield brown ochre, posteriorly with two slightly darker colored spots, medianly with fine light line, meso- and metathoracic plates, basal plate of cerci and claws sepia brown; other chitinized parts brown ochre to pale brown; membranous parts vermillion red with slightly lighter pattern above heart and muscle attachments;

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[1]Adam Böving and A. B. Champlain: Larvae of North American beetles of the family Cleridae. Proc. U. S. Nat. Mus., vol. 57, No. 2323, p. 620.

intersegmental membranes slightly lighter red than segments. Setae pale yellow. Mandible with two setae. Spiracles very small; the mesothoracic spiracle with diameter in proportion to diameter of abdominal spiracles as 3 : 2; peritrema and finger-shaped tubes slightly chitinized. Basal plate of cerci circular, flat, well chitinized, covers median half of the dorsal surface of ninth abdominal segment; cerci entirely absent.

The present larva agrees in general shape, in size, color and almost every detail, except the complete lack of cerci, with the larva of *Thaneroclerus girodi* Chevrolat. In the family Cleridae it belongs to the sub-family "D," established on larval characters by Böving and Champlain.[1] The genus *Zenodosus* Wolcott has been separated by Wolcott[2] from the genus *Thaneroclerus* Spinola, in which the present species hitherto was placed. This separation, however, is hardly supported by any valid larval characters. The only difference between the larvae of the two genera as represented by *Thaneroclerus girodi* Chevrolat and *Zenodosus sanguineus* Say is rudimentary cerci in the former and no cerci in the latter form. All the other generic characters are identical as comparison will show between the generic description of *Thaneroclerus* given by Böving and Champlain[3] and the present figures 1–11, Plate 4.

## EXPLANATION OF PLATE 4.[4]

*Zenodosus sanguineus* Say.

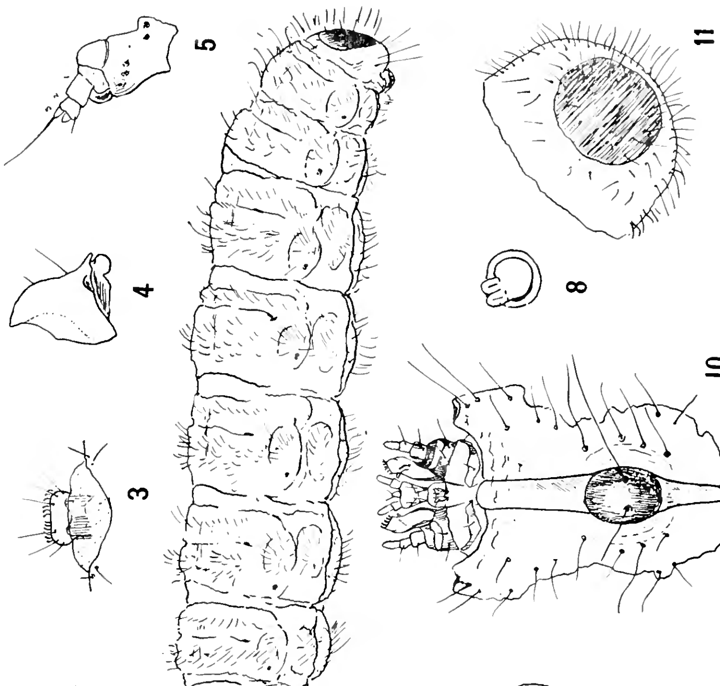
Fig. 1. Ocelli and antenna, external view.
Fig. 2. Left mandible, ventral side.
Fig. 3. Labrum and clypeus, external view (epipharyngeal plate shining through).
Fig. 4. Right mandible, dorsal side.
Fig. 5. Ocelli and antenna, internal view.
Fig. 6. Larva, lateral view, slightly turned to show the epicranial suture.
Fig. 7. Mesothoracic spiracle.
Fig. 8. Third abdominal spiracle.
Fig. 9. Left leg of first pair.
Fig. 10. Maxillae, labium, mentum, submentum, gular plate with large conical protuberance.
Fig. 11. Basal plate of cerci on the dorsal side of ninth abdominal segment.

[1]Adam Böving and A. B. Champlain: Larvae of North American beetles of the family Cleridae. Proc. U. S. Nat. Mus., vol. 57, No. 2323, p. 620.

[2]Ent. News, Vol. XXI, 1910, p. 321.

[3]L. c., p. 621.

[4]Drawings by Adam G. Böving.



*Zenodosus sanguineus Say.*

# EXTERNAL ANATOMY OF THE ELATERID GENUS MELANOTUS (COLEOP.) WITH REMARKS ON THE TAXONOMIC VALUE OF CERTAIN CHARACTERS.[1]

By R. H. Van Zwaluwenburg.

In the following study of the general external anatomy of the *Melanotus* adult, discussion is confined to American representatives of the genus, and detailed descriptions are drawn either from *M. fissilis* Say or *M. communis* Gyllenhal, both widely distributed species throughout the eastern United States. Throughout the genus, as far as the writer has examined, there is a great uniformity in the general anatomical features.

Form elongate; unicolorous (only *leonardi* Leconte and *taenicollis* Leconte are bicolored); varying with the species from yellowish brown to black; size varies from less than 5 mm. (*insipiens* Say) to more than 18 mm. (♀ *decumanus* Erichson).

HEAD. (*M. fissilis* Say, fig. 1.) Oval in outline as seen from above, with eyes somewhat protruding. Occipital foramen higher than wide, its lateral margins slightly converging; the superior margin (Spm, fig. 1) regularly curved on its median portion with its sides oblique and nearly straight to the lateral margins; inferior margin sinuate between the gular sutures (fig. 2). Lateral and superior margins with a finely rounded carina.

Throughout the genus a heavy carina (shown in fig. 2 in profile at the posterior margin of the eye) arises on the anterior end of the gena near the mandible, and extends backward and upward at a varying distance from the margin of the eye; it is most strongly pronounced along the basal third of the eye, less so on the upper part of the gena, and finally (in *fissilis* Say) ending in a more or less distinct, impressed line on the occiput, varying somewhat in length but usually extending about halfway along the inner margin of the eye, and parallel with it.

The occiput in *fissilis* Say is finely and closely punctate; the upper part of the gena impunctate and shiny. Across the epicranium a sudden transverse coarsening of the punctuation to a widely umbilicate character marks the approximate position of the anterior margin of the pronotum in the undissected insect. Anteriorly and ventrally the gena is narrowed between the maxilla and the eye to the inferior basal margin of the mandible (fig. 2).

[1]Note.—The writer is indebted to Dr. A. G. Böving, Dr. G. C. Crampton, Mr. J. A. Hyslop and Mr. R. E. Snodgrass for reading the manuscript and offering valuable suggestions, and to Mr. K. M. King for verifying some of the details in the drawings.

Throughout the genus the *fronto-buccal* region inclines forward and downward (figs. 3 & 4). The *frons* is strongly transverse, bounded laterally by the eyes and anteriorly by the free margin of the frons (Fm, fig. 1). The frons is flat to feebly convex in *fissilis* Say and in most other species; in *decumanus* Er., it is strongly concave. The free margin of the frons is distinct throughout the genus; rounded broadly or acutely or subtruncate, according to the species; in a few species deflexed over the fronto-clypeal region.

The *fronto-clypeal* region (FCL, fig. 5, *M. fissilis* Say) is the area bounded laterally by the eyes, above by the free margin of the frons, and below by the base of the labrum and the insertion of the mandibles; it bears the antennal bases and is always transverse. A suggestion of a suture on either side below the antennal foveae separates vaguely the clypeus from the frons.

The fovea of the antenna (Ant Fov, figs. 3, 4 & 5) is located near the lateral margin of the fronto-clypeal region and a little above the middle. Leading from it in a downward and outward direction is a shallow, opaque antennal fossa which in some species continues across the exterior basal part of the mandible. Situated between the antennal foveae is another pair of foveae, here termed the *parantennal foveae* (Prt Fov, figs. 3, 4 & 5) which are extremely variable in form. The parantennal fovea may be only a shallow impression (*fissilis* Say and *communis* Gyll.) or a wide ear-shaped chamber with deep recesses entering sideways into the cranium behind the anterior face of the parantennal region (*sagittarius* Leconte and *Melanotus* sp., fig. 3). For the taxonomically important area between the parantennal foveae Dr. Böving suggests the term *parantennal region* (Prt A, figs. 3, 4 & 5). Besides the foveal differences, the shape of the parantennal region (transverse, quadrate or vertical), and its plane with reference to the rest of the fronto-clypeal region, promise to be of great value in the taxonomy of the genus.

In all the species examined the *eye* is nearly hemispherical and somewhat emarginate at the lateral extremities of the free margin of the frons.

The *labrum* (fig. 6) is transverse, convex and coarsely punctate; its superior margin straight, the sides and lower margin broadly rounded. This structure varies little in shape throughout the genus. On its inner face is the membranous *epipharynx* which is partially visible below the lower margin of the labrum (ep, fig. 6).

*Mandible.* (Mnd, figs. 5, 7 & 8.) External part robust, strongly curved, cleft near the apex, and in some species rugosely punctate; the left overlying the tip of the right; the right mandible a little more strongly curved than the left. In some species a fovea enters more or less sideways the external face of the mandible near its base (Mnd fov, fig. 3); this fovea varies in shape and size, and is entirely absent in about half of the known American species, including *communis* Gyll. and *fissilis* Say. The *prostheca* (prs. figs. 7 & 8) is broadly rounded, pubescent along its free margin and prominent when the mandible is extended. In the species examined its superior surface is shiny except for an opaque, suboval area near its base. The flexor muscle (flx, figs. 7 & 8) is strongly developed and is attached along the middle of the basal margin; the weaker retractor muscle (rtr, figs. 7 & 8) used only in opening the mandible is attached in the condylar fossa. The posterior condyle (pc, fig. 8) is strongly developed and with its articulation forms a ball-and-socket joint. The anterior condyle (ac, figs. 7 & 8) is less prominent; it bears a shallow longitudinal depression on its side along the fossa, into which the condyle of the clypeus fits.

Throughout the genus, as far as the writer has examined, the *mental suture* (mt sut, fig. 2) lies just back of a sharp, anteriorly deflexed carina which forms the posterior margin of the submentum. The outline of the *gula* (fig. 2) is clepsydral (resembling an hour-glass) being strongly constricted behind its middle. The gula is declivous on its anterior part from the mental suture to its narrowest point; the part behind the constriction is sharply raised above the plane of the narrowest part of the sclerite.

*Labium* (figs. 2 & 9, *M. fissilis* Say). Except for its sharply carinate, anteriorly recurved posterior margin, the *submentum* (Smt, figs. 2 & 9) is evenly and deeply depressed as compared with the gula. It bears two pairs of long, converging, anteriorly directed hairs; its posterior margin is sinuate; its sides anteriorly convergent, rising posteriorly to meet the level of the posterior margin. The *mentum* (Mt, figs. 2 & 9) is semi-membranous, its sides continuing the line of the submentum, and its anterior margin nearly truncate with a small sinuation curving between the bases of the palpigers. The *ligula* (Lgl, figs. 2 & 9) is membranous, broadly triangular, with a median slit extending nearly to its base; its anterior margin bears a fine pubescent fringe. There is no trace of the paraglossae.

The buccal side of the ligula (fig. 10) is thickly covered with short bristly hairs in *communis* Gyll. About half way down the buccal face the slit ends in a semi-chitinous point. From this point down along the median line toward the base is a prominent carina which is accentuated by a thick fringe of medianly directed hairs which curve upward from the bottom of a concavity lying on either side of the median line. This heavily pubescent carina ends posteriorly in a shallow depression which separates it from the *hypopharynx* (hyp. fig. 10).

The hypopharynx is suboval, pubescent and not prominent; directly above and behind it is the buccal opening. As far as could be seen in dried specimens of *fissilis* Say the ligula does not differ appreciably on either face from that of *communis* Gyll.

The *labial palpus* (LbPlp, fig. 9) is 3-jointed. In *fissilis* Say the first joint is short, barely longer than wide; the second is nearly twice as long as the first along its internal margin, more than twice as long on its external margin, obconical, slightly arcuate; the terminal segment is twice as long as the second, securiform, curved at its base, its internal and apical margins subequal. The palpiger (plgr, fig. 9) is robust, about half as long again as wide, and slightly arcuate.

*Maxilla* (described from *M. fissilis* Say) (fig. 11). The cardo (Cd, figs. 2 & 11) is located in a depression of the gena, and is separated on its external face from the basistipes by a sharp transverse carina which extends on either side, continuing the line of the posterior carina of the submentum. The cardo is externally more prominent than the gular and genal areas. The *basistipes* (Btp, fig. 11) bears a thick cluster of long bristles on its exterior face below the palpus. (Note.—Dr. Crampton points out to the writer that the terms "stipes" and "subgalea" as commonly used by coleopterists are morphologically incorrect, the former being the basistipes and the latter the true stipes). The *lacinia* (Lc, fig. 11) is a semi-membranous blade, very thickly ciliate toward its external margin, and when at rest lies along the interior margin of the galea. The *galea* (Gal, fig. 11) is oval, distinctly two-jointed, and is provided with thickly set cilia on the apical segment. The galeal and lacinial brushes curve upward toward the buccal cavity. The *maxillary palpus* (MxPlp, figs. 2 & 11) is large and 4-jointed. The first joint is small and subspherical, and is attached to the slightly smaller, oblique *palpifer* (plfr, fig. 11); the second joint is elongate obconical and slightly longer than the third; the third is also obconical and distinctly arcuate; the fourth is slightly longer than the second, broadly triangular, its interior margin arcuate and about as long as the apical margin; its exterior margin the longest and nearly straight.

The *antennae* of *Melanotus* are 11-jointed and the terminal joint is entire, never being constricted to suggest a pseudo 12th segment as is the case in *Parallelostethus*, *Crigmus*, etc. The basal joint is about 2½ times the length of the second, subcylindrical and distinctly arcuate. The second joint is small and subglobular; the third is variable in size and shape depending upon the species. In *fissilis* Say the fourth to tenth segments are subtriangular, giving that part of the antenna a serrate appearance, and are subequal in length. The eleventh segment is elongate oval with the apex rather acutely rounded.

The size of the third antennal joint as compared with that of the second and fourth is a character which has been used by nearly every worker with the genus; in spite of the fact that there are some intermediate and variable species, lack of more satisfactory characters has made necessary its continued use. The sexes can be distinguished by the presence of a thick and erect pubescence on the inferior margin of the fourth to eleventh antennal segments of the male (fig. 12). In some species this pubescence is very short and therefore difficult to see (e. g. *cribricollis* Candèze) but so far as the writer knows the character can be seen in all the American species.

PROTHORAX. Throughout the genus the *notum* (fig. 13) is roughly quadrilateral, but the outline of the lateral margins is so variable within a species that this character has proved less valuable than many earlier writers have supposed. The anterior margin of the notum may be truncate or sinuate; the anterior angles are sometimes produced and sometimes extend no further anteriorly than the middle of the margin itself. Posteriorly the notum of the prothorax is nearly truncate, varied by slight sinuations. The posterior angles are generally prominent, though varying in width and length with the species. Medianly from each posterior angle, at a distance varying with the species, is the short sulcus (sul, figs. 13 and 15) which varies somewhat in length, width and direction; it is apparently of slight taxonomic value. Another character sometimes, but not often, useful is the presence or absence of a median basal groove on the notum (shown in fig. 13)

The posterior angle always bears one carina and in some species a second, more or less well-defined, which diverges inwardly. Candèze and other writers have attached much importance to uni- and bicarination, much more in the present writer's opinion than the character merits, for in many species a series of specimens will show all gradations from a well-defined second carina to the most vague and uncertain suggestion of bicarination; this is particularly true of *decumanus* Er. The first carina is variable in length, and the second, when present, is always the shorter.

The notal punctuation is variable, but is generally (except in *opacicollis* Leconte and *gradatus* Leconte) noticeably sparser and finer on the disc than on the rest of the notum.

The relative length and width of the notum have been very generally used in the taxonomy of the genus, but unfortunately, writers have differed in their use of these measurements, with the result that much confusion has arisen. The present writer has found it convenient to confine himself (as Candèze usually does) to the use of the *median measurements*, as indicated in the figure of *M. communis* Gyll. (ML and MW, fig. 13). Throughout the genus the relative width of the prothorax is greater in the female than in the male.

The anterior foramen of the notum is regularly and transversely elliptical, except for the more strongly arched margin of the sternum and the anterior excavations of the sterno-pleural sutures. In *fissilis* Say the posterior foramen of the pronotum (fig. 15) has the superior margin strongly arched and very sinuate, being brought down on the sides to meet the posterior margin of the fused pleura and the inflexed part of the notum at a point about midway between the apex of the posterior angle and the juncture of the pronotal-epipleural margin with the coxal cavities; this superior margin of the foramen is strongly reentrant just before attaining the lateral margin. The sides of the foramen are strongly convergent ventrally but are separated below by the coxae and the mucro. Above the superior margin of the foramen, and meeting it only along the middle, is the transverse posterior margin of the plane of the notal disc, extending between the posterior angles and bearing the sulci. This leaves on either side of the center and above the posterior foramen, a roughly triangular, deeply excavate area bounded by the superior margin of the foramen, by the posterior margin of the plane of the disc of the notum and by the exterior half of the posterior margin of the pronotal epipleura or tergo-pleural region.

The *sternum* of the prothorax throughout the genus is convex and longitudinal, with the sides subparallel as far as the coxae (St 1, fig. 16, *M. fissilis* Say). Anteriorly it is broadly rounded and more or less deflexed, depending upon the species, to form a vague lobe (PtL, fig. 16) whose free margin is finely raised. On either side the sternum is bounded by externally concave, double sterno-pleural sutures (Sps, fig. 16) which are somewhat widened and excavate anteriorly. Posteriorly these sutures curve outward and the inner of them ends in a small pit near the anterior edge of the coxal cavity. The outer suture continues backward, passing around the coxal cavity and finally disappearing in the general direction of the posterior angle as a vague sinuate line more or less parallel with the posterior margin of the pronotal epipleura.

Posteriorly the sternum of the prothorax is sharply narrowed by the coxal cavities to form the *prosternal process* or *mucro* (figs. 13 & 16). In *fissilis* Say the mucro is slightly concave between the coxae, with its lateral margins somewhat rolled; along the posterior third of the coxae the mucro becomes gently declivous, at the same time narrowing more sharply on its ventral than on its dorsal face; its tip is slightly declivous, forming a blunt apical point which curves gently toward the body.

Between the sterno-pleural sutures and the lateral margin of the notum lies a wide area, the *pronotal epipleura* or *tergo-pleural area* (PE, fig. 16) which is composed of the inflexed part of the tergum of the prothorax and the pleura, which are indistinguishably fused together. Anteriorly the outline of this area is subogival (more or less resembling a pointed arch); for a short distance along the middle its sides are nearly parallel; its posterior margin is oblique and widely sinuate and bears the vague suture described above. This pronotal-epipleural area is nearly flat except for a shallow excavation near the posterior angle.

The coxae of the prothorax are subglobular and prominent.

MESOTHORAX. Little of the *notum* of the mesothorax is visible without removing the elytra, except the prominent elevation of the scutellum (scl, fig. 14) which rises between the bases of the elytra to approximately the plane of their disc. In *communis* Gyll., the prescutum (psc, fig. 14) is roughly yoke-shaped, transverse and has a medianly reentrant anterior margin and a strongly depressed central area. It bears the anterior notal wing process (ANP, fig. 14). The elevated portion of the scutellum is suboval and prominent, sloping away sharply on either side to the axillary cord (AxC2, fig. 14). The scutum (sct, fig. 14) is small and closely fused with the scutellum; it bears the posterior notal wing process (PNP, fig. 14). The structure of the notum of the mesothorax is generally uniform in all the species so far examined.

The *sternum* of the mesothorax (St 2, fig. 17) in *fissilis* Say is roughly pelecoidal (i. e., like the axe of the Roman fascis), and except for its posterior intercoxal portion is not so prominent ventrally as the sternum of the metathorax. The anterior margin is double, being split transversely; each of these anterior edges is interrupted by a prominent median bifid knob which marks the anterior end of the mesosternal cavity. The lateral margins of the sternum slope away to meet the coxal cavities. The posterior margin of the sternum is defined by the regularly rounded coxal cavities which are separated by a space equal to about one-third the width of the anterior margin of the sternum. The posterior part of the sclerite ends at the narrowest point between the coxae, and the margin is marked by the transverse, deeply incised meso-metasternal suture. The mesosternal cavity (MsC, figs. 17 & 18), which occupies about one-third the entire area of the sclerite, is roughly oval; its posterior margin is met by the concave, declivous intercoxal portion of the mesosternum.

The *episternum* of the mesothorax (eps2, fig. 18) in *fissilis* Say, is roughly triangular, with its exterior angle bluntly rounded; its anterior margin is sinuate and oblique; its interior margin is concave. Its exterior margin is convex and on its anterior part has an oblique marginal cleft just below the exterior angle, into which the inflexed margin of the elytron fits when at rest.

The *epimeron* of the mesothorax (epm2, fig. 18) in *fissilis* Say suggests rather vaguely an anvil. Its short anterior margin is transverse. The interior margin is divided distinctly into a posterior and an anterior portion; the anterio-interior portion is concave; the posterio-interior portion partially closes the coxal cavity. The posterior margin is concave and contiguous with the sternum and part of the episternum of the metathorax. The exterior margin is thick and somewhat sulcate to receive the margin of the elytron; the outermost edge of this marginal cleft combines with the anterior margin of the sclerite to form an acute external angle.

The coxae of the mesothorax are subspherical, rather large, but not protruding (Cx2, fig. 17).

METATHORAX. The *notum* of the metathorax (fig. 14) is semi-membranous, and in *communis* Gyll., is subquadrate. The *scutellum* (Scl, fig. 14) divides the *scutum* (sct) by a narrow median tongue extending forward from a more robust basal scutellar area from which the axillary cord (AxC3, fig. 14) extends on either side. Each longitudinal division of the scutum is partially divided by a transverse suture into anterior and posterior areas, the former of which bears the anterior notal wing process (ANP, fig. 14), and the latter the posterior notal wing process (PNP). The *postscutellum* or *postnotum* (PS, fig. 14) is strongly transverse and partially divided by a broken transverse suture.

The *sternum* of the metathorax (St 3, fig. 17) is convex. In *fissilis* Say it is subquadrate, its anterior margin roundly emarginated by the coxal cavities of the mesothorax. Its lateral margins are straight and slightly divergent posteriorly. The posterior margin is sinuate, acuminate at the middle with the apex of the acumination finely emarginate. The posterior coxae (Cx3, fig. 17) are contiguous with the sternum along the entire length of its posterior margin except for a separation along the median line. The sternum bears a median longitudinal impressed line which varies with different species in depth and length; it may prove of taxonomic value in some cases.

Of the *pleura* of the metathorax only part of the episternum (eps3, figs. 17, 19 & 20) is visible when the elytra are closed. The entire *episternum* (fig. 19) in *communis* Gyll., is elongate and roughly triangular; it ends anteriorly in the wing process and parapterum (WP & P, fig. 19). The portion concealed beneath the closed elytron is semi-corneous, while that part ordinarily visible is oblong, about six times as long as wide, and as heavily chitinized as the sternites. The two parts of the episternum are separated by an impressed line, and the concealed area is slightly depressed.

The *epimeron* (epm3, figs. 19 & 20) of *communis* Gyll., lies in two planes, a lateral and a dorsal. The lateral plane is very narrow and elongate anteriorly, widening behind to form a rough parallelogram. On the dorsal plane is a distinctly semi-chitinized subtriangular plate the posterior corner of which is separated by a suture from the rest of the plate. The rest of the dorsal area of the epimeron is membranous except for its anterior portion which is semi-chitinous along its outer margin where it fuses with the tergo-pleural membrane, gradually becoming more strongly chitinized anteriorly until it ends in the wing process (WP, fig. 20).

The coxae of the metathorax (Cx3, fig. 17) are flat throughout the genus, strongly transverse, gradually narrowed outward, and separated along their inner margin. The posterior margin is sulcate or strongly excavate for the reception of the femora.

The *legs* of Melanotus are not remarkable. The pectination of the claws is characteristic of the genus; while two other Elateroid genera in America have pectinate claws (*Eniconyx* and *Aptopus*), they are not easily confused with Melanotus. There is considerable variation in the number and character of the pectinations in Melanotus, but as Candèze has said, not only does the pectination vary in the same species and in the same individual, but even in the two claws of the same tarsus.

The *elytron* throughout the genus bears nine striae. It is strongly deflexed along its anterior third and at the humeral angle. The disc is flat to feebly convex anteriorly, depending on the species, and distinctly convex posteriorly. The outer margins of the elytra of the females are subparallel to their middle or posterior third, depending on the species, and thence narrowed to the apex; in the males the elytra are narrowed from the humeral angle or, in other species, from their anterior third, to the apex. The striations vary in form and depth with the species; they are sometimes posteriorly (*cribricollis* Cand.) or laterally (*paradoxus* Melsheimer) obsolete. The interstrial spaces are flat or convex, and vary from finely and sparsely (*angustatus* Erichson) to very coarsely (*tenax* Say and *difficilis* Blatchley) punctate. The anterior margin of the elytron is transverse and sinuate with often a more or less prominent knob at the base of the fourth stria. The anterior margin of the elytra is always deeply emarginate to receive the scutellum. The humeral angle is strongly carinate in some species. The elytra are conjointly and acutely rounded and in a few species (e. g., *scrobicollis* Leconte) the tip of each elytron is sometimes faintly acuminate.

The *wing* (fig. 21) is of the Cantharoidean type as characterized by Gahan (The Entomologist, v. 44, p. 121, 1911), having the anterior branch of the media and the posterior branch of the radius hooked so as to look like recurrent branches of their respective veins. The second anal vein crosses and interrupts the first anal vein throughout the genus.

ABDOMEN. Only five abdominal segments are visible ventrally (S3-S7, fig. 17), while seven are visible dorsally (T1-T7, fig. 22). The first apparent ventral segment is therefore morphologically the third or the fused second and third. Sometimes anywhere from one to three additional segments are partially visible, but these form a protrusible carrier for the external genitalia and are not ordinarily visible in dry specimens. The outline of the abdomen is elongate triangular with the sides gently arcuate, especially on the apical third. The following descriptions of the abdomen are from *communis* Gyll., but are applicable in general in every species the writer has examined

The first six *tergites* (T1-T6, fig. 22) are membranous and hardly distinguishable from the tergo-pleural membrane. The median length of the first tergite is slightly less than that of the second, and the two together are about as long as each of the following five. The seventh tergite (T7, figs. 22 & 23) is similar in both sexes; it is slightly narrower than the preceding segment, slightly longer, and is moderately chitinized and flexible. Its outline is roughly parabolic; it is fimbriate posteriorly and broadly rounded medianly; emarginate on either side before the apex, with a longitudinal impression beginning at the emargination and continuing more or less parallel with the lateral margin nearly to the base.

The tergum of the abdomen is bordered on either side by a sharp lateral ridge (LR, fig. 22) extending from the second to about midway of the seventh tergite. It is formed by the pleura. A gutter-like channel into which the edge of the elytron fits, separates it from the sternites.

Borne on the tergo-pleural membrane, and therefore visible only dorsally, are seven pairs of spiracles, each marking a urosegment (Sp1-Sp7, fig. 22). The first spiracle (Sp1, figs. 14 & 22) is wide and soft-lipped and deeply set in the membrane; it is suboblong, extends along the entire length of the oblique lateral margin of the first tergite and is arcuate on its anterior fourth. The second spiracle is slightly elongate-oval, somewhat obliquely placed and is about one-fifth the length of the first; it is located in a deep fold of the membrane about one-third of a millimeter from the lateral ridge. The stoma of this and the succeeding spiracles is somewhat chitinized. The third to seventh spiracles are slightly smaller and rounder and are located a little nearer the lateral ridge.

The *sternites* of the abdomen (S3-S7, fig. 17) are heavily chitinized and strongly convex. The posterior angles of sternites 4, 5 and 6 are somewhat produced, the prolongation becoming more pronounced proceding posteriorly. The last visible sternite is subtriangular, its sides arcuate and its apex acutely rounded. In *fissilis* Say the median length of the first two visible sternites is subequal except for the intrusion of the metathoracic coxae; the last sternite is about one-third longer than each preceding pair. A narrow membrane connects the last two visible sternites. The fifth visible sternite in different species exhibits some variation in the degree of its convexity and in the nature of its punctuation.

The number and character of the retractile segments of the abdomen vary with the sex and the species (figs. 23, 24, 25 and 26). They are most easily seen in specimens which have been prepared in dilute acetic acid.

*Retractile segments of the male* (described from *communis* Gyll., figs. 23, 24 & 25). The eighth tergite is about as long as the seventh, and about as wide. It is slightly longer than broad; its sides are subparallel and broadly rounded on the apical third, and fimbriate on its posterior margin; it is very nearly flat and of the same degree of chitinization as the seventh tergite. The ninth tergite is subquadrate; its posterior margin is deeply emarginate, the outer third on either side being free, while the inner third is fused with the tenth tergite. The tenth tergite at its base is about two-thirds as wide as the posterior margin of the ninth, and is subtriangular in outline. The ninth and tenth tergites are subequal in length, together a little shorter than the eighth. They are less heavily chitinized and more flexible than the eighth.

The eighth sternite is subquadrate, slightly wider at the base and a little longer than wide; it is nearly flat, and along its outer margins about as heavily chitinized as the corresponding tergite. The ninth sternite is slender and bullet-shaped, about two and one-half times as long as its basal width. It is narrowly rounded and on the sides is flexed sharply upward. Its base is membranous, but towards its apex it becomes well chitinized. The tenth sternite is ovate and flat; it is flexible and about one-third the length of the ninth sternite.

The pleurites are entirely membranous (fig. 24). A small prominently-borne spiracle (Sp8, fig. 24) is present on the eighth pleurite about halfway from the base of the eighth tergite; in dried specimens it is usually completely hidden by the collapse of the pleural region and the consequent approximation of the tergite and sternite.

The *anus* (An, fig. 24) lies just beneath the tip of the tenth tergite, and may be strongly everted.

*Retractile segments of the female* (described from *communis* Gyll., fig. 26). The eighth tergite is subogival in outline, with the sides almost parallel along their basal half; it is membranous at the base but well chitinized apically; it is about two-thirds the length of the seventh tergite. Its sides are flexed downward along their basal third to partially enclose the pleurite, and just beneath the flexed edge at about the point where it curves upward to the dorsal plane is a small spiracle on the eighth pleurite, borne on a small backwardly-directed prominence. The ninth urosegment is entirely membranous and is not differentiated into tergite, sternite or pleurite. It encloses the ovipositor, being everted when that organ is extruded.

The eighth sternite is about two-thirds the length of the seventh, about half as long again as wide, its sides subparallel and rounded toward the apex. It is slightly narrower and shorter than the eighth tergite. In *fissilis* Say the apical margin is more or less acuminate medianly. The eighth sternite is as heavily chitinized as the corresponding tergite.

As in the male, the pleurites are membranous. The writer has been unable to trace the alimentary tract of the female to its anal opening.

*External genitalia of male* (figs. 23, 24 & 25, *M. communis* Gyll.) Throughout the genus the male genitalia are depressed and consist of a *basal piece* (Bs) (orismology of Sharp and Muir) which is chitinous and horse-shoe shaped, and encloses within its open margin the bases of a slender *median lobe* (Mlb) and two slender *lateral lobes* (Llb). The entire apparatus including the basal piece and the three lobes is termed the *aedeagus*. The basal piece is well chitinized on its lateral surfaces and on its ventral face; the dorsal side of the median lobe and the entire structure of the lateral lobes is likewise well chitinized. The part within the horse-shoe of the basal piece, on its ventral surface, the entire dorsal surface of the basal piece, and the ventral side of the median lobe are membranous. The ejaculatory duct leads through the dorsal face of the basal piece to the interior of the median lobe. The membranous ventral face of the median lobe is perforated near its apex by the *median orifice* (mo, fig. 24) through which the membranous internal sac is everted when the apparatus is functioning. At such time the membranous ventral surface of the lobe becomes turgid, as does also of course, the everted internal sac. The lateral lobes articulate laterally and are capable of opening at nearly right angles to the median lobe. (Note.—The orientation of the male genitalia is apt to be confused due to the fact that when fully exerted the aedeagus is bent upon the turgid membranous structure which supports it, upward and forward, and its surfaces become reversed, as shown in fig. 24. The terms ventral and dorsal as here used refer to directions when the genitalia are at rest within the body.)

Valuable taxonomic characters have been found in the male genitalia in the shape and relative slenderness of the median lobe, and especially in the shape of the lateral lobes (see fig. 1). One group of species (to which belong *fissilis* Say and *communis* Gyll.) has the outer margin of the lateral lobe strongly angulated near its apex; the second group (containing *cribulosus*

Leconte and *trapezoideus* Leconte) has the lateral margin straight or simply curved, but in all cases entire. Within these two groups there are many variations of shape which have proved to be of specific value. On the other hand unquestionably distinct species tend to group about certain genitalic types. The presence or absence of an angle on the outer margin of the lateral lobe is not consistently correlated with any recognized external character.

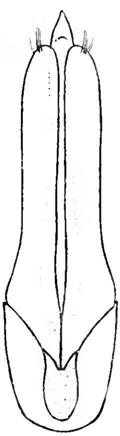


Fig. 1. Male genitalia of *Melanotus hyslopi* Van Zwaluwenberg.[1]

*External genitalia of female* (fig. 26, *M. communis* Gyll. & fig. 27, *M.* sp.). Throughout the genus the ovipositor is a slender, rather depressed, transparent, cylindrical tube, ending in a bulbous structure which bears the *genital valves* (GV) and the terminal *styli* (Sty). The valves and styli are finely and sparsely haired. The genital valves are elongate and spatulate, articulating laterally. Each is surmounted near its apex by a cylindrical stylus about one-third as long as the valve. Showwing conspicuously within the cylindrical part of the ovipositor, and connecting posteriorly with a less conspicuous pair in the bulb, is a pair of narrow, elongate, flexible chitinous rods (Rd) which serve to strengthen the ovipositor when it is thrust into the nidus at oviposition. As the ovipositor belongs more properly to a consideration of internal, rather than external anatomy, a more detailed description is left for future discussion.

Although the writer has not studied the female genitalia as carefully as those of the male, it is apparent that they do not offer such satisfactory characters as the male aedeagus does.

## EXPLANATION OF ABBREVIATIONS USED IN THE FIGURES.

| | |
|---|---|
| A 1, A2 | —first and second anal vein. |
| AJ | —antennal joint. |
| An | —anus. |
| Ant Fov | —antennal fovea. |
| ANP | —anterior notal wing process. |
| Ax | —axillary sclerites by which the wing articulates with the scutum of the metathorax. |
| AxC | —axillary cord (2, of mesothorax; 3, of metathorax). |
| B | —basalar plate; the parapterum of Snodgrass. |
| Bs | —basal piece of aedeagus. |
| Btp | —basistipes, a subdivision of the true stipes; the "stipes" of coleopterists. |
| Cd | —cardo. |

[1]For description of this species and reference to this figure see Proc. Ent. Soc. Wash., vol. 23, no. 9, 1921, p. 211.

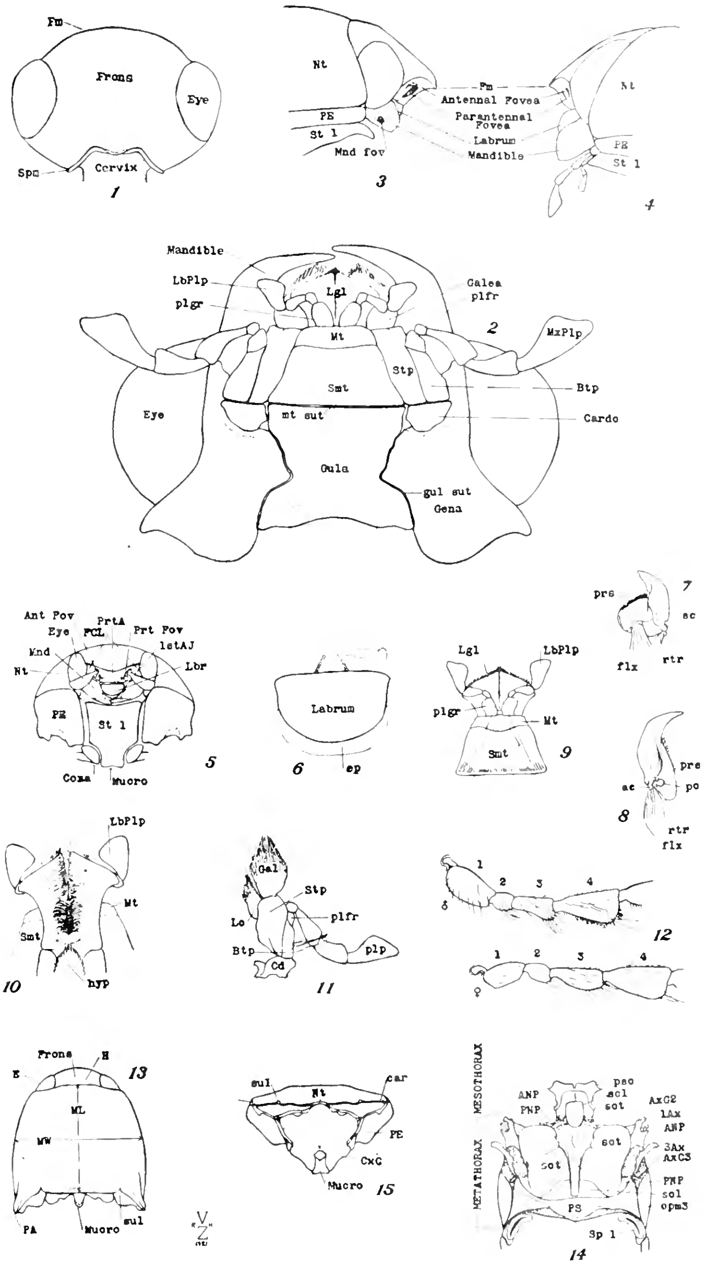
Cu 1, Cu 2—first and second cubitus.
Cx —coxa (2, of mesothorax; 3, of metathorax).
CxC —coxal cavity.
E —eye.
EL —elytron.
FCL —fronto-clypeal region.
Fm —free margin of frons.
Gal —galea.
GV —genital valve of ovipositor.
H —head.
LbPlp —labial palpus.
Lbr —labrum.
Lc —lacinia.
Lgl —ligula.
Llb —lateral lobe of aedeagus.
LR —lateral ridge of abdomen.
M —membrane.
M 1, M2 —first and second media.
ML —median length of notum of prothorax.
Mlb —median lobe of aedeagus.
Mnd —mandible.
Mnd fov —fovea of mandible.
MsC —mesosternal cavity into which the mucro fits when at rest.
Mt —mentum.
MW —median width of notum of prothorax.
MxPlp —maxillary palpus.
Nt —notum of prothorax.
Ov —ovipositor.
OvSh —sheath of ovipositor, which is everted when ovipositor is extruded.
PA —posterior angle of prothorax.
PE —pronotal epipleura; the tergo-pleural area.
PNP —posterior notal wing process.
PrtA —parantennal region.
Prt Fov —parantennal fovea.
PS —postscutellum or postnotum.
PtL —anterior lobe of sternum of prothorax; the prosternal lobe.
R 1, R 2 —first and second radius.
Rd —chitinous rod of ovipositor.
S —sternite of abdomen, numbered to show the segment to which it belongs.
Sc —subcosta.
Smt —submentum.
Sp —spiracle; those of abdomen numbered to indicate the segment to which they belong.
Spm —superior margin of occipital foramen.
Sps —sterno-pleural suture; "prosternal suture" of Candèze and others.
St —sternum (1, of prothorax; 2, of mesothorax; 3, of metathorax).

| | |
|---|---|
| Stp | —the true stipes according to Dr. Crampton; the "subgalea" of coleopterists. |
| Sty | —stylus of genital valve of ovipositor. |
| T | —tergite of abdomen, numbered to indicate the segment to which it belongs. |
| Ur9 | —ninth segment of abdomen, forming in the female Melanotus, the sheath of the ovipositor, and not differentiated into tergite, sternite or pleurites. |
| WP | —wing process. |
| ac | —anterior condyle of mandible. |
| car | —carina. |
| ep | —epipharynx. |
| epm | —epimeron (2, of mesothorax; 3, of metathorax). |
| eps | —episternum (2, of mesothorax; 3, of metathorax). |
| flx | —flexor muscle. |
| gul sut | —gular suture. |
| hyp | —hypopharynx. |
| mt sut | —mental suture. |
| mo | —median orifice of median lobe of aedeagus. |
| plfr | —palpifer. |
| plgr | —palpiger. |
| plp | —palpus. |
| pc | —posterior condyle of mandible. |
| prs | —prostheca. |
| psc | —prescutum. |
| rtr | —retractor muscle. |
| scl | —scutellum. |
| sct | —scutum. |
| sul | —sulcus. |

## EXPLANATION OF PLATES.

### PLATE 5.

1. Head of *Melanotus fissilis* Say, in dorsal aspect.
2. Ventral view of head and mouthparts; *M. fissilis* Say.
3. Lateral view of head and part of prothorax; *Melanotus* sp.
4. Lateral view of head and part of prothorax; *M. fissilis* Say.
5. Frontal and slightly ventral view of head and prothorax; *M. fissilis* Say.
6. External view of labrum, with edge of epipharynx visible; *M. fissilis* Say.
7. External (superior) view of right mandible; *M. communis* Gyll.
8. Lateral view of right mandible; *M. communis* Gyll.
9. External view of labium; *M. fissilis* Say.
10. Buccal aspect of labium; *M. communis* Gyll.
11. Left maxilla; *M. fissilis* Say.
12. First four antennal joints of *M. fissilis* Say, male and female, showing erect pubescence on 4th joint of male.
13. Head and prothorax in dorsal aspect; *M. communis* Gyll.
14. Meso- and metathorax, dorsal view; *M. communis* Gyll.
15. Posterior view of prothorax; *M. communis* Gyll.


Fm
Frons
Eye
Spm
Cervix
1
Nt
PE
St 1
Mnd fov
3
Fm
Antennal Fovea
Parantennal Fovea
Labrum
Mandible
Nt
PE
St 1
4
Mandible
LbPlp
plgr
Lgl
Galea
plfr
2
MxPlp
Mt
Stp
Smt
Btp
Eye
mt sut
Cardo
Gula
gul sut
Gena
prs
7
sc
flx
rtr
Ant Fov
PrtA
Eye
FCL
Prt Fov
1stAJ
Mnd
Nt
Lbr
PE
St 1
Coxa
Mucro
5
Labrum
6
ep
Lgl
LbPlp
plgr
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Smt
9
pre
ac
po
8
rtr
flx
LbPlp
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hyp
Gal
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plfr
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Btp
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11
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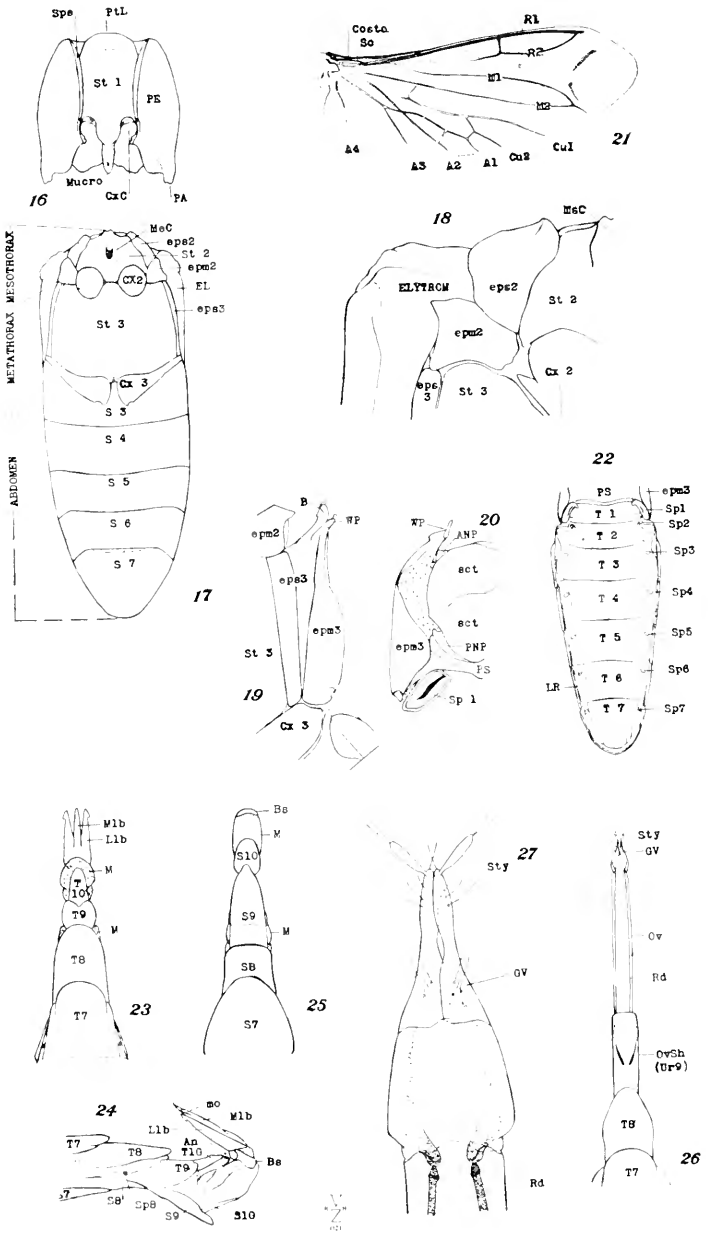
Frons
E
13
ML
MW
PA
Mucro
sul
sul
car
Nt
PE
CxC
Mucro
15
MESOTHORAX
METATHORAX
ANP
PNP
psc
scl
sct
AxC2
1Ax
ANP
sct
sct
3Ax
AxC3
PNP
scl
opm3
PS
Sp 1
14


16
Spe
PtL
St 1
PE
Mucro
CxC
PA
17
MeC
eps2
St 2
epm2
CX2
EL
eps3
St 3
Cx 3
S 3
S 4
S 5
S 6
S 7
METATHORAX MESOTHORAX
ABDOMEN
18
MsC
ELYTRON
eps2
St 2
epm2
Cx 2
eps 3
St 3
19
B
WP
epm2
eps3
epm3
St 3
Cx 3
20
WP
ANP
act
act
epm3
PNP
PS
Sp 1
21
Costa
Sc
R1
R2
M1
M2
Cu1
Cu2
A1
A2
A3
A4
22
PS
epm3
T 1
Sp1
T 2
Sp2
T 3
Sp3
T 4
Sp4
T 5
Sp5
T 6
Sp6
LR
T 7
Sp7
23
Mlb
Llb
M
T 10
T9
M
T8
T7
24
mo
Mlb
Llb
An
T10
T7
T8
T9
Bs
S8
Sp8
S9
S10
25
Bs
M
S10
S9
M
S8
S7
27
Sty
GV
Rd
26
Sty
GV
Ov
Rd
OvSh
(Ur9)
T8
T7

16. Prothorax in ventral aspect; *M. fissilis* Say.
17. Ventral view of mesothorax, metathorax and abdomen; *M. fissilis* Say.
18. Latero-ventral view of pleurites of mesothorax; *M. fissilis* Say.

PLATE 6.

19. Latero-ventral view of left pleurites of metathorax; *M. communis* Gyll. (partially diagrammatic).
20. Dorsal view of left epimeron of metathorax (showing parts not visible in fig. 19), and portion of notum of metathorax; *M. communis* Gyll.
21. Wing of *Melanotus* sp.; from balsam slide mount.
22. Dorsal view of abdomen with elytra and wings removed; *M. communis* Gyll. (fimbriation of last segment omitted).
23. Dorsal view of protusible abdominal segments of male *M. communis* Gyll. with aedeagus lying along the plane of the body axis; (fimbriation of 7th and 8th tergites omitted).
24. Lateral view of protrusible abdominal segments and aedeagus of male *M. communis* Gyll., with aedeagus directed forward over the tergum, the position assumed when fully extruded.
25. Ventral view of protrusible abdominal segments of male *M. communis* Gyll. In this figure only the bottom of the basal piece is visible, the aedeagus being held at right angles to the body axis in this instance.
26. Dorsal view of protrusible abdominal segments of female *M. communis* Gyll., with ovipositor fully extruded.
27. Apex of ovipositor; *Melanotus* sp.; drawn from balsam slide mount.

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## THE SPECIFIC NAMES OF TWO OTIORHYNCHID WEEVILS OF FLORIDA.

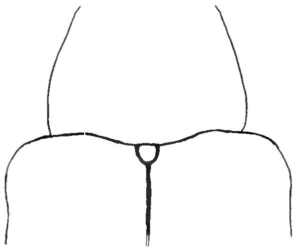
BY E. A. SCHWARZ AND H. S. BARBER, *U. S. Bureau of Entomology.*

Incorrect application of the names for our two species of *Pachnaeus* recently became apparent and the correction should be noted before the changes appear in forthcoming biological notes.

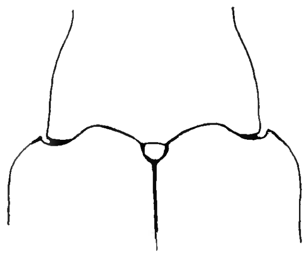
One species is abundant in tropical Florida from near Miami to Key West, and the other, common from central Florida (Tampa, Crescent City, Lake Poinsett, etc.) to Alabama and North Carolina, being recorded also from New Jersey. Simpson, in his very readable popular account of the natural history of southern Florida,[1] discusses the dual character of the fauna and flora, and it appears to us that the two species here considered offer a striking parallel to the cases he cites (pp. 144–5); —that our northern form of *Pachnaeus* was perhaps part of the pre- or interglacial fauna of north Florida long before the drift- or tempest-borne migrants from the West Indies (to which fauna the second species belongs) began to find lodgment on the newly forming reefs which now constitute the most southerly

[1] "In Lower Florida Wilds" by C. T. Simpson, 1920, G. P. Putnam's Sons.

part of the U. S. The northern form seems to be very closely related to a species (*P. citri* Marshall 1918) recently described from Jamaica, and the southern form appears to be identical with a Cuban species. The two species are most readily distinguished by the degree of sinuosity of the suture between the pronotum and elytra, as shown in the accompanying figure.



P. opalus Oliv. (= distans Horn)



P. litus Germar (= opalus Horn, not Oliv)

When Horn, 1876, recognized that two species were to be distinguished among these green weevils, he appears to have committed an error in applying the old specific name to the wrong species and in describing the old species as new. At that time none of our American coleopterists knew much of the tropical forms living adjacent to our southern border, and even to-day we are just beginning to realize that many of the peculiar species of Florida, Texas or Arizona are only strays from complex tropical groups. Their nomenclatorial status can only be determined after study of the greatly involved and often very unsatisfactory literature and specimens representing our knowledge of the fauna of the American tropics.

Of the series in the National Collection we are unable to distinguish between those from south Florida and those from Cayamas, Cuba, which have been identified as the *Cyphus litus* of Germar 1824 (Ins. Spec. Nov. p. 451) except that the latter average slightly larger, but there seems to be considerable doubt as to Schoenherr's 1840 (Gen. et Spec. Curcul., vol. 6, p. 426) record of its occurrence in Mexico.

The synonymy of our two species of *Pachnaeus* may be indicated thus:

**Pachnaeus opalus** (Olivier 1807). Type data, Carolina (Bosc). Range, N. J. to Central Fla.

Syn. *Pachnaeus distans* Horn 1876. Type data, Cedar Keys & Capron, Fla. (Hubbard & Schwarz).

**Pachnaeus litus** (Germar 1825). Type data, Cuba. Range, Cuba, South Fla. (Mex.?)

Syn. *Pachnaeus opalus* Horn 1876 et auct.—non Oliv.

## NEW BEES FROM THE MADEIRA ISLANDS. (HYM.)

By T. D. A. Cockerell

Three of the species now described were collected by Wollaston, the greatest student of the entomology of the Atlantic Islands, and placed in the British Museum as far back as 1858. The fourth was recently obtained by myself in Porto Santo, an island from which no bees had been recorded All of the species are closely related to European forms. These are the only endemic bees described from Madeira, excepting the beautiful *Anthophora maderae* Sichel, which the British Museum has from Canical, Madeira, April 21–25, 1904. This *Anthophora*, though a very striking form, is so near to the European *A. quinquefasciata* Vill., that authors treat it as a mere variety. The bee-fauna of the Madeira Islands is certainly very limited as Wollaston and Eaton obtained only eleven species, and I found only two more. This fact, and the close relationship of the endemic species to continental ones, indicate clearly that the Madeiran bees are not relics of extreme antiquity, such as many of the snails, but are derived from ancestors which reached the islands in comparatively recent times. Probably they date back to the Pleistocene, but certainly not to the Miocene. During Tertiary time, it would seem that the islands possessed no bees, or if they existed, they have become extinct. Had there been Tertiary bees, we should expect to find a fauna with numerous allied species, as in the Hawaiian Islands.

### **Halictus wollastoni**, n. sp.

*Female.*—Length about 5.5 mm.; a small species of the subgenus *Chloralictus*, with the head and thorax bluish-green; abdomen very dark brown, with the hind margins of the segments pallid; stigma dusky reddish, wings dusky. The mesothorax may or may not show brassy tints. Very closely allied to *H. morio* Fab., but the head and thorax are larger, the mesothorax dull and closely punctured, the area of metathorax considerably longer. The type is a female.

*Male.*—Differs from *morio* by the much broader face, the clypeus not snout-like, and not at all pallid apically; mesothorax with a distinct median groove; abdomen broader basally, not at all claviform. The flagellum is clear ferruginous beneath.

Madeira, several of each sex in British Museum, collected by Wollaston. One of the males has a darker stigma, and lacks the median groove of mesothorax; it may possibly be distinct. Some specimens have clearer wings.

Edward Saunders recorded this in 1903 as *Halictus* n. sp., near *morio*. In the Museum, it has stood as *H. unicolor* Brullé, but quite erroneously, as that Canarian insect is entirely black. Brullé described four Canarian species with green thorax, but this seems to agree with none of them.

**Andrena maderensis**, n. sp.

*Female.*—Length about 12 mm.; very close to *A. bimaculata* Kirby, but differing thus: clypeus shining, with well separated punctures, smooth down the middle; labrum fringed with shining red hair, and its process pointed; mesothorax posteriorly not distinctly punctate, and without a shining area; stigma with a strong dark margin; nervures fuscous; second submarginal cell very broad; area of metathorax less distinctly defined and less coarsely sculptured; abdomen distinctly greenish, and first two segments without distinct punctures; hair at apex of abdomen dark reddish; scope of hind tibiae redder, blackened posteriorly. The dark chocolate facial foveae are like those of *bimaculata*.

*Male.*—Similar to *A. bimaculata*, but easily separated by the shining clypeus, dark margined stigma, and other characters as in the female.

Madeira, 4 ♀, 2 ♂, in British Museum (*T. V. Wollaston*). This was recorded by E. Saunders as *A. bimaculata* var?

**Andrena portosanctana**, n. sp.

*Female.*—Like *A. maderensis*, and differing similarly from A. *bimaculata*, but the thin abdominal hair-bands are white, without any fulvous tint, the apical tuft is black; the wings are clearer, not so red; the hair of front and vertex (but not occiput) is black, and on face dull white, but there is a conspicuous reddish band from eye to eye at level of antennae; the discs of mesothorax and scutellum have pure black hair, that on pleura is long and white; the process of labrum is more rounded, without a distinct point or tubercle; the clypeus, though shining, lacks a distinct smooth median line. The greenish tint of the abdomen is very obscure.

Porto Santo, near the south side of the Pico do Castello, January, 1921, at flowers of *Oxalis cernua* and *Calendula* (*Cockerell*). 3 ♀.

**Andrena wollastoni**, n. sp.

*Female.*—Like *A. minutula* Kirby, but area of metathorax dull and granular, with sculpture hardly visible under a lens; mesothorax less punctured; stigma larger and darker.

*Male.*—Recorded by E. Saunders from the Mount, Funchel (Eaton); the specimens are in the British Museum. He remarks that they are apparently *minutula*, a form with the mesonotum rugulose and with very distinct shallow punctures, with the long-haired face characteristic of the first brood.

Madeira; eight in British Museum; the females collected by Wollaston. *A. pusilla* Pérez, from Constantine, Algeria, is very similar, and agrees in the sculpture of the metathorax, but is easily separated by the more shining mesothorax.

A single female, collected by my wife in Porto Santo, is referred to *A. wollastoni*, though it is distinctly smaller and otherwise slightly different. It was on flowers of *Euphorbia*, north of the Villa Baleira, January 16, 1921. Possibly a series would indicate a separate form.

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*Actual date of issue January 31, 1922*

VOL. 24 FEBRUARY, 1922 No. 2



# PROCEEDINGS

OF THE

# ENTOMOLOGICAL SOCIETY

OF WASHINGTON

## CONTENTS



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VOL. 24 FEBRUARY 1922 No. 2

## A LIST OF PHYTOPHAGOUS CHALCIDOIDEA WITH DESCRIPTIONS OF TWO NEW SPECIES.[1]

By A. B. Gahan.

Phytophagous habits among certain groups of Chalcidoidea although strenuously disputed at one time are now established and well known facts. C. R. Crosby in 1909 (Cornell Univ. Agr. Exp. Sta. Bull. 265, p. 368) gave a short resumé of the groups and species at that time known to be plant-feeders. Included in this list are representatives of three families, viz., Agaonidae, Callimomidae (=Torymidae), and Eurytomidae. Excepting the Agaonidae or true fig insects, and the Callimomid subfamily Idarninae associated with the fig-insects but whose relationship is not clearly understood, all of the phytophagic forms listed by Crosby, with one exception, are either seed chalcids or grass and grain stem-infesting species. The single exception is the Eurytomid, (*Isosoma*) *Eurytoma orchidearum* Westwood, which infests the leaves and stems of orchids.

Crosby apparently overlooked two or three interesting papers, and more recent literature has brought to light numerous additional examples of phytophagic species. These additional records not only involve other groups of Chalcidoidea, but show an interesting diversity in modes of life.

Whereas Crosby's list showed representatives of only three families, the present list includes species placed in six families. The three not included by Crosby are *Perilampidae*, *Encyrtidae*, and *Eulophidae*. There is considerable doubt in the writer's mind whether all of the species are correctly placed but the fact remains that they probably represent groups quite different from those commonly known to include plant-feeding species. In Ashmead's systematic arrangement of the families, the *Agaonidae* are placed first and the *Eulophidae* last with the four other families, in which phytophagy is said to occur, ranging themselves between. This fact, provided they are correctly classified, would seem to indicate that plant-feeding

[1]This paper is a contribution from the Division of Cereal and Forage Crop Insects, Bureau of Entomology, U. S. Department of Agriculture. Credit for the included list of phytophagous species is largely due to Miss Margaret Fagan who has compiled from literature most of the references and data.

species may be looked for in other families and that ultimately phytophagy may prove to be much more common than at present suspected.

Seed-chalcids and joint-worm flies are by no means the only phytophagic forms. Certain species are definitely stated to be makers of galls, the galls in some instances at least showing a marked resemblance to Cynipid galls. Other species are said to bore in plant tissue much as do certain Coleoptera, Diptera, and Lepidoptera.

The list of food plants is a varied one. Species are shown to infest seeds of such widely different groups of plants as Leguminaceae, Lauraceae, Pomaceae, Rosaceae, Myrtaceae, Vitaceae, Mimosaceae, and Anacardiaceae, as well as the various groups of conifers. The so-called joint worms are found attacking a long list of grains and grasses and a new species described herewith infests the young stems of bamboo. The gall-makers are found on *Acacia*, *Eucalyptus*, *Asparagus*, *Scutia*, and on other unnamed plants. Of the species which may be classed as borers, one infests orchids, another lives in the fleshy part of juniper berries, while still another is said to bore under the bark of *Eucalyptus*.

Thus it will be seen that both in manner of living and in the matter of food plants the phytophagous Chalcidoidea exhibit no small degree of adaptability. So far as known none of the species feed as exposed larvae, all being internal feeders in the larval state. Doubtless this will prove to be an invariable rule since the structure of the larva would need to be greatly modified from the usual type in order to enable it to exist as an external feeder. With this single limitation there seems to be no good reason why they should be confined in their activity to the few modes of living which have been enumerated. It would appear entirely within the range of probability that species may yet be found duplicating in their modes of living many of the other internally feeding insects of other orders. For example, many species of Chalcidoidea are parasitic upon leaf-mining hosts, and, in the light of what has already been shown, it would not be surprising eventually to discover a Chalcidoid which is itself a genuine leaf-miner.

It may be noted here that not only are the phytophagous forms distributed through a number of families but in many cases they apparently do not offer even minor group characters which will permit them to be differentiated even generically from species known to be parasitic. Thus we find phytophagous species of the genus *Eurytoma* which can be separated specifically only with great difficulty from forms known to be parasitic upon Lepidoptera, Diptera, and Coleoptera. The genera *Syntomaspis*, *Callimome*, *Megastigmus*, and *Tetrastichus* each contains both parasitic and phytophagous forms, if published records are to be credited.

Attention should also be called to the fact that the phytophagous species, so far as known, belong almost exclusively to groups in which a large percentage of the related parasitic forms breed in host larvae which are concealed within plant tissue. Parasitic Eurytomidae and Callimomidae are largely found infesting gall-makers, borers in wood or herbaceous plants or insects which infest fruits or seed capsules. Rarely if ever is a species of either of these groups parasitic upon a free living or exposed larva. The phytophagous Eulophidae likewise apparently belong to groups in which many of the species are parasitic upon gall-makers and leaf-miners although the hosts are not so restricted as in the previously mentioned groups. The single phytophagous genus and species of Encyrtidae placed by its describer in the subfamily Eupelminae, tribe Tanaostigmini, is unknown to the writer except through the description and figure. The tribe is an anomalous one and its relation to the Eupelminae is open to serious doubt. The known species are not numerous. The type genus and species were described by Howard (Ins. Life, vol. 3, 1890, p. 147) from specimens cut from abnormally swollen ovaries of a leguminous tree (*Coursetia? mexicana*), and the author was uncertain whether the species was phytophagous or parasitic, although he states that no indications of parasitism were found. Other species of the tribe are said to be parasitic upon various species of Coleoptera, which cause gall-like malformations of the seed heads of *Prosopis*, *Hibiscus*, *Helianthus*, and other plants. The phytophagous species of Perilampidae, if rightly placed, would form an exception to this rule since true Perilampids are usually associated, either as primary or secondary parasites, with free living host larvae. The writer is strongly inclined to doubt the relationship of these gall-making forms to true Perilampids. They appear to be more closely related to the Decatomini, and it is not improbable that all of these so-called Perilampids really belong to the Eurytomidae(?) and that they should constitute a separate subfamily made up of many genera now placed in the Perilampidae, as well as several from the Pteromalid tribe Isoplatini. The writer is not willing to commit himself definitely on this point without further study.

Consideration of the foregoing facts very naturally starts a train of speculation as to the evolution of the phytophagous habit in Chalcidoidea. Were the Chalcidoids originally parasitic as a group with phytophagy a more recently acquired habit? Were they as a group originally vegetable feeders and is the present parasitic habit of the vast majority of the species a later development, the phytophagous habit being retained by only a comparatively few forms. Or were they originally plant-feeders, later turning to parasitism and then again to phytophagy, perhaps in a different form?

There can be no doubt that the progenitors of the Chalcidoidea at perhaps the earliest period in their developmental history were plant feeders. Whether the morphological break away from the ancestral type of structure which resulted in the development of the modern Chalcidoidea took place before the beginning of the parasitic habit, coincidental with it, or whether parasitism developed after the break is an interesting problem but is beside the point. Unless one is willing to believe that they arose from a source entirely separate from that of other insects and at a later date, it is impossible to conceive of the Chalcidoids and their ancestors always having been parasitic. The possibility of such an origin will, I think, be rejected without serious consideration and the first stated hypothesis may, therefore, be discarded.

It is evident, then, that at some point in their evolution the Chalcidoidea themselves or their ancestors were phytophagous and that parasitism must have been a subsequent development. The second and third hypotheses may be restated as one in the following manner: Did a part of the original Chalcidoid stock become adapted to a parasitic life while another part retained its original plant-feeding habits, and could these two habit-groups (if I may so designate them) maintaining such entirely different modes of existence have come down to us through the ages without any radical divergence in structure which would enable us at the present day to separate them into different genera and only with great difficulty into different species?

I believe not. The very numerous and highly specialized forms to be found among the Chalcidoids seem to indicate a high degree of plasticity and it would appear extremely unlikely that two such different modes of existence could be maintained throughout long geological periods without resulting in the development of marked structural differences to correspond. One would naturally expect structural differentiation between two such habit-groups if long continued and it would be much easier to believe that phytophagy as found to-day is a continuation from ancestral type if it were at present confined to a restricted group or to nearly related groups. Such is apparently not the case, however, as we find it showing up more or less sporadically throughout the superfamily and in such widely separated groups, as regard specialization of structure, as Eurytomidae and Eulophidae. Acceptance of the idea that phytophagy on the one hand and parasitism on the other could exist for any great length of time without differentiation of structure would, it seems, in an inverse manner, entail rejection of the fundamental principle that environment is one of the controlling factors in structural modification. Verification of this point is apparently to be found in the Cynipoidea, another group containing both parasitic and phytophagous forms. While it is probably not possible to point to any one structural character or group of characters which will separate the parasitic Cynipoids as a whole from the gall-making forms, it is nevertheless true that certain more or less definite structural groups are always parasitic while others are always phytophagous and one is able to determine with considerable confidence from examination of any given specimen whether it is parasitic or phytophagous. This does not warrant the assumption that phytophagy even among the Cynipoids is a continuation from ancestral type but certainly does seem to indicate that it has longer existed in this group than in the Chalcidoids.

Parasitic forms of the Chalcidoids have been shown to possess to an extremely high degree the ability to adapt themselves to different environmental conditions. Not only do they attack successfully all manner of insect hosts under almost every conceivable condition as regards environment, but they attack them in the egg, larval, and pupal stages, and they may be either primary parasites or hyperparasites. Some individual species are not confined to a single host or to closely related hosts but live at the expense of widely different hosts, in some cases embracing even different orders. Several instances are known of species that develop either as primary or secondary parasites as circumstances determine. Considering these facts it seems certain that if phytophagy had long existed it would be found much more common than at present seems to be the case since there appears to be no good reason why the phytophagous forms should be more restricted in their powers of adaptation than the parasitic forms.

The most important point confirmatory of the probable recent development of phytophagy among Chalcidoids is found in the assertion by three different authors that certain species of Eurytomidae are parasitic in their early stages and finish their development as plant-feeders. Nielsen has claimed this to be the habit of an unnamed species of *Eurytoma*; Rimsky-Korsakov has recorded the same habit for *Harmolita inquilinum;* and Phillips asserts that *Eurytoma pater* follows the same mode of development. There is evidence that this phenomenon may occur in the development of other Chalcidoid species, notably with some of the gall infesting species which have been supposed to be commensals. Such a mode of development if proven to be at all common would seem to leave little room for doubt that phytophagy is a recent specialization.

On first thought the transition from a parasitic to a phytophagic existence would appear to involve an extremely radical ecological readjustment. One must, however, bear in mind that these now phytophagous species were, as shown by their parasitic relatives, probably originally parasitic upon some internally feeding larva, frequently one living within a gall, or possibly a seed or a grass stem. More than likely in every instance the host larva lived in some such circumscribed position where not only its movements were restricted but its food confined to a particular kind of plant tissue. The parasite larva attacking such a host externally would be in direct contact with the plant food of its host. Feeding as it would upon a larva whose food was restricted to a particular kind of plant tissue, the food of the parasite would consist of the same material after it had undergone digestion and assimilation by the host. Just how great would be the chemical changes involved in these processes is of course unknown. In the case of an insect larva they would probably be relatively simple as compared to those of higher animals. The nutritive requirements of the parasite doubtless approximate chemically those of the host especially if the two be closely related as host and parasite sometimes are. Be this as it may, the fact is established that some insects are capable of accomodating themselves to a degree to either animal or vegetable food. Examples of this are found among Meloïd beetles which live parasitically in bees' nests, their young larvae first destroying the bee egg and then feeding upon the vegetable contents of the cell. Cannibalism is by no means an uncommon occurrence among certain plant feeding Lepidoptera. Among Hymenoptera, the Ichneumonid, *Grotea anguina* Cresson has been shown to live parasitically in bees' nests destroying first the egg or young larva of the bee and then feeding upon the bee bread. (Graenicher, Ent. News, vol. 16, 1905, p. 44.) That certain species of Chalcidoidea can and do develop partly as parasite and partly as plant feeders has just been shown.

Partial phytophagy probably was first forced upon the parasite by premature exhaustion of the natural food supply due to attacking a host which was insufficient in itself to furnish food for complete development. The transition from such a habit to that of development entirely as a plant feeder does not appear as such a difficult matter after all.

## SPECIES CATALOG OF PHYTOPHAGOUS CHALCIDOIDS OTHER THAN THE FIG INSECTS.

Following is a list, compiled from literature, of the species of Chalcidoidea said to be phytophagous, omitting only the fig insects, *Agaonidae* and *Idarinae*. Only those species are included which have been expressly stated to be plant-feeders or probably plant-feeders. Records such as "reared from galls" or "reared from stems" have been disregarded unless the author has definitely indicated that the species was probably phytophagous. In most cases only the most comprehensive account of the insect has been cited, no attempt having been made to catalog all of the references to the individual species. The host plant is given as found in the reference cited. For corrected botanical names see appended list of host plants.

### Family AGAONIDAE.

AGAON, BLASTOPHAGA, AND RELATED GENERA. The fig-insects or caprifiers of the figs (*Ficus*). The entire family is supposed to be phytophagous, living in the seeds of figs.

### Family CALLIMOMIDAE.

CALLIMOME TSUGAE Yano and Koyama, Rept. For. Bur. Tokyo, 1918, p. 38–58. (Rev. Appl. Ent., ser. A, vol. 6, 1918, p. 403.) Said to infest seeds of *Tsuga sieboldi* in Japan.

IDARNINAE.—This whole subfamily is found associated with the true fig-insects. Very little is known of their actual habits. Some are said to be inquilines while others are believed to be true parasites of *Agaonidae*.

MEGASTIGMUS ACULEATUS (Swederus): Wachtl, Wien. Ent. Zeit., 3, 1884, p. 38–39. Said to be phytophagous in seeds of rose in Europe. Also recorded from seeds of rose in North America by Crosby (Ann. Ent. Soc. Amer., vol. 6, 1913, p. 165); and in Japan, by Weiss (Journ. Econ. Ent., vol. 10, 1917, p. 448).

MEGASTIGMUS ALBIFRONS Walker: Crosby, Ann. Ent. Soc. Amer., vol. 6, 1913, p. 167–8. Reared from seeds of *Pinus ponderosa* from Placerville, California.

MEGASTIGMUS AMELANCHIERIS Cushman, Proc. Ent. Soc. Wash., vol. 19, (1917) 1918, p. 81. Reared from seeds of *Amelanchior canadensis* from Pickens, West Virginia, French Creek, West Virginia, and North East, Pennsylvania.

MEGASTIGMUS BALLESTRERII (Rondani): Stefani, Boll. Studi. Inform. R. Giardina Col. Palermo, 4, 1917, p. 101–131. Reared from fruits of *Pistacio vera* and *P. terebinthus* from Sicily. Probably occurs also throughout southern Europe, North Africa, and Asia Minor.

MEGASTIGMUS BORRIESI Crosby, Ann. Ent. Soc. Amer., vol. 6, 1913, p. 169. Reared from seeds of *Abies mariesi* in Japan.

MEGASTIGMUS BREVICAUDIS Ratzeburg: Rodzianko, Comment. Torym., 1908, p. 608–11. Reared from seeds of *Sorbus aucuparia* at Poltava, Russia. Recorded also by Crosby (Bul. 265 Cornell Agr. Exp. Sta., 1909, p. 375) from *Sorbus* seeds in New York.

MEGASTIGMUS CRYPTOMERIAE Yano, Rept. For. Bur. Tokyo, 1918, p. 35–58. Reared from seeds of *Cryptomeria japonica*, and *Chamaecyparis obtusa* in Japan.

MEGASTIGMUS INAMURAE Yano, Rept. For. Bur. Tokyo, 1918, p. 35–58. Reared from seeds of *Larix leptolepis* in Japan.

MEGASTIGMUS LARICIS Marcovitch, Can. Ent., vol. 46, 1914, p. 435. Reared from seeds of *Larix laricina* du Roi at Ithaca, N. Y. Larva completely devours the kernel.

MEGASTIGMUS LASIOCARPAE Crosby, Ann. Ent. Soc. Amer., vol. 6, 1913, p. 163. Reared from seeds of *Abies lasiocarpa*, from Rye, Colorado.

MEGASTIGMUS NIGROVARIEGATUS Ashmead: Crosby, Ann. Ent. Soc. Amer., vol. 6, 1913, p. 158–60. Reared from seeds of *Rosa rugosa* and other roses. Northern United States from Atlantic to Pacific.

MEGASTIGMUS PHYSOCARPI Crosby, Ann. Ent. Soc. Amer., vol. 6, 1913, p. 158. Reared from *Physocarpus pulifolius* (probably from the seeds), at Allentown, Missouri.

MEGASTIGMUS PICEAE Rohwer, Can. Ent., vol. 47, 1915, p. 97. Reared from seeds of *Picea sitchensis* in California. Records of the Bureau of Entomology show this species to have been reared from seeds of *Picea engelmanni* and *Picea parryana* also.

MEGASTIGMUS PICTUS (Förster): Wachtl, Wien. Ent. Zeit., 3, 1884, p. 214. From seeds of rose in Germany.

MEGASTIGMUS PINUS Parfitt: Crosby, Ann. Ent. Soc. Amer., vol. 6, 1913, p. 160. Infests seeds of *Abies nobilis*, *A. magnifica*, *A. concolor*, *A. amabilis*, *A. grandis*, and *Tsuga* sp. Western United States.

MEGASTIGMUS PISTACIAE Walker: Wachtl, Wien. Ent. Zeit., 12, 1893, p. 28. Lives in fruits of *Pistacio lentiscus* Linné. Probably phytophagous. France and Italy.

MEGASTIGMUS SPERMOTROPHUS Wachtl: Crosby, Ann. Ent. Soc. Amer., vol. 6, 1913, p. 163. Infests seeds of *Pseudotsuga taxifolia*, *Abies magnifica*, *A. amabilis*, *A. grandis*, *A. concolor*. Recorded in the Bureau of Entomology from seeds of *Abies shastensis* also. Occurs in Europe and western part of North America.

MEGASTIGMUS STROBILOBIUS Ratzeburg: Judeich and Nitsche, Lehrbuch der Forstins., 1893, p. 704, 1339. From seeds of *Abies pectinata*. Germany.

MEGASTIGMUS THUYOPSIS Yano, Rept. For. Bur. Tokyo, 1918, p. 35–58. In seeds of *Thuyopsis dolabrata* in Japan.

MEGASTIGMUS TSUGAE Crosby, Ann. Ent. Soc. Amer., vol. 6, 1913, p. 162. Reared from seeds of *Tsuga Mertensia hookeriana* in the western United States.

SYNTOMASPIS AMELANCHIERIS Cushman, Proc. Ent. Soc. Wash., vol. 19 (1917) 1918, p. 82–3. Reared from seeds of *Amelanchier canadensis* collected at Pickens, West Virginia, and North East, Pennsylvania. Doubtfully phytophagous. At least, sometimes parasitic on *Megastigmus.*

SYNTOMASPIS AUCUPARIAE Rodzianko, Bull. Soc. Nat. Moscou, (1907), 1908, p. 592–601. Reared from seeds of *Sorbus aucuparia* in Russia.

SYNTOMASPIS DRUPARUM (Boheman): Mokrzecki, Zeitschr. wiss. Insektb 2, 1906, p. 390–92; Crosby, Bul. 265 Cornell Agr. Exp. Sta., 1909, p. 369; Cushman, Journ. Agr. Res., vol. 7, 1916, p. 487. Infests seeds of apple (*Pyrus*) and of Mountain ash (*Sorbus*) in Europe and North America.

SYNTOMASPIS MYRTACEARUM da Costa Lima, Arch. Mus. Nac. Rio Janeiro T. 19, 1916, p. 199. Phytophagous in seeds of *Psidium guayava* (Guava) in Brazil.

## Family EURYTOMIDAE.

BEPHRATA CUBENSIS Ashmead: Crawford, Proc. U. S. Nat. Mus., vol. 41, 1911, p. 274. Infesting seeds of *Anona* in Cuba.

BEPHRATA PARAGUAYENSIS Crawford, Proc. U. S. Nat. Mus., vol. 41, 1911, p. 274. Reared from seeds of *Anona* sp. received from Paraguay.

BRUCHOPHAGUS FUNEBRIS (Howard): Webster, Bur. Ent. Circ. 69, 1906. Infests seeds of clover (*Trifolium*) spp. and alfalfa (*Medicago sativa* Linné.). Probably cosmopolitan.

BRUCHOPHAGUS MELLIPES Gahan,[1] Proc. U. S. Nat. Mus., vol. 56, 1919, p. 513; *Eurytoma indi* (Girault) Ramakrishna Ayyar, Rept. Proc. 3d Ent. Meeting, Pusa, 1919, Calcutta, 1920, p. 315. Pl. 9, fig. *f*. Said to live in the pods of dhaincha (*Sesbania aegyptiaca*), destroying the seeds. Also recorded from "red gram pods" (*Cajamus indicus*) and from "agathi pods" (*Sesbania grandiflora*). India.

DECATOMIDEA COOKI Howard, Bur. Ent. Bull. Techn. ser. 2, 1896, p. 23. Reared from grape seeds collected at Lansing, Michigan. Four specimens from Vienna, Austria, reared from *Vitis californica* imported from California.

EURYTOMA ACACIAE Cameron, The Ent., vol. 43, 1910, p. 115. Infests seeds of *Acacia decurrens* in New Zealand.

EURYTOMA AMYGDALI Enderlein: Rodzianko, Kiev, 1913, 10 pp. (Rev. Appl. Ent., ser. A, vol. 2, 1914, p. 348); Lesne, Ann. Serv. Epiphyties, Paris, T. 6, 1919, p. 228–241, 14 figs. Infests mature seeds of almond in Bulgaria and plums and apricots in Astrachan.

EURYTOMA JUNIPERINUS Marcovitch, Ann. Ent. Soc. Amer., vol. 8, 1915, pp. 166–68. Tunnels in fleshy part of fruits of *Juniperus virginiana*, at Ithaca, New York.

EURYTOMA LARICIS Yano, Rept. For. Bur. Tokyo, 1914, pp. 35–58. Infests seeds of *Larix dahurica* in Japan.

EURYTOMA LONGIPENNIS (Walker): Weijenbergh, Arch. Neerl. Sci. Exact., 5, 1870, p. 420–7. Makes galls on *Ammophila arundinacea* (beach grass). Holland.

(*Isosoma*) EURYTOMA ORCHIDEARUM (Westwood),[2] Trans. Ent. Soc. Lond., 1882, p. 323, f. 13. Larvae injure buds of *Cattleya* in Brazil and Mexico. Known to occur as a pest of orchids in the United States also.

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[1]Specimens of this species were examined by Girault and given the manuscript name, *Eurytoma indi*. This identification was returned to the Government Entomologist of India, but so far as known no description of the species has ever been published by Girault. A later sending of material from the same source came into the hands of the writer, who was at the time unaware of Girault's manuscript name, and were described in 1919 as *Bruchophagus mellipes*. Subsequently Girault's type was discovered and found to be the same species. The description of *Bruchophagus mellipes* antedates the note and figure by Ramakrishna Ayyar. Hence, *Eurytoma indi* is a synonym of *Bruchophagus mellipes* and the synonym should be credited to Ayyar and not to Girault.

[2]Specimens believed to be this species are in the National Collection reared from orchids and are not *Harmolita* (=*Isosoma*) but belong more properly to *Eurytoma*.

EURYTOMA PATER Girault: Phillips, Journ. Econ. Ent., vol. 10, 1917, p. 145. Larva said to be a true parasite, in its early stages, of *Harmolita* (=*Isosoma*). Consumes host larva before completing more than one-third of its own growth and continues its development upon plant tissue. Ohio, Oklahoma, New York, Virginia.

EURYTOMA PHYTOPHAGA Girault, Treubia, vol. 1, no. 2, 1919, p. 55. From fruit of an orchid in Java. "This species has been reared by Doctor van Leeuwen from the fruits of the large earth orchid, *Rhajus* sp. This Chalcis seems to be truly phytophagous."—Roepke, Treubia, vol. 1, 1919, p. 60.

EURYTOMA PICUS Girault, The Ent., vol. 47, 1914, p. 53. Seems phytophagous, according to Girault, since he "found it inhabiting short grooves or channels under the bark of young *Eucalyptus* trees somewhat after the manner of Scolytidae. Where occurring the stems of the trees were somewhat swollen." Australia.

EURYTOMA RHOIS Crosby, Can. Ent., vol. 41, 1909, p. 52. Reared from seeds of *Rhus hirta* collected at Ithaca, and Taughannock Falls, New York.

EURYTOMA SAMSONOVI Vassiliev, Mem. Bur. Ent. Sci. Comm. Centr. Bd. Agr., Petrograd, vol. 11, 1915, 11 pp., 9 figs. (Rev. Appl. Ent., ser. A, vol. 3, 1915, p. 727.) In kernels of apricot in Ferghana.

EURYTOMA SCHREINERI Schreiner, Zeitschr. wiss. Insektb., 4, 1908, p. 26. Infests seeds of plum in Astrachan, Russia.

EURYTOMA(?) SP. da Costa Lima, Arch. Mus. Nac. Rio Janeiro, T. 19, 1916, p. 199. Phytophagous in seeds of *Psidium guayava* (guava) in Brazil.

EURYTOMA SP. Nielsen, Zeitschr. wiss. Insektb., Bd. 2, 1906, p. 46. Larva in first stages parasitic on *Cryptocampus angustus* on *Salix*, later phytophagous. Denmark.

EURYTOMOCHARIS ERAGROSTIDIS Howard, Bur. Ent. Bull. 2, Techn. ser. 1896, p. 21. Reared from stems of *Eragrostis poaeoides* from Lafayette, Indiana. Stems not at all or very slightly swollen. First or second joint below the head seems to be portion most commonly attacked.

EURYTOMOCHARIS TRIODIAE Howard, l. c., p. 21. From dry stems of *Triodia cuprea* from Virginia side of the Potomac near Washington, D. C.

EVOXYSOMA VITIS (Saunders): Crosby, Bul. 265, Cornell Univ. Agr. Exp. Sta., 1909, p. 380. Infests seeds of grape in Canada.

(*Isosoma*) HARMOLITA ACICULATUM (Schlechtendal), Jahresb. Ver. Nat. Zwickau, 1891 (1890), p. 10. Causes a scarcely noticeable swelling of stem above third or fourth node on *Stipa capillata*. Central Europe.

(*Isosoma* HARMOLITA AGROPYRI (Schlechtendal), Jahresb. Ver. Nat. Zwickau, 1891 (1890), p. 10; 1896 (1895), p. 7. Infests *Triticum repens* causing the leaf sheath above the nodes to be thickened and usually split on one side, showing on the inner side as long spindle-shaped galls. Central Europe.

HARMOLITA AGROPYROCOLA Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 458. Is a gall-maker in stems of *Agropyron* sp. Salt Lake City, Utah.

HARMOLITA AGROPYROPHILA Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 450. Inhabits the center of the stem and breeds only in species of *Agropyron*. United States from Atlantic west to Kansas.

(*Isosoma*) HARMOLITA AGROSTIDIS (Howard), U. S. Dept. Agr. Bur. Ent. Bull. 2, Techn. ser., 1896, p. 12. Reared from small galls occurring rarely upon *Agrostis* sp. in Placer County, California. Galls distinct elliptical swellings about 7–10 mm. long and from 2-3 mm. in greatest diameter and occurring upon different parts of the stalk. Placer County, California.

(*Isosoma*) HARMOLITA AIRAE (Schlechtendal), Jahresb. Ver. Nat. Zwickau, 1891 (1890), p. 7. Causes a scarcely noticeable swelling of stalk of *Aira caespitosa* Linné above first or second node. Central Europe.

HARMOLITA ALBOMACULATA (Ashmead): Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 443. Inhabits the center of the stem and breeds only in timothy (*Phleum pratense*). Central and Eastern United States.

HARMOLITA APTERUM (Portchinsky): Rimsky-Korsakov, Mem. Bur. Ent. Sci. Comm. Centr. Bd. Land Admin. and Agr., St. Petersburg, vol. 10, 1914, p. 22 (Rev. Appl. Ent., ser. A, vol. 2, 1914, p. 472). Adults oviposit in internodes of summer and winter-sown wheat. Russia: Government of Cherson.

HARMOLITA ATLANTICA Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 461. Infests species of *Agropyron* in which it forms galls. United States east of Mississippi River.

(*Isosoma*) HARMOLITA BRACHYPODII (Schlechtendal), Jahresb. Ver. Nat. Zwickau, 1891 (1890), p. 8. Causes a spindle-shaped swelling at top of stem with formation of a tuft of leaves on *Brachypodium pinnatum*. Central Europe.

(*Isosoma*) HARMOLITA BREVICORNE (Walker): Ashmead, Psyche, vol. 8, 1897, p. 138. Supposed to be a gall-maker on oats. Central Europe.

(*Isosoma*) HARMOLITA BRISCHKEI (Schlechtendal), Jahresb. Ver. Nat. Zwickau, 1891 (1890), p. 8. Questionably a gall-maker in stems of *Elymus arenarius* Linné. Central Europe.

(*Isosoma*) HARMOLITA BROMI (Howard), U. S. Dept. Agr. Bur. Ent. Bull. 2, Techn. ser. 1896, p. 11. Reared from *Bromus ciliatus*. Los Angeles, California.

(*Isosoma*) HARMOLITA BROMICOLA (Howard), U. S. Dept. Agr. Bur. Ent. Bull. 2, Techn. ser., 1896, p. 16. Reared from *Bromus ciliatus*. Los Angeles County, California.

(*Eurytoma*) HARMOLITA CALAMAGROSTIDIS (Schlechtendal), Jahresb. Ver. Nat. Zwickau, 1891 (1890), p. 8; Reuter, Med. Soc. Faun. Flor. Fenn., 23, 1908, p. 65. (German summary, p. 208.) Makes galls on *Calamagrostis epigejos* (Linné). Galls red, frequently showing a hardly noticeable, long spindle-shaped, sometimes weakly transversely wrinkled, tubercle-like swelling on the stalk between the upper nodes and the flower pannicle. The gall contains several small, longitudinal larval cells one behind the other. Central Europe.

HARMOLITA CAPTIVA (Howard): Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 444. Makes inconspicuous galls near the base of the seed stalks of blue grass (*Poa pratensis*). Known only from Illinois and Indiana.

(*Isosoma*) HARMOLITA CYLINDRICUM (Schlechtendal), Jahresb. Ver. Nat. Zwickau, 1891 (1890), p. 10. Forms long, spindle-shaped fruit-galls on

*Stipa capillata*, causing mixing of flower parts with fruit glume and scattering of the grain. Central Europe.

HARMOLITA DACTYLICOLA Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 446. Inhabits the center of the stem and breeds only in orchard grass (*Dactylis glomerata*). United States east of Mississippi River.

(*Isosoma*) HARMOLITA DEPRESSUM (Walker): Schlechtendal, Jahresb. Ver. Nat. Zwickau, 1891 (1890), p. 8. Causes tubular, irregular, usually yellowish green swelling of stalk above first or second node on *Festuca ovina*. Central Europe.

HARMOLITA ELYMI (French): Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 447. Inhabits the center of the stem and breeds only in spurs of *Elymus* sp. United States.

HARMOLITA ELYMICOLA Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 460. Makes very conspicuous galls in stems of *Elymus* sp., usually at the second or third internode from the base of the plant. Indiana and Virginia.

HARMOLITA ELYMIVORA Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 464. Makes inconspicuous galls near the head of species of *Elymus*. United States east of the Mississippi River.

HARMOLITA ELYMOPHILA Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 462. Makes inconspicuous galls in species of *Elymus*. California.

HARMOLITA ELYMOPTHORA Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 465. Forms galls in the stems of the species of *Elymus*. Minot, North Dakota.

HARMOLITA ELYMOXENA Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 459. Reared from *Elymus americanus*. Santa Cruz Mountains, California.

(*Isosoma*) HARMOLITA EREMITUM (Portchinsky): Rimsky-Korsakov, Mem. Bur. Ent. Sci. Comm. Centr. Bd. Land Admin. and Agr., St. Petersburg, vol. 10, no. 11, 1914, p. 20. (Rev. Appl. Ent., ser. A, vol. 2, 1914, p. 471.) Inhabits stems of rye, usually at the fourth internode. Russia: Government of Cherson.

(*Isosoma*) HARMOLITA EREMITUM (Portchinsky) var. NODALE Rimsky-Korsakov. (See *eremitum*.)

HARMOLITA FESTUCAE Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 454. Breeds only in species of *Festuca*, making conspicuous hardened enlargements or galls in the second to fourth internode from the base of the plants. Virginia.

(*Isosoma*) HARMOLITA GIRAUDI Schlechtendal, Jahresb. Ver. Nat. Zwickau, 1891 (1890), p. 8. Makes scarcely noticeable swelling above second or third node on *Festuca gigantea* Vill. Central Europe.

(*Isosoma*) HARMOLITA GRAMINICOLA (Giraud): Schlechtendal, Jahresb. Ver. Nat. Zwickau, 1891 (1890), p. 10. Causes thickening of stem tip and by shortening of internodes causes bunching of leaves on *Triticum repens* and *Triticum junceum*. Central Europe.

HARMOLITA GRANDIS form GRANDIS (Riley) and form MINUTA (Riley): Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 440. Inhabits the center of the stem of wheat. North America wherever wheat is grown.

(*Isosoma*) Harmolita hageni (Howard), U. S. Dept. Agr. Bur. Ent. Bull. 2, Techn. ser., 1896, p. 12. "In quick grass." Boston, Massachusetts.

Harmolita hesperus Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 457. Gall-former on species of *Elymus*. Holliday, Utah.

(*Isosoma*) Harmolita hieronymi (Schlechtendal), Jahresb. Ver. Nat. Zwickau, 1891 (1890), p. 8. Causes a spindle-shaped, more or less bulging yellowish stem gall above second or third node on *Festuca glauca* Schrad. Central Europe.

Harmolita hordei (Harris).[1] Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 452. Gall-former in stems of barley making conspicuous hardened enlargements above the second to fourth nodes. Auburn and Little Falls, New York.

(*Isosoma*) Harmolita hyalipenne (Walker): Schlechtendal, Jahresb. Ver. Nat. Zwickau, 1891 (1890) p. 7. Causes thickening of tops of young shoots of *Ammophila arenaria*, and through shortening of internodes causes crowding of leaves. Central Europe.

(*Isosoma*) Harmolita inquilinum Rimsky-Korsakov, Mem. Bur. Ent. Sci. Comm. Centr. Bd. Land Admin. and Agr. St. Petersburg, vol. 10, no. 11, 1914, p. 19. (Rev. Appl. Ent., ser. A, vol. 2, 1914, p. 471). Oviposit in galls of *Harmolita rossicum* on wheat, and larvae in first stage attack and kill those of gall-maker, and then finish development phytophagically. Russia: Government of Cherson.

(*Isosoma*) Harmolita macalusoi (Stefani Perez), Marcellia, vol. 7, 1908, p. 148. Produces galls on *Sideroxylon* sp. with hypertrophy of leaf parenchyma. Italian Somaliland.

Harmolita maculata (Howard): Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 449. Inhabits the center of the stem and breeds only in cheat (*Bromus secalinus*) and other species of *Bromus*. United States east of the Mississippi River.

(*Isosoma*) Harmolita noxiale (Portchinsky); Rimsky-Korsakov, Mem. Bur. Ent. Sci. Comm. Centr. Bd. Land Admin. and Agr., St. Petersburg, vol. 10, no. 11, 1914, p. 18. (Rev. Appl. Ent., ser. A, vol. 2, 1914, p. 471.) Inhabits center of stems of wheat at third and fourth internodes. Russia: Government of Cherson.

Harmolita occidentalis Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 466. Makes inconspicuous galls near head of species of *Agropyron*. Koehler, New Mexico.

Harmolita ovata Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 459. Forms galls on species of *Elymus*. Wellington, Kansas.

Harmolita phyllotachitis Gahan, described beyond. Inhabits center of the stem of young growth of bamboo, *Phyllotachys bambusoides*. Florida.

(*Isosoma*) Harmolita poae Schlechtendal, Jahresb. Ver. Nat. Zwickau, 1891

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[1]Hedicke, Deutsche Ent. Zeitschr., 1919, p. 205–6 (Rev. Appl. Ent., ser. A, vol. 9, 1921, p. 92), records *Isosoma lineare* Walker and *Isosoma agropyri* Schlechtendal as synonyms of this species and states that it infests wheat, rye, and grass. Also states habits vary with food plant. Hedicke has probably confused three different species.

(1890), p. 9. Causes a hard spindle-shaped, longitudinally striate, yellow green, swelling of stalk of *Poa nemoralis*. Central Europe.

HARMOLITA POACOLA Gahan (n. n. for *poae* Phillips and Emery not Schlechtendal): Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 445. Inhabits the center of the stem in the seed stalks of blue grass (*Poa pratensis*). Lafayette, Indiana.

HARMOLITA POOPHILA Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 463. Reared from galls in *Poa lucida*. Husted, Colorado.

(*Isosoma*) HARMOLITA ROSSICUM Rimsky-Korsakov, Mem. Bur. Ent. Sci. Comm. Centr. Bd. Land Admin. and Agr., St. Petersburg, vol. 10, no. 11, 1914, p. 15. (Rev. Appl. Ent., ser. A, vol. 2, 1914, p. 470.) Infests stems of rye and wheat. Russia: Government of Cherson.

HARMOLITA RUFIPES Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 453. Forms inconspicuous galls in the internode just below the head of *Elymus* sp. There is often no external enlargement of the stem where the galls occur. Central United States.

(*Isosoma*) HARMOLITA SCHEPPIGI Schlechtendal, Jahresb. Ver. Nat. Zwickau, 1891 (1890), p. 10. Infests *Stipa pennata* Linné, causing a spindle-shaped two- or three-winged swelling of the bud axil which is abnormally lengthened. Central Europe.

HARMOLITA SECALIS (Fitch): Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 456. Makes conspicuous hardened enlargements or galls usually in the second or third internodes from the base of the rye plant. Lafayette, Indiana, and Warsaw, Poland.

(*Isosoma*) HARMOLITA STIPAE Stefani Perez, Nuovo Giorn. Bot. Ital., Firenze, vol. 8 (n. s.), 1901, p. 543. Infests *Stipa tortilis* Desfontaines, producing graceful, cylindrical, more or less fusiform galls upon the ovaries when the grain is the size of a pea or a little less. The gall at first is green, becoming red later, and on reaching maturity, straw color. The walls are polished, thick, resistant, and contain a narrow and elongate larval chamber. Sicily.

HARMOLITA TRITICI (Fitch): Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 451. Makes conspicuous hardened enlargements or galls in wheat stems, usually about the second or third internode from the base of the plant, though they may occur at every internode. Central and Eastern United States.

HARMOLITA VAGINICOLA (Doane): Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 455. Gall-former in wheat making a conspicuous hardened enlargement in the sheath surrounding the head. North America from Atlantic coast to Rocky Mountains.

HARMOLITA WEBSTERI (Howard): Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 442. Inhabits the center of the stem and breeds only in rye. United States from Atlantic to Pacific.

(*Isosoma*) HARMOLITA sp. (Rübsaamen in lit.): Schlechtendal, Jahresb. Ver. Nat. Zwickau, 1896 (1895), p. 5. Makes scarcely noticeable swelling in pithy stems of *Arundo phragmites*. Central Europe.

(*Isosoma*) HARMOLITA SP. (Kieffer): Schlechtendal, Jahresb., Ver. Nat. Zwickau, 1896 (1895), p. 6. Infests stem of *Festuca duriuscula* causing slight swelling. Central Europe.

(*Isosoma*) HARMOLITA SP. (Rübsaamen): Schlechtendal, Jahresb. Ver. Nat. Zwickau, 1896 (1895), p. 5. Causes weakly spindel-shaped swelling above a node in the stem of *Calamagrostis lanceolata* Roth. Central Europe.

(*Isosoma*) HARMOLITA SP. (Schlechtendal), Jahresb. Ver. Nat. Zwickau, 1896 (1895), p. 7. Causes a short, thick, spindle-shaped swelling in stems of *Triticum repens*. Central Europe.

(*Isosoma*) HARMOLITA SP. (Schlechtendal), Jahresb. Ver. Nat. Zwickau, 1896 (1895), p. 7. Causes a thick knot-shaped swelling above a node in stem of *Triticum repens*. Central Europe.

(*Isosoma*) HARMOLITA SP. (Schlechtendal), Jahresb. Ver. Nat. Zwickau, 1896 (1895), p. 7. Inhabits a long, spindle-shaped swelling in stems of *Triticum repens*. Central Europe.

(*Isosoma*) HARMOLITA SP. (Schlechtendal), Jahresb. Ver. Nat. Zwickau, 1896 (1895), p. 7. Causes a knot-shaped swelling close above the stem nodes of *Triticum repens*. Central Europe.

(*Isosoma*) HARMOLITA SP. (Schlechtendal), Jahresb. Ver. Nat. Zwickau, 1896 (1895), p. 7. Inhabits a hardly noticeable swelling above the node in stems of *Triticum repens*. Central Europe.

ISOSOMA Walker.[1] See *Harmolita*.

ISOSOMA ORCHIDEARUM Westwood. See *Eurytoma orchidearum* (Westwood).

ISOSOMORPHA MUHLENBERGIAE Howard, Bur. Ent. Bull. 2, Techn. ser, 1896, p. 20. Reared from gall on *Muhlenbergia diffusa*, from Cadet, Missouri, closely resembling deformation made by *Isosoma hordei*.

PRODECATOMA PHYTOPHAGA Crosby, Can. Ent., vol. 41, 1909, p. 50. Reared from seeds of *Parthenocissus quinquefolia* from Ithaca, and Taughannock Falls, New York.

PRODECATOMA SP. da Costa Lima, Arch. Mus. Nac. Rio Janeiro, T. 19, 1916, p. 199. Phytophagous in seeds of *Psidium* (guava) in Brazil.

## Family **ENCYRTIDAE.**

MINAPIS NIGRA Brèthes, An. Mus. Nac. Hist. Nat. Bs. As., T. 27, 1916, p. 422. Produces rather large spherical or elongate galls on the branches of *Scutia buccifolia* in Argentina.

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[1]As indicated by Phillips and Emery (Proc. U. S. Nat. Mus., vol. 55, 1919, p. 435) *Isosoma* Walker is preoccupied in Coleoptera by *Isosoma* Billberg, making it necessary to substitute the generic name *Harmolita* Motschulsky for that of *Isosoma*. Phillips and Emery restricted *Harmolita* to those species of Isosoma having no umbilicate punctures and a non-carinate occiput. The effect of this was to leave many species formerly placed in *Isosoma* without a generic name. Inasmuch as it is impossible to determine from the description of many species whether they would fall within or without this restricted definition, the writer has considered it better, for the purposes of this paper, to treat *Harmolita* as the full equivalent of *Isosoma* Walker et Auct.

## Family PERILAMPIDAE.

ASPARAGOBIUS BRAUNSI Mayr, Verh. Zool. Bot. Ges. Wien, vol. 55, 1905, p. 553. Gall-maker on *Asparagus striatus* in Cape Colony, South Africa.

MAYRELLUS MIRABILIS Crawford, Proc. U. S. Nat. Mus., vol. 39, 1910, p. 238. Reared from galls on an unknown plant from Ceara, Brazil, and said to be the probable gall-maker.

MONOPLEUROTHRIX KIEFFERI Mayr, Marcellia, vol. 4, 1905, p. 79. Gall-maker on an unknown plant from Paraguay.

PERILAMPOIDES BICOLOR Girault, Mem. Queensland Mus., vol. 2, 1913, p. 302. Makes small round isolated galls on the foliage of *Eucalyptus* in Australia.

TRICHILOGASTER ACACIAE-DISCOLORIS (Froggatt), Proc. Linn. Soc. N. S. Wales, vol. 7, 1892, p. 153; Girault, Mem. Queensland Mus., vol. 5, 1916, p. 222. Gall-maker on twigs of *Acacia discolor* in Australia.

TRICHILOGASTER ACACIAE-LONGIFOLIAE (Froggatt), Proc. Linn. Soc. N. S. Wales, vol. 7, 1892, p. 154; Mayr, Verh. Zool. Bot. Ges. Wien, vol. 55, 1905, p. 560. Gall-maker on flower stalks of *Acacia longifolia* in Australia.

TRICHILOGASTER MAIDENI (Froggatt), Proc. Linn. Soc. N. S. Wales, vol. 7, 1892, p. 155; Mayr, Verh. Zool.-Bot. Ges. Wien, vol. 55, 1905, p. 558. Gall-maker on twigs and small branches of *Acacia longifolia* in Australia.

TRICHILOGASTER PENDULAE Mayr, Verh. Zool. Bot. Ges. Wien, vol. 55, 1905, p. 560. Gall-maker on axillary buds of *Acacia pendula* in Australia.

RELATED GENERA OF PERILAMPIDAE. *Epiperilampus* Girault (=*Trichilogaster* according to Girault), *Melanosomella* Girault (=*Terobiella* Ashmead according to Girault), *Coelocybomyia* Girault (=*Coelocyba* Ashmead according to Girault), *Brachyscelidiphaga* Ashmead, *Paracoelocyba* Girault, *Coelocybelloides* Girault, *Perilampomyia* Girault, *Parelatus* Girault, *Neoperilampus* Girault, *Eucoelocybomyia* Girault, *Coelocybella* Girault, *Perilampella* Girault, *Euperilampus* Girault, *Epichrysomalla* Girault, and *Parachrysomalla* Girault, are all placed in this group by Girault (Mem. Queensland Mus., vol. 2, 1913, p. 300–302; vol. 3, 1915, p. 303–310; and vol. 5, 1916, p. 222–226). Among the numerous species recorded in these genera are many reared from galls on various plants in Australia. Doubtless many and perhaps all will eventually be found to be actual gall producers.

## Family EULOPHIDAE.

GENIOCERUS JUNIPERI Crawford, Proc. U. S. Nat. Mus., vol. 48, 1915, p. 585; Marcovitch, Ann. Ent. Soc. Amer., vol. 8, 1915, p. 169. Tunnels in the flesh of berries of *Juniperus virginiana* at Ithaca, New York.

RHICNOPELTELLA EUCALYPTI Gahan, new species described beyond. Said to be a gall-maker on *Eucalyptus globulus* in New Zealand.

RHICNOPELTELLA SPP. (Several species have been described by Girault in the genus *Rhicnopeltella* from Australia and at least two of these are recorded from galls on *Eucalyptus*, but without indication that they were the producers of the galls. If the above record is correct it seems probable that other species of the genus may prove to have similar habits.)

ZAGRAMMOSOMOIDES FASCIATUS Girault, The Entom., vol. 47, 1913, p. 177. Reared in enormous numbers, according to Girault, from globular green galls on the foliage of bloodwood gum (*Eucalyptus* sp.) in Australia. Girault concludes his remarks with the statement: "This Eulophid appears to be a true gall-making species."

## HOST PLANT LIST.

The writer is indebted to Dr. Paul C. Standley of the U. S. National Museum for having checked over the botanical names in the following list and brought the nomenclature down to date.

| PLANT. | CHALCIDOID. |
|---|---|
| ABIES AMABILIS Loud. | *Megastigmus pinus* Parfitt. |
| | *spermotrophus* Wachtl. |
| CONCOLOR Gord. | *Megastigmus pinus* Parfitt. |
| | *spermotrophus* Wachtl. |
| GRANDIS Lindley | *Megastigmus pinus* Parfitt. |
| | *spermotrophus* Wachtl. |
| LASIOCARPA Hooker | *Megastigmus lasiocarpae* Crosby. |
| MAGNIFICA Murray | *Megastigmus pinus* Parfitt. |
| | *spermotrophus* Wachtl. |
| MARIESI Mast | *Megastigmus borriesi* Crosby. |
| NOBILIS Lindley | *Megastigmus pinus* Parfitt. |
| PECTINATA Poiret = Abies picea, q. v. | |
| PICEA Lindley | *Megastigmus strobilobius* Ratzeburg. |
| SHASTENSIS Lemmon | *Megastigmus spermotrophus* Wachtl. |
| ACACIA DECURRENS Willdenow | *Eurytoma acaciae* Cameron. |
| DISCOLOR Willdenow | *Trichilogaster acaciae-discoloris* (Froggatt). |
| LONGIFOLIA Willdenow | *Trichilogaster acaciae-longifoliae* (Froggatt). |
| | *maideni* (Froggatt). |
| PENDULA Cunningham | *Trichilogaster pendulae* Mayr. |
| AGATHI PODS see Sesbania grandiflora. | |
| AGROPYRON JUNCEUM (Linné) Beauv. | *Harmolita graminicola* Giraud. |
| REPENS (Linné) Beauv. | *Harmolita agropyri* (Schlechtendal). |
| | *agropyrophila* Phillips and Emery. |
| | *graminicola* Giraud. |
| | spp. (Schlechtendal). |

AGROPYRON (cont.)
?REPENS (Linné) Beauv. . . . . . *Harmolita hageni* (Howard).
SPP. . . . . . . . . . . . . . . . *Harmolita agropyrocola* Phillips and Emery.
*atlantica* Phillips and Emery.
*occidentalis* Phillips and Emery.
AGROSTIS sp. . . . . . . . . . . . . . *Harmolita agrostidis* (Howard).
AIRA CAESPITOSA Linné . . . . . . . . *Harmolita airae* (Schlechtendal).
ALFALFA see Medicago sativa.
ALMOND see Prunus amygdalus.
AMELANCHIER CANADENSIS (Linné) Medic. *Megastigmus amelanchieris* Cushman.
*Syntomaspis amelanchieris* Cushman.
AMMOPHILA ARENARIA (Linné) Link . . . *Eurytoma longipennis* Walker.
*Harmolita hyalipenne* (Walker).
AMYGDALUS COMMUNIS (Linné) Fritsch
= Prunus amygdalus Stokes, q. v.
ANONA SPP. . . . . . . . . . . . . . . *Bephrata cubensis* Ashmead.
*paraguayensis* Crawford.
APPLE see Pyrus spp.
APRICOT see Prunus armeniaca Linné.
ARUNDO PHRAGMITES Linné
= Phragmites communis Trinius, q. v.
ASPARAGUS STRIATUS Thunb. . . . . . . *Asparagobius braunsi* Mayr.
AVENA SATIVA Linné . . . . . . . . . *Harmolita brevicorne* Walker.
BAMBOO see Phyllotachys bambusoides.
BARLEY see Hordeum.
BEACH GRASS see Ammophila arenaria Linné.
BLOODWOOD GUM see Eucalyptus.
BLUEGRASS see Poa pratensis.
BRACHYPODIUM PINNATUM (Linné) Beauv. *Harmolita brachypodii* (Schlechtendal).
BROMUS CILIATUS Linné . . . . . . . . *Harmolita bromi* (Howard).
*bromicola* (Howard).
SECALINUS Linné . . . . . . . *Harmolita maculata* (Howard).
SPP. . . . . . . . . . . . . . . *Harmolita maculata* (Howard).
CAJANUS INDICUS Sprengel . . . . . . *Bruchophagus mellipes* Gahan.
CALAMAGROSTIS EPIGEJOS (Linné) Roth . *Harmolita calamagrostidis* (Schlechtendal).
LANCEOLATA Roth . . . . . . . *Harmolita* sp. (Rübsaamen).
CATTLEYA SPP. . . . . . . . . . . . . *Eurytoma orchidearum* (Westwood).
CHAMAECYPARIS OBTUSA Sieb. and Zucc. . *Megastigmus cryptomeriae* Yano.
CHEAT see Bromus secalinus.
CLOVER see Trifolium.
CRYPTOMERIA JAPONICA Don. . . . . . *Megastigmus cryptomeriae* Yano.
DACTYLIS GLOMERATA Linné . . . . . *Harmolita dactylicola* Phillips and Emery.

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|---|---|
| DHAINCHA see Sesbania aegyptiaca. | |
| DOUGLAS FIR see Pseudotsuga. | |
| EARTH ORCHID see Phajus sp. | |
| ELYMUS AMERICANUS Vasey & Scribner = E. glaucus Buckley, q. v. | |
| ARENARIUS Linné | *Harmolita brischkei* (Schlechtendal). |
| GLAUCUS Buckley | *Harmolita elymoxena* Phillips and Emery. |
| SPP. | *Harmolita elymi* (French). |
| | *elymicola* Phillips and Emery. |
| | *elymivora* Phillips and Emery. |
| | *elymophila* Phillips and Emery. |
| | *elymopthora* Phillips and *Emery.* |
| | *hesperus* Phillips and Emery. |
| | *ovata* Phillips and Emery. |
| | *rufipes* Phillips and Emery. |
| ERAGROSTIS POAEOIDES Beauvois | *Eurytomocharis eragrostidis* Howard. |
| EUCALYPTUS GLOBULUS Labill | *Rhicnopeltella eucalypti* Gahan. |
| SPP. | *Eurytoma picus* Girault. |
| | *Perilampoides bicolor* Girault. |
| | *Rhicnopeltella* spp. Girault. |
| | *Zagrammosomoides fasciatus* Girault. |
| FESTUCA DURIUSCULA Linné | *Harmolita* sp. (Kieffer). |
| GIGANTEA (Linné) Vill. | *Harmolita giraudi* (Schlechtendal). |
| FESTUCA GLAUCA Lamark | *Harmolita hieronymi* (Schlechtendal). |
| OVINA Linné | *Harmolita depressum* (Walker). |
| SP. | *Harmolita festucae* Phillips and Emery. |
| FICUS | *Agaonidae.* |
| FIR see Abies. | |
| GRAPE see Vitis. | |
| GUAVA see Psidium. | |
| HEMLOCK see Tsuga. | |
| HORDEUM SATIVUM Linné | *Harmolita hordei* (Harris). |
| JUNIPERUS VIRGINIANA Linné | *Eurytoma juniperinus* Marcovitch. |
| | *Geniocerus juniperi* Crawford. |
| LARCH see Larix. | |
| LARIX DAHURICA Turcz | *Eurytoma laricis* Yano. |
| LARICINA (Du Roi) Koch | *Megsatigmus laricis* Marcovitch. |
| LEPTOLEPIS Murray | *Megastigmus inamurae* Yano. |
| MEDICAGO SATIVA Linné | *Bruchophagus funebris* Howard. |

MOUNTAIN ASH see Sorbus.
MUHLENBERGIA DIFFUSA Willdenow
= M. schreberi Gmelin, q. v.
SCHREBERI Gmelin . . . . . . . *Isosomorpha muhlenbergiae* Howard.
OATS see Avena sativa.
OPULASTES OPULIFOLIUS (Linné) Kuntze . *Megastigmus physocarpi* Crosby.
ORCHARD GRASS see Dactylis glomerata.
ORCHID see Cattleya.
PARTHENOCISSUS QUINQUEFOLIA (Linné) Planch . . . . . . . . . . *Prodecatoma phytophaga* Crosby.
PHAJUS SP. . . . . . . . . . . . . . . *Eurytoma phytophaga* Girault.
PHLEUM PRATENSE Linné . . . . . . . *Harmolita albomaculata* (Ashmead).
PHRAGMITES COMMUNIS Trinius . . . . *Harmolita* sp. (Rübsaamen).
PHYLLOTACHYS BAMBUSOIDES Sieb. and Zucc. . . . . . . . . . . . *Harmolita phyllotachitis* Gahan.
PHYSOCARPUS OPULIFOLIUS (Linné) Maxim
= Opulastes opulifolius (Linné) Kuntze, q. v.
PICEA ENGELMANNI (Parry) Engelmann . *Megastigmus piceae* Rohwer.
PARRYANA André
= Picea pungens Engelmann, q. v.
PUNGENS Engelmann . . . . . . *Megastigmus piceae* Rohwer.
SITCHENSIS Bong. . . . . . . . *Megastigmus piceae* Rohwer.
PINE see Pinus.
PINUS PONDEROSA Dougl. . . . . . . . *Megastigmus albifrons* Walker.
PISTACIA LENTISCUS Linné . . . . . . *Megastigmus pistaciae* Walker.
TEREBINTHUS Linné . . . . . . *Megastigmus ballestrerii* (Rondani).
VERA Linné . . . . . . . . . . *Megastigmus ballestrerii* (Rondani).
PLUM see Prunus spp.
POA LUCIDA Vasey . . . . . . . . . . *Harmolita poophila* Phillips and Emery.
NEMORALIS Linné . . . . . . . . *Harmolita poae* (Schlechtendal).
PRATENSIS Linné . . . . . . . . *Harmolita captiva* Howard.
*poacola* Gahan.
PRUNUS AMYGDALUS Stokes . . . . . . *Eurytoma amygdali* Enderlein.
ARMENIACA Linné . . . . . . . *Eurytoma amygdali* Enderlein.
*samsonovi* Vassiliev.
SPP. . . . . . . . . . . . . . . *Eurytoma amygdali* Enderlein.
*schreineri* Schreiner.
PSEUDOTSUGA MUCRONATA (Raf.) Sudw. . *Megastigmus spermotrophus* Wachtl.
TAXIFOLIA (Poiret) Britton
= P. mucronata (Rafinesque), q. v.
PSIDIUM GUAJAVA Linné . . . . . . . *Syntomaspis myrtacearum* Costa Lima.
SPP. . . . . . . . . . . . . . . *Eurytoma* sp. Costa Lima.
*Prodecatoma* sp. Costa Lima.
PYRUS SPP. . . . . . . . . . . . . . *Syntomaspis druparum* Boheman.

"Quick grass" see Agropyron? repens (Linné).
Red gram see Cajanus indicus.
Rhus hirta (Linné) Sudworth . . . . *Eurytoma rhois* Crosby.
Rosa rugosa Thunb. . . . . . . . . . *Megastigmus nigrovariegatus* Ashmead.
spp. . . . . . . . . . . . . . . . *Megastigmus aculeatus* (Swederus).
*pictus* (Förster).
Rose see Rosa.
Rye see Secale cereale.
Salix alba Linné . . . . . . . . . . *Eurytoma* sp. Nielsen.
purpurea Linné . . . . . . . . *Eurytoma* sp. Nielsen.
Scutia buccifolia Reiss . . . . . . . *Minapis nigra* Brèthes.
Secale cereale Linné . . . . . . . . *Harmolita eremitum* (Portchinsky).
var. *nodale* (Portchinsky).
*rossicum* Rimsky-Korsakov.
*secalis* (Fitch).
*websteri* (Howard).
Service berry see Amelanchier.
Sesbania aegyptiaca Poiret . . . . . *Bruchophagus mellipes* Gahan.
grandiflora . . . . . . . . . *Bruchophagus mellipes* Gahan.
Sideroxylon sp. . . . . . . . . . . . *Harmolita macalusoi* (Stefani).
Sorbus aucuparia Linné . . . . . . . *Megastigmus brevicaudis* Ratzeburg.
*Syntomaspis aucupariae* Rodzianko.
sp. . . . . . . . . . . . . . . . *Megastigmus brevicaudis* Ratzeburg.
*Syntomaspis druparum* Boheman.
Spruce see Picea.
Stipa capillata Linné . . . . . . . . *Harmolita aciculatum* (Schlechtendal).
*cylindricum* (Schlechtendal).
pennata Linné . . . . . . . . . *Harmolita scheppigi* Schlechtendal.
tortilis Desfontaines . . . . . *Harmolita stipae* (Stefani).
Thujopsis dolobrata Sieb. and Zucc. . *Megastigmus thuyopsis* Yano.
Timothy see Phleum pratense.
Trifolium spp. . . . . . . . . . . . *Bruchophagus funebris* Howard.
Triodia cuprea (Walt.) Chapm.
= T. flava (Linné) Hetche, q. v.
flava (Linné) Hetche . . . . . *Eurytomocharis triodiae* Howard.
Triticum junceum
= Agropyron junceum, q. v.
repens
= Agropyron repens, q. v.
aestivum Linné *Eurytoma pater* Girault.
*Harmolita apterum* (Portchinsky).
*grandis* form *grandis* (Riley).
*minuta* (Riley).

TRITICUM AESTIVUM (cont.) *inquilinum* Rimsky-Korsakov).
*noxiale* (Portchinsky).
*rossicum* (Rimsky-Korsakov).
*tritici* (Fitch).
*vaginicola* (Doane).

TSUGA MERTENSIANA HOOKERIANA (Bong.)
= T. mertensiana (Bong.) Sargent, q. v.
MERTENSIANA (Bong.) Sargent . . *Megastigmus tsugae* Crosby.
SIEBOLDII Carr . . . . . . . . . *Callimome tsugae* Yano.
SP. . . . . . . . . . . . . . . . . . *Megastigmus pinus* Parfitt.

UNKNOWN PLANTS . . . . . . . . . . *Mayrellus mirabilis* Crawford.
*Monopleurothrix kiefferi* Mayr.

VITIS CALIFORNICA Bentham . . . . . *Decatomidea cooki* Howard.
SPP. . . . . . . . . . . . . . . . . *Decatomidea cooki* Howard.
*Evoxysoma vitis* (Saunders).

WHEAT see Triticum aestivum.
WILLOW see Salix.

## NEW SPECIES.

### Family EULOPHIDAE.

**Rhicnopeltella eucalypti,** new species.
(Pl. 7, Fig. 1, 1a, 1b.)

This species seems to be very close to *purpurea* Girault but differs from the description of that species in having the anterior tibiae pale in front and black behind instead of pale throughout, the knees not at all pale, and the antennal joints somewhat differently proportioned.

*Female.*—Length 1.6 mm. Head, thorax, and abdomen with fine shallow, reticulate-punctate sculpture, subopaque; vertex broad; ocelli in a low triangle, widely separated, the posterior ocelli separated from the eye margin by about the diameter of an ocellus; the antennae very short, 11-jointed, strongly clavate; pedicel large, approximately twice as long as thick and half as long as the scape; funicle 6-jointed, not longer than the pedicel, joints all transverse and increasing gradually in width toward the club, the first four joints of funicle ring-like and nearly equal in length, joint five approximately twice as long as four, joint six a little more than twice as long as five; club ovate, distinctly much broader than the funicle, about four-fifths as long as the scape, nearly twice as long as funicle, distinctly 3-jointed, broadest at apex of first joint, and tapering gradually to apex; distal club joint longer than the last funicle joint; parapsidal grooves deep, complete, short and sharply curved outward, the scapulae short; scutellum rather large, almost as long as the mesoscutum and only slightly convex; propodeum very short, medially barely longer than the postscutellum, sculptured like the rest of thorax; marginal vein rather thick, not quite twice as long as the rather long stigmal; postmarginal distinctly longer than the stigmal, tapering gradually from the base until lost in the margin of wing; hind femora a little thickened; hind tibiae with one spur; apical joint of hind tarsi as long as the metatarsus; tarsal joints 2 and 3 subequal and shorter than the others; claws very short, blunt at apex; pulvilli large; abdomen not longer than the thorax, subspherical, not at all pointed at apex, the ovipositor not exserted. Black, faintly tinged with purplish on the thorax; antennal club grayish; anterior tibiae pale in front, black behind; middle and hind tarsi pale except the apical joint which is dark; rest of the legs concolorous with the body; wings mostly hyaline but a faint duskiness behind the marginal vein; venation grayish black.

*Male*.—Unknown.

*Type locality*.—Wellington, New Zealand.

*Type*.—Cat. No. 24372, U. S. Nat. Mus.

Described from twenty-nine females received from David Miller and reared by him from galls on *Eucalyptus globulus*. According to the collector "There is no doubt that the galls are the work of the Chalcid itself and the pest has now become extremely widespread and serious." Mr. Miller does not indicate on what part of the plant the galls occur.

Family **EURYTOMIDAE.**

Tribe HARMOLITINI.

**Harmolita phyllotachitis,** new species.

(Pl. 7, Fig. 2, 2a.)

This species runs straight in Ashmead's Classification to the genus *Harmolita* (=*Isosoma*) but does not fall wholly within that genus as restricted by Phillips and Emery[1] on account of the partly umbilicate punctuation of the thorax. The abdominal petiole is also unusually prominent for members of this genus and the antennal funicle is apparently 6-jointed instead of 5-jointed as in typical *Harmolita*. The agreement in other characters is so close, however, and the habits apparently so similar that it does not seem advisable at this time to erect a new genus for it, especially in view of the fact that differences pointed out are purely relative ones which would probably break down as other species are discovered.

*Female*.—Length 5.5 mm. An elongate rather slender species. Head broader than thorax, convex in front, concave behind, strongly rugulose-punctate but without distinct umbilicate punctures, a narrow median area below antennae and a space below the eye nearly smooth, the area surrounding ocelli more finely sculptured than the face; occiput immargined, ocelli in a low triangle, postocellar and ocellocular lines subequal; viewed from in front the head is slightly broader than long, subcircular in outline; malar space subequal in length to the height of eye; antennal depression moderately deep and rather narrow; antennae 11-jointed, the flagellum scarcely at all clavate; pedicel

[1]Proc. U. S. Nat. Mus., vol. 55, 1919, p. 435.

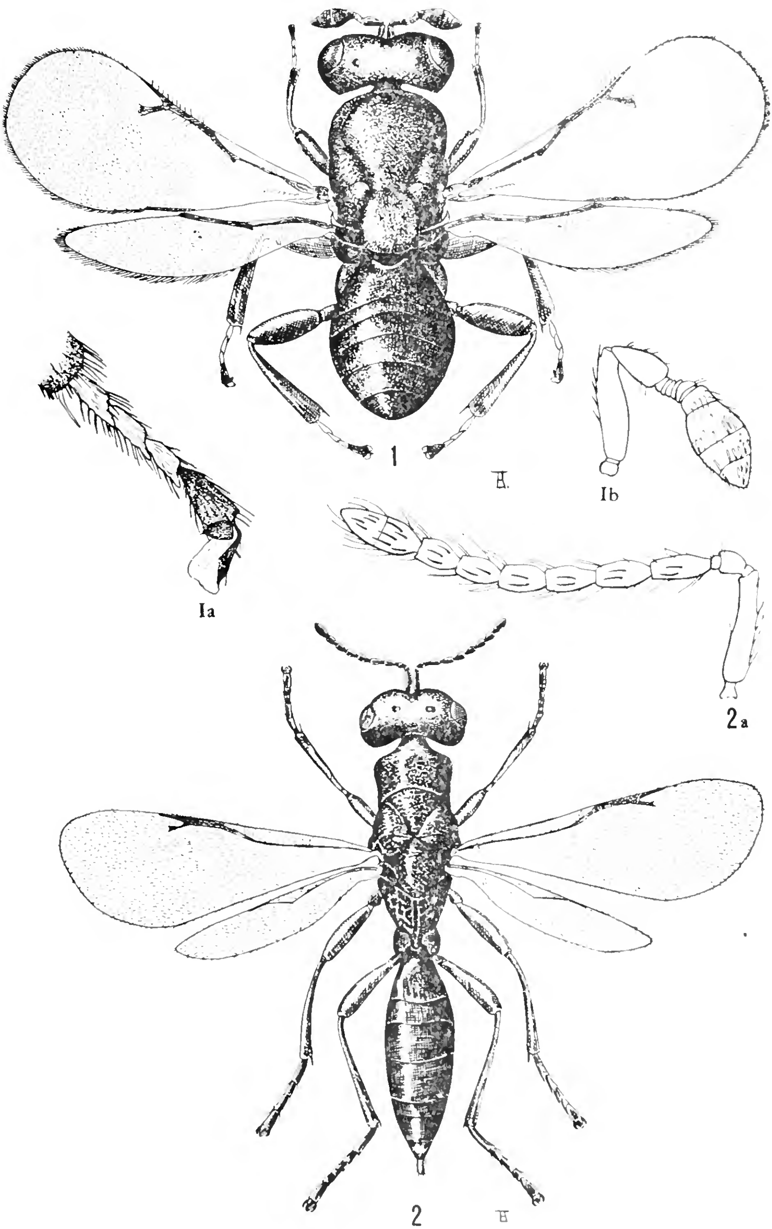
cone-shaped and somewhat longer than broad at apex; ring-joint small; funicle distinctly 6-jointed, the first funicle joint about twice as long as the pedicel, following joints shorter but each distinctly longer than broad; club scarcely thicker than the funicle joints, about as long as the two preceding funicle joints combined, 2-jointed, the joints subequal; pronotum large, the dorsal portion behind the anterior declivity as long or nearly as long as the mesoscutum, narrowest at the posterior margin, coarsely rugoso-punctate anteriorly, more finely reticulate-punctate posteriorly; mesoscutum and scutellum nearly uniformly rugoso-punctate, some of the punctures more or less rounded and indistinctly umbilicate; propodeum coarsely rugose with a narrow moderately deep, immargined median longitudinal channel, the sculpture within this groove similar to that of remainder of propodeum; forewings reaching nearly to apex of abdomen; marginal vein thick, fully twice as long as the stigmal; postmarginal nearly twice as long as the stigmal, indistinct toward apex; hind coxae reticulate-punctate; abdomen as long as the head and thorax, subcylindrical, slightly compressed, distinctly petiolate; abdominal petiole usually a little broader than long (in one specimen as long as broad), rugosely sculptured; tergites beyond the petiole (except the first which is polished) faintly shagreened; first tergite constituting approximately one-fourth the total length of abdomen; second about one-third as long as first; third and fourth subequal and a little less than twice as long as second; fifth and sixth longer than the second and not as long as the third; ovipositor sheaths slightly exposed at tip. Black; antennal scape, pedicel, all tarsi, anterior tibiae, apices of all femora, and the middle and hind tibiae at base and apex testaceous; all femora except apically, and the middle and hind tibiae except base and apex black or brownish-black; wings hyaline, the venation brownish. Male unknown.

*Full grown larva.*—Length 7.5 to 9 mm.; width at second segment approximately 1.2 mm. Long, slender, cylindrical, tapering slightly from the second segment to a blunt point posteriorly; on the median line of the dorsal surface are eight more or less prominent, bluntly cone-shaped protuberances each arising at the junction between the segments, the first between the third and fourth segments and the eighth between the tenth and eleventh segments, the first and last usually much smaller than the other six; occasionally a similar process indicated between the eleventh and twelfth segments but this never prominent; spiracles very small and circular; mandibles curved, acute at apex, with or without a distinct tooth on the inner margins some distance from the apex. Color pale yellowish white with the mandibles dark brown. Described from specimens in alcohol.

The larvae live within the young stems and the adults emerge in the spring through small round shothole-like apertures cut in the flattened side of the previous year's growth.

Mr. Sasscer has supplied the following notes:

"A number of dead shoots of *Phyllotachys* which were undoubtedly killed by the jointworms were found in the gardens. Adults were found in living as well as dead branches. Exit holes are most frequently found in dead branches, although some branches which were alive exhibited adults ready to emerge,



1 Ia Ib 2a 2

larvae, and pupae. On April 19th, fully 85 per cent of the overwintering larval stage had pupated and were emerging as adults. In all probability there is but one generation a year, the adult appearing in early spring and depositing eggs in the young shoots in which the larvae develop until late fall and overwinter as full grown larvae.

"From present indications, it would appear that this joint-worm is a comparatively recent introduction into the Brooksville gardens, or else it has been there for some time and is slowly developing into a serious pest. It is recalled that in January, 1917, an inspector of the Florida Plant Board reported the finding of a borer in bamboo from Avery Island. Unfortunately, this larva was not preserved." The following observation was made by Dr. B. T. Galloway: "The adult fly always pierces the node through the sheaf in such a position that the egg may develop just above the node where the larval and pupal stages take place."

*Type locality.*—Brooksville, Florida.
*Type.*—Cat. No. 24371, U. S. N. M.
*Host Plant.*—*Phyllotachys bambusoides.*

Described from five female specimens reared by E. R. Sasscer from young stems of bamboo, April 10, 1918, and three females reared by C. A. Bennett in April, 1919, from the same source.

**Harmolita poaeola**, new name.

*Harmolita poae* Phillips and Emery, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 445 (not Schlechtendal 1891). See ante, p. 46.

EXPLANATION OF PLATE 7.

Figures prepared by Eleanor T. Armstrong under the writer's direction.

| | | |
|---|---|---|
| Figure 1. | *Rhicnopeltella eucalpti* Gahan, | adult female. |
| 1a. | " " " | hind tarsus of female. |
| 1b. | " " " | antenna of female. |
| Figure 2 | *Harmolita phyllotachitis* Gahan, | adult female. |
| 2a. | " " " | antenna of female. |

## NEW TIPULIDAE FROM BRITISH COLUMBIA (DIPTERA).

By C. B. D. Garrett, *Cranbrook, B. C.*

The season of 1920 produced a large number of specimens many of which were new to the Kootenay List, however, I did not have the time this winter (1920–21) to work them further than to the genera, the following few notes being of more than passing interest were completed. On August 2, 1920, I was lucky enough to secure a perfect female of that very rare fly *Protoplasa vipo* O. S. I took it on the window of a pool room in the center of Cranbrook, B. C., doubtless attracted there by the light of the previous evening. This I think is the first Canadian record of this genus.

The next items are of three new species belonging to the *Dicranomyia whartoni* (Needham) group, all representing the least development of the medial vein in the tribe Limnobini, an almost similar veination existing in the Limnobinae tribe Antrochini, or species *Diotrepha mirabilis* O. S., which has but one media and three radii reaching the wing margin, but this tribe is largely separated by having sixteen antennal segments instead of fourteen as in the Limnobini. Another somewhat similar veination is found in the tribe Anisomerini, species *Anisomera magacera* O. S., this having one media and four radii to the margin, and only six to ten antennal segments and tibial spurs, etc. Dr. Needham when describing *Dicranomyia whartoni* inferred that it may represent another distinct group, he however did not erect a new genus possibly due to having only a single female and single specimens may often be of the freak of nature when considering Tipulid veination. Before me are three other distinct species (in the first case a male and female, the second two males and a female, and third a single male) seemingly quite sufficient material to establish the constancy of this veination in particular species, I would thus propose the new generic name of *Alexandriaria* to contain these three new species and *Dicranomyia whartoni* of Needham. The latter should have the right to be the type of the genus but it does not quite fulfill the idea of the characters, namely the complete absence of that vein usually representing M3 or M3 + 4, in *whartoni;* this seems to be represented as a spot occurring near the wing margin situated on $Cu^1$ and I would therefore select *suffusca* as the genotype.

I take much pleasure in naming the proposed genus after the well known Tipulid expert Dr. C. P. Alexander, whose kindness to me in the past is much appreciated and most helpful. In a recent letter, without having examined the specimens, Dr. Alexander suggests that it may be only of subgeneric rank, but contrary to the usual male hypypogium of *Dicranomyia* which are always supposed to have a base of fleshy lobes, these have quite a distinct form, being all horny; thus I did not follow his suggestion. Whether subgenus or not they are at least distinctly separated from the general tangle of the two genera *Dicranomyia* and *Limnobia*, which at times seem impossible to separate distinctly.

Excepting where mentioned the types and paratypes are in the author's collection.

It will be noted that the type of *Dicranomyia whartoni*, the male paratype of *Alexandriaria intermedia* and the type of *A. kooteniensis* were all taken at lamplight, which would indicate a habit of night flying. The types of *suffusca* were taken about 2 to 3 P. M. when out duck hunting.

**Alexandriaria**, new genus.

Type.—*Alexandriaria suffusca*, new species.

This genus would contain the usual characters of *Dicranomyia* of Stephens, except that but one branch of the median vein reaches the margin of the wing and that there is no cell 1st M2.

In describing *D. whartoni* Dr. Needham mentioned that the antennal segments (tip) show a tendency to fuse; in *A. suffusca* n. sp. the right antenna has segments three and four apparently united, four being smaller than usual. This is not the case with the other new species which have all segments clear.

**Alexandriaria suffusca**, n. sp.

*Male.*—Length 5 mm.; wing 5 mm. Head brown, pale; occiput to vertex suffused; face and rostrum yellow brown; palpi gray black, first joint paler. Antennae dark brown, segment one slightly paler; thorax dorsum pale brown, with a broad median dark brown stripe from the collar to the suture and a short broad one on each side from the suture to near the tuberculate pits which are plainly visible; pleura and coxae yellow to whitish brown. Abdomen dorsally all dark brown, ventral segments 2 and 3 yellow brown shading to dark brown at the anus; hypopygium lighter, in part yellow brown; anal style and its base completely visible, not covered by the 9th sternite. Legs brown, tarsi dark. Wings broad, hyaline, veins yellowish to dark. Sc joining C at the origin of RS, RS leaving R at a broad angle somewhat curved; vein R at about the middle of cell 1st R becomes pale and colorless reaching C in this condition; cross vein R is also pale.

*Female.*—Length 5.5 mm.; wing 5 mm. Similar to the male but darker throughout; pleura blackish; no yellow on the abdomen ventrally; only coxae, face and rostrum yellow brown. Wing veins all heavy and strong, except the tip of R and cross vein R which are as in the male. Cu2 does not reach the wing margin, stopping abruptly and strongly near the wing margin, the other wing is torn in this place.

*Holotype* male, and *allotype* female taken at the same place and time on Oct. 9, 1920, Cranbrook, B. C., Alt. 2950 ft.

**Alexandriaria intermedia**, n. sp.

*Male.*—Length 5 mm.; wing 5 mm. Head rich yellow brown, occiput to vertex only a shade darker; face, rostrum and base of first palpi yellow brown, rest of palpi gray black; antennae dark brown, most of segment one yellow brown. Thorax, dorsum rich brown, a broad median dark brown stripe from collar to near tuberculate pits, the pits are not distinctly marked. Pleura yellowish. Abdomen all yellow brown parts infuscated. Hypopygium yellowish, base of anal style about half covered by the 9th sternite. Legs brown, tarsi darker. Wings, hyaline; Sc joins C slightly before the origin of RS; RS leaves R more acutely than in *suffusca* and less curved; tip of R and cross vein R where they join pale and colorless. Wings narrower than suffusca but less so than *kootenionsis*.

Paratype male differs from the type as follows: Thorax dorsum yellow brown, the broad median stripe from the collar to less than half way to the suture, the side stripes indicated by shade only; abdomen more yellow than the type.

*Female.*—Length 5 mm.; wing 5 mm. The female is as pale as the paratype male, but the thoracic stripes are more evident but less so than in the type. Hypopygium, tergite valves longer than the sternite. Segment one of the antennae is pale yellowish.

Described from: *Holotype* male 10 July 1920, Cranbrook, B. C., 2950 ft.
*Allotype* female 6 July 1920, Cranbrook, B. C., 2950 ft.
*Paratype* male 15 July 1920, Cranbrook, B. C., 2950 ft. Lamplight. In collection of Dr. C. P. Alexander.

**Alexandriaria kooteniensis**, n. sp.

Description of type male. Length 5 mm.; wing 5 mm. Color almost exactly as paratype of *intermedia* except dorsum of thorax which is paler but the dark stripes are more pronounced, the tuberculate pits are not evident. Wings hyaline, distinctly narrow; Sc joins C at the origin of RS; RS leaves R at an acute angle and straight. Vein R beyond origin of R4 + 5 and cross vein *r* colorless. Base of anal style almost completely covered by the 9th sternite.

Described from one male. (*Monotype*) 15 July 1920, Cranbrook, B. C., 2950 ft. Lamplight.

The males of the three species show other differences in the construction of the hypopygium. Antennal segments 3 and 4 vary in size. A wing of all male types have been mounted on slides.

By the descriptions it would seem the three species are very closely allied. The following comparisons will be helpful. In *suffusca*, RS up to branch R 4 + 5 is shorter than the last part of M to the wing margin and is shorter than Cu 1, from the basal deflection of Cu 1 to the wing margin. In *kooteniensis* the RS part is longer and in *intermedia* the RS part is equal to the M part but shorter than the Cu1 part. *Suffusca* has cell 1st R I deep; *intermedia* is medium depth, and *kooteniensis* distinctly narrow. This key will separate the species.

1. Sc joining C beyond origin of RS . . . . . . . . . . . . . . . . . . . . . 2[1]
Sc joining C at or slightly before origin of RS . . . . . . . . . . . . . 3

[1]The figure illustrating *Dicranomyia whartoni* at the time of describing or on plate 27, p. 476, 23d report State Ento. New York, shows Sc joining C about one-third across the length of cell 1st R; the figure given by Dr. Alexander in Crane Flies of New York, Plate 31, fig. 12, shows Sc joining C almost above the origin of R, *but beyond it.*

2. Type female; lower valves obtuse at apex, upper valves short triangular at the base, apex prolonged and upcurved; tips of both pairs nearly on a level. (Type description of.) . . . . . . . . *whartoni* Needham.
3. Rs leaves R obtusely or at a curve . . . . . . . . . . . . . . . . . 4
   RS leaves R acutely or straight . . . . . . . . . . . . . . . . . . . 5
4. RS shorter; wings broader; abdomen dark; October form; anal style completely visible in the male; sternite valves reach to the tip of the tergite in female . . . . . . . . . . . . . . . . . . . *suffusca*, n. sp.
   RS longer; wings narrower; pale species; July form; anal style half covered by ninth sternite in male; sternite valves not reaching the tips of the tergites in the female . . . . . . . . . . . . . . *intermedia*, n. sp.
5. RS long; wings narrow; cell 1st R I, distinctly narrow; base of anal style almost completely covered by the ninth sternite . . . *kooteniensis*, n. sp.
   RS shorter; wings broader cell 1st R I, deeper; base of anal style about half covered by ninth sternite . . . . . . . . . . . . *intermedia*, n. sp.

The last item is the description of a new *Chionea* allied to *noveboracensis* Alex. I wrote the description and sent it to Dr. Alexander asking him to be kind enough to compare it with the type female of *noveboracensis*, in which specimen it is most unfortunate that the antennae are missing, as the antennae of this new species are distinct from any known species of *Chionea*, because of the few number of segments, having only five whilst six is the accepted number for the genus. Again · I take much pleasure in naming it after Dr. C. P. Alexander who has already done so much work on this genus, and at the same time I thank him for his kindness in comparing the notes.

### Chionea alexandriana, n. sp.

*Male* and *female*.—Length about 5 mm., width about 1 mm.

Description of male and female. Antennae, five segments. Segment one long, cylindrical, with some dorsal, basal, black hairs. Segment two cylindrical, swelling to an apical club, a whorl of black hairs at $\frac{1}{3}$ and another at $\frac{2}{3}$ with more hairs and longer. Segment three short, about half the length of one or two, conical, with a few short hairs. Segments four and five short, cylindrical, four with two or three basal, five with three or four terminal, very long, golden hairs, longer than the whole five segments together. Segment one equals two in length, and one is longer than 3, 4, 5 together. Antennae, palpi, head, thorax, abdomen, black with slight gray pruinosity, in strong lights a brownish shade. Head with some coarse black hairs from occiput to vertex. Collar with a bunch of black hairs each side dorsally. Thorax with a scattered bunch of black hairs on the dorsum as long as the haltres, which are pale yellow. Abdomen with apparently seven complete segments in the female each with a few short scattered black hairs. (In strong sunlight all hairs shine brownish.) Legs with all femora very slightly incrassated, brownish black (in strong sunlight brown), tibia and tarsi the same, all with longitudinal rows of black hairs, bristly. Male hypopygium with base very solid, thick, somewhat conical to

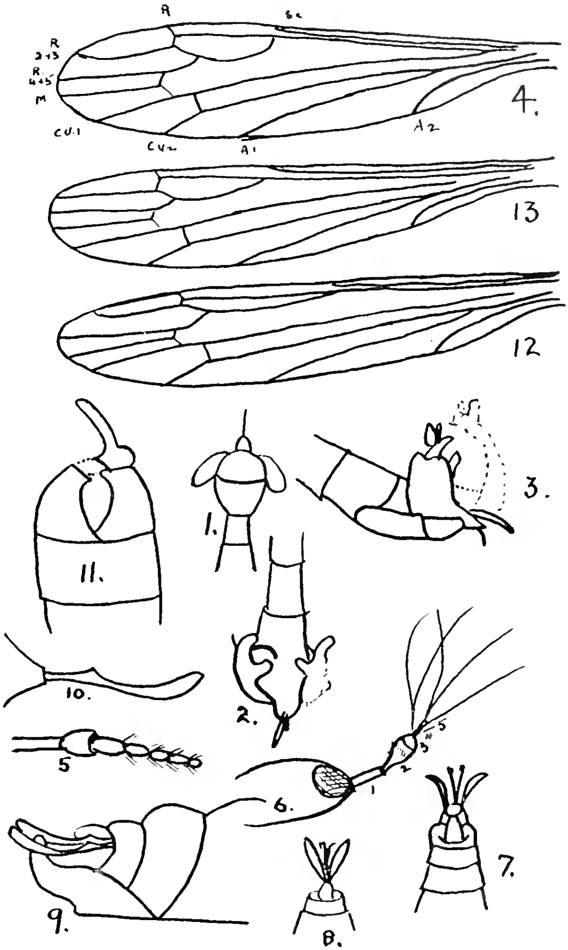



Fig. A.—1. *Alexandriaria suffusca*, ventral view, showing exposed sternite base; 2. same, left clasper from end and above; 3. same, clasper, lateral view; 4. same, wing of type male; 5. same, antennal segments 1 to 7; 6. *Chionea alexandriana*, antennae, male and female; 7. *Chionea alexandriana*, female hypopygium dorsal view; 8. same, ventral view; 9. same, lateral view; 10. same, tergite valve; 11. *Chionea alexandriana*, male, hypopygium, one clasper open; 12. *Alexandriaria kooteniensis*, wing of male type; 13. *Alexandriaria intermedia*, wing of male type. The illustrations are merely rough sketches to give some idea of the form. The wings are from a lantern slide sketch.

half way, color as abdomen, fleshy; below and inside with a prominent round point near the apex. Claspers, horny, subhyaline, bases thick and with an inside point which is modified on the outside. All with some black hairs. Female hypopygium subhyaline with four valves, tergal pair in lateral view flat, sword like; from base slightly up curved to the tips; base, thin, swelling from the second half diminishing to the tips and a bump dorsally at the first basal quarter.

Described from six specimens. *Holotype*, male, and *Allotype*, female, 22 Feb., 1921, Cranbrook, B. C., 3500 ft.

Four female paratypes. One data as types sent to Dr. C. P. Alexander. One data as types sent to U. S. Nat. Coll., Wash., D. C. One, 13 Feb., 1920, Cranbrook, B. C., taken a few hundred yards off the type spot, sent to the Canadian Nat. Coll., Ottawa. One taken in March or April, 1921, from the hills near Canal Flats, Kootenay Valley, taken by a trapper and given to me (damaged).

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## THE IDENTITY OF A HYMENOPTERUS PARASITE OF THE ALFALFA LEAF WEEVIL.

BY R. A. CUSHMAN,

*Bureau of Entomology, United States Department of Agriculture.*

At the time of the description of *Aenoplegimorpha phytonomi* the only specimen known to Viereck had been reared as a parasite of *Phytonomus postica* at Hoytsville, Utah. Since that time additional specimens have been reared from the same host in Italy. This European record led me to try to identify it among the European species with the result that it was found to be identical with *Hemiteles micator* Gravenhorst.

The synonymy is therefore as follows:

*Aenoplegimorpha micator* (Gravenhorst).

*Ichneumon micator* Gravenhorst, Vergl. Uebers. Zool. Syst., 1807, 260.

*Hemiteles micator* Gravenhorst, Ichn. Eur., vol. 2, 1829, p. 832, ♀ only.

*Aenoplegimorpha phytonomi* Viereck, Proc. U. S. Nat. Mus., vol. 42, 1912, p. 147.

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## A COMPARISON OF THE FIRST MAXILLAE OF APTERYGOTAN INSECTS AND CRUSTACEA FROM THE STANDPOINT OF PHYLOGENY.

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The present paper dealing with the phylogenetic origin of the maxillae of insects, is offered as the fourth of a series of articles in which the evidence for deriving the various insectan structures from crustacean prototypes, has been presented in order to demonstrate that the Crustacea, rather than the Chilopoda or other "myriopods," are the nearest representatives of the ancestors of insects. The other papers of this series were published in Vol. 28 of Psyche (an article on the evolution of the paragnaths or "superlinguae" of insects), in Vol. 29 of the Journal of the New York Entomological Society (an article on the evolution of the mandibles of insects), and in Vol. 32 of the Entomological News (a paper on the evolution of the cerci of insects). A general review of the subject was presented in the 50th Annual Report of the Entomological Society of Ontario for 1919, and in the Transactions of the Entomological Society of London for 1921; but it is only in the papers dealing with each phase of the subject separately, that drawings of the anatomical details were given to demonstrate the truth of the contentions made, since it would not be feasible to attempt to present all of the evidence, accompanied by the necessary illustrations, in a single paper.

It is manifestly disadvantageous (although unavoidably necessary) to scatter the evidence through a series of disconnected papers, since in so doing, the ever increasing mass of evidence loses much of its cumulative effect, and it is not so readily apparent that each additional study of another structural feature merely adds its quota to the overwhelming accumulation of facts driving one irresistibly to the conclusion that the Crustacea, rather than the Chilopoda, have departed the least from the type ancestral to the Insecta—for in each case, it has been the Crustacea alone which have furnished the key to the proper interpretation of the parts in insects, and they alone furnish an unbroken series of evolutionary stages connecting the insects with the lower arthropods. On this account, I would especially emphasize the fact that a preliminary study of crustacean anatomy is indispensible to the proper understanding of insectan anatomy, since the parts of a crustacean (unlike those of a chilopod) are for the most part built upon exactly the same plan as those of an insect, but have remained in a condition much nearer the ancestral one; and by comparing the parts in a series of Crustacea, we can trace the development of the various modifications back to their very source, thereby revealing the true nature of the various parts in a way that is not even approached, for completeness, by any other group of arthropods. The chilopods, on the other hand, present practically no structures built upon exactly the same plan as in insects, but are modified along their own special paths of development, so that it would be impossible to derive the parts of an insect in general, from the types of structures present in any known chilopod. The truth of this statement is so readily apparent if one will only take the trouble to make even the most superficial comparison of the parts of one of our common and easily obtained chilopods (which are to be found under dead logs in any wood) with those of a common mayfly nymph, *Machilis*, or any similar primitive insect, that it is hardly in keeping with the modern spirit of scientific truth to continue to foist upon unsuspecting and inexperienced students the fallacious and easily refuted hypothesis that insects are descended from chilopods!

**Current Misconceptions.**

One of the prevalent misconceptions concerning the nature of the maxillae of insects, is the view that they represent the second maxillae of Crustacea, instead of the first maxillae of Crustacea, with which they are really homologous. This practically universally accepted view apparently owes its origin to the erroneous claim of Hansen, 1893, and Folsom, 1900, who maintain that the so-called "superlinguae" of insects are homologous with the maxillulae or first maxillae of Crustacea; and since they mistake the "superlinguae" of insects for the first maxillae of Crustacea, they naturally mistake the first maxillae of insects for the second maxillae of Crustacea. The only semblance of proof brought forth in defense of the view that the "superlinguae" represent the maxillulae (first maxillae) of Crustacea is Folsom's description of an alleged superlingual segment in an embryo of *Anurida*, which he claims is the representative of the first maxillary segment of Crustacea; and those unfamilar with the embryology of insects in general (in which no superlingual segment has ever been found) or with the embryology and anatomy of Crustacea, have been completely deceived by Folsom's much-heralded "discovery." In his extensive and extremely thorough study of apterygotan embryology, Philiptschenko, 1912, has very clearly shown that the supposed superlingual segment described by Folsom in *Anurida* does not exist in this or any other insect, and that in all probability what Folsom mistook for an embryonic superlingual segment was merely an artifact of some sort—or as Philiptschenko more tactfully expresses it, Folsom's description of a superlingual segment is a "*lapsus calami.*"

It was hardly necessary, however, for Philiptschenko to point out the falsity of the claim that there is an embryonic "superlingual" segment in *Anurida*, since it is absolutely patent that the developing superlinguae of *Anurida* correspond in every way to the developing paragnaths of the isopod crustacean *Jaera* if one compares Folsom's Fig. 21 of an *Anurida* embryo with Fig. of a *Jaera* embryo by McMurrich, 1895; and since the paragnaths of Crustacea are not modified limbs of a distinct segment, it naturally follows that their homologues, the superlinguae of insects, can not represent modified limbs of a distinct segment, as I have pointed out in an article published in Vol. 28 of Psyche, where it was shown that the location, form, structure and embryological development of the superlinguae of insects give absolute proof of the fact that the superlinguae are in every way homologous with the paragnaths (not the maxillulae) of Crustacea. Since the superlinguae are homologous with the paragnaths, it is an easy matter to compare the maxillae of insects with the first maxillae (maxillulae) of Crustacea, and comparative embryology has long shown that the latter is the only correct method of homologizing the parts in question in insects and Crustacea.

In Vol. 29, No. 2, of the Journal of the New York Ent. Soc. for June, 1921, I have shown that the mandible of an insect represents only the basal or first segment (coxopodite) alone of a crustacean limb, and in the present paper I would point out the fact that the lacinia of an insect's maxilla represents a lobe of the second segment (basipodite) of a crustacean limb, while the galea represents a lobe of another segment—the third or ischiopodite—of a crustacean limb. It is therefore impossible that the galea, lacinia, and other parts of an insect's maxillae could be repeated in the mandible, as Smith, Packard, and many others have claimed is the case. Furthermore, the commonly accepted view that the palpus of an insect's maxilla represents the exopodite of a biramous crustacean limb, while the galea and lacinia of an insect's maxilla represent the endopodite of such a biramous crustacean limb is absolutely unfounded, for, as will be shown later, the maxillary palpus represents the terminal segments of the endopodite of a crustacean limb in which lobe-like outgrowths of the second and third segments of the endopodite form the lacinia and galea. These misconceptions of the true nature of the maxillae of insects, and other misinterpretations of the parts of the maxillae (such for example as the mistaking of the lacinial lobes for the galea in the maxillae of *Anurida*, *Orchesella*, etc., by Folsom, 1899–1900, Imms, 1906, and their followers) very clearly indicate the need of a more thorough understanding of the modifications of the corresponding parts in those Crustacea which approach the insectan type very closely before attempting to interpret the homologies of the various insectan structures, which can be interpreted aright only by comparing them with their prototypes among the Crustacea. On this account, it may be of some interest to briefly review certain evolutionary tendencies in the Crustacea which eventually result in the production of the insectan type of maxilla.

**Evolution of the Maxillae.**

The derivation of a typical arthropodan limb from the parapodium of an annelid has been discussed in Vol. 29 of the Journal of the N. Y. Entomological Society, so that it is unnecessary to go into the matter further here; and a typical biramous crustacean or trilobitan limb (see text figure 1) having an exopodite *ex*, usually serving as a gill, and an endopodite *en*, used as a locomotor organ, may be taken as the starting point in the developmental series resulting in the production of the insectan type of maxillary mouthpart-limb. It may be remarked parenthetically, that trilobites are exceptionally favorable forms for demonstrating the fact first discovered by Savigny, 1816, that the mouthparts of an arthropod are merely modified legs, since all of the mouthparts of a trilobite such as *Triarthrus* are exactly like the trunk limbs, mesal outgrowths of the basal segments of the limbs serving to hold and comminute the food.

The main axis of a typical crustacean limb (formed by the basal segments and the endopodite) is composed of seven segments, which, beginning with the basal one, have been termed the coxopodite, basipodite, ischiopodite, meropodite, carpopodite, propodite, and dactylopodite, by carcinologists, or students of the group Crustacea. The exopodite, or outer branch of the biramous limb, is borne on the second segment or basipodite in most Crustacea (or on the fused basipodite and coxopodite, termed the protopodite by carcinologists), and this fact is of some value in determining the identity of the basipodite in certain cases in which it has become secondarily divided into subdivisions superficially resembling segments, as in Fig. 8, Plate 8. The basal segment or coxopodite of a crustacean limb may bear a lateral gill-like appendage, the epipodite (*ep* of Figs. 8, 2, etc., Plate 8), but the epipodite is of relatively slight importance for the study of insectan anatomy. On the other hand, the median outgrowths or endites labeled *ce*, *be*, *ie*, *me*, etc., borne on the median surface of the coxopodite, basipodite, ischiopodite, meropodite, etc. (which, for convenience, may be termed the coxendite, basendite, ischiendite, merendite, etc., to indicate the segment on which they are borne) are of considerable importance in the study of insectan anatomy, since the galea, lacinia, and certain structures of the masticating surface of the mandibles of insects are derived from these endites of a crustacean limb, the coxendite, basendite, and merendite (or the endites of the coxopodite, basipodite, and meropodite) being the ones chiefly involved.

The coxendite, or endite of the coxopodite (basal segment) of the mouthpart-limb—in other words, the homologue of the structure labeled *ce* in Plate 8, Fig. 6, or in text figure 1—is called the gnathobase by students of the trilobites and lower Crustacea. This coxendite, or gnathobase, in the trilobites, merostomes, and related forms, acts as a holding and comminuting structure (by abutting against its fellow borne on the corresponding limb of the opposite side of the body) in manipulating the food, and is the prototype of the masticatory portion of the mandible of insects, as was pointed out in a previous paper (Vol. 29, Jour. N. Y. Ent. Soc.). The coxendite, or gnathobase, however, is not of any importance for the study of the evolution of the maxilla, since it is the basendite and ischiendite (or endites of the second and third segments of the limb) which form the lacinia and galea of the maxilla, as will be presently seen.

In the trilobitan limb shown in Fig. 6 (Plate 8) the second, third, and fourth segments of the limb bear endites (i. e. the basendite, ischiendite, and merendite) labeled *be*, *ie*, and *me*, and if the trilobitan limb were straightened up to assume the position of the main axis of the crustacean limb shown in Fig. 8 of *Mysis*, it would be seen that the endites labeled *be*, *ie*, and *me* in Fig. 8 correspond to the endites bearing these labels in Fig. 6 (although the basal endite *ce* of Fig. 6 is not represented in Fig. 8). The exopodite (*ex* of Fig. 8) has been omitted from Fig. 6, since it would overlap and hide the endites, if drawn in this view.

If we compare Fig. 10 of a maxilliped of the crustacean *Gammarus*, with Fig. 8 of a maxilliped of the crustacean *Mysis*, it will be seen that the exopodite *ex* and epipodite *ep* of Fig. 8, have been lost in Fig. 10, and instead of three endites *be*, *ie* and *me* being present as in Figs. 8 and 6, only two of them *be* and *ie* are retained in the maxilliped shown in Fig. 10. By comparing the maxilliped of *Gammarus* (Fig. 10) with that of the other crustacean shown in Fig. 8, there can be no doubt that it is the endopodite *en* alone, and not the exopodite *ex* of Fig. 8, which is retained in Fig. 10, and this fact is of the greatest importance in comparing the parts of the maxilliped of the crustacean shown in Fig. 10 with those of the maxilla of the insect shown in Fig. 11, since there is a wonderfully close resemblance in the relative sizes, etc., of the segments in the mouthpart-limbs shown in Figs. 11 and 10, enabling us to compare the parts without the least difficulty, so that having in our possession the key furnished by the mouthpart-limb shown in Fig. 10, the veriest tyro would be able to homologize the parts of the insect's maxilla shown Fig. 11 (and hence the parts of the maxillae of all insects as well); and we are thus able at once to demonstrate the fallacy of the generally accepted view that the maxillary palpus of an insect represents the exopodite of a crustacean limb, or that the galea and lacinia of an insect's maxilla represent the endopodite of such a crustacean limb, for the basal segment *cp* of Fig. 11 clearly represents the basal segment *cp* of Fig. 10, while the second segment *bp* of Fig. 11, which is large and bears an endite *be*, clearly corresponds to the second segment *bp* of Fig. 10, which is also large and bears an endite *be*. The third segment *ip* of Fig. 11 is smaller and bears an endite "*ie*," and is clearly homologous with the third segment *ip* of Fig. 10, which is also smaller and bears an endite *ie*. The fourth segment *mp* is the smallest of all the segments in both Figures 11 and 10, while the fifth segment *crp* is long and slender in both, and is followed by a shorter slender segment *pp* in both figures. The terminal segment *dp* is still shorter in both figures, but in Fig. 10 it bears a terminal claw not present in Fig. 11—although the terminal claw is also absent in many Crustacea as well as in the insect shown in Fig. 11. The remarkable resemblance even to the details of the relative sizes of the different segments composing the mouthpart-limbs thus enables us to establish beyond all possibility of doubt, that the maxillary palpus *en* of Fig. 11 represents the endopodite *en* of Fig. 10, while the galea *ie* and lacinia *be* of Fig. 11 are clearly the representatives of the endites *ie* and *be* of the third and second segments of the mouthpart limb shown in Fig. 10, thus showing conclusively that it is folly to claim that the palpus of an insect's maxilla represents the exopodite of a crustacean limb, and that the galea and lacinia represent the endopodite of such a biramous limb! Furthermore, a comparison of the parts in Figs. 11 and 10 would indicate that a four-jointed maxillary palpus, such as that labeled *en* in Fig. 11 probably represents the condition typical for insects in general or that four was probably the "ancestral" or primitive number of segments entering into the composition of the palpi of the maxillae of the first insects.

By comparing Fig. 11 with Fig. 12 it may be seen that the basal segment or cardo *cp* of Fig. 12 is proportionately much smaller than in Fig. 11, while the second segment or stipes *bp* becomes more elongate in Fig. 12, and its endite *be* becomes differentiated into several lacinial structures which will be discussed later. The third segment or palpifer *ip* of Fig. 12 becomes more closely applied to the second segment *bp* and its endite, the galea *ie* is proportionately much larger in Fig. 12 than in Fig. 11. The maxillary palpus *en* of Fig. 11 consists of only four segments, as was mentioned above, while the palpus *en* of the maxilla of *Machilis* shown in Fig. 12 is composed of seven segments. It is also a simple matter to compare the parts of the maxilla shown in Fig. 11 with those of the maxilla of the primitive apterygotan insect *Eosentomon* shown in Fig. 17, since the basal segment *cp* of Fig. 11 evidently corresponds to the small basal segment *cp* of Fig. 17, while the second segment *bp* of Fig. 11, with its endite *be*, evidently corresponds to the second segment *bp* of Fig. 17, which also bears an endite *be*, although the endite *be* of Fig. 17 has become differentiated into certain lacinial structures not present in the endite *be* of Fig. 11. The third segment *ip* of Fig. 17 with its endite *ie* clearly corresponds to the third segment *ip* with its endite *ie* of Fig. 11, and there are indications of four segments in the maxillary plapus *en* of Fig. 17 suggestive of the four-segmented maxillary palpus *en* of Fig. 11. It is a simple matter to compare the maxillae of higher insects, such as the one shown in Fig. 18, with the type of maxilla shown in Fig. 12, and one may easily compare the parts of the maxilla of an apterygotan insect, such as the one shown in Fig. 17, with the type of maxilla shown in Figs. 16, 14, 9, etc., so that, having established the meaning of the parts of the maxilla in one case, it is a comparatively easy matter to apply the knowledge thus gained, to insects in general.

In order that there may be no misunderstanding in this matter, I would call attention to the fact that in comparing the parts of Fig. 10 with those of Fig. 11, I have compared the parts of a *maxilliped* of a crustacean with the parts of an insect's *maxilla*, instead of comparing a crustacean maxilla with an insect's maxilla. This however is perfectly justifiable, since the segments of a crustacean's maxilliped are in every way homologous (serially) with the segments of a crustacean's maxilla and may be compared part by part, just as the prothoracic leg is in every way serially homologous with a metathoracic leg in an insect, and the prothoracic coxa, trochanter, femur, etc., correspond in every way to the metathoracic coxa, trochanter, femur, etc. Since the parts of the maxilliped are homologous with those of the maxilla in Crustacea, it is therefore justifiable to homologize the parts of a crustacean's maxilliped with the parts of an insect's maxilla in an attempt to determine the proper interpretation of the insect's parts, if the maxilliped serves the purpose better than the maxilla does, as is the case with those Crustacea available to me at present (although there are certain Crustacea in which the maxillae are as suitable as the maxillipeds, for comparison with the maxillae of insects—but specimens of these are inaccessible to me, and one must perforce do the best he can with such material as he is able to procure.

Unfortunately, the diagrams of hypothetical evolutionary stages employed by many investigators to illustrate the probable mode of origin of various animal structures, all too frequently correspond to nothing which has ever existed "in the heavens above, or the earth beneath, or the waters under the earth," and in order to avoid this pitfall, I have at first purposely used only actual cases occurring in some living or fossil arthropod, to illustrate the probable evolutionary stages in the development of the insectan type of maxilla, since, if modifications occurring in existing cases are used, they at least represent actual developmental tendencies which have manifested themselves in nature, and are not purely a figment of one's imagination. On the other hand, despite the fact that in using diagrams one frequently is obliged to sacrifice accuracy to simplicity, the *judicial* use of diagrams (safeguarded by reference to actual structures upon which they are based) is an invaluable aid in explaining in a concise and readily understandable form, the ideas one has worked out in his own mind from evidence collected from many sources; and in this account, I have ventured to add the appended text figures to aid one in visualizing the probable evolutionary stages through which the mouthpart appendages have passed in the evolution of the insectan type of maxilla.

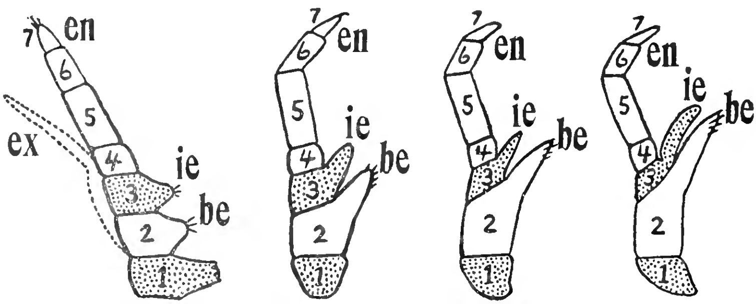



Fig. 1 Fig. 2 Fig. 3 Fig. 4

Fig. 1, biramous limb of trilobite or crustacean. Fig. 2, maxilliped of *Gammarus*. Fig. 3, maxilla of neuropteron larva. Fig. 4, Maxilla of *Machilis*. 1, coxopodite or cardo; 2, basipodite or stipes; 3, ischiopodite or palpifer; 4, 5, and 6, segments of endopodite or maxillary palpus. ex, exopodite; en, endopodite; ie, ischiendite or galea; be, basendite or lacinia. The stippled segments are the homologues of the cardo and palpifer.

In textfigure 1 is represented the typical buccal appendage of a trilobite (compare Fig. 6 of Plate 8) having a gill-like exopodite "ex" and a locomotor endopodite "en," in which segments two and three bear short flat endites "be" and "ie" (the endite of segment four has been omitted for simplicity). In textfigure 2, based upon the maxilliped of Gammarus (compare Fig. 10) the exopodite "ex" of texfigure 1 has been lost, and the endopodite "en" assumes a palp-like appearance, while the endites "be" and "ie" of segments two and three become more elongate. In textfigure 3, based upon the maxilla of a larval Neuropteron (compare Fig. 11) the endopodite "en" has become the maxillary palp, and the endites "be" and "ie" of segments two and three have become modified to form the slender lacinia and galea; while in textfigure 4, based upon *Machilis* (compare Fig. 12) segment number two becomes more elongate and segment number three is more closely applied to it, forming the palpifer still distinguishable as a distinct segment, but tending to unite with the second segment or stipes. In the higher insects, the union of the palpifer segment with the stipes segment is usually complete, although traces of the palpifer are retained in certain forms.

### Comparison of Structural Details.

In the foregoing discussion, it was shown that the maxilla of an insect can be readily derived from crustacean prototypes (although it would be impossible to derive an insect's maxilla from any of the chilopod buccal appendages I have been able to examine), and in the following brief discussion, I would point out the fact that even the minuter details of structure bear out the contention that we must seek the prototypes of the parts of insects among the Crustacea, rather than among the chiolpods—and after all, it is the evidence of the minute details of structure which is of the greatest value in any phylogenetic study, since convergent development may bring about a general resemblance in the various parts, but when this resemblance extends to the more minute details of structure as well, the possibility of the resemblance being due to convergent development is very slight, and we are forced to the conclusion that a common heredity is the cause of the resemblance, when it extends to the structural details of many organs from widely separated regions of the body—as is the case with numerous structures in insects and Crustacea.

In the maxilla of the primitive crustacean *Nebalia* shown in Fig. 4, Plate 8, the endite, or mesal lobe, of each of the two basal segments is bordered by an endofimbrium or mesal fringe of seta-like, or spine-like structures, shown more highly modified in Fig. 29, where it may be seen that the seta-like structures may become broader and exhibit a tendency to become serrate upon one side. In Fig. 25, the endofimbrium, or mesal fringe, of the second segment of the maxilla of the amphipod crustacean *Talorchestia* is seen to have become differentiated into a tooth-like spine labeled "a" and a series of somewhat broader flattened processes or lacinulae, "le," which exhibit a tendency to become serrate, or "pectinate," on one side. In the isopod crustacean Trichoniscus, shown in Fig. 22, there occurs in the median fringe of the second segment of the maxilla, an elongate midappendix, "b," which is apparently a modified member of the median fringe. In Fig. 23 of the maxilla of the amphipod crustacean *Gammarus*, the endofimbrium of the second segment has become differentiated into a group of laciniadentes "a," or tooth-like processes, a midappendix labeled "b," and the lacinulae, "le," which are "pectinate" on one side, and suggest very strongly the condition occurring in the apterygotan insects next discussed; and having determined the nature of these structures in Crustacea, we are now in position to determine the nature of their homologues in insects.

If one compares the mesal fringe, or endofimbrium, of the stipes (or second segment) of the maxilla of the apterygotan insect *Tetrodontophora* shown in Fig. 24, with the mesal fringe of the second segment of the maxilla of the crustacean *Gammarus*, shown in Fig. 23, it is a very simple matter to identify all of the parts, which correspond in an astonishingly close fashion, in both forms (as has also been pointed out by Boerner, 1909). Thus the laciniadentes or incisor processes "a" of Fig. 23 clearly correspond to the laciniadentes or incisor processes "a" of Fig. 24, while the midappendix "b" of Fig. 23 is evidently the midappendix "b" of Fig. 24, and the "pectinate" lacinulae "le" of Fig. 23 are clearly the pectinate lacinulae "le" of Fig. 24. It is likewise a very simple matter to identify with the incisor processes "a" of Fig. 24, the incisor processes "a" of the insects shown in Figs. 27, 28, 30, etc., while the midappendix "b" of Fig. 24 is apparently the homologue of the process labelled "b" in Figs. 27, 28, 30, etc., and the lacinulae "le" of Fig. 24 evidently correspond to the processes labeled "le" in Figs. 27, 28, 30, etc.; and it is quite evident that the lacinial structures (i. e. those borne on the second segment or stipes of the maxilla) correspond, even in their minutest details, throughout the sub-class Apterygota, and it is folly of Handlirsch, 1908, to attempt to divide the apterygotan insects into several "classes," since the great similarity among them in other structural details as well, would preclude such a course of procedure on the part of any one familar with the structure of the Apterygota in general.

It is very surprising that Folsom, 1900, Imms, 1906, and others, who have made a detailed study of the mouthparts of the apterygotan *Anurida*, have wholly missed the significance of the parts of the maxilla in this insect, thus showing very clearly that is impossible to interpret the parts in insects aright, without first making a study of related forms, and comparing the parts with those of the Crustacea. Thus, Folsom and Imms apply the term "galea" to the incisor process of the lacinia labeled "a" in Figs. 20 and 21 of *Anurida*, and they restrict the term "lacinia" to the right hand lacinular plate labeled "le" in Fig. 20, while Imms applies the designation "maxillary palp" to the left hand lacinular process labeled "le" in Fig. 20. Folsom, 1899, has also misinterpreted the parts of the lacinia of the maxilla of *Orchesella*, as may be seen by comparing his figure of the parts with Fig. 31 of the present paper.

The lacinial fringe of *Nicoletia* (Fig. 19) is quite different from that of *Machilis* (Fig. 27) and this feature adds further confirmation of the contention that *Machilis* should be placed in an order distinct from that containing *Nicoletia* and the other Lepismatidae. On the other hand, the lacinia of *Nicoletia* (Fig. 19) is quite like that of certain pterygotan insects such as the one shown in Fig. 18, since the laciniadentes, or incisor processes "a" of Fig. 19, evidently correspond to the incisor processes labeled "a" in Fig. 18, and the process labeled "b" (provisionally homologized with the midappendix "b" of other apterygota) in Fig. 19 is apparently the homologue of the appendage labeled "b" in Fig. 18. The small processes labeled "le" in Fig. 19 doubtless correspond to the processes labeled "le" in Fig. 27, but they appear to be wanting in Fig. 18, unless they are represented by the seta-like structures borne on the lacinia, but not represented in Fig. 18.

Several investigators have recently questioned the advisability of grouping the Protura with the rest of apterygotan insects, since they claim that the Protura are not true insects, but belong in a class by themselves—or the Protura are even regarded by some investigators as being nearer the "myriopods" than insects. The head, thoracic, and terminal abdominal structures of the Protura, however, are clearly insectan, as is further borne out by the structure of the maxilla, as one may readily see by comparing the maxilla of the insect shown in Fig. 16 with that of the proturan shown in Fig. 17, and I can see no reason why the Protura should not be grouped with such apterygotan insects as *Tomocerus*, *Tetrodontophora*, and similar forms with which they have so much in common. The Protura are evidently an early offshoot of the primitive Apterygota, from which the sminthurids and entomobryids were also derived, and the evidence derived from the study of the maxillae of the Protura is fully in accord with that drawn from other sources, clearly indicating that the Protura are true insects.

In many of the primitive representatives of the sub-class Pterygota, the cardo "cp" of these insects is divided into eucardo "ec" and paracardo "pc" as in Fig. 18, and the stipes "bp" is divided into parastipes "ps" and eustipes "es" as in Figs. 18 and 12. In a paper published in Vol. 23, p. 83, of Psyche, in which these subdivisions were first described, I suggested that the division of the cardo and stipes into two parts might indicate traces of the union of parts formerly distinct. I am now inclined, however, to regard the subdivision of the cardo "cp" in Fig. 18, as of the same nature as the division of the basal segment "cp" into two parts in the maxilla of the crustacean shown in Fig. 25, in which the subdivision of the segment is purely secondary. Furthermore, the narrow marginal sclerite "ps" of Figs. 18 and 12, may possibly represent the narrow structure labeled "ps" in Fig. 25, but I have not been able to obtain suitable material for definitely determining this point.

**Summary.**

The principal points brought out in the foregoing discussion may be briefly summarized as follows:

The Crustacea, rather than the chilopods or other "Myriopoda," furnish us with the prototypes of the various insectan structures, and much of the misinterpretation of the parts in insects is due to the fact that entomologists are largely ignorant of the anatomy of the Crustacea.

The basal segment of a crustacean buccal appendage forms the cardo of an insect's maxilla. The second segment with its endite in the Crustacea, forms the stipes with the lacinia in insects. The third segment with its endite in Crustacea, forms the palpifer with the galea in insects. The terminal segments of the endopodite of the crustacean's buccal appendage forms the palpus of an insect's maxilla. It is therefore incorrect to state that the maxillary palpus of an insect represents the exopodite of a biramous crustacean limb, while the galea and lacinia represent the endopodite of such a biramous limb.

Since the galea represents the endite of the third segment of a mouthpart limb, and the lacinia represents the endite of a second segment of such a mouthpart limb in insects, it is likewise incorrect to state that the mandible of an insect, which corresponds to the basal segment alone of such a limb, may exhibit structures corresponding to the galea, lacinia, and other structures of the maxilla.

The maxilla of an insect corresponds to the first maxilla of a crustacean, and it is therefore incorrect to state that the "superlinguae" of insects represent the first maxillae (maxillulae) of

Crustacea. Comparative embryology and anatomy clearly show that the superlinguae of insects are the paragnaths of Crustacea, and the first maxillae of insects are the first maxillae of Crustacea, and the evidence of comparative anatomy and embryology if further confirmed by the form and function of the organs in question.

The evidence obtained from the study of the minuter details of the maxillary structures of insects substantiates that drawn from other sources, indicating so close a relationship between the apterygotan insects, that it would be wholly unjustifiable to attempt to group the Apterygota otherwise than in a single sub-class; and a study of the minute details of structure of the maxillae furnishes further confirmation of the claim that the Crustacea alone represent the probable types ancestral to insects, and if the Crustacea are not the actual ancestors of insects, they at least enable us to determine what the ancestors were probably like, possessing as they do a number of features unmistakably suggestive of the prototypes of many of the structures of insects, which are built upon the same plan, but are much more highly modified in insects.

The present paper is largely of the nature of a preliminary study, in which an attempt has been made to determine the true nature of the maxilla as the basis of further work along this line. In the second part of this paper, it is proposed to trace the various modifications of the maxilla in different insects, with particular reference to the evidence it may add to that from other sources, in determining the closest affinities and the interrelationships of the various insectan orders.

## Appendix.

The appended textfigures of the embryonic development of the head structures of insects and Crustacea have been added to show that the evidence of embryology is in full accord with that of comparative anatomy (Psyche, Vol. 28, p. 84) which clearly indicates that the "superlinguae" of insects represent the paragnaths of Crustacea. As may be seen in Textfigure 5, the superlinguae" of insects (labeled "e") are mandibular structures arising (in the embryo) upon the mandibular ganglia, immediately mesal to the forming mandibles (labeled "d"); while the paragnaths of a crustacean embryo (labeled "e" in Textfigure 6) are likewise mandibular structures arising upon the mandibular ganglia, immediately mesal to the forming mandibles (labeled "d" in Textfigure 6). The evidence of embryology is therefore no less conclusive than that of comparative anatomy in demonstrating that the "superlinguae" of insects are really the paragnaths of Crustacea, and it is therefore wholly incorrect to homologize the "superlinguae" of insects with the first maxillae (maxillulae) of Crustacea, and to homologize the first maxillae of insects with the second maxillae of Crustacea, etc., as is done by recent investigators who have not made a sufficiently thorough comparison of the structures in question in the two groups of arthropods.

FIG. 5

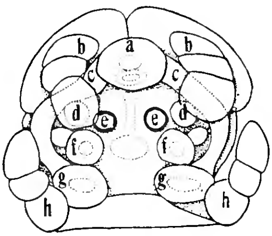
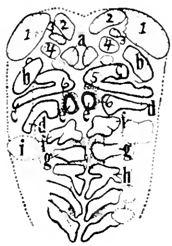


FIG. 6



*Textfigure 5.*—Ventral view of anterior portion of embryo of *Anurida*, after Folsom, 1900. *Textfigure 6.*—Same of the isopod crustacean *Jaera*, after McMurrich, 1895. 1, optic ganglion; 2, cerebral ganglion; 3, pre-antennular ganglion; 4, antennular ganglion; 5, antennal ganglion; 6, mandibular ganglion; a, upper lip or labrum; b, first antenna (antennule) of crustacean, antenna of insect; c, second antenna of crustacean, mouth fold of insect; d, mandible; e, paragnath; f, first maxilla (maxillula) of crustacean, maxilla of insect; g, second maxilla of crustacean, labium of insect; h, first maxilliped of crustacean, prothoracic leg of insect; i, liver of crustacean.

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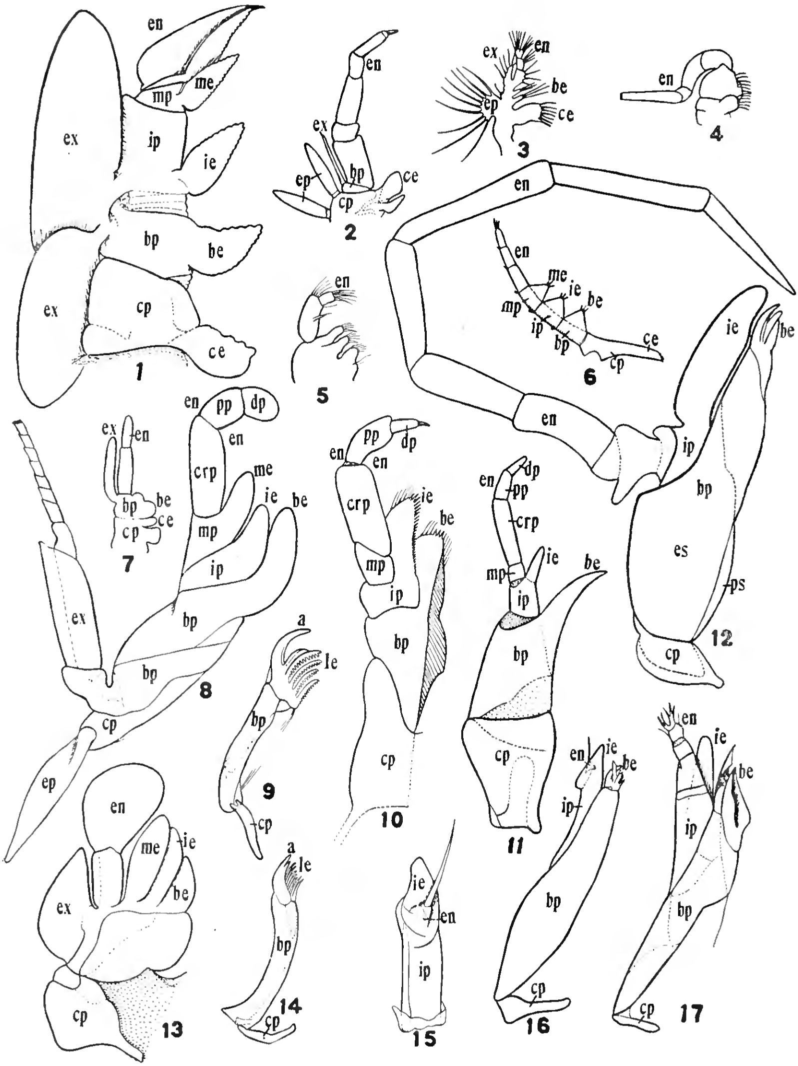
## ABBREVIATIONS.

a —Laciniadentes or incisor processes of lacinial region.
b —Midappendix, or median appendage of lacinial region.
be —Basendite, or endite of crustacean basipodite; lacinia of insectan maxilla.
bp —Basipodite of crustacean limb; stipes of insectan maxilla.
ce —Coxendite, or endite of crustacean coxopodite.
cp —Coxopodite of crustacean limb; cardo of insect's maxilla.
crp—Carpopodite of crustacean limb.
dp —Dactylopodite of crustacean limb.
ec —Eucardo, or subdivision of cardo of maxilla.
ei —Endites of crustacean limb.
en —Endopodite of crustacean limb; maxillary palpus of insect.
ep —Epipodite of crustacean limb.
es —Eustipes, or subdivision of maxillary stipes.
ex —Exopodite, or outer branch of biramous crustacean limb.
ie —Ischiendite, or endite of ischiopodite of crustacean limb; galea of insect's maxilla.
ip —Ischiopodite of crustacean limb; palpifer of insect's maxilla.
le —Lacinulae, or lamellar processes of lacinial region.
me —Merendite, or endite of meropodite of crustacean limb.
mp —Meropodite of crustacean limb.
pc —Paracardo, or subdivision of cardo of maxilla.
pp —Propodite of crustacean limb.
ps —Parastipes, or subdivision of stipes of maxilla.

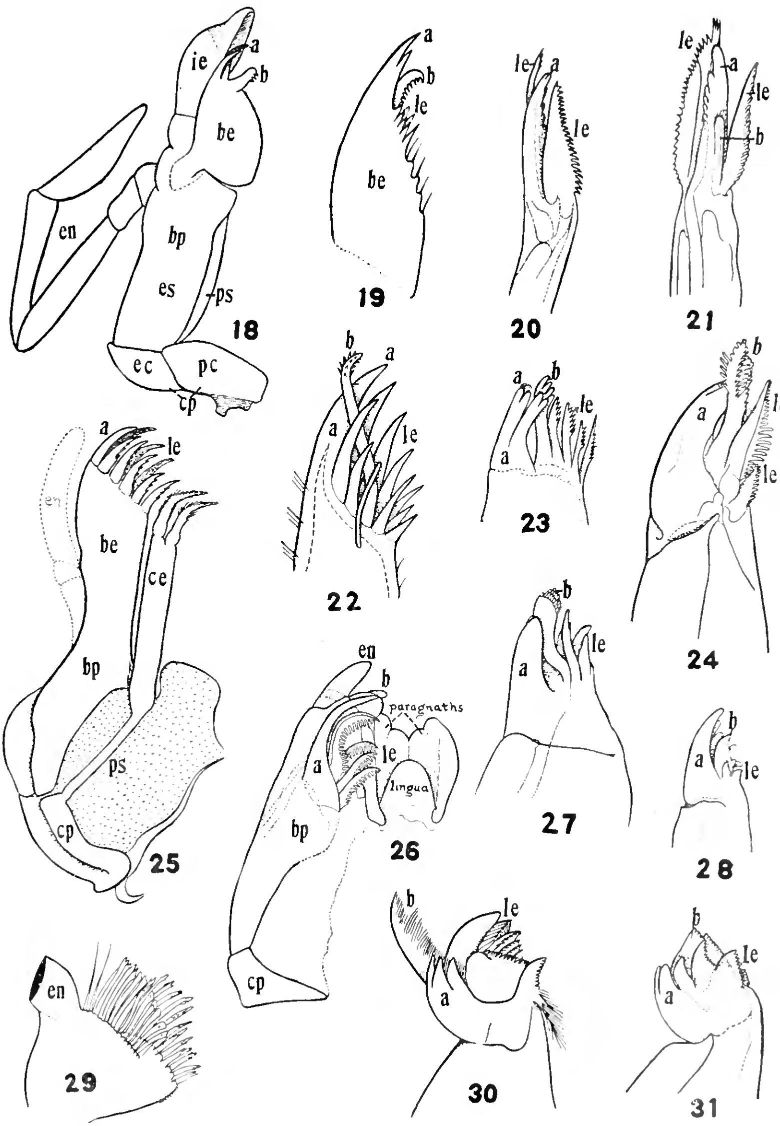
## EXPLANATION OF PLATES.

Figures 4 and 7 are after Boas, 1883; Figs. 15, 16, 20, 21, 23, 24, 26, 27, 28, 30, and 31 are after Boerner, 1908; Fig. 2 is after Calman, 1896; Fig. 29 is after Claus, 1889; Fig. 5 is after Daday, 1910; Fig. 19 is after Escherich, 1905; Fig. 3 is after Korschelt and Heider, 1890; Fig. 17 is after Prell, 1913; Fig. 22 is after Racovitza, 1908; Fig. 6 is after Raymond, 1921; Figs. 9 and 14 are after Stummer-Traunfels, 1892.

Fig. 1—A trunk limb of crustacean *Apus productus.*
Fig. 2—First thoracic limb of crustacean *Anaspides tasmaniae.*
Fig. 3—Maxilla of crustacean *Calanella* sp.
Fig. 4—First maxilla of crustacean *Nebalia bipes* (terminal portion cut off).
Fig. 5—Maxilla of female of crustacean *Cypris denticulata.*




CRAMPTON—MAXILLAE OF INSECTS.




CRAMPTON—MAXILLAE OF INSECTS.

Fig. 6—A posterior trunk limb of the trilobite *Triarthrus*.
Fig. 7.—Second maxilla of crustacean *Nebalia bipes*.
Fig. 8—Maxilliped of crustacean *Mysis* sp.
Fig. 9—Maxilla of apterygotan insect *Japyx solifugus*.
Fig. 10—Maxilliped of crustacean *Gammarus* sp.
Fig. 11—Maxilla of larval neuropterous insect *Sialis* sp.
Fig. 12—Maxilla of apterygotan insect *Machilis* sp.
Fig. 13—Maxilla of crustacean *Mysis* sp.
Fig. 14—Maxilla of apterygotan insect *Campodea staphylinus*.
Fig. 15—Enlarged palpifer and maxillary palpus of apterygotan insect *Tetrodontophora bielanensis*.
Fig. 16—Maxilla of *Tetrodontophora bielanensis*.
Fig. 17—Maxilla of apterygotan insect *Eosentomon* sp.
Fig. 18—Maxilla of pterygotan insect *Periplaneta orientalis*.
Fig. 19—Lacinia of maxilla of apterygotan insect *Nicoletia neotropicalis*.
Fig. 20—Lacinial structures of apterygotan insect *Anurida maritima*.
Fig. 21—Same from another view.
Fig. 22—Tip of endite of second segment of first maxilla of crustacean *Trichoniscus corsicus*.
Fig. 23—Tip of endite of second segment of maxilla of crustacean *Gammarus* sp.
Fig. 24—Lacinial structures of apterygotan insect *Tetrodontophora bielanensis*.
Fig. 25—First maxilla of crustacean *Talorchestia longicornis*. The position of a hypothetical palpus is indicated by dotted lines.
Fig. 26—Hypopharynx and maxilla of apterygotan insect *Japyx japonicus*.
Fig. 27—Lacinial structures of apterygotan insect *Machilis* sp., from Japan.
Fig. 28—Lacinial structures of apterygotan insect *Sminthurides serroseta*.
Fig. 29—Distal lobe (endite) of first maxilla of crustacean *Nebalia geoffroyi*.
Fig. 30—Lacinial structures of maxilla of apterygotan insect *Pogonognathus* (Tomocerus?) *plumbeus*.
Fig. 31—Lacinial structures of apterygotan insect *Allacma fusca*.

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## NOTES ON APION, WITH DESCRIPTIONS OF TWO NEW SPECIES (COLEOP., CURCULIONIDAE).

By L. L. Buchanan, *Washington, D. C.*

The following paper presents a few notes on a collection of *Apion* from the vicinity of Lake Okoboji, northwestern Iowa; and the descriptions of two new species, one from Iowa, the other from the South Atlantic region. The Lake Okoboji series at hand represents 12 or 13 species, but among them I can recognize only 5 or 6 of the dozen which appear in Wickham's Iowa catalog, the remainder being heretofore unrecorded from the state. It may not be out of place to mention here that, as a whole, the coleopterous fauna of the Lake Okoboji region is distinctive in containing a considerable scattering of species of a decided northern or western type, that disappear a little further south in the state.

By the kind permission of Messrs. Schwarz and Barber I have been able to make comparisons with the *Apion* material in the U. S. National Museum.

### Apion delta, n. sp.

Oblong, rather robust, strongly convex longitudinally, with a faint luster; legs pale. Pubescence of rather sparse but conspicuous hair-like scales, evenly distributed except for 3 spots at base of elytra, forming the apices of a triangle. Beak (♂) as long as head and prothorax, subcylindrical, shining above, dull laterally, scaly almost to tip, evenly and weakly curved, strongly dilated, finely and sparsely punctured. Front wider than tip of beak, bisulcate: beak (♀) 1/7 longer than head and thorax, plainly more slender, punctate and sparsely scaly in anterior half, almost sculptureless and shining to tip. Dilation conspicuous. Bisulcation of front not so well indicated. Eyes prominent in both sexes. Antennae black, stout, and scaly, inserted ⅓ or less from base, 1st joint hardly as long as next two, 3d reaching eyes. Thorax subconical, 1/5 wider than long, base strongly bisinuate, sides sinuate, widest a little behind middle, thence strongly narrowing to the weakly constricted apex, median groove entire. The punctures are good sized, but not crowded. Elytra ovate, 8/11 as wide as long, humeri rounded; base marked with 3 conspicuous patches of broader scales, one white post-scutellar spot ⅓ the length of thorax, and two smaller ones at base of 3d interval, the latter sometimes pale brownish or dirty white. The striae are deep and clean cut, nearly as wide as the intervals, and set with coarse punctures; intervals flat, each with a row of vague more or less confused punctures; both intervals and striae with rows of white or brownish hair-like scales. Legs reddish, coxae and trochanters black, tips of femora, and tarsal joints dusky, claws small with a minute basal tooth. Punctuation of under surface well marked but not coarse or crowded. Sterna with quite dense white scales, 1st and 2d ventrals with sparser and narrower scales. Length, 2 mm.

*Hab.:* Virginia, North Carolina, South Carolina.

Described from 4 specimens; type ♂, Southern Pines, N. C. (A. H. Manee); and 1 paratype, Petersboro, Va. (L. O. Jackson) are in my collection; 1 paratype, Manning, S. C. (F. A. Chapin) in collection of U. S. Biological Survey; 1 paratype, Holly Hill, S. C. (Russell) on croton, Chittendon No. 385, in U. S. National Museum.

This finely marked species is closely allied to *fumitarse* Fall, from San Diego, Tex., but a comparison with Fall's type shows his species to be a narrower insect, with finer pubescence, and a comparatively shorter thorax which is grooved only half its length. In *fumitarse* the scales are diffused far along the suture, not condensed in a sharply defined scutellar spot as in *delta*.

### Apion notabile, n. sp.

Moderately elongate, a little wider behind; black, sparsely pubescent with fine white hairs. Beak (♂) cylindrical, about as long as head and thorax, curved, feebly dilated, finely but distinctly punctate, alutaceous and dull except for the shining tip. Front more coarsely punctured, the punctures confluent, forming longitudinal grooves. Eyes not prominent. Antennae inserted at basal 1/4, first joint piscescent, equal at least to the next two, but shorter than next three, 2d joint subcylindrical much longer than wide, and more than reaching eye. Thorax wider than long (5 to 4) widest behind middle, sides narrowed at base, decidedly converging from middle to the constricted apex. Punctuation strong and close, but not coarse. Basal fovea distinct, reaching middle. Elytra 8/13 as wide as long, widest behind middle, humeri subangulate, striae not very deep, intervals convex, nearly twice width of striae, both intervals and striae with rows of fine white hairs. Meso- and meta-sternal side pieces covered with white scales. Punctuation of 1st and 2d ventrals rather fine and sparse, coarser on metasternum. Legs black, first joint of mid and hind tarsi with a strong spine, tibiae unarmed, fore and mid femora equally, not excessively dilated. Length, 2.2 mm.

*Hab.:* Iowa.

Type, a male in my collection from Lake Okoboji.

In Fall's key this species will come next to *spinipes* Fall, from which it can be easily separated by the elongate, almost cylindrical second antennal joint which is as long as, or longer than, 3 + 4, while in *spinipes* the 2d joint is more triangular in outline and distinctly shorter than 3 + 4. The beak in *spinipes* is also more strongly and evenly curved, the thorax less convex longitudinally and with weaker punctures.

*Apion impunctistriatum*, *melanarium*, *robustum*, *minor*, and *griseum*, already recorded from Iowa, were found at Okoboji, and, in addition, the following 7 which are new to the state list:

*A. occidentale* Fall. Inhabits most of the country west of the Mississippi River.

*A. punctinasum* Smith. Fall gives its range as Wyoming, Nevada, and B. C. I also have Alberta specimens.

*A. tenuirostrum* Smith. 15 specimens. Known from Kansas, Nebraska, Texas, Colorado and Montana.

*A. turbulentum* Smith. Three specimens. The mucro of the mid-tibiae of the one male is dentate, of the hind tibae simple.

*A. centrale* Fall. Known from Colorado, Montana, Hudson Bay Territory, and British Columbia.

*A. varicorne* Smith. A dozen individuals, which agree best with Fall's var. b. The range of this form is given as "North-West Territory," Nebraska, Texas, and Colorado.

*A. carinatum* Smith. Ranges over most of the country, but not common.

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## ON THE TAXONOMIC VALUE OF LARVAL CHARACTERS IN TACHINID PARASITES (DIPT.).

By W. R. Thompson, *Bureau of Entomology.*

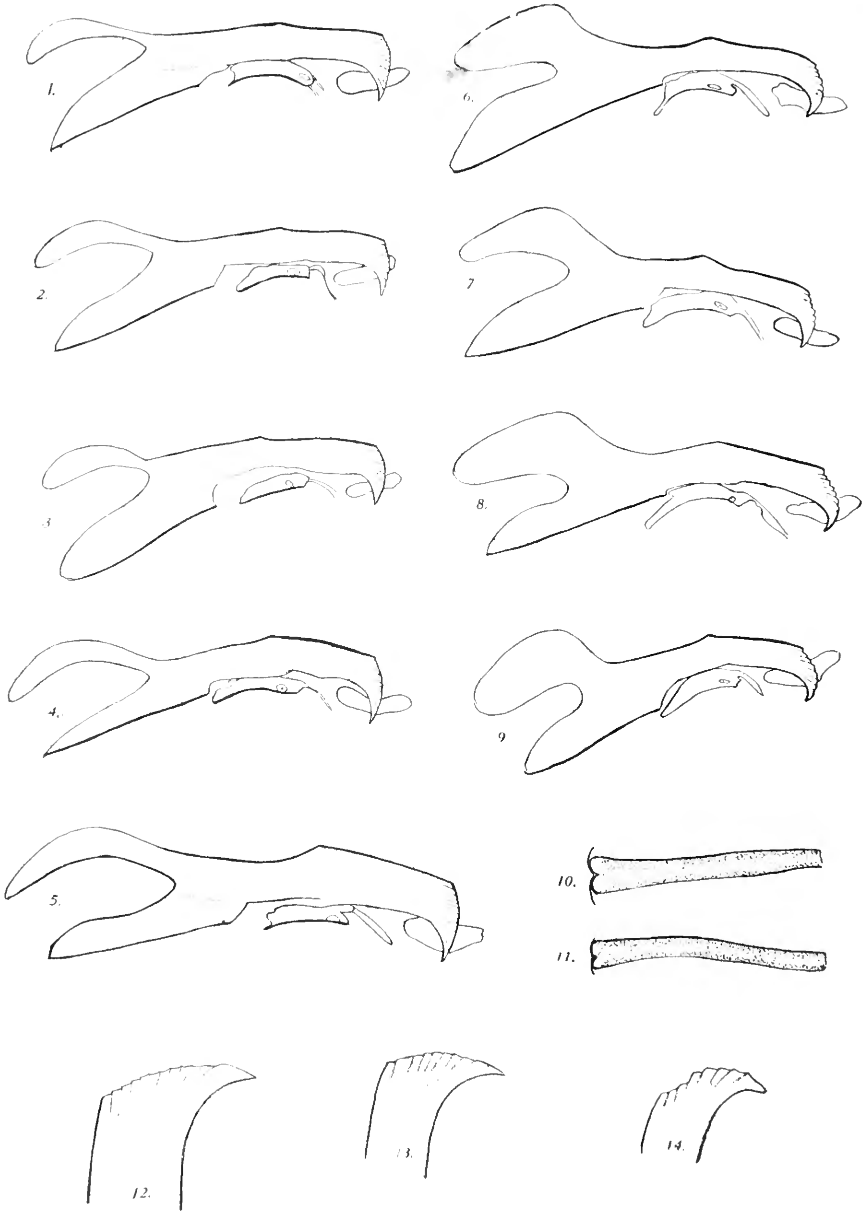
The present paper, which deals with one of the parasites of the European Corn Borer, is offered as a proof and an example of the fact that in the family Tachinidae, it is at times almost or quite impossible to define genera or species with the precision necessary in practical entomological work with reference to the morphology of the adult flies alone. It sometimes happens that species belonging to this group, though easily separated by constant and well marked characters in the larval stage are in the adult stage so similar that it is only possible to separate them, by characters, whose value in the group as a whole is so open to question, that to admit their validity in general, would be to plunge the taxonomy of the family into inextricable disorder Such is precisely the state of affairs in the case of the parasites considered in this paper.

In 1919, Madame A. Vuillet of the French Entomological Service reared from specimens of *Pyrausta nubilalis* collected in South-Western France, a Tachinid determined by Dr. J. Villeneuve as the dark variety of *Paraphorocera senilis* Rond. In the following year I reared further specimens of the same form which were determined by the same authority.

On comparing the primary larvae of the species reared from the Corn-Borer with larvae extracted from a female labelled *Paraphorocera senilis* in the collection of the Entomological Museum of the University of Cambridge, I found that certain well marked and constant differences in the conformation of the bucco-pharyngeal armature existed between these larvae.

A little later I sent to Dr. Villeneuve for determination a lot of Tachinids among which were several specimens collected in the garden of Haslar Hospital, near Portsmouth, England. These were labelled by him as *Paraphorocera senilis;* but on examining the larvae, of which I possess a large series, taken from a number of different females collected on the same spot, I found that they differed from those of both the other forms mentioned above.

On June 9, 1920, I collected in the garden of the laboratory of




THOMPSON—LARVAL CHARACTERS IN TACHINIDAE.

*Figures 1–4.*—*Paraphorocera senilis*, typical form, first stage buccopharyngeal armature: 5, *senilis*, variety "c" first stage buccopharyngeal armature: 6–9, *senilis*, variety *gratiosa* (from caterpillars of *Pyrausta nubilalis*) first stage buccopharyngeal armature: 10, *senilis*, variety "c," felt-chamber of the posterior spiracles, first stage: 11, *senilis*, typical form, felt-chamber of posterior spiracles first stage: 12, *senilis*, variety "c," tip of first stage buccopharyngeal armature: 13, *senilis*, typical form, tip of first stage buccopharyngeal armature: 14, *senilis*, variety *gratiosa* (from caterpillar of *Pyrausta nubilalis*), tip of first stage buccopharyngeal armature.

the United States Bureau of Entomology at Auch, Gers, (South-West France), a female Tachinid which seemed to me to be practically indistinguishable from the form reared from the Borer and which contained fully-developed larvae. I sent the specimen to Dr. Villeneuve and he returned it with the label, *Paraphorocera senilis*, dark variety, stating further that this form had been described by Brauer and von Bergenstamm under the name of *Leptotachina gratiosa*. The larvae obtained from this female differed from those found in the caterpillars of the Corn Borer but were morphologically inseparable from those of the species in the Cambridge Museum collection.

*Figure 15.*—*Paraphorocera senilis*, variety "c," first stage buccopharyngeal armature. This specimen was collected at Auch, while that represented in figure 5 is from a Cambridge specimen.

Thus, in the material examined there exist three types of larvae corresponding to adult females all determined by the same distinguished dipterologist. Of the form which appears to be the typical *senilis* we have a large[1] series of larvae extracted from a series of adult females taken at Haslar: of the form reared from the Corn Borer we have numerous larvae taken from caterpillars of *Pyrausta nubilalis* in an area extending from Mont-de-Marsan (Landes) in South-Western France, through Menton (Alpes Maritimes) near the Italian frontier, to the region around Naples: finally, of the third form we have two series of larvae, one from a female in the Cambridge collection the other from a female taken at Auch. As has already been stated, each of these larval forms is morphologically distinct and each is represented by material sufficiently extensive to prove the relative constancy of the characters distinguishing it. In order to make this clear the accompanying series of drawings has been prepared showing four buccal armatures of each of the first two forms and two of the third. Each armature represented has been taken either from a separate female or from a separate larva of the Borer in order to demonstrate that the various forms are not simply variations characteristic of certain

[1]With the exception of the Cambridge female, determined, I think, by Mr. Wainwright.

females but represent races, varieties or species. The figures of the anterior extremity of the mouth hook of the three types show the precise nature of the differences between the three varieties: while the drawings of the thoracic region show the differences in the pattern of the spine bands as well as the differences in the dimensions of the first stage larvae. It should be noted, however, that the figure of the larva of the *gratiosa* variety was prepared from a specimen taken from a caterpillar of the Borer and that consequently this specimen is probably larger than are the newly born larvae of this type. Finally, although the body and mouth armature of the larvae of the females taken at Haslar are uniformly larger than those of the larvae of the specimens from the Cambridge female, the felt-chambers of the posterior spiracles are of the same size in these two forms.

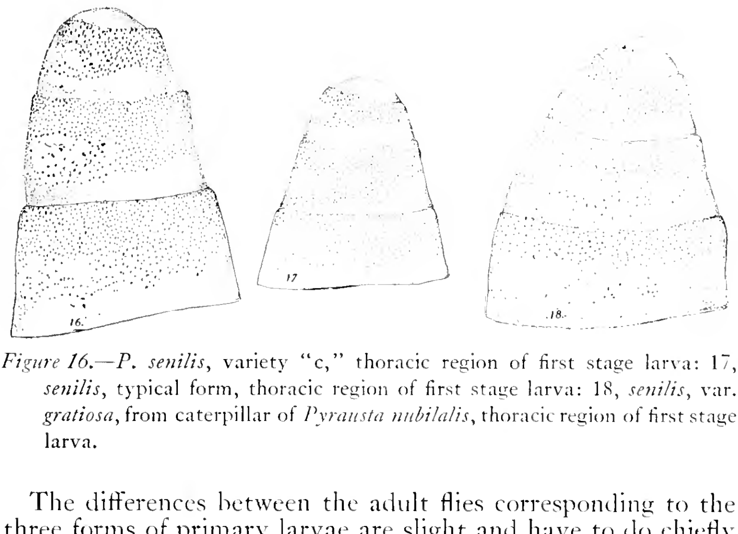



*Figure 16.—P. senilis*, variety "c," thoracic region of first stage larva: 17, *senilis*, typical form, thoracic region of first stage larva: 18, *senilis*, var. *gratiosa*, from caterpillar of *Pyrausta nubilalis*, thoracic region of first stage larva.

The differences between the adult flies corresponding to the three forms of primary larvae are slight and have to do chiefly with the color and distribution of the pollen of the head and thorax. The adults collected at Haslar, which may be considered as the typical *senilis*, since they agree with a specimen of this species which Dr. Villeneuve kindly supplied from his own collection and with a female (containing undeveloped larvae) so determined by him and collected at Auch, have the pollen of head and body yellowish or golden. The specimens reared from the Corn Borer, determined by Dr. Villeneuve as *senilis* var. *gratiosa* B. B., have the pollen of the head and body blue or bluish grey: but as the specimen of the third variety collected at Auch is also bluish grey and was also determined by Dr. Villeneuve as the *gratiosa* variety, it is not now possible to say which of these two forms really corresponds to the variety described by Brauer and von Bergenstamm, especially since according to these two authors (Denks. Akad. Wien. LVIII, 330, 1891), both forms are blue-grey or grey-black species. The adults corresponding to the three forms of larvae may be separated somewhat as follows:

Pollen of head and body yellowish — *senilis* (typical)
Pollen of head and body bluish.
  Three rather ill defined and broad post-sutural thoracic vittae
   *senilis* var. *gratiosa* (B. B.?)
  Five well defined and narrow post-sutural thoracic vittae
   *senilis* var. "c."

However, as I possess but one specimen of the variety "c" and but three of the form provisionally called *gratiosa*, the value of these distinctions, which in some species of Tachinids would come well within the limits of specific variation, remains somewhat doubtful For this reason, in spite of the fact that the differences between the primary larvae are sufficiently well defined and apparently constant, it does not appear advisable to create new specific or varietal names to cover any of the three types of *senilis*, especially since the synonymy of this species is already fairly extensive. To give these forms definite systematic status as species or even as varieties will not increase the value of the differences between them nor will it make them any easier to separate in the adult stage than they now are

The case considered in this paper, of a species presenting in the larval condition several morphologically distinct forms—associated perhaps with different larval environments—but in the adult condition morphologically homogeneous or almost so, belongs to a group of phenomena studied in a series of papers by the eminent biologist Alfred Giard, and grouped by him under the general techical term of *pœcilogony* (Giard, Oeuvres Diverses, I Biologie, nos XLI–XLVI).

The phenomenon of pœcilogony if it really exists is not one which either the systematician or the practical entomologist can afford to neglect. If in a given "species" there exist races or varieties almost or quite inseparable in the adult, which are nevertheless separated in the larval stage by distinct and constant differences, it follows that between these races there may exist fundamental or constitutional differences which the practical worker is obliged to take into account. To make this clear it will be sufficient to consider briefly the case of the parasite studied in this paper. This species is in certain regions of Europe an important parasite of the Corn Borer and an effort is therefore being made by the United States Bureau of Entomology to introduce it into the North American areas invaded by this insect. Now let us suppose that one of the other races of *senilis* here described was found to parasitize abundantly some other European insect already existing in the infested areas: and that this race had been assumed on the report of a reputable specialist to whom the adult parasites had been submitted to be identical with the form attacking the Borer. In such a case the collection and shipment of parasitized caterpillars of the other insect would naturally appear to be a legitimate and desirable proceeding: and unless a subsequent study of the larval forms disclosed the differences between the two parasites, the total failure of an experiment which perhaps entailed a considerable expenditure of time and money would come as a disagreeable surprise and the reasons for this failure would remain quite obscure.

The question is, however, whether the phenomenon of pœcilogony really exists: or in other words whether it might really be impossible for the trained specialist, even when fully awake to the difficulties presented by a particular case, to discover definite characters for the separation of the races in the adult stage.

At first sight it would seem that such differences must of necessity exist: for if two individuals produce offspring morphologically different at birth it would seem to follow logically that the differences in these offspring must have their origin in differences in the adults which it ought to be possible for the trained eye of the specialist to detect. Viewed from this stand-point—which I have found in practice to be that of a representative and reliable specialist—the phenomenon of pœcilogony appears to be an impossibility. Nevertheless it can be shown to be practically if not theoretically possible: and to demonstrate this it is only necessary to reduce the phenomenon to its simplest expression and study it in its simplest form.

Reduced to its most general form the question of the existence of pœcilogony may be expressed somewhat as follows:

*Whether two continuous series expressed by different formulae and consequently fundamentally different when taken as a whole are nevertheless under certain circumstances practically indistinguishable in certain homologous portions of their trajectories.*

So expressed, the question can for practical purposes be solved by the use of elementary mathematical methods: bearing in mind the fact that the mathematical study of plane curved and straight lines is simply a morphological study of a type much simpler than that with which the biologist has usually to deal—a morphology in which the laws of form are both clearly and simply expressed.

In figures 19 A and 19 B I have plotted the corresponding portions of two plane curves of which the laws of development or in mathematical language, the formulae, are known. An inspection of these two curves will show that they are so similar in form as to be practically identical: so that it would not be possible by an examination of the morphology of these regions of the curves, to refer them to different species. An inspection of the following table, giving the length at a series of points of the radius vector whose extreme point sweeps out the curves, will serve to show how close the correspondence is in the regions considered:

| Vectorial angle Degrees | Length of Radius Vector Curve A | Curve B |
|---|---|---|
| 0 | 4.002 | 4.000 |
| 10 | 3.968 | 3.970 |
| 20 | 3.870 | 3.880 |
| 30 | 3.728 | 3.730 |
| 40 | 3.530 | 3.530 |
| 50 | 3.300 | 3.280 |
| 60 | 3.050 | 3.000 |
| 70 | 2.800 | 2.680 |
| 90 | 2.280 | 2.000 |
| 110 | 1.860 | 1.320 |
| 130 | 1.570 | 0.710 |
| 150 | 1.390 | 0.270 |
| 170 | 1.289 | 0.030 |
| 180 | 1.290 | 0.000 |

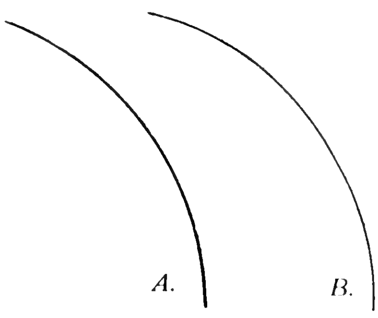



*Figure 19.*—A, B, similar portions of the two curves represented in Figure 20.

As the table shows, until the radius vector has swept through an angle of about 60 degrees its length is practically the same for the two curves, the slight differences in the figures being due at least in part to inaccuracies in calculation and to an imperfect choice of constants in the formulae. After this point, however, as the figures for the length of the radius vector show, the differences between the two curves become more and more marked until the vectorial angle approaches 300 degrees after which the curves again become similar.

The complete curves are represented in figures 20 A and 20 B and it is obvious from these that the mere inspection of the portions of the curves on the left hand side of the figures enables us to classify them at once as distinct morphological species. The curve A is of course the circle, whose formula, in polar coordinates is in this case

$$r^2 - 2Rr \cos \theta + R^2 - a^2 = O$$

the circle plotted being represented by the equation

$$r^2 - 2.7 \ r \cos \theta - 5.2 = O$$

while the curve B is the one known as "Pascal's snail," whose formula is

$$r = a \cos \theta - a$$

where r = length of radius vector, R = length of radius of the circle plotted, a = a constant and $\theta$ = the vectorial angle: the value of *a* in the equation for the curve B being in this case, 2.

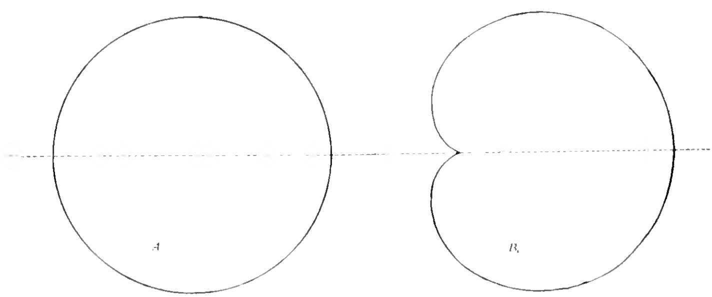



*Figure 20.*—A, circle, B, "Pascal's snail" or cardioide.

Thus, from two forms which are at least in practice morphologically indistinguishable one from another but nevertheless develop according to different laws of growth, there may arise forms morphologically quite different: or conversely, two forms which are at a certain stage of development morphologically very dissimilar may in later stages become so much alike that it is practically impossible to refer them to different species: and this is precisely the phenomenon which we have found to exist in the case of the species studied in this paper, or more generally, the phenomenon of *pœcilogony*.

Pœcilogony is therefore a practical possibility: and since this is so it follows that the biologist undertaking operations with groups of organisms in which this phenomenon exists can not safely rely on the appearances presented by any given stage of the animal with which he has to deal: but must acquire a thorough knowledge of it in all the transformations through which it passes in the cycle of its development.

Finally, it is of interest to note that although such cases as the one studied in this paper may be considered as illustrations of certain special modes of the transformations of species—the differences between the larvae being interpreted as the result of the action of different environments or the resemblance between the adults as convergence resulting from the action of similar environments on forms originally unlike—nevertheless as the mathematical example shows, these cases could exist were species as fixed or immutable as are the mathematical formulae for the curves given above. Such cases can not therefore be considered as furnishing evidence for the transformist hypothesis as they can be perfectly understood without reference to this theory.

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## NEW SPECIES OF CICADELLIDAE (HOMOPTERA) FROM THE EASTERN AND SOUTHERN UNITED STATES.

By J. G. Sanders and D. M. DeLong, *State Capitol, Harrisburg, Pa.*

This paper presents the descriptions and figures of eleven new species of Cicadellidae (Jassidae) including original descriptions of the males of two species previously described. The types, where not otherwise indicated, are in the collections of the authors at Harrisburg.

### Chlorotettix dozieri, n. sp.

Plate 11, Fig. 1, 1a, 1b.

A species with broadly rounded vertex, in general appearance greatly resembling *viridius* but slightly larger with distinct genital characters. Length 6 mm.

Form rather stout and robust. Vertex broadly rounded and parallel margined, a little more than twice as wide between the eyes as the length at middle. Pronotum more than twice as wide as long and less than twice as long as vertex. Scutellum as long as pronotum. Elytra rather short and broad with a small appendix.

Color: Varying from pale yellowish green to bright apple green as in *viridius* and without definite markings. Legs dark green.

Genitalia: Female last ventral segment more than three times the length of preceding. Lateral angles strongly produced and broadly rounded either side of a deep V-shaped notch two thirds distance to base; lateral margins of notch sinuate to a small rounded median notch either side of which is a small indentation. Pygofers narrow, outer margins straight. Male valve one and one-half times as long as last ventral segment, very bluntly angled. Plates four times as long as valve, broad at base, outer margins convexly rounding to near the apices where they are slightly concave forming bluntly rounded tips. Apical third of plates bent upward.

This species might easily be taken for *viridius* without examination of the genital characters.

Described from one female and five males collected by H. L. Dozier, at Helena, Mississippi, July 18, 1920. Mr. Dozier had labeled the species *C. suturalis?* and stated in an accompanying letter that these were taken abundantly while sweeping among cypress shrubs. Most of the species of the genus are grass and sedge feeders, and if this occurs on Cypress it is an interesting addition to the known food plants of the group. We take pleasure in dedicating this species to the collector.

**Chlorotettix fallax**, n. sp.

Plate 11, Fig. 2, 2a.

Resembling *Ch. tergatus* in appearance, size and coloration, but with male genitalia very similar to the much smaller *Ch. viridius*. Length of male, 7.5 mm.

Vertex broadly rounded and almost parallel margined. Elytra subhyaline as in *tergatus*, and somewhat smoky at tips.

Male genitalia with valve slightly more than one-half length of preceding segment; convexly rounded but scarcely angled; width of plates together at base twice their length, very strongly and convexly rounded, and semicircular in outline.

Described from a single male specimen swept from prairie grasses in the Everglades, Paradise Key, Fla., Apr. 10, 1921, by D. M. DeLong.

**Chlorotettix divergens**, n. sp.

Plate 11, Fig. 3, 3a, 3b.

In size and coloration resembling *tergatus* but with a bluntly angled, produced head and very different genital characters. Length 7 mm.

Vertex bluntly, angularly rounded, almost one-third longer on the middle than next the eyes, not quite twice as wide as long. Pronotum less than twice the length of vertex, elytra long, tips appressed. Face almost as wide as long, gradually narrowed to clypeus.

Color: Face, lorae, clypeus and genae greenish yellow, unmarked; vertex, pronotum and scutellum dark greenish yellow, irregularly marked with darker areas. Elytra sordid greenish hyaline often smoky toward the tips, the dark veins of the wings showing through them. Beneath greenish.

Genitalia: Female last ventral segment more than twice as long as preceding, lateral margins convexly rounded to prominent, bluntly pointed lateral angles either side of a deep "U"-shaped excavation extending two-thirds the distance to the base with the apex slightly notched, exposing base of ovipositor. The basal portion of concavity narrowly brown bordered. Male valve rounded, longer but narrower than last ventral segment. Plates twice longer than valve and broader at base, outer margins strongly convexly rounded two-thirds the distance to the apex where they are distinctly narrowed and produced into long divergent tips. Secondary brown foliaceous plates are visible at the margins of the ventral plates.

Described from six female and twelve male specimens collected at Cape Charles, Va., by the Junior author, August 2 and 3, 1920. They were swept from patches of tall grasses growing in pine woodland.

**Chlorotettix latifrons**, n. sp.

Plate 11, Fig. 4, 4a.

Resembling *unicolor* in size and form, but dull greenish yellow in color and with distinct genitalia. Length 8 mm.

Vertex broadly rounded, parallel margined, more than twice as wide as long, and strongly rounded to front. Pronotum twice as long as vertex. Face very broad, gradually narrowed to clypeus.

Color: Dull yellow without definite markings, often spots or blotches slightly bronzed and usually a darker blotch on apex of vertex. Veins somewhat darker especially on the smoky apical portion.

Genitalia: Last ventral segment of female longer than preceding. Lateral angles rounded but prominently produced. Between these the posterior margin is strongly concavely excavated half way to the base, in the middle of which is a rather V-shaped notch extending entirely to the base. The notch and posterior margin are broadly bordered with dark brown.

Because of the large size and distinct genital characters it is strange this species has not been previously captured and described.

Described from two female specimens collected by the junior author at Cape Charles, Virginia, August 3, 1920, swept from very coarse sedges on the sandy margins of a salt marsh, and a female specimen received from Mr. H. L. Dozier taken at Pascagala Mississippi.

**Chlorotettix capensis**, n. sp.

Plate 11, Fig. 4, 4a.

A narrow yellow species with bluntly angled head. Length of male and female 6 mm.

Length of vertex equals one half width between eyes, strongly produced. Pronotum almost twice as long as vertex, very convex anteriorly.

Color above dull greenish yellow; elytra subhyaline; paler beneath; eyes rich maroon in fresh specimens.

Genitalia: Female last ventral segment equals preceding one, lateral angles strongly produced, slightly rounded; posterior margins shallowly concave to prominent rounded angles either side of a narrow V-shaped notch extending two-thirds of distance to base; median notch broadly bordered with brown. Basal pieces of ovipositor plainly visible behind posterior segment. Male valve bluntly angled, length one-half the width; plates exceeding valve by more than its length, gradually narrowed toward tips which are broadly rounded to distinct inner angles.

Described from four specimens collected from *Panicum hemitomum* (Maiden Cane) at Paradise Key, Fla., Apr. 6–9, '21, by D. M. DeLong; 2 specimens same locality, Apr. 1 and 9, 1919, by C. A. Mosier; also 4 specimens from Cleveland, Fla., Apr. 25–28, one from Miami, Fla., Apr. 12, and one from Ft. Myer, Fla., Apr. 24, collected by DeLong in 1921.

**Chlorotettix productus** S. & DeL.

Plate 11, Fig. 6.

This species was described[1] from female specimens only collected at Battle Pt., Va., by the senior author. Numerous females have been collected at LaBelle and Cleveland, Fla., by D. M. DeLong, as well as males which apparently belong to this species, and are here characterized for the first time.

Male, dull yellowish green, as in the female. Length, 4.5 mm.

Genitalia: Male valve triangular with apex rounded, equal in length to preceding segment. Plates exceeding valve by almost twice its length, lateral margins almost straight, gradually narrowed to rather broad, blunt apices.

**Chlorotettix minimus** Baker.

Plate 11, Fig. 7, 7a, 7b.

Resembles *Ch. viridius* VD. in form and color, but is closer to *Ch. productus* S. & DeL., in size and genital characters. Length of female 5 mm.; male, 4.5 mm.

Vertex bluntly rounded and slightly produced, twice as wide as long. Elytra pale subhyaline and faintly smoky at tips.

Genitalia: Female last ventral segment twice the length of preceding with lateral margins gradually sloping to the posterior margin, which is strongly produced at middle. A narrow sinuate incision extends nearly to the base of posterior segment, forming a small rounded projecting inner lobe, bounded outwardly by a concave emargination often forming a small indistinct secondary lobe from which the margin slopes gradually toward the base. Male valve broadly rounded, almost twice the length of preceding segment. Plates exceed

[1] Am. Entom. Soc. Amer. XII, p. 236 (1919). Figures.

valve by two and one-half times its length, broad at base, gradually and evenly narrowed to sharp-pointed tips.

Eighteen specimens were collected at Miami, Cleveland and La Belle, Fla., Apr. 2–28, 1921, by D. M. DeLong from coarse grasses.

*Note*: In Baker's original description (Can. Ent. XXX, p. 220, 1898) he ascribes to *minimus* a male collected at Corumba, Brazil, which doubtless is the male of another species (undetermined), the female of which was collected at this place and is labeled erroneously as "*Ch. minima*" var. The females of typical *minimus* were collected at Chapada, Brazil. This is therefore the first description of the true male of *Ch. minimus* Baker.

The male Chlorotettix originally ascribed by Baker to *minimus* and the female labeled as "*Ch. minima* var." both of which were collected at the same place in Brazil are described below.

**Chlorotettix bakeri**, n. sp.
Plate 11, Fig. 8, 8a.

This species resembles *Ch. minimus* in size and form, but differs strikingly in the genital characters.

Female last ventral segment about twice as long as preceding segment; lateral angles broadly rounded to posterior margin which is broadly and roundingly notched one-third distance to base of segment. Male valve equals preceding segment in length, broadly and evenly rounded; plates about four times as long as valve, broadly and convexedly expanded toward the base, then abruptly and concavely narrowed two-thirds their distance to apex forming narrow rounded tips.

A male (holotype) and female specimen in the Baker collection, U. S. Nat. Museum labeled "Corumba, Brazil, May." U. S. Nat. Mus. Type No. 24951.

The male specimen was labeled originally "*Chlorotettix minima*"; and the female as "*Ch. minima* var" by C. F. Baker.

**Chlorotettix excultus**, n. sp.

*Chlorotettix minimus* DeLong, Bull. Ohio St. Univ. XXIII, No. 15, p. 21, Figs. 18 a and 18 *b* (1919), cited in error.

The description and figures appearing as above were prepared from two specimens, one each from Florida and Jamaica, loaned to the junior author by Mr. E. P. Van Duzee and labeled "*Ch. minimus* Baker." On examination of Baker's types, it became evident that these specimens were erroneously identified, and that they require a new specific name. No description is appended on account of the availability of the description and figures as cited above. The type is from Florida and has been returned to Mr. Van Duzee and doubtless is in his collection at the present time.

**Phlepsius cottoni,** n. sp.
Plate 12, Fig. 1, 1a, 1b.

A blunt headed, rather robust species resembling *incisus* in size and form but with unusually distinct genital characters. Prevailing color pale. Length: female 6.5 mm.; male 6 mm.

Vertex very blunt and almost parallel margined, a little longer on middle than next the eyes, more than three times as broad as long and broadly rounding to the front. Pronotum more than twice as long as vertex and twice wider than long. Elytra rather broad and flaring at tips. Face broad and convexly rounded.

Color: Vertex, pronotum, scutellum and face white, rather heavily but irregularly irrorate with brown. Scutellum more heavily marked, with three conspicuous white spots, one at apex and one midway on either side. Elytra white rather sparsely and irregularly inscribed with brown. Posterior half more heavily inscribed, apex and spots along costa dark brown.

Genitalia: Female last ventral segment twice as long as preceding. Side margins abruptly narrowed about one-third the distance to apex, then convexly produced to posterior margin which is slightly sinuated forming four indistinct lobes, a small one at either side and two larger ones at middle, the latter two separated by a rather broad shallow notch. Male valve triangular, almost equilateral, longer than last ventral segment; plates divergent, produced the length of valve beyond its apex, outer margins at base almost straight then abruptly narrowed at two-thirds their length to the robust, parallel margined and bluntly rounded apices.

Described from five females and one male; one female collected by R. T. Cotton, Orlando, Fla., Aug. 20, 1920; three females collected at Cleveland, Fla., Apr. 26, 1921, and a pair at Orlando, Apr. 29, 1921, by D. M. DeLong.

**Phlepsius planus,** n. sp.
Plate 12, Fig. 4, 4a, 4b, 4c.

A plain undecorated, buff species resembling *Ph. nebulosus* in size and color-tone, but with a short sharp vertex. Length of female, 8 mm.; male, 7 mm.

Vertex short, almost parallel-margined, margin somewhat compressed and slightly upturned, four times as wide as long, and less than half the length of pronotum. Elytra broad and flaring.

Color: Face, vertex, pronotum and scutellum irregularly and sparsely marked and inscribed with dull brown. Markings of elytra very sparse, following the veins or in linear pattern. Two female specimens show a distinct brownish spot near middle of elytra. General color-tone above and below is dull buff.

Genitalia: Female last ventral segment more than twice length of preceding. Lateral angles strongly produced and rounded either side of a broad rectangular excision one-fourth distance to base, the posterior margin of which is produced and angularly notched at middle forming two broad brown teeth. Male valve distinctly triangular and pointed at apex, exceeding length of preceding segment. Plates exceed valve by three times its length, somewhat concavely narrowed from base to small blunt tips.

Described from twenty-three specimens from Paradise Key, 22 collected by D. M. DeLong, Apr. 5–10, 1921, swept from *Panicum hemitomum* (Maiden cane) in the everglades, and one specimen collected by Schwarz and Barber, U. S. National Museum Collection, Feb. 19, 1919; also one specimen collected at Cleveland, Fla., Apr. 25, 1921, by J. N. Knull.

**Thammotettix virginianus**, n. sp.

Plate 12, Fig. 2, 2a, 2b.

Resembling *fitchii* in size and general appearance but with blunter head, strongly marked with orange stripes and with distinct genital characters. Very similar to *Thamnotettix aureovitattus*.[1] Length: female, 4 mm.; male, 3.5 mm.

Vertex blunt, almost rounded, a little longer on middle than next eyes and a little broader at base between eyes than length at middle. Pronotum twice as wide as long, longer than vertex. Elytra long, greatly exceeding abdomen.

Color: Dull yellowish marked with black and orange. Vertex with ocelli and four spots above margin black. Two approximate ones at apex and a somewhat larger one either side just above ocellus. Vertex washed with orange, a definite longitudinal stripe either side extending across pronotum and onto scutellum. Pronotum with two fainter longitudinal stripes either side behind eyes. Elytra orange shading to dusky orange at apex; veins pale, smoky margined on posterior portion. Beneath dull yellow, marked with orange.

Genitalia: Female last ventral segment about one-half longer than preceding. Posterior margin convexly rounding and slightly notched either side of a central, rather narrow blunt embrowned tooth, produced at least one-third the length of the segment. Male valve as long as last ventral segment, broadly convexly rounded. Plates two and one-half times longer than valve, broad at base, gradually narrowed to closely appressed tips which together are broadly rounded.

Described from two female specimens from Cape Charles, Virginia, collected by the junior author, July 31, 1920, swept from tall grasses along the sandy shore; and a male specimen collected at Battle Point, Virginia, June 22, 1918, by the senior author.

**Typhlocyba inscripta**, n. sp.

Plate 12, Fig. 3, 3a, 3b, 3c.

A milky white species with bizarre brown markings on apical portion of wings. In general appearance resembling species of *Empoa*. Length 4 mm.

Head rounded before, twice as wide between eyes as length at middle. Pronotum more than twice as long as vertex and much broader, with humeral

[1]Penna. Bur. Plant Industry, Tech. Ser. Bull. 1, p. 16 (1920).

angles produced and rounded. Elytra long, narrow, broadly rounded on outer apical margin and concavely truncate toward inner margin. Two apical veinlets reflexed to costal margin.

Color: Face, vertex and scutellum white, washed with yellow. Pronotum and elytra milky white, the latter with a large central area on apical cross veins dark brown. From this area a number of brown lines radiate to apex, costa and corium, following the veins; with an irregular brown band returning diagonally toward middle of costal margin. Venter black, borders of abdominal segments and male genital plates pale.

Genitalia: Female last ventral segment four times as long as preceding, lateral margins strongly produced and rounded. Posterior margin roundingly excavated one-third the distance to the base either side of a broad central rounded tooth one-third as broad as the segment and equaling or exceeding in length the lateral angles. Male valve more than twice as long as last ventral segment, posterior margin with broad V-shaped notch extending from the lateral angles one-third the distance to the base. Plates narrower than valve and twice longer, margins almost parallel, tips broadly rounded.

Described from a series of eleven female specimens collected at Kew Garden, London, England, August 27, 1919, by the senior author, and seven male specimens taken from pear tree at New Haven, Connecticut, July 6, 1920, by Mr. B. H. Walden.

We have not been able to identify this species with any described European form, and since a record of its occurrence in the United States should be established we are giving it the above name.

## DESCRIPTION OF PLATES

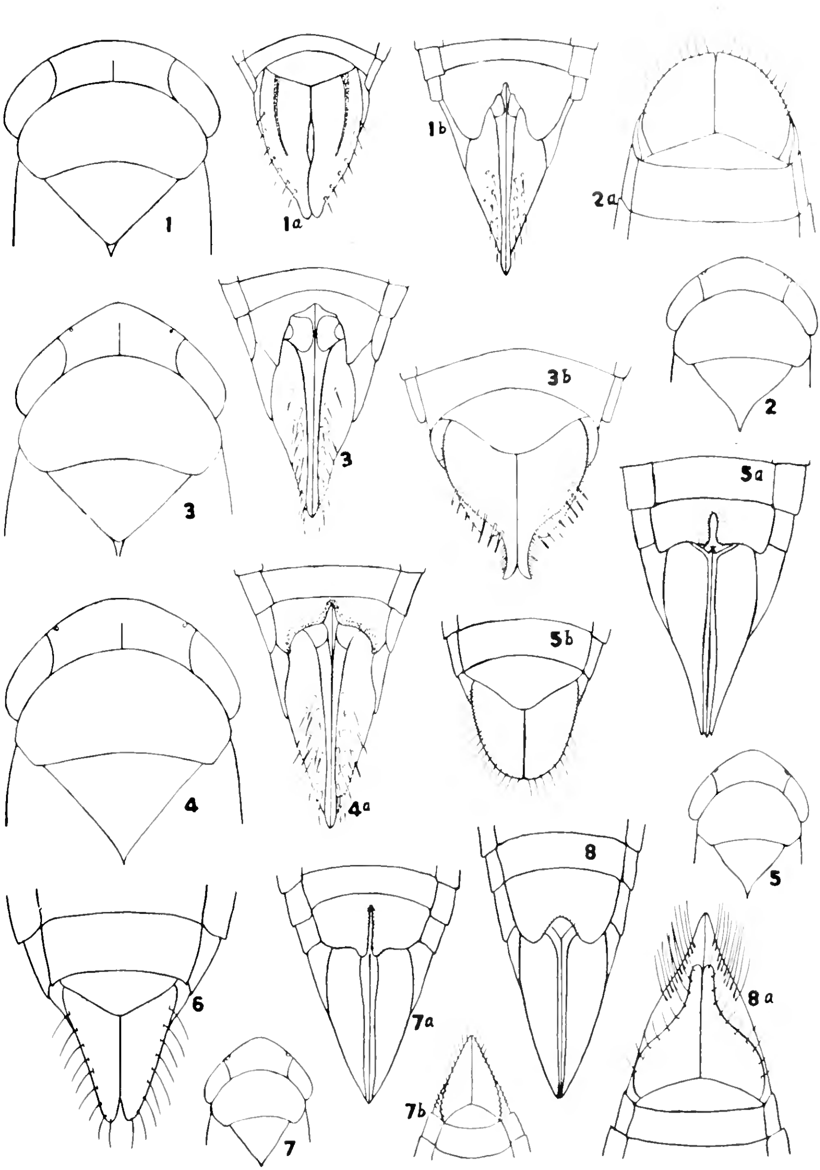
### Plate 11.

1. *Chlorotettix dozieri* n. sp. 1a—male genitalia; 1b—female genitalia.
2. *Chlorotettix fallax* n. sp. 2a—male genitalia.
3. *Chlorotettix divergens* n. sp. 3a—female genitalia, letter *a* obliterated by engraver; 3b—male genitalia.
4. *Chlorotettix latifrons* n. sp. 4a—female genitalia.
5. *Chlorotettix capensis* n. sp. 5a—female genitalia; 5b—male genitalia.
6. *Chlorotettix productus* S. & DeL.—male genitalia.
7. *Chlorotettix minimus* Baker. 7a—female genitalia; 7b—male genitalia.
8. *Chlorotettix bakeri* n. sp. female genitalia; 8a—male genitalia.

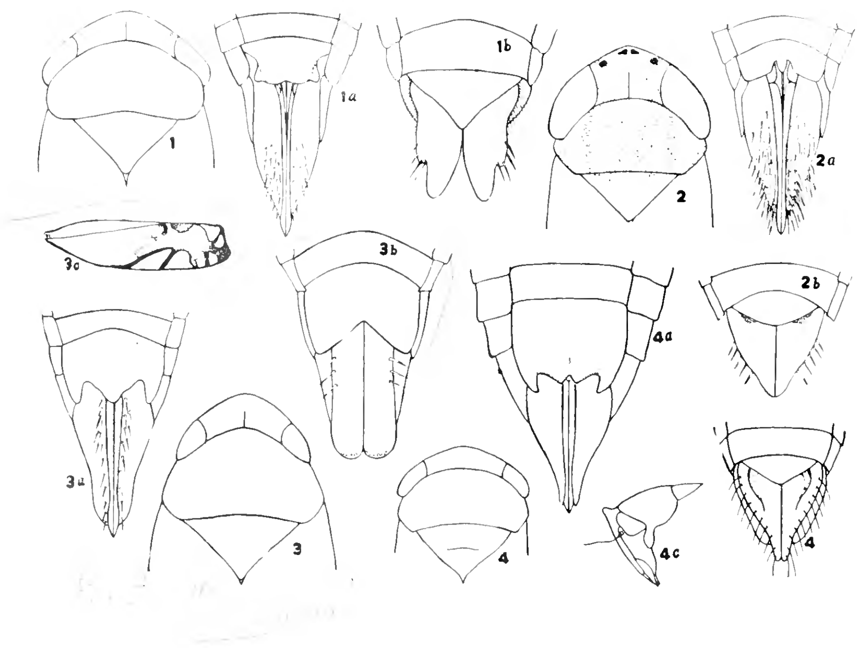
### Plate 12.

1. *Phlepsius cottoni* n. sp. 1a—female genitalia. 1b—male genitalia.
2. *Thamnotettix virginianus* n. sp. 2a—female genitalia; 2b—male genitalia.
3. *Typhlocyba inscripta* n. sp. 3a—female genitalia; 3b—male genitalia; 3c—elytron.
4. *Phlepsius planus* n. sp. 4a—female genitalia; 4b—male genitalia, letter *b* obliterated by engraver;[1] 4c—side view of head.

[1] Block supplied by authors.




SANDERS AND DE LONG—NEW CICADELLIDAE.




SANDERS AND DE LONG—NEW CICADELLIDAE.

# TWO NEW SPECIES OF REDUVIIDAE FROM THE UNITED STATES (HEM.).

H. G. Barber, *Roselle, N. J.*

## Alloeorrhynchus Fieb.

The genus *Alloeorrhynchus* almost world-wide in its distribution has three representatives in the neotropical realm. No member of the genus has hitherto been reported from within the United States, although a closely related genus *Phorticus* is represented in Texas. Members of the genus *Alloeorrhynchus* can be differentiated by the unkeeled ventral base of the abdomen; shining body; longer basal segment of the antenna and by the character of the fore and intermediate femora which are angularly dilated or toothed beneath near the middle and finely denticulate from thence to apex. The anterior tibiae are inwardly widened at apex and provided with spongy fossa.

## Alloeorhynchus nigrolobus, n. sp.

Flavo-testaceous, sparsely pilose. Head, posterior lobe of pronotum, scutellum, meso- and metasternum nigro-piceous; apical part of corium and antennae except basal segment infuscated. Scutellum and metapleura dull; corium, membrane and remaining parts shining. First segment of antenna pale, clavate, the remainder of the antenna embrowned, more densely pilose, second segment fully twice as long as first segment. Rostrum pale testaceous, second segment as long as third and fourth taken together. Anterior lobe of pronotum bright yellow verging into orange, over twice as long and nearly two-thirds as wide as posterior lobe. Legs entirely pale testaceous; fore femora angularly dilated forming a stout tooth about middle and furnished with minute black spines from thence to apex; fore tibia finely spinulose, abruptly expanded within on its apical third and furnished with spongy fossa along its obliquely truncated apex. Less incrassate intermediate femora widest across the middle point and there armed beneath with two acute black spines, from thence to apex with minute black spinules; inner face of intermediate tibia very finely serrate. Scutellum dull black, provided outwardly with few long hairs. Entire corium and clavus very shining, finely and sparsely pilose. Membrane less shining, irridescent, translucent, somewhat lacteous. Connexivum pale flavo-testaceous exposed beyond middle point of hemielytra. Venter shining, sparsely pilose, somewhat embrowned towards apex.

Length, 3½ mm.

Type ♂ Brownsville, Tex. (coll. by H. S. Barber); Paratype ♂ San Antonio, Tex. (coll. by H. Osborn.)—Collection of U. S. National Museum (Cat. No. 25205).

*Key to American Species of Alloeorrhynchus.*

1. Pronotum entirely nigro-piceous . . . . . . . . . . . . . . . . . . . . 2
— Pronotum with anterior lobe testaceous or rufo-testaceous . . . . . . . 3

2. Corium bright yellow, clavus and apical part piceous black. Length, 3½ mm. (Is. Grenada) . . . . . . . . . . . . . . . . *armatus* Uhler.
— Corium entirely nigro-piceous and shining throughout. Length 5 mm. (Panama, Colombia) . . . . . . . . . . . . . . . . *vittativentris* Stal.
3. Posterior lobe of pronotum rufo-testaceous, trimaculate with black. Corium fuscous with pale costal margin, inner field opaque. Length 5½ mm. (Mex., Guat., Panama, Brazil) . . . . . . *trimacula* Stein.
— Posterior lobe of pronotum entirely nigro-piceous. Corium pale testaceous, apically infuscated, shining throughout. Length 3½ mm. (Texas) . . . . . . . . . . . . . . . . . . . . . . . . *nigrolobus*, n. sp.

**Oncerotrachelus pallidus**, n. sp.

Color pale stramineous except outer marginal vein of membrane which is lightly infuscated and the apical portion of the venter which is slightly embrowned, as is the membrane.

Compared with *O. acuminatus* Say the body parts and appendages are less densely pilose, the antennae and legs being almost entirely devoid of the long hairs so distinctive of that species. The head is more prolonged before the eyes, these being relatively larger; the posterior lobe of head being slightly more globose dorsally and laterally.

Size larger measuring from 7–7½ mm. long.

Described from four specimens. Type ♀ Sabinal, Tex. (collected by F. C. Pratt); Paratypes ♀ Zavalla Co., Tex. (coll. by Hunter and Pratt) and 2 ♀s from Victoria, Tex., Collection of the U. S. Nat. Museum (Cat. No. 25204).

Easily distinguished from *O. acuminatus* Say by differences in size, coloration and pilosity. Say's species is always of a flavo-testaceous color with distinct fuscous markings above and below. Judging from the artist's figures Pl. XI, figs. 8, 8ª, Biol. Cent. Amer., the specimens from Mexico and Central America referred to by Champion, p. 180, may in all probability be referred to *pallidus*.

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## THREE NEW SPECIES OF PECULIAR AND INJURIOUS SPIDER MITES.

By H. E. Ewing, *U. S. Bureau of Entomology*.

Of the large number of spider mites that recently have been sent to the writer for determination, three species are somewhat remarkable; one for the dimorphism shown by the male, another for its wonderful plumose and foliaceous coat of setae, and the third for its gall-making habit, its peculiar mouth-parts and its possession of but six legs in all instars. The latter species, which is the second gall-making spider mite to be reported, has many morphological and biological affinities with the true gall mites, the Eriophyidae, and throws much light on the origin of the latter degenerate and highly specialized group. This gall-making species will be made the subject of a paper to be presented later on the phylogeny of the Eriophyids.

The first mentioned species belongs to the genus *Paratetranychus* Zacher, which genus is characterized by having one simple and one strongly deflexed divided tarsal claw.

The divided claw is split into 5 or 6 spurs, the inner one or two of which are usually somewhat stouter than the others. A formal description of the new species follows.

### **Paratetranychus heteronychus**, new species.

*Female.*—Distinctly larger and stouter than the male. Mandibular plate about three-fifths as broad as long and evenly rounded in front. Palpi moderate; thumb slightly exceeding claw, terminal digit about one and two-thirds times as long as broad at its base and pointed distally, two terminal digituli situated just above digit and each slightly surpassing the latter, sense seta fusiform, equal to digit in length; claw of palpus rather slender and strongly hooked toward tip; antepenultimate segment of palpus ring-like, about three times as broad as long. Abdomen with rather long simple setae arranged in the usual manner. Legs moderate, the anterior and posterior pairs being about equal and longer than the second and third pairs. Tarsal armature as follows: four tenent hairs in two groups as usual, outer hair shortest, inner next in length and two middle hairs longest and subequal; a single simple claw slightly over one-half as long as middle tenent hairs and a deflexed split claw of the six usual prongs the inner, or most strongly deflexed, ones being slightly stouter than the others. The deflexed claw is about two-thirds as long as the simple one, its inner spurs very slightly surpassing the somewhat tubercle-like base of claws. The simple claw is more strongly curved toward its tip and is rather slender throughout its length. Length, 0.38 mm.; width, 0.20 mm.

*Male.*—Smaller and more slender than the female, especially in the abdominal region. Palpal spur conspicuous, slightly recurved and situated on a prominent internally and dorsally situated tubercle. When the palpus is viewed from the inside this spur-bearing tubercle is seen to extend forward and upward for over half the length of the antepenultimate segment; antepenultimate segment longer, relatively in the male than in the female. Penis of the *telarius* type; inner lobe slightly longer than the shaft; basilar lobe apparently absent; shaft broad and stout, being fully one-half as broad at its base as it is long; hook short, recurved beyond 90° and with flattened barb. Legs relatively more slender than in the female; tarsi of first pair with two simple claws! One of these claws slightly shorter and deflexed. It evidently represents the barbed claw of the female. The deflexed claw of the second pair of legs is not simple yet differs from the corresponding claw of the female in that it is split into barbs for only a part of its length. Length of male, 0.31 mm.; width, 0.15 mm.

*Type locality.*—Coachella Valley, California.

*Type slide.*—Cat. No. 24720, U. S. N. M.

Description based upon specimens on two slides, one of them the type slide and the other a slide of cotypes. All specimens collected July 22, 1921, in Coachella Valley, California, and submitted by A. D. Borden with the label "date mite." The females of this species are similar to those of *P. viridis* (Banks) but differ from *viridis* individuals in having the finger of palpal thumb about one and two-thirds times as long as broad at the base instead of being almost as broad as long as in *viridis*. In the dimorphism of the male, as reflected in the tarsal claws, this species differs apparently from all other species of the genus.

**Eupalopsis pavoniformis**, new species.

Species of *Eupalopsis* are characterized especially by having the tarsal claws provided with pectines and by having the abdomen divided by one or more transverse sutures. The species here to be described is clothed with foliaceous and plumose setae. At the caudal end of the abdomen is a whorl of the latter, enormous in size. When this whorl is thrown forward the plumose setae arrange themselves into a fan, like the feathers of a peacock's tail when the peacock is strutting, hence the name *pavoniformis*. As a common name for this mite that of "The Peacock Spider Mite" is suggested.

*Female.*—Skin coarsely and somewhat irregularly reticulate; body clothed with large foliaceous setae and at the tip of abdomen with enormous, finely pectinate plumes; setae on legs foliaceous, pectinate setiform and simple setiform. Beak very long, slightly surpassing the palpi and deeply grooved above for the reception of the chelicerae. Palpi rather large; claw large, stout and strongly hooked; thumb slender, not swollen, tipped with two unequal setae, and not quite reaching the tip of claw. Dorsally the cephalothorax bears six foliaceous setae arranged into two longitudinal rows of three each. Abdomen apparently two-segmented, the dividing suture passing entirely around the body and just in front of the posterior coxae. Foliaceous setae on the dorsum of abdomen arranged as follows: A transverse row of eight setae just behind cephalothoracic groove; a similar transverse row, but of only six setae, just behind the abdominal groove; a row of eight setae, the posterior one being much reduced, along each lateral margin of abdomen; a circle of eight setae around middle part of postabdomen and a single seta in the middle of circle. The tail plumes are in a single whorl and number an even dozen. They are fully equal in length to the total length of the body, are wavy and flagelliform toward their tips, the flagelliform part of each seta being exceedingly minutely pectinate. Legs short and stout; first pair longer than the others which are sub-equal. Length, 0.44 mm.; width, 0.19 mm.

*Male.*—Unknown.

*Type locality*.—Hawaii.

*Type*.—Cat. No. 24721, U. S. N. M.

Description based exclusively on the type specimen. A paratype is in the writer's private collection, and a slide containing two distorted but well stained specimens is in the United States National Museum. All material taken on *Hibiscus*, from Hawaii, by L. A. Whitney at the port of San Francisco. This splendid and beautiful species differs not only from all other species of its genus, but from all mite species known to the writer, in the possession of its erectile whirl of long tail plumes.

## PHYTOPTIPALPIDAE, new family.

In 1905 Trägårdh described from an *Acacia* species, in Egypt, a very peculiar gall-making spider mite. He created for its reception the genus *Phytoptipalpus*, which he placed in the subfamily Tetranychinae. Not only was this species peculiar in its gall making habits, but, according to Trägårdh, even more peculiar in its transformations. Because of the structure of the mouth-parts being of the same type as in *Eriophyes* (formerly *Phytoptus*), Trägårdh suggested the name *Phytoptipalpus* for his new genus.

Quite recently there has been sent to me through Nathan Banks a collection of gall-making Phytoptipalpi, sent by C. S. Misra from India. The specimens were collected from the jujube tree (*Zizyphus jujuba*), the galls being cut off and inclosed with specimens in vials. Mr. Misra also sent, sealed in a glass tube, a fine specimen of a galled twig of the jujube preserved in spirit. The mite species makes blister-like galls by feeding under the bark, and specimens are found in all stages of development in a single gall, which during its earlier growth has no opening to the exterior.

A study of this species from the jujube shows it to be closely related to the one described by Trägårdh. I am convinced, however, that it has no such remarkable transformations as he describes for his *paradoxus*, also that the genus *Phytoptipalpus* has important morphological homologies with the Tetranychidae on the one hand and the Eriophyidae on the other, that were not observed by Trägårdh. In fact a morphological study of the species from the jujube, convinces the writer that in the genus *Phytoptipalpus* we not only have a group of family importance but a group that probably included species which were the direct ancestors of the gall mites, or Eriophyidae.

*Description of Family*.—The following characters are given for the new family, Phytoptipalpidae: Prostigmatic mites which are hexapod in all stages; palpi greatly reduced and completely fused with the maxillary base to form a guttered beak for holding the needle-like chelicerae. Chelicerae elbowed at the base as in Tetranychidae and situated in a greatly reduced mandibular plate which is completely concealed from above. Legs stout, six-segmented; tarsi in immature individuals with tenent hairs and in all instars with pecten-bearing claws. Vulva situated ventro-posteriorly; anus and penis terminal.

**Phytoptipalpus transitans**, new species.

*Female.*—In general appearances similar to *Tenuipalpus* species, cephalothoracic-abdominal groove marked and abdomen long and swollen in egg-bearing individuals. Cephalothorax with much of its anterior margin formed into a collar-like projection above the retractile mandibular plate. Eyes four, subequal, and with well developed corneas; posterior eye situated less than its diameter behind the anterior eye. Mandibular plate completely concealed from above; it is greatly reduced in size, being much narrowed and shortened in front, while posteriorly it is bilobed as usual. Chelicerae very slender, except near their bases where they are elbowed and enlarged; they lie in an almost capillary gutter on the upper side of the beak and are thrust from the beak at its tip and not through the opening on the lower side as stated to be the case with *paradoxus*. Palpi so completely fused with the beak that only the vestige of a single segment remains more-or-less marked off and bearing a single small seta. Beak as a whole rather stout and conspicuous and extending to tips of femora. Abdomen sparsely clothed with moderate, curved, obsoletely pectinate, setiform setae. Anus a subterminal and almost vertical, irregular slit. Vulva large, with more or less evenly folded, or crumpled, integument around its rim, situated as in Tetranychidae, *i. e.* ventrally, just in front of the anus. Legs stout and nearly subequal; posterior pair falling far short of tip of abdomen. Tarsi armed with a pair of inner, subequal claws and an outer pecten-bearing pair; pecten composed of several short subequal elements each of which is knobbed at its tip. Length, 0.33 mm.; width, 0.18 mm.

*Male.*—Considerably smaller than female and more slender. Abdomen frequently somewhat drawn out and always bilobed behind, each lobe bearing a distal and two inner setae. Penis very large and stout, composed of two elements that fit together making a strongly chitinized spike-like structure that is frequently observed extending beyond the abdominal lobes. Length, 0.20 mm.; width, 0.10 mm.

*Type locality.*—Pusa, India.

*Type slide.*—Cat. No. 24722, U. S. N. M.

Described from hundreds of specimens many of which were dissected or given special treatment. Some of the cotypes are on the type slide, some in a vial of material retained for the United States National Museum, some on slides for my private collection and some in a vial to be returned to Mr. Misra. All specimens were taken from galls on *Zizyphus jujuba* and were sent in by Mr. Misra from Pusa, India.

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PROCEEDINGS OF THE

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# A PRELIMINARY ACCOUNT OF TWO SERPHOID (PROCTOTRYPOID) PARASITES OF THE HESSIAN FLY.[1]

By Chas. C. Hill, *Bureau of Entomology*.

## INTRODUCTION

The Serphoids (Proctotrypoids), *(Polygnotus) Platygaster vernalis* Myers and *(Polygnotus) Platygaster hiemalis* Forbes, two important parasites of the Hessian fly, *Phytophaga destructor* Say, have been confused in the past as the same species by entomologists of this country. Although Webster (*19*)[2] predicted more than one species of Polygnotus as being involved with the Hessian fly, it was not until 1917 when Myers (*27*) published his description of *Polygnotus vernalis*, that two separate species were definitely distinguished. Recently, however, many inquiries concerning them have arisen among workers on the Hessian fly because of the similarity in appearance of their adult stages and the lack of information concerning their respective life histories. It has, therefore, been deemed advisable to publish without further delay a brief treatise on these two species rather than to await the completion of the more exhaustive investigations under way.

In a recent article on the genus Platygaster Latreille by Fouts (*29*), the genera Polygnotus Förster and Platygaster Latreille are declared synonymous, with priority given to Platygaster Latreille. Both species under discussion, therefore, rightly belong to the genus Platygaster.

In the following account the life history observations were made on material reared in confinement from carefully determined adults. Nearly all the phases of development were also obtained from the field for comparison and checking of results.

## HISTORY

Herrick (*1*) in 1841 was the first investigator to record the occurrence in this country of a parasite which oviposited into

[1]The author wishes to express his appreciation for kindly criticisms by Mr. P. R. Myers, Mr. A. B. Gahan and Dr. R. W. Leiby.

[2]Reference is made by number (italic) to Bibliography, p. 115.

the egg of the Hessian fly, and from his description of the habits of the parasite under his observation it was evidently the species *Platygaster hiemalis*. He briefly recorded observing it oviposit in the egg of the Hessian fly in autumn, and mentioned that four or five eggs were laid in a single egg of the fly, and that the host continued its development but never reached the adult stage. All of these habits conform identically to those of *Platygaster hiemalis*. In 1847 (2) and again in 1862 (3 Asa Fitch reviewed Herrick's account of this insect but added no original observations. Herrick's account was again quoted by Packard both in 1880 (4) and in 1883 (5). In these articles the statements of Herrick were assumed to refer to the larger proctotrypoid parasite *Platygaster herrickii* Pack.

According to Ashmead (10) *Platygaster hiemalis* was first reared by Riley in 1876 and again by Forbes in 1888, in which year Forbes published the original description (7). The following year, Riley (8) called att.ntion to Forbes' description, and in 1891, (9), he listed the species. Two years later Ashmead (10) incorporated Forbes' description in his "Monograph of the North American Proctotrypidae," and in 1897 the species was again listed by Paul Marchal (11). Osborn (12), in 1898, cited the original description, and in 1899 Lugger (13) recorded finding six cocoons of this parasite in a Hessian fly puparium. In an article by Webster and Newell (14), published in 1902, this parasite was mentioned as being reared in quantities in Ohio, and in 1906 Tucker (16) discussed the economic importance of this parasite, citing a letter by Webster in which was mentioned the introduction of *P. hiemalis* from North Dakota into Kentucky, Tennessee, and California. This same year Webster (17) gave a brief discussion of *P. hiemalis*, and Gossard and Houser (15) mentioned the abundance of *P. hiemalis* in Ohio. The following year Bruner and Swenk (18) referred to *P hiemalis* in Nebraska, and Webster (19) recounted the great importance of this parasite in control of the Hessian fly and discussed its possible polyembryonic nature. In 1907 (21) he also gave a very interesting economic account of this parasite and related various attempts to introduce it from one part of the country to another He attributed two generations a year to Polygnotus, but more recent observations have shown that each species normally has but one generation a year. The erroneous conclusion was undoubtedly due to a confusion of the two species one of which emerges in the spring, the other in the fall In 1908 C. N. Ainslie (20) gave an account of the parasitism of Polygnotus by Tetrastichus. In so far as this material was taken from wheat stubbles collected during July, the species involved was very likely *vernalis*. In this same article Mr. Ainslie told of the attempted introduction of Polygnotus into Sharpsburg, Md., conducted by F. M. Webster.[1] *P. hiemalis* was listed by Smith (22) in 1910, and the same year a brief mention of this parasite as a means of control of the Hessian fly in Michigan was made by R. W. Pettit (23). In 1915 a reference to *P. hiemalis* was made by Webster (25), and in 1916 it was briefly redescribed by Viereck (26). Early in the year of 1916, Myers (27) identified the species *vernalis* from the other parasites of the Hessian fly which resulted in the publication of his original description the following year. In 1920 *P. hiemalis* was again mentioned by Walton (28).

### (Polygnotus) Platygaster vernalis Myers.

#### GEOGRAPHICAL DISTRIBUTION

This species occurs in New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, West Virginia, Michigan, Ohio, Indiana and Missouri. Records so far obtained show that its distribution extends as far west as Charleston, Mo., and as far south as Buchanan, Va.[2]

#### LIFE HISTORY

The egg is highly refractive, claviform in shape, and before oviposition measures about 0.07 mm. long by 0.016 mm. wide. Immediately after oviposition the main body of the egg is usually found dilated to about twice the above width. A minute projecting piece of membrane may sometimes be found at the swollen extremity of the egg.

The eggs are deposited singly in the eggs of the host, and sometimes in the newly hatched larvae before they have left the exposed surface of the leaf.

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[1]Mr. Ainslie said that "wheat plants containing Hessian fly larvae" infested with Polygnotus were transferred from Marion, Pa., to Sharpsburg, Md., and that in July of the same year "ripening straw containing numerous flaxseeds" was gathered and sent to Washington. The account further stated that examinations of these flaxseeds revealed the presence of Polygnotus, which was thought to have proved the success of the introduction. It might be mentioned that, in another review of this experiment made by Dr. Howard, (24) the Polygnotus introduced were referred to as being the species *hiemalis*. Our present knowledge of the life histories of these parasites in these localities indicates that in this experiment a mistake was made in the identity of the parasites used, because *hiemalis* does not emerge in this locality in time to parasitize the summer generation of the Hessian fly. This generation of the fly is, however, parasitized by *vernalis* which accounts for Polygnotus being found in the flaxseeds secured from the ripening wheat straws.

[2]The records from Michigan and Indiana were obtained from Mr. W. H. Larrimer, those from Ohio, through the kindness of Mr. Larrimer and Mr. Parks, and those from Missouri from Mr. A. F. Satterthwait.

The egg differs in its manner of development from those of most insects by being polyembryonic in nature. The original germ-cell, instead of giving rise to a single embryo, develops many separate embryos. At the same time the nutritive functioning plasm of the egg develops in a remarkable way to accommodate the rapidly multiplying embryos. The egg always develops in the mid-intestine of the host and during its early growth, is constantly tossed back and forth in the chyle of the mid-intestine by peristaltic action.

The primary larva is bluntly rounded at extremities, with length of body about three times its width. Before it has become very much inflated with food, a broad, deep constriction is evident on each side slightly posterior to the mouth. This is caused by the greatly enlarged and projecting bases of the mandibles. The large size of the mandibles is characteristic of this stage, the length of each being nearly one-third the width of the head. They are slightly curved, setosous toward the extremity, and practically colorless. During this stage the body segments are not distinct.

In the succeeding larval development the mandibles are replaced by small, distinctly chitinized mandibles, the body segments become apparent, and the body assumes a more obtusely ellipsoidal form.

When the primary larvae have freed themselves from the surrounding gelatinous-like mass, they commence to imbibe the chyle from the host stomach and soon ingest particles of the stomach wall itself. They shortly pass into the advanced larval stage of development, and it is not long before nearly the entire contents of the host is consumed. At this point each larva forms for itself a separate cocoon in which it pupates and transforms to the adult. The parasitized host larva very seldom succeeds in pupating.

The cocoons are broadly ellipsoidal, pale yellowish brown in color, and made of a tough, flexible material. The number which develop in a single flaxseed varies somewhat. An examination of 100 Hessian fly puparia taken from the field and containing *Platygaster vernalis* cocoons showed an average of 7.91 cocoons per puparium with a maximum number of 13 and a minimum of 3. The average number of cocoons in which adults developed was 5.49 All these adults, however, did not emerge. This was probably due to the artificial conditions under which they were reared.

## SEASONAL HISTORY

Normally this parasite emerges in the early spring when the Hessian flies are beginning to lay their eggs. It begins at once to oviposit into the host eggs. Development progresses rapidly and pupation usually takes place about the last of July, the exact date varying considerably in different years according to meteorological conditions. By the end of the first week in August the adult stage is usually reached and the remainder of the summer, fall, and winter is passed inside the cocoons as adults. Occasionally adults emerge in the fall and oviposit into the fall generation of the fly, but field observations indicate that these ovipositions fail to mature.

### (Polygnotus) Platygaster hiemalis Forbes.

#### GEOGRAPHICAL DISTRIBUTION

This species occurs throughout most of the wheat growing region where the fly is found. According to F. M. Webster (21, 25) this parasite was introduced several years ago into Washington and California and has been found in abundance in Washington since that time. Mr. C. M. Packard informs me, however, that this species has never been reared from rather extensive collections of Hessian fly material made in California.

#### LIFE HISTORY

The egg, like that of *Platygaster vernalis*, is highly refractive. In form it is ellipsoidal, slightly flattened along one side, and with two tiny, flagellum-like processes at one extremity. Freshly oviposited eggs measure approximately 0.02 mm. long by 0.01 mm. wide. The size and shape of the egg undergoes no appreciable change upon oviposition.

The parasite oviposits in the host egg, or occasionally in the newly hatched larva while the latter is exposed to attack. From the examination of 81 ovipositions it has been found that from 1 to 7 eggs with an average of 4.22, are laid at each single oviposition.

The eggs always develop in the body cavity of the host and never in the mid-intestine as is the case with *Platygaster vernalis*. The young embryos may nearly always be found as colorless, spherical masses entirely separated from each other and loose in the haemolymph of the host larva.

In the larval stage the segments are always discernible and the mandibles are very small. Upon reaching the larval stage development usually proceeds rapidly. The contents of the host are soon almost entirely devoured, and the larvae form individual cocoons which are broadly ellipsoidal, pale yellowish brown in color, and made of tough, flexible material, being similar to those made by *Platygaster vernalis*. From 1 to 23 cocoons have been found in a single puparium, and from 100 puparia examined, an average of 6.52 cocoons were found.

Within these cocoons adults developed to the average number of 6.31 per host puparium, although, as in the case of *P. vernalis*, all did not emerge. The host larva very seldom succeeds in pupating, although a well developed puparium case is always formed.

### SEASONAL HISTORY

In the eastern states in winter wheat this parasite normally has but one generation a year. The adults emerge in the fall at the time the Hessian flies are laying their eggs for the over-wintering generation. They begin at once to oviposit into the eggs of the fly. Cold weather setting in now greatly retards the development of the growing embryos, and usually the entire winter and spring, and frequently the early summer are passed in the embryonic stage. The larvae and pupae commence to develop during July, and by the end of August most of them have transformed into adults within their cocoons. Weather conditions modify the rapidity of development, and sweeping records prove that adults occasionally emerge throughout the summer months.

### COMPARISON OF THE TWO SPECIES

The immature stages of *Platygaster vernalis* may be distinguished from those of *P. hiemalis* by the following characteristics and habits:

| *P. vernalis* | *P. hiemalis* |
|---|---|
| Egg claviform; about 0.07 mm. long by 0.016 mm. wide. | Egg ellipsoidal, slightly flattened along one side; about 0.02 mm. long by 0.01 mm. wide. |
| Embryos held together in a spherical or ellipsoidal, elastic polyembryonic mass. | Embryos individual, spherical masses separated one from the other except in rare instances. |
| Embryos always develop inside the mid-intestine of the host. | Embryos always develop in the haemolymph of the body cavity of the host. |
| Primary larva with greatly enlarged, setosous mandibles. | Mandibles very small and smooth throughout larval period. |
| Mandibles of mature larva distinctly curved. | Mandibles of mature larva almost straight. |

The two species may also be distinguished by certain habits of the adults. *Platygaster vernalis* is rather sluggish and seldom flies when in captivity. *P. hiemalis*, on the other hand, is normally very active and flies readily. In ovipositing, *P. vernalis* holds the body parallel to the long axis of the Hessian fly egg, while *P. hiemalis* poises the body at right angles to this axis of the host egg. These habits of oviposition furnish a positive means of identification sometimes very convenient.

The adults of the two species may also be distinguished by certain structural characteristics. Mr. P. R. Myers has kindly outlined the following comparison of outstanding features:

| *P. vernalis* | *P. hiemalis* |
|---|---|
| Head quadrate; about as wide as thorax. | Head subquadrate, distinctly wider than thorax. |
| Face convex. | Face nearly flat. |
| Occiput, vertex, and face distinctly transversely rugulose. | Occiput transversely rugulose, vertex and face shining with faint aciculations running obliquely away from an indistinct median carina. |
| Antenna with base of scape black. | Antenna with base of scape pale yellow. |
| Scutellum laterally margined. | Scutellum not laterally margined. |
| Legs entirely piceous; tarsi fuscous. | Legs dark brown to piceous; tarsal joints pale brown except apical joint which is fuscous. |
| Wings $2\frac{1}{2}$ to 3 times as long as abdomen. | Wings about twice the length of abdomen. |
| Ovipositor straight; slightly enarged and blunt at apex. | Ovipositor curved and attenuated. |

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## CALOPTERYX MACULATA BEAUVOIS. AN INTERESTING PHOTOGRAPH.

By W. J. HOLLAND.

Through the kindness of one of my correspondents, Mr. Fred H. Beer of Pittsburgh, I have been put in possession of a photograph, showing the male and female of *Calopteryx maculata* Beauvois *in copula*. So far as I am now aware this is the first time that a good photograph of this common species engaged in the act of coition has been secured. References to the matter are common enough in the literature of the subject and there are a few drawings and cuts which are available, but no actual photographs, unless I am greatly mistaken. In the Proceedings of the United States National Museum, Volume XLIX, pp. 259 *et seq.*, Dr. Charles H. Kennedy in his paper, entitled "Notes on the Life History and Ecology of the Dragonflies (Odonata) of Washington and Oregon," gives some drawings and an excellent description of the conjunction and oviposition of one of the Odonata found on the Pacific Slope. Needham in a volume entitled "Aquatic Insects in New York State," published in 1903, at page 225 says in reference to the species represented in the photograph, "The females descend to stems of more or less completely submerged aquatic plants (Elodea), and unattended by the males, insert their eggs into the green stems just below the surface of the water."

In the case of the form described by Kennedy, the female is accompanied, as he states, during the act of oviposition, by the male still clasping her by the prothorax.

In the act which the photograph represents the male, shown in the lower figure, seizes the female by the prothorax and copulation ensues The sexual organ of the male is located on the second post-thoracic segment; that of the female being located at the extremity of the abdomen.

That the female of many species of the Odonata deposits her eggs in minute incisions in the stems of aquatic plants is a fact known to specialists. I have before me a dried piece of the stem of a yellow water lily (*Nenuphar*), which under the magnifying-glass shows that it is covered all over with deep pittings made by the ovipositors of female dragonflies. These pits are surrounded by circular elevations of the tissue of the plant, which continued to grow after the incisions were made. They are somewhat crater-like in appearance. The female in the act of oviposition submerges the anal extremity of her abdomen below the water-line, continuing to descend as she makes incision after incision, in which she deposits the eggs, until she is submerged up to the head, and she frequently descends further, until she is completely submerged below the surface, in which submerged position she may remain for as much as an hour, as I am told by one of my colleagues. Where the female is accompanied by the male both of them may be completely submerged during the act of oviposition for a long time. These creatures, the airy flight of which, as they dash about in the sunshine in quest of their prey, consisting of midges, gnats, and mosquitoes, would not be suspected by one who has thus seen them, to be capable of living under water, but they not only do this in the larval stage continuously, but also in copulation for long periods after they have emerged as imagoes.

## WEEVILS OF THE GENUS APION INJURIOUS TO BEANS IN MEXICO.

By H. F. Wickham.

While engaged upon the principal subject of the investigation of the Mexican bean beetle, it was noticed almost from the

HOLLAND—CALOPTERYX MACULATA.

first that the bean plants were infested by one or more species of Apion. These little beetles were seen mostly upon the leaves, in which they ate small holes, thus inflicting some damage upon the foliage. Sometimes they were seen puncturing the terminal or lateral buds of the plants, perhaps only for feeding purposes, but at no time were they observed ovipositing, though, from future developments, it seems that eggs must have been laid in the pods.

These weevils occurred on the bean plants all around the city of Mexico, at San Angel, Mixcoac, Atzcapotzalco and Tacuba, and were very abundant in the grounds of the Agricultural College at the last named place. They occurred on beans in the corn and on those planted in the open, were active during the middle of the day and took flight readily if disturbed, or, as an alternative habit, would drop to the ground and run off. No other insects were seen to attack them. Specimens could be caught by hand or with a small net and many were secured for study and determination. Examples were submitted to Mr. H. C. Fall, specialist on the genus, who identified one species as *A. griseum* Smith, the other three species are apparently unknown in this country. *A. griseum* is common to the United States and Mexico, being recorded by Fall as occurring from New York to Florida and westward to Colorado and Arizona.

After receiving, through Mr. Graf, a copy of Dr. Chittenden's paper upon this genus, in which the bean-feeding habit of *A. griseum* is recorded,[1] some further notes were made, although time did not permit of a thorough study. These notes are based almost entirely upon observations carried on in the grounds of the Agricultural College, since this place is easily accessible and, through the courtesy of the administration, was thrown open to me.

In these bean plots, it was noticed that a great many of the pods which were just beyond the "snap" stage and in which the seeds were well filled out, showed yellowish or brownish discolorations along the sides, often several blotches to the pod. A rot frequently set in, apparently starting from these blotches, so that the tissues broke down in the wet atmosphere, especially if in contact with the soil. This gave the product a very disgusting appearance and would serve at once to diagnose the worst cases of infestation.

When one of these pods was opened, it would show the seed more or less badly eroded by the attacking larva. The grub sometimes burrowed well within the seed while the latter was still soft, but sometimes fed largely from the surface. The fat larva appeared to be of great size in comparison with its parent,

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[1]Chittenden, F. H.—Bul. 64, Bur. Ent., U. S. Dept. Agr., pp. 29, 30, Jan. 14, 1908.

but there seems to be no doubt as to the relationship of the two, in the light of future observations. Because of the danger of introducing a most serious pest, no living examples were brought out.

The larva forms a case for pupation, composed of a brownish material, probably largely excrementitious. This case lies within the bean pod and the adult emerges through an irregular opening which is broken out at or near the end of the cell. Several pods which were opened for examination showed the newly disclosed adult weevils, feeding larvae and other larvae in their cells. Sometimes as many as three grubs had attacked a single bean. Occasionally one seed in a pod would be sound while all of the rest would be damaged.

In order to estimate the percentage of damage, a lot of pods were picked and opened. Further, a number were examined for the blotches but not gathered. This estimate indicates that in the plot most carefully studied the injury runs about 80 per cent. Badly attacked seed did not mature in the pod but shrivelled and became distorted.

From my observations, it appears that the adults emerge from the pupa case into the lumen of the pod and probably depend upon the pod splitting to effect their escape. If this be true, it follows that the danger of introduction of this pest into the United States lies mostly in permitting shipment of green beans, i. e., snap beans and fresh shell beans. It is doubtful if there is much danger from dried beans of good grade, although they can not be considered entirely safe.

In my opinion, shipment of beans in the pod, whether green or ripe, from Mexico to the United States, would be dangerous and might easily result in the introduction of another bean pest of first rate importance. I consider that on the plateau, near Mexico City at least, this Apion is a worse menace than Epilachna. Since observations in Mexico show it to be coincident in bean fields with Epilachna, it is probable that the same habit would obtain in the United States, and I consider it likely that in case of introduction it would do as great damage in this country as in its native home.

## THE IDENTITY OF HABROBRACON BREVICORNIS (WESMAEL). (HYM., BRACONIDAE).

By R. A. Cushman,

*Bureau of Entomology, United States Department of Agriculture.*

Wesmael's description[1] was based on an insect having 17 joints in the antennae in the female and 20 to 26 joints in the male.

[1] Nouv. Mem. Ac. Sc. Bruxelles, vol. 11, 1838; p. 23, fig. 2, wing.

Marshall[2] later referred to it certain British specimens having 14-jointed antennae in the female and 21 to 23-jointed antennae in the male.

The present writer,[3] following Marshall's determination, synonymized with *brevicornis*, *Bracon juglandis* Ashmead, *Habrobracon hebetor* Johnson (not Say), and *Bracon* (*Habrobracon*) *honestor* Riley and Howard (misprint for *hebetor*). In the large number of specimens examined the female antenna in no case had more than 15 joints and the male antenna never more than 22. The species as thus determined is apparently invariably parasitic on lepidopterous larvae such as *Ephestia*, *Plodia*, and *Galleria* infesting stored products.

In connection with the importation into the United States from Europe of parasites of the European Corn Borer (*Pyrausta nubilalis* Hubner) there has been reared in considerable numbers a species of *Habrobracon*, the females of which have 17-jointed (in one small specimen 16), and the males 21 to 27-jointed antennae. This species is very closely allied to the one previously determined as *brevicornis*, differing from it, in addition to the antennal characters, apparently only in the slightly shorter malar space and larger eyes, a somewhat greater tendency to black coloration, and shorter ovipositor.

There seems to be no room for doubt that these European specimens are the true *brevicornis* Wesmael. This makes it necessary to call the parasite of storage insects by the oldest name, which is *juglandis* Ashmead. This is, in a way, unfortunate, since the species has nothing to do with *Juglans* except as stored walnuts become infested by lepidopterous larvae.

Such host records as that of Brischke recording *brevicornis* as a parasite of *Dioryctria abietella* and of Webb (quoted by Marshall) with *Myelois ceratoniae* as host should probably be credited to *brevicornis*.

The two species may be separated by the following characters:

Antennae in female 17-jointed, in male 20 to 27-jointed; malar space in female hardly one-third, in male barely one-fourth as long as eye; ovipositor sheath hardly longer than hind femur
*Habrobracon brevicornis* (Wesmael).

Antennae in female 13 to 15-jointed, in male 20 to 23-jointed; malar space in female quite, in male nearly one-third as long as eye; ovipositor sheath distinctly longer than hind femur
*Habrobracon juglandis* (Ashmead).

[2] Trans. Ent. Soc. Lond., 1885; p. 24, Pl. I, figs. 1a, 1b.

[3] Proc. Ent. Soc. Wash., vol. 16, 1914, p. 101.

## NOTES ON AGRILUS LATERALIS SAY (COLEOP.).

By W. S. Fisher, *U. S. Bureau of Entomology.*

This apparently rare species was described by Thomas Say from Missouri, from material collected on the expedition to the Rocky Mountains under Major Long, and has been reported from a number of widely separated localities from Maine to New Mexico, but its host plant remained unknown, at least it has not been reported in the literature.

On March 12, 1918, Mr. A. B. Champlain, of Lyme, Connecticut, submitted some limbs of Bayberry (*Myrica carolinensis* Mill) infested with *Agrilus* larvae to the writer for identification. As this was a new host plant for the genus, the material was caged, and on June 2, the first adult emerged, which proved to be *Agrilus lateralis* Say.

During the summer of 1918 the writer was located at Lyme, Connecticut, and had a chance of making observations on the habits of this species during the season. On May 29 a large patch of Bayberry was carefully examined and this species was found in the larva, pupa and adult stages. Some of the adults had nearly burrowed through the bark, but no emergence holes could be found after a careful search. The first adult was found on the Bayberry foliage on June 3, and the last one on July 8, and were most abundant about the middle of June. The adults are very active, and when disturbed, would alight on the upper surface of the foliage without making any attempt at hiding on the underside of the leaves, as is the habits of some species of this genus. They seem to prefer the foliage on the low plants growing along the outside of the patches, and usually select the sunny places that are protected from the wind. The adults feed around the margins of the leaves, causing them to become somewhat ragged in appearance.

The eggs are rather variable in outline, usually oval and somewhat flattened. The surface is feebly corrugated, especially towards the margins, and each egg is partially covered with fine excrement. When first laid, the egg is whitish, but in a few days it changes to a grayish color, similar to that of the bark, resembling some of the soft scales, and is rather difficult to distinguish on the bark. The eggs are glued tightly to the bark, and are usually deposited singly near the ground on healthy plants. In captivity the adults would not oviposit on anything except freshly cut limbs, and this was also found to be the case out-doors, as no eggs were found on dead stalks. The larva on hatching from eggs laid in captivity were unable to bore into the wood, on account of the wood drying out very rapidly and becoming extremely hard. All of the eggs laid on the plants out-doors had hatched by July 31, and the larvae had bored into the wood.

This is a two year species. In most cases the eggs were laid near the ground, and the larvae on hatching, bore directly into the bark from the underside of the eggs, filling the empty shells with excrement, then burrowing downwards into the roots where they pass the first winter, the following spring they start making spiral mines around the limbs and extending upwards for a considerable distance before reaching maturity, when they extend their mines into the wood and make their pupal cells near the outer wood, from which they emerge the following year. These mines are rather difficult to distinguish, and as the plant is a rapid grower, the new wood grows over the larval mines, causing a slight swelling on the outside, which is scarcely noticeable. When these mines are examined, those made by the larvae during the first year are covered with new wood, and represented by a raised spiral ring on the wood, while the mines made during the second year are only covered by a thin filament of wood, allowing the dark borings in the mines to be readily seen through the new wood.

This species seems to be apparently free from natural enemies in the localities where the writer made observations, as no evidence of parasites was found in any of the mines.

In some sections a great many of the plants have been killed by this beetle, but where the plants were only slightly infested, the mines were soon overgrown, without any noticeable injury to the plants.

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## A DIVING WASP.

By A. N. Caudell.

The following is an extract from my Entomological Journal:

"Monday, July 4, 1921.—A blazing hot day, but I went picnicking to Great Falls, on the Maryland side of the Potomac. Very disagreeable weather, but in spite of the heat I secured a few desirable insects and made some interesting observations. Before crossing the swinging bridge I found a pair of green stone flies mating on the ground and after crossing the bridge I took a nymph of *Pterophylla camellifolia* on a large oak leaf but a few feet from the ground. Among other insects taken was a female psammocharid wasp which Mr. Rohwer identified later as *Anoplius illinoiensis* Robt. I first observed this wasp on a flat stone barely rising above the surface of a stagnant pool of water, about three inches in depth, lying near the river. The wasp was lying on one side and kicking the hind legs as if severely injured. Soon it dragged itself a few inches and turned over on the other side and kicked the legs, mostly the long hind ones, with which it rubbed the end of the abdomen, but still giving the appearance of being hurt. I watched it fully a minute, wondering what ailed it, when it suddenly righted itself and ran rapidly and nervously about, showing it was not in the least injured. But it almost immediately went through the same performance of lying on the side and kicking the legs, the posterior ones moving the most. Soon it again got to its feet and ran to the edge of the stone where a large leaf was floating flat on the surface of the water. To my surprise it deliberately crawled beneath this floating leaf and out of sight. I failed to see just when or where it emerged but soon it was again on the stone and going through its queer actions. Then, after taking a short but very active flight for a few feet, it did the most interesting thing of all. It alighted near the edge of the same stone and crawled deliberately down the edge into the water, which, as stated before, was about three inches deep, and ran across the bottom, moving freely but not nearly so fast as when on top of the rock in the open air. It crossed the narrow channel to another stone, a distance of about one-half foot, where it came to the surface by climbing up the edge of that stone.[1] After again going through its kicking performance it flew across the pool with the legs and apparently the tips of its wings touching the surface of the water. It then ran along for some distance on the surface of the pool somewhat after the manner of a water-strider, but the wings, I think, vibrating rapidly all the time. Fearing it would leave the vicinity I then swatted it with a bunch of weeds, as I had no net, knocked it down and caught it, injuring it somewhat in doing so."

The above notes were written the same day the observations were made, and essentially as here presented.

## BOOK NOTICE.

*An Introduction to Cytology.*—By Lester W. Sharp. New York, McGraw-Hill Book Co., 1921.

Intended, on the animal side, as supplementary to Wilson's well known work, this book brings into one volume the more recent phases of both plant and animal cytology. For this reason it will be of special interest to the entomologist whose field includes not only the nature of the insects themselves but their relation to the tissues of the plants on which they feed. —EDITOR.

[1]This probably explains why its emergence from beneath the floating leaf was unobserved, as it probably went to the bottom of the pool on that occasion, and perhaps ran around to the opposite side of the stone before coming to the surface.

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# PROCEEDINGS

OF THE

# ENTOMOLOGICAL SOCIETY

OF WASHINGTON

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## NEW SPECIES OF PYRALIDAE OF THE SUBFAMILY CRAMBINAE FROM TROPICAL AMERICA.

By W. Schaus.

The specimens from Castro and Sao Paulo, Brazil, were collected by E. D. Jones, those from Venadio, Mexico, by J. A. Küsche, and were presented to the Museum by B. Preston Clark. Where not otherwise stated the bulk of the species were collected by Barnes and Schaus or purchased by Schaus for the collection. In a few cases the specimens have been in the Museum for a long time and only their locality is known.

### Culladia castrella, new species.

*Male.*—Head whitish, the palpi avellaneous, darker shaded at base, the third joint mouse gray. Collar and thorax avellaneous with some brown scales. Abdomen above avellaneous, the base with subdorsal white scaling, the anal segment buff white; underneath whitish buff. Fore wings irrorated with sayal brown becoming denser and forming fine striated lines before the subterminal fine brown black line which is almost straight and parallel with termen; the brown irrorations form a vague spot antemedially below cell, an oblique patch on costa medially, and an indistinct postmedial line outcurved around cell; termen white with a few fine brownish striae; black spots terminally on interspaces; cilia silvery white. Hind wings white faintly suffused with light buff; cilia white. Fore wings below suffused with grayish buff, the costa of hind wings with similar irrorations.

Expanse 12 mm.

*Habitat.*—Castro, Carana.
*Type.*—Cat. No. 25521, U. S. N. M.

### Culladia francescella, new species.

*Male.*—head and palpi white, the latter with some gray scaling at tip. Thorax white the patagia deep mouse gray. Abdomen above mouse gray, the two last segments silvery gray; underneath white. Fore wings white with transverse striations; some brownish striations at tornus, and on postmedial space; an inbent brown line from end of cell to inner margin; subterminal line double, curved below costa, then vertical, the inner line thick, brown, the outer line forming a triangular spot on costa, then very fine and barely traceable; a dark terminal line preceded by fuscous spots on interspaces, obsolete towards apex. Hind wings white very faintly suffused with whitish buff.

Expanse 9 mm.

*Habitat.*—San Francesco Mountains, San Domingo.
*Type.*—Cat. No. 25522, U. S. N. M.
Collected by A. Busck.
Near *C. psythiella* Schaus.

**Culladia habanella**, new species.

*Female.*—Head whitish, the palpi mouse gray. Collar and thorax grayish buff. Abdomen above vinaceous buff, underneath gray. Legs white streaked with gray. Fore wings light silvery gray with darker irrorations; base shaded with light buff, and a few black scales subbasally below cell and on inner margin; antemedial black scales below cell and below submedian; a few black scales at end of cell; a medial cinnamon buff line from end of cell to middle of inner margin; a similar thick subterminal line, outangled on costa then parallel with termen; termen rather broadly cinnamon buff with terminal black points, the scaling striated; cilia gray. Hind wings whitish gray with a fine darker gray terminal line; cilia buff at base followed by a dark gray line and tipped with white.

Expanse 16 mm.

*Habitat.*—Havana, Cuba.
*Type.*—Cat. No. 25523, U. S. N. M.
*Culladia eucosmella* Dyar has as synonym *Crambus argyriplagalis* Hampson.

**Eufernaldia panamella**, new species.

*Male.*—Head white, palpi drab brown. Thorax ochraceous buff, the patagia tipped with white. Abdomen brownish above, white underneath; legs white, the tarsi shaded with light buff. Fore wings ochraceous buff, the veins silvery white, also the costal edge except at base; base of costal vein fuscous; a white line along submedian fold; all the veins and lines finely edged with dark brown; discocellular not white and with a dark brown spot; a dark line in cell with only a few white scales; a medial series of dark spots on veins, outbent at discocellular spot, then inbent to submedian fold; a postmedial series of spots on veins from vein 5 to inner margin; a white line on inner margin at base, and from middle to near tornus. Hind wings fuscous gray; cilia on both wings white.

Expanse 18 mm.

*Habitat.*—Alhajuelo, Panama.
*Type.*—Cat. No. 25524, U. S. N. M.
Collected by A. Busck.

**Crambus edredellus**, new species.

*Male.*—Head, collar and thorax warm buff. Abdomen above light buff; body below and legs white, the fore legs buff. Fore wings whitish thickly irrorated and suffused with warm buff; a whitish indistinct postmedial line oblique on costa, vertical from vein 4 to inner margin; minute terminal black points; cilia white. Hind wings white irrorated with light buff; cilia white.

Expanse 16 mm.

*Habitat.*—Jamaica, British West Indies.

*Type.*—Cat. No. 25525, U. S. N. M.
Vein 11 suffuses with 12.

**Crambus santiagellus**, new species.

*Female.*—Head, collar and thorax buff white, the palpi laterally shaded with gray. Abdomen above light cinnamon buff; body underneath and legs white. Fore wings white, with some grayish brown irrorations; inner margin to near cell suffused with olive buff; termen with fine olive buff striae; a short subbasal black streak on costal vein; some black scaling forming an antemedial line from within cell to inner margin, outbent from below fold; a cluster of fuscous brown scales at lower angle of cell; traces of a postmedial line outbent on costa; a subterminal grayish shade preceded below costa by two short black streaks; terminal black points. Hind wings silvery white suffused with gray except in cell and between veins 2 and 3 to near termen; cilia white, on fore wing tipped with gray. Fore wings below silvery gray. Hind wings below silvery white.

Expanse 15 mm.

*Habitat.*—Santiago, Cuba.
*Type.*—Cat. No. 25526, U. S. N. M.

**Crambus paucipunctellus**, new species.

*Male.*—Head and palpi white, the latter brownish below and laterally. Collar white shaded with buff. Thorax and abdomen white. Fore wings white with a few brown irrorations; a short brown streak at end of cell, one below middle of cell, and one below base of vein 2; basal third of costal edge brown, and a fine streak on costa medially; subterminal clusters of brown scales from below costa to below vein 2 partly suffusing, closely followed from vein 5 to vein 2 by a fine dark line; minute terminal dark points. Hind wings white. Fore wings below and costa of hind wings fuscous gray.

Expanse 18 mm.

*Habitat.*—Castro, Panama.
*Type.*—Cat. No. 25527, U. S. N. M.
Belongs to the group of *C. immunellus* Zeller and *C. intangens* Dyar.

**Crambus domingellus**, new species.

*Male.*—Head white, the palpi below mouse gray. Collar white, shaded with brown in front and with outer brown spots. Thorax steel gray, in front whitish; patagia white. Abdomen silvery white; from base laterally steel colored lines meet dorsally at middle; anal hairs steel gray. Legs white, the fore tarsi with brown rings. Fore wings silvery white, the costal margin shaded with tawny olive; some tawny olive irrorations on inner margin, a short inbent streak antemedially below cell, a medial streak from vein 2 to middle of inner margin, and a postmedial line very oblique from costa above end of cell to near subterminal line at vein 4 following it closely to inner margin; the subterminal line also oblique from costa and much finer than the postmedial both starting from gray spots on costa with a third spot nearer apex; minute terminal black points; cilia white. Hind wings silvery white. Fore wings below suffused with gray.

Expanse 10 mm.

*Habitat.*—San Francesco Mountains, San Domingo, West Indies.

*Type.*—Cat. No. 25528, U. S. N. M.

**Crambus elphegellus,** new species.

*Male.*—Head white, palpi laterally mouse gray. Collar and thorax white. Abdomen silvery gray, the anal tufts buff. Legs white, the fore tarsi brown. Fore wings silvery white, the markings antimony yellow; a streak at base of costa; a faint medial line outangled at end of cell, forming a larger spot on inner margin mottled with dark brown; two fine outer parallel lines, oblique from costa and curved to submedian fold, where they are somewhat interrupted and again outcurved; a terminal line with small black spots at veins 4 and 3; cilia silvery white becoming golden from vein 4 to tornus. Hind wings white, the costa shaded with light buff.

Expanse 12 mm.

*Habitat.*—Caracas, Venezuela.

*Type.*—Cat. No. 25529, U. S. N. M.

Near *C. albellus* Clemens.

Very similar to *Culladia psythiella* Schaus; but vein 9 present.

**Crambus sinaloellus,** new species.

*Male.*—Head white, palpi laterally vinaceous buff. Thorax and fore wings pale orange yellow, the patagia tipped with white. Abdomen above avellaneous, underneath white; the legs white. Fore wings: all the veins except discocellulars narrowly white; a white streak in cell and along submedian fold; cilia long, white. Hind wings white suffused with light brownish gray; cilia white. Fore wings below grayish, the veins terminally white. Hind wings below slightly whiter than above.

Expanse 27 mm.

*Habitat.*—Venadio, Sinaloa, Mexico.

*Type.*—Cat. No. 25530, U. S. N. M.

In appearance somewhat like *Eufernaldia cadarellus* Druce but the white lines much narrower and on fore wing vein 3 is present, veins 4 and 5 stalked.

**Crambus damotellus,** new species.

*Male.*—Body cupreous buff. Fore wings silvery buff white; a cupreous brown streak along subcostal and above vein 6 to termen; a similar streak from cell to fold not reaching termen; a broad silvery white streak through cell to termen between veins 4 and 6; a narrow white streak on costal margin extending on to costal edge above vein 8; terminal white streaks above and below vein 7; cilia white; no transverse lines or markings. Hind wings white, the costal margin broadly suffused with buff gray. Fore wings below fuscous; the costal margin light buff; the termen and inner margin, also a shade from within cell to termen, whitish.

Expanse 36 mm.

*Habitat.*—Popocatepetl slopes, Mexico.
*Type.*—Cat. No. 25531, U. S. N. M.

**Crambus dukinfieldiellus**, new species.

*Male.*—Head verona brown; palpi white at base and underneath. Collar and thorax deep neutral gray. Abdomen whitish buff. Fore wings glossy buffy brown; costa finely white except at base; a silvery white streak through cell from base to terminal black point on discal fold; a white streak below median, becoming silvery lead color at middle of cell and continued below vein 2; similar lines below veins 3, 4, 5 and 7; inner margin silky pale buff gray; a subterminal silvery lead shade consisting of fine striations; terminal black points; cilia silvery lead at base, then silvery white. Hind wings white suffused with light buff on costal margin and below cell and vein 5 to vein 2, also on inner margin; cilia white.

Expanse 26 mm.

*Habitat.*—Castro, Parana.
*Type.*—Cat. No. 25532, U. S. N. M.
Near *C. albiradiellus* Hampson.

**Catharylla paulella**, new species.

*Female.*—Head white, palpi wood brown laterally, fringed above with white. Collar and thorax white. Abdomen above brown; basal segment and segmental lines white; underneath white. Legs white streaked with pinkish buff. Fore wings white with a few light brown irrorations in cell and on postmedial space to termen; basal third of costa finely brown; fine, oblique, brownish streaks on costa medially, postmedially, subterminally, and a short streak along costa before apex; a fine, wavy, light brown medial line, outcurved at end of cell with a black spot on discocellular; postmedial below costal margin only indicated by irrorations; subterminal line fine, distinct, curved below costa and parallel with termen, straight and with minute darker points on interspaces; termen finely brownish with black points; cilia golden silvery. Hind wings white; a fine, dark brown, terminal line and faint marginal gray shading at apex. Wings below silvery, the fore wing and costal margin of hind wing suffused with brown; a terminal dark line, partly interrupted; cilia of fore wing dark, of hind wing white with a brownish dividing line.

Expanse 21 mm.

*Habitat.*—São Paulo, South East Brazil.
*Type.*—Cat. No. 25533, U. S. N. M.
Near *C. tenella* Zeller.

Under the genus Catharylla the first species mentioned by Zeller is *tenella* which I consider the type of the genus and I retain this generic name as it is not synonymous with Argyria, veins 7, 8, 9 on fore wing being stalked; the palpi are shorter than in *Crambus* to which it is allied.

**Diptychophora pictella**, new species.

*Male.*—Head and palpi white, the latter broadly circled with cinnamon buff; some similar scaling on frons anteriorly. Thorax vinaceous buff, the patagia tipped with white. Abdomen silvery white with light buff shading at base dorsally and on anal segment; legs white. Fore wings creamy white, the costa medially and inner margin white; black irrorations forming a subbasal shade from costa to vein 1; at middle of cell and extending below it a black patch of scales inwardly oblique, its outer edge rounded followed by a streak of black scales from subcostal to vein 2; fine oblique chrome streaks on costa medially, postmedially and at outer line; outer line creamy white finely edged with black, oblique to vein 6, then wavily curved and indentate on vein 2 preceded and followed between veins 4 and 6 by black spots consisting of finely striated lines; apex beyond line mars yellow containing a silvery streak above vein 7, and an upright fine white line above it to costa; termen mars yellow except between veins 3 and 4, and from vein 2 to tornus; cilia iridescent silvery white or fuscous gray. Hind wings silvery white; a fine dark terminal line from vein 4 to vein 7. Wings below silvery white a fuscous shade through cell to near termen on fore wing.

Expanse 15 mm.

*Habitat.*—Rio de Janeiro, Brazil; also from French Guiana.
*Type.*—Cat. No. 25534, U. S. N. M.

**Diptychophora herstanella**, new species.

*Male.*—Head and thorax white. Abdomen whitish buff. Fore wings white; costal edge finely fuscous; a small brown spot on costa near middle; a dark point in middle of cell; some dark scales just beyond cell; a fine subterminal black line outcurved from costa, followed by a short thick light orange yellow line from costa to vein 7, outbent to termen on vein 7, and a shorter streak below it; an interrupted terminal yellow line with black points below veins 4–2; cilia white, basally fuscous towards apex. Hind wings white; a terminal fuscous line from apex to vein 2.

Expanse 9 mm.

*Habitat.*—Porto Bello, Panama.
*Type.*—Cat. No. 25535, U. S. N. M.

**Argyria quevedella**, new species.

*Female.*—Head and palpi cinnamon. Collar and thorax silvery white. Abdomen white at base, otherwise light buff with white segmental lines. Fore wings silvery white; costal edge finely light brown; a small light orange yellow spot on costa above end of cell; a similar short curved subterminal streak from costa, followed by a shorter streak; cilia white with a very fine golden brown line at base. Hind wings white. Wings below silvery white.

Expanse 17 mm.

*Habitat.*—Quevedo, Ecuador.
*Type.*—Cat. No. 25536, U. S. N. M.

**Argyria tunuistrigella**, new species.

*Male.*—Head and palpi white, the latter cinnamon below. Front of collar, thorax and abdomen pale drab gray, the collar otherwise and patagia silvery white. Fore wings silvery white; the costa narrowly light buff shaded with brown at base; an inbent line of small reddish brown spots from beyond end of cell to middle on inner margin; a curved series of spots from costa to vein 7; terminal brown streaks almost forming a line; cilia silvery golden. Hind wings creamy white. Fore wings below whitish buff, the disc shaded with brown; the base of costa brown.

Expanse 19 mm.

*Habitat.*—Castro, Parana, Brazil.

*Type.*—Cat. No. 25537, U. S. N. M.

A specimen from São Paulo has the fore wing thinly irrorated with brown, and the line more pronounced forming an angle beyond cell with a fine inbent line to costa; this costal line is very faintly indicated in the type specimen.

**Argyria antonialis**, new species.

*Male.*—Head and palpi white, the latter cinnamon below. Thorax and shoulders reddish brown, the collar and patagia white. Abdomen white shaded dorsally with gray. Fore wings white; costa cinnamon with an orange streak at base; a medial orange yellow line, suffused with dark reddish brown, slightly oblique and wavy, outangled at vein 5 and more deeply so at submedian, preceded in cell by a small curved similarly colored line, so a small white spot is enclosed at end of cell; a triangular orange yellow spot on costa at apex with a fine line from it to termen; termen narrowly and cilia orange yellow with a reddish brown line at base of cilia. Hind wings silvery white. Fore wings below suffused with gray.

Expanse 16 mm.

*Habitat.*—San Antonio, Colombia.

*Type.*—Cat. No. 25538, U. S. N. M.

*Argyria tingurialis* Dyar has veins 7, 8, 9 stalked and should be removed to *Crambus.*

**Platytes arimatheella**, new species.

*Male.*—Head brown, palpi grayish brown, vertex light gray. Collar and shoulders orange cinnamon; thorax gray with some brown scaling. Abdomen above gray irrorated with cinnamon buff. Fore wings cupreous brown, paler on inner margin and termen; costal margin broadly whitish, the costal edge buff brown; from end of cell a broad, whitish, oblique fascia, narrower at inner margin near tornus, edged with purple black scales; an outer inbent dark, but indistinct, line from costa to fascia, followed by a lilacine shade obscured by darker scales; faint dark terminal spots. Hind wings white with a terminal grayish shade at apex.

Expanse 22 mm.

*Habitat.*—Nicaragua.

*Type.*—Cat. No. 25539, U. S. N. M.

Near *Platytes endochalybella* Hampson.

**Platytes damienella**, new species.

*Male.*—Head and palpi white, the latter mottled laterally with cinnamon buff. Collar and thorax white mottled with cinnamon buff. Abdomen whitish buff above with white segmental lines, underneath white. Fore wings mostly white; base of costa finely buff; some brown scaling subbasally in and below cell; medial space from below subcostal light cupreous brown with darker brown edging on either side, the inner side inangled between fold and submedian, the outer side incurved; a few brown scales on discocellular; a dark silky brown spot beyond cell, its inner edge sinuous from vein 6 to vein 3; its outer edge straighter extending to vein 8; below it to inner margin and beyond it to apex a pale buff brown shade with two darker streaks on veins 7 and 8; a very fine terminal cupreous line with darker terminal spots; cilia white. Hind wings silvery white.

Expanse 15 mm.

*Habitat.*—Pernambuco, Brazil.
*Type.*—Cat. No. 25540, U. S. N. M.

**Erupa somenella,** new species.

*Male.*—Head and thorax buff brown. Abdomen cinnamon; venter with light buff segmental lines. Legs light buff streaked in front with brown. Fore wings cinnamon buff thickly irrorated with buff brown, the veins on termen light buff; a fuscous point antemedially below cell; a dull fuscous spot at end of cell, preceded by a short pale streak; a deeply dentate lunular postmedial fuscous line, not reaching costa or inner margin, oblique from vein 6 to submedian fold, macular on last two interspaces; terminal black points; cilia whitish buff. Hind wings dull white, the veins irrorated with brown terminally; a lunular fine subterminal brown line; terminal black points. Wings below whitish buff with a distinct postmedial fuscous line and black discal spots; terminal black points; the costal margin of fore wing pale cinnamon.

Expanse 34 mm.

*Habitat.*—Volcan de Santa Maria, Guatemala.
*Type.*—Cat. No. 25541, U. S. N. M.

**Erupa huarmellus,** new species.

*Male.*—Head and thorax purplish brown, the patagia paler tipped with lilacine white. Abdomen above brown, whitish at base and on anal segment. Fore wings avellaneous glossed with purple; a dark brown line from costa at one fourth from base to inner margin at two-thirds; a small dark spot in cell and a larger oblique spot at end of cell continued as a dark shade to termen at submedian fold; a fine postmedial dark dentate line outwardly paler shaded; a terminal black brown line; cilia whitish with black spots terminally. Hind wings whitish suffused with light silky brown; a very fine dark terminal line. Wings below iridescent ochreous brown; dark discal spots; a dark terminal line partly cut by veins; discal area of fore wing darker shaded.

Expanse 35 mm.

*Habitat.*—Yahuarmayo, Peru.
*Type.*—Cat. No. 25542, U. S. N. M.

**Erupa chilopsisina,** new species.

*Male.*—Head light buff, the palpi laterally brown. Thorax light buff shaded in front with light brown, the neck darker brown. Abdomen above brown gray, the two basal segments light reddish brown; underneath white with a ventral and lateral brown line. Legs whitish partly streaked with brown, especially the fore legs. Fore wings light buff, the margins pinkish buff; a few reddish brown irrorations on basal half and beyond the subterminal line; from before middle of costa an oblique reddish brown line partly suffused with fuscous, outangled at end of cell, and inbent to inner margin, followed at discal angle by a round black spot from which a reddish brown line extends to apex; a fine fuscous brown line on inner margin not reaching base or subterminal line; two black points above the discal spot; a postmedial series of black points on veins, closely followed by the fine subterminal line; marginal black spots on interspaces; cilia divided by a grayish line. Hind wings whitish suffused with brown on costal margin and inner area; a subterminal diffuse grayish brown line; terminal space light buff with a few dark irrorations, the terminal spots almost forming a wavy line. Wings underneath whitish; a subterminal dark line cut by veins; terminal spots forming a line on fore wing, well separated on hind wing; a dark brown discal spot on fore wing, a round black spot on hind wing, the latter with brown irrorations below costa and on submedian fold.

Expanse male 35 mm., female 45 mm.

*Habitat.*—Castro, Parana.
*Type.*—Cat. No. 25543, U. S. N. M.

**Erupa impunctella**, new species.

*Female.*—Head white. Collar and thorax white, iridescent, changing to lilacine gray. Abdomen light buff, the base dorsally white, the following three segments shaded with light brown. Fore wings light pinkish cinnamon, the veins light buff; the cell and a streak to termen slightly darker; a similar streak above submedian from base to termen; a few dark scales above and below submedian. Hind wings white; faint brownish suffusions on termen towards apex. Fore wings below whitish buff. Hind wings below white, the costa whitish buff.

Expanse 40 mm.

*Habitat.*—Paraguay.
*Type.*—Cat. No. 25544, U. S. N. M.

**Macrochilo herstanellus**, new species.

*Male.*—Head, palpi, collar and thorax auburn. Abdomen buffy brown, legs auburn. Fore wings auburn glossed with lilacine except on costal margin and terminal area; a medial black brown line outangled at end of cell inwardly marked by a few pale blue scales in cell, on fold, and on inner margin; an outer fine dark line, outcurved and wavy followed on costa by a white spot, below vein 7 forming a thicker inbent black brown line to inner margin, preceded by light blue streaks on veins 5–8 and with some blue scaling on inner margin; terminal silvery white spots with dark edges; cilia a little paler than wing. Hind wings whitish buff; a grayish brown subterminal line; termen narrowly darker. Fore wings below fuscous brown, the margins golden buff.

Expanse 32 mm.

*Habitat.*—San Antonio, Colombia.
*Type.*—Cat. No. 25545, U. S. N. M.
Near *M. pravella* (*Erupa*) Schaus.

Vein 5 on both wings from above angle; this is also the case in *pravella*. *Erupa luceria* Druce also belongs here, but has vein 5 from angle of cell. It is probable that other species of *Erupa* described by Druce have veins 7–10 stalked.

**Macrochilo eambardella**, new species.

*Male.*—Head, palpi and thorax sayal brown. Abdomen cinnamon buff. Fore wings glossy sayal brown; basal white spots in and below cell; a subbasal wavy, interrupted white line; an antemedial white line, outangled at median and vein 2, below fold finely edged with black; some black scaling on discocellular; an outer wavy lunular line black brown, slight-outcurved below costa, outwardly edged with white scales to vein 4, broadly so at costa; terminal white points not reaching apex; termen faintly shaded with purple. Hind wings whitish suffused with cinnamon buff; a brown point at upper angle of cell; a faint subterminal line; the termen narrowly rufous brown. Wings below with the outer line distinct, the surface cinnamon buff, the fore wing shaded with light sayal brown from base to outer line.

Expanse 24 mm.

*Habitat.*—El Tepo, Rio Pastaza, Ecuador.
*Type.*—Cat. No. 25546, U. S. N. M.

**Eoreuma paranella**, new species.

*Female.*—Head, palpi and thorax pale congo pink thinly irrorated with pale bister brown scales; abdomen similar above at base, otherwise white. Fore wings pale congo pink thinly irrorated with pale bister brown; a point at end of cell; a postmedial series of minute clusters of scales outcurved beyond cell, vertical below vein 2; a similar subterminal series of minute clusters of scales; terminal black points; cilia white. Hind wings silky white faintly suffused with gray. Fore wings below wood brown, the inner margin white. Hind wings below white, the margins suffused with pale wood brown.

Expanse 30 mm.

*Habitat.*—Sao Paulo, South East Brazil.
*Type.*—Cat. No. 25547, U. S. N. M.

**Eoreuma donzella**, new species.

*Female.*—Head, body and legs cinnamon buff. Fore wings cinnamon buff; costa finely white; a narrow cinnamon shade from end of cell to termen; a similar streak above submedian vein; an almost imperceptible dark point at end of cell; no terminal markings. Hind wings silky white. Fore wings below paler. Hind wings below white, the costal margin cinnamon buff.

Expanse 33 mm.

*Habitat.*—Sao Paulo, South East Brazil.
*Type.*—Cat. No. 25548, U. S. N. M.

This species and *E. paranella* Schaus are the two undescribed species referred to by Ely in his description of the genus *Eoreuma.*

**Haimbachia dumptalis,** new species.

*Male.*—Head and thorax white, palpi avellaneous. Abdomen whitish buff, the basal segments dorsally yellow ocher; underneath and legs light buff. Fore wings light buff suffused with avellaneous on terminal half; scattered black irrorations; traces of an avellaneous line outcurved around cell, inbent from vein 2 to inner margin and better defined; a fine subterminal line outcurved before apex, white with darker edging; marginal white streaks above veins 6 and 7, small fuscous terminal points; cilia silvery white at base followed by a fine fuscous line, the tips avellaneous. Hind wings white; an indistinct double tilleul buff subterminal line from costa to vein 2; a similarly colored terminal line. Fore wings below silky avellaneous; the hind wings below whitish, the costa faintly darker tinged.

Expanse 16 mm.

*Habitat.*—Cayuga, Guatemala.

*Type.*—Cat. No. 25550, U. S. N. M.

Also in collection from Mexico and French Guiana.

*Diatraerupa guapilella* Schaus belongs to the genus *Iesta* Dyar which has priority.

**Haimbachia gloriella,** new species.

*Female.*—Head wood brown; two black points on vertex. Collar brown broadly tipped with white. Thorax brown in front, tilleul buff behind with black points, the patagia white with an angled dark line. Abdomen buff brown. Fore wings white, the basal half irrorated with black; an ochraceous buff stripe across middle of wing, angled on costa from a brownish line; an oblique postmedial line on costal margin; veins 1–7 edged with fuscous gray scales, filling some of the interspaces; two subterminal fuscous gray lines, somewhat apart on costa, outcurved, slightly sinuous from vein 3 to inner margin, followed by ochraceous buff spots on interspaces; geminate black points at veins terminally, forming a line at apex; cilia silvery white with dark tips. Hind wings buffish white; a faint subterminal and a dark terminal line. Hind wings below white, the costa broadly suffused with fuscous gray.

Expanse 15 mm.

*Habitat.*—Venadio, Sinaloa, Mexico.

*Type.*—Cat. No. 25551, U. S. N. M.

*Eromene chiriquitensis* Zeller belongs to the genus *Haimbachia*

**Haimbachia quiriguella,** new species.

*Female.*—Head, collar and thorax white, the palpi irrorated and tipped with gray. Abdomen white, the two basal segments dorsally shaded with ochraceous buff. Fore wings white with some brown irrorations, more numerous on interspaces beyond cell, leaving the veins white; a fine ochraceous line from costa outcurved around cell and incurved below vein 2, oblique below submedian; a double ochraceous buff subterminal line outcurved from costa to near termen, deeply inangled on vein 2, and again outcurved followed on veins 7 and 8 by ochraceous buff streaks; a fuscous terminal line at apex, changing to minute paired spots at veins 6–4, below vein 2 and 3 a single larger black spot; cilia silvery tipped with fuscous. Hind wings white.

Expanse 18 mm.

*Habitat.*—Quirigua, Guatemala.
*Type.*—Cat. No. 25552, U. S. N. M.
Closely allied to *H. squamulellus* Zeller.

**Haimbachia prestonella,** new species.

*Male.*—Head and body white; palpi with a few gray brown hairs laterally and near tip; abdomen dorsally ochraceous buff at base. Legs white, the tarsi with brown rings. Fore wings white irrorated with coarse black scales to postmedial line, with finer black scales on space beyond; postmedial line cinnamon buff, outcurved around cell, vertical below vein 2, followed on costal margin by a similar oblique line; subterminal line double, outcurved on costa where it is cinnamon buff, from vein 8 to inner margin fine, black; terminal cinnamon buff streaks on veins 6–8 finely edged with black; a terminal fine black line and one on cilia. Hind wings white suffused with light grayish buff. Wings below fuscous gray; a dark terminal line; cilia white tipped with black on fore wing; inner margin of hind wings white.

Expanse 12 mm.

*Habitat.*—Venadio, Sinaloa, Mexico.
*Type.*—Cat. No. 25553, U. S. N. M.

**Diatraea guatemalella,** new species.

*Male.*—Head, palpi and body light ochraceous buff, the base of abdomen dorsally cinnamon. Body below and legs light buff. Fore wings light buff; warm buff streaks in cell and interspaces; the median, submedian and veins from cell finely brown; a black point at end of cell; postmedial line deeply outcurved around cell indicated by streaks on veins from costa to vein 6, then by small clusters of scales, partly suffusing and inbent to inner margin near base, below vein 2 expanding into a spot; a subterminal series of black points on veins, outcurved and inbent to inner margin; terminal black points on interspaces. Hind wings whitish buff with terminal black points.

Expanse 25 mm.

*Habitat.*—Cayuga, Guatemala.
*Type.*—Cat. No. 25554, U. S. N. M.
Near *D. tabernilla* Dyar, but differs in genitalia and the absence of tufts on hind tibiae.

**Diatraea postlineella,** new species.

*Male.*—Head light buff. Thorax and abdomen above wood brown, the base of abdomen shaded with rufous; underneath white, legs light buff. Fore wings light buff irrorated with wood brown; a minute cluster of black scales at end of cell; a postmedial and subterminal series of similar clusters, deeply inbent from vein 4 to inner margin, the postmedial hardly defined above vein 5; terminal black points on interspaces. Hind wings whitish irrorated with wood brown; a distinct subterminal dark line. Wings below light buff; discal area of fore wings suffused with fuscous; veins on hind wings darker.

Expanse 27 mm.

*Habitat.*—Quirigua, Guatemala.
*Type.*—Cat. No. 25555, U. S. N. M.
The only species of Diatraea I know with a distinct line on hind wing.

**Diatraea fuscella,** new species.

*Male.*—Head and palpi buff brown. Abdomen light buff irrorated above with wood brown, the basal segments orange buff. Fore wings pinkish buff; a white line from within cell to termen with a black point at end of cell, and a fine cinnamon line on discal fold; whitish lines on costa, below veins 11, 8, 4, 3, 2, below cell, and above submedian; from vein 6 an inbent series of small clusters of black scales forming a streak below vein 1 towards base; an outer series of small clusters of black scales on veins, only slightly inbent from vein 7 to inner margin; terminal black points on interspaces. Hind wings gray brown. Fore wings below fuscous with pale margins; hind wings below whitish irrorated with wood brown.

Expanse 25 mm.

*Habitat.*—Carillo, Costa Rica.
*Type.*—Cat. No. 25556, U. S. N. M.

**Diatraea maronialis,** new species.

*Male.*—Head and palpi whitish gray. Thorax whitish with a medial avellaneous line and shading on patagia. Abdomen whitish, the two basal segments dorsally ochraceous buff. Legs whitish. Fore wings light buff, the veins, two lines in cell, and a streak below costa ochraceous buff; a black point at end of cell. Medial space from inner margin to vein 2 cinnamon, limited inwardly by a slightly darker curved line; base of interspaces from veins 2 to 4 gray, with gray streaks on interspaces above; veins 6 to 8 terminally fuscous gray; short ochraceous buff streaks subterminally below veins 3 to 5; terminal black spots; cilia white. Hind wings white shaded with light buff on inner margin; veins 6 and 7 brownish; terminal fuscous points towards apex.

Expanse 26 mm.

*Habitat.*—St. Jean, Maroni River, French Guiana.
*Type.*—Cat. No. 25557, U. S. N. M.
The apex of fore wings rounded.
A cotype in Collection Dognin.

**Diatraea umbrialis,** new species.

*Female.*—Head white, the palpi laterally cinnamon buff; a medial buff line on vertex. Collar white edged in front with wood brown. Thorax white; a medial line and patagia wood brown. Abdomen white, the second and third segments above cinnamon buff; legs white. Fore wings white, the veins wood brown; two similar streaks on costa, two in cell, two between cell and fold, one above and below submedian, also on interspaces from cell to near termen, heavier postmedially forming a vague shade from inner margin to apex; the discocellular white; a subterminal line from veins 4–2; a terminal cinnamon buff line with dark points above and below vein 2; cilia white. Hind wings white.

Expanse 31 mm.

*Habitat.*—St. Jean, Maroni River, French Guiana.

*Type.*—Cat. No. 25558, U. S. N. M.

The apex of fore wing is rounded as in *D. maronialis* Schaus.

**Diatraea sobrinalis,** new species.

*Male.*—Head, palpi and thorax drab. Abdomen white, the second and third segments dorsally cinnamon buff. Fore wings light buff, the veins light wood brown; the basal area suffused with wood brown; light wood brown streaks on interspaces; a black point at end of cell; a terminal brown line with black points on interspaces. Hind wings white.

The female has the fore wing more of a light brownish buff, the veins and streaks darker.

Expanse male 21 mm.; female 29 mm.

*Habitat.*—Cayuga, Guatemala.

*Type.*—Cat. No. 25559, U. S. N. M.

Allied to *D. angustellus* Dyar, but with shorter and broader wings.

**Xubida,** new genus.

*Male.*—Proboscis minute; palpi three times the length of head, porrect, the third joint downcurved and with short hairs; maxillary palpi triangularly scaled; antennae thick and flattened, slightly serrate at tips; tibiae with long spurs. Fore wing with the apex acute and slightly produced; vein 3 from before angle of cell; 4 and 5 from a point; 7 and 10 from cell; 11 oblique. Hind wing with vein 3 from before angle or stalked; 6 and 7 from upper angle.

*Type of genus.*—*Xubida dentilineella* Schaus.

Near *Platytes* but with longer palpi.

**Xubida cayugella,** new species.

*Male.*—Head and thorax cinnamon buff, abdomen whitish buff, dorsally thinly irrorated with ochraceous scales. Legs whitish, the fore legs tinged with brown. Fore wings cinnamon buff with a purplish gloss and some dark irrorations; cell darker shaded with a fuscous purple spot at end; traces of a subbasal dark shade; an antemedial outangled macular line; a medial series of small brown spots curved around end of cell and deeply inbent to inner margin before middle; a more pronounced series of postmedial purplish spots also outcurved beyond cell; terminal space darker, shaded with purplish and with fine fuscous streaks on interspaces; no terminal spots or lines; cilia dark purple brown. Hind wings white, the cilia towards apex grayish. Fore wings below ochraceous, the discal area dark shaded. Hind wings below whitish, the costal margin irrorated with ochraceous brown scales.

Female brighter, the fore wings suffused with roseate; no dark streak in cell, only a small spot at end; antemedial and medial macular lines very faint.

Expanse male 25 mm.; female 35 mm.

*Habitat.*—Cayuga, Guatemala.
*Type.*—Cat. No. 25560, U. S. N. M.

**Xubida narinella**, new species.

*Male.*—Head whitish; palpi laterally brownish gray, collar and thorax medially whitish, otherwise brownish gray. Abdomen above gray brown, the basal segment and anal tufts whitish. Legs white, the fore tibiae streaked with brown. Fore wings pale ochraceous buff thinly irrorated with black scales; a black point at end of cell; a fine line from costa at one third from base, extending obliquely to above end of cell, then forming a series of small clusters of scales deeply curved beyond cell and inbent to just before middle of inner margin; a fine subapical line, dark from costa to vein 7, then whitish, faint and dentate to inner margin, the apex above it somewhat whitish; terminal black points on interspaces; a darker brown shade above submedian from base to termen with a whitish shade above it to cell and vein 3; a brown antemedial point on inner margin. Hind wings whitish, the subterminal space broadly irrorated with ochreous. Fore wing below whitish irrorated with ochreous brown; a darker shade beyond cell; veins finely ochreous brown on terminal third with fine dark gray streaks on interspaces. Hind wings below with costal margin broadly irrorated with light brown.

Expanse 21 mm.

*Habitat.*—Cayuga, Guatemala.
*Type.*—Cat. No. 25561, U. S. N. M.

**Xubida dentilineella**, new species.

*Male.*—Head whitish buff, the palpi laterally bister brown. Collar and thorax whitish buff laterally shaded with cinnamon. Abdomen gray with sublateral white lines; legs whitish with avellaneous streaks. Fore wings cinnamon, the veins rufous brown; fine white lines on costa, in cell and on submedian fold; cell shaded with fuscous extending beyond to termen below apex; a few scattered brown scales; a fuscous streak above submedian; a black point at end of cell; a faint medial line consisting of minute brown spots outcurved well beyond cell and inbent to below cell; minute postmedial brown spots on veins; a fine dark line from costa above end of cell to termen at vein 8, then partly whitish and deeply dentate from postmedial spots to terminal dark points on interspaces; cilia silvery divided by a gray line. Hind wings white suffused with gray; veins 4 and 5 form a point. Fore wing below and costal half of hind wing fuscous gray, the hind wing otherwise white.

Expanse 23 mm.

*Habitat.*—Volcan de Santa Maria, Guatemala.
*Type.*—Cat. No. 25562, U. S. N. M.

Allied to *X. narinella* Schaus, paler and the dentate marginal line twice as deep.

**Xubida minorella,** new species.

*Male.*—Head white, a medial brown line on vertex; palpi laterally buffy brown. Thorax and collar medially light buff, laterally brownish. Abdomen above grayish brown, underneath buff with paired converging gray lines on segments; legs whitish partly streaked with fuscous gray. Fore wings cinnamon, the veins from cell reddish brown; edge of costa white; two silvery lines below costa, one in cell edged above with fuscous gray; a silvery line on submedian vein edged above by a brown line and below with fuscous gray to near inner margin; a black point at end of cell; a grayish shade from cell above vein 5; faint traces of a curved line beyond cell; fine dark streaks terminally on interspaces; a dark line from costa above end of cell to termen at vein 8; a subterminal dentate line from vein 4 to inner margin; terminal black points; cilia dark silvery gray divided by a fuscous line. Hind wings silvery gray. Fore wings below and costa of hind wing broadly dark silvery gray, the hind wing otherwise white.

Expanse 19 mm.

*Habitat.*—Volcan de Santa Maria, Guatemala.
*Type.*—Cat. No. 25563, U. S. N. M.

**Xubida venadialis,** new species.

*Male.*—Body white; palpi laterally buff brown; thorax streaked with gray; legs streaked with buff brown. Fore wings white, the veins streaked with grayish brown; similar streaks on costa, in cell and on interspaces; the submedian fold white with dark streaks above and below it; a black point at end of cell; a faint brownish line from middle of costa, outcurved around cell; a subterminal dentate gray brown line; terminal black points; cilia white divided by a grayish brown line and another at base. Hind wings white suffused with pale grayish brown; a terminal line from apex to vein 2; cilia white. Fore wings below grayish brown. Hind wings below white, the costa faintly darker shaded.

Expanse 14 mm.

*Habitat.*—Venadio, Sinaloa, Mexico.
*Type.*—Cat. No. 25549, U. S. N. M.

*Platytes thyonella* Schaus, *P. rutubella* Schaus, *P. circumvagans* Dyar, *Ubida neogynaecella* Dyar, *U. monodisa* Dyar, *U. cretaceipars* Dyar and *U. delinqualis* Dyar should be transferred to *Xubida* Schaus.

**Chilo truncatellus,** new species.

*Male.*—Body above pale ochraceous buff, underneath whitish buff; palpi laterally avellaneous. Fore wings clay color; costa finely white; the basal third brownish; inner margin white to above submedian; a black point at end of cell; some dark gray scaling in cell, and similar irrorations beyond cell to the fine brownish postmedial line, which is very indistinct, outcurved beyond cell and obsolete below vein 3; a faint darker subterminal line, outcurved below costa; white points terminally on interspaces with black points on either side; cilia fuscous gray at base, then broadly white. Hind wings white; a fine fuscous gray terminal line somewhat interrupted from apex to below vein 2. Fore wings below light buff, the termen white; a black discal point. Hind wings below white; a black discal point; a broken black terminal line on both wings; cilia light buff at base, then white.

Expanse 27 mm.

*Habitat.*—Castro, Parana.
*Type.*—Cat. No. 25564, U. S. N. M.

**Chilo matanzalis,** new species.

*Female.*—Head pinkish buff, the vertex white. Collar and thorax wood brown. Abdomen pinkish buff, faintly paler underneath. Fore wings pinkish buff, a few scattered dark irrorations; a fine dark lunule on discocellular; a wood brown shade from base below cell to termen at vein 2; a narrower similar streak from base of vein 6 along discal fold to termen; streaks above and below vein 3, and above vein 2; vein 4 terminally darker; the inner margin from below fold light buff; terminal black points; cilia silky light buff. Hind wings white faintly suffused with light buff. Wings below whitish, the costal margins of both wing- light buff.

Expanse 46 mm.

*Habitat.*—Matanzas, Cuba.
*Type.*—Cat. No. 25565, U. S. N. M.
The fore wings are rather broad.

**Chilo cynedradellus,** new species.

*Female.*—Head and body pinkish buff; a few darker scales on palpi and patagia; a small black spot dorsally at base of abdomen. Fore wings pinkish buff; some faint darker irrorations; a black point at end of cell; faint traces of a curved dentate line beyond end of cell; a faint fuscous streak along submedian fold from base to vein 2; a very faint series of outer points forming a line, curved below costa and parallel with termen; small terminal black points; cilia pinkish buff. Hind wings white; a faint terminal light brown line from apex to vein 2. Wings below white; fore wings from subcostal to median, and below submedian shaded with pale avellaneous to an erect postmedial line inbent on costa; terminal dark points on both wings. The fore wings long and narrow.

Expanse 41 mm.

*Habitat.*—Castro, Parana.
*Type.*—Cat. No. 25566, U. S. N. M.

**Chilo alfoldellus,** new species.

*Male.*—Head and thorax pinkish buff, the palpi laterally with some dark shading. Abdomen grayish buff, the two basal segments dorsally pinkish cinnamon. Fore wings pinkish buff suffused with sayal brown except below submedian fold and vein 2 to subterminal line; a small white spot with a black point at end of cell; a few dark irrorations on costa and terminal half; a fine postmedial crenulate but indistinct line outangled well beyond cell and inbent to before middle of inner margin; an outcurved similar subterminal line, the two lines connected on discal fold by a faint fuscous bar; almost imperceptible terminal fuscous points. Hind wings whitish buff, the termen suffused with pale sayal brown. Wings below whitish; cilia of fore wings iridescent whitish to rufous brown.

Expanse 39 mm.

*Habitat*.—Rio de Janeiro, Brazil.
*Type*.—Cat. No. 25567, U. S. N. M.
Fore wings rather broad.

**Chilo venatella,** new species.

*Female*.—Head white, the palpi avellaneous fringed above with white. Collar and thorax white with wood brown shading at neck and shoulders. Abdomen whitish buff; legs white inwardly, whitish buff outwardly. Fore wings silvery white; the subcostal, median and veins 1–8 cinnamon brown; some similar coloring on inner margin; cilia white. Hind wings silvery white; a faint brownish shade at apex. Fore wings below tinged with pale grayish brown.

Expanse 18 mm.

*Habitat*.—Baracoa, Cuba; also from Pernambuco, Brazil.
*Type*.—Cat. No. 25568, U. S. N. M.
The type from Baracoa collected by A. Busck.

**Chilopsis peruanellus,** new species.

*Male*.—Head, collar and thorax ochraceous buff, the collar and thorax striated with pale olive buff. Abdomen above fuscous brown. Body below and legs light buff. Fore wings pale ochraceous buff with some scattered large black scales; some vinaceous fawn shading in cell; a black point at end of cell; minute terminal black points; a very faint brownish postmedial line curved around cell, dentate, broader below vein 2; cilia ochraceous buff. Hind wings suffused with smoky olive gray, the costa and postmedial space from vein 4 to below vein 2 whitish. Wings below light buff with some black irrorations at apices; black points on discocellulars.

Expanse 40 mm.

*Habitat*.—Yahuarmayo, Peru.
*Type*.—Cat. No. 25570, U. S. N. M.

**Chilopsis castrellus,** new species.

*Male*.—Head and palpi ochraceous buff, the palpi laterally wood brown. Thorax and abdomen above buffy brown, the abdomen irrorated with cinnamon, the basal segments suffused with cinnamon; body below and legs ochraceous buff. Fore wings light buff suffused with brownish buff except at end of cell and on discal and submedian folds; large scattered black scales, also on base of cilia; a small black spot at end of cell; a faint dark line around end of cell, inbent to inner margin before middle; a subterminal deeply crenulate line; terminal black points on interspaces; cilia white. Hind wings fuscous brown, slightly paler on termen; large terminal black points; the costal margin light buff. Wings below light buff; terminal black points; dark brown points at end of cells; a postmedial fuscous line; space from cell to inner margin and postmedial line suffused with grayish brown on both wings.

Expanse 50 mm.

*Habitat.*—Castro, Parana.
*Type.*—Cat. No. 25571, U. S. N. M.
Allied to *C. nigristigmellus* Hampson.

**Chilopsis dorsipunctellus,** new species.

*Male.*—Head and body light buff; at base of abdomen dorsally a large fuscous brown spot with brownish shading on two following segments. Fore wings light buff and with some dark gray irrorations; no point at end of cell; terminal black points on interspaces; a slightly darker postmedial line outangled below costa then oblique and wavy to before middle of inner margin; a faint subterminal dentate line; cilia whitish buff. Hind wings glossy light buff; a terminal dark line between veins 5 and 6. Wings below light buff; the discal space on hind wing more thinly scaled, whiter and faintly opalescent; traces of a postmedial darker line.

Expanse 40 mm.

*Habitat.*—Yahuarmayo, Peru.
*Type.*—Cat. No. 25569, U. S. N. M.

**Doratoperas biumbrata,** new species.

*Female.*—Head and body above ochraceous buff, underneath light buff; legs ochraceous buff. Fore wings light buff; a few scattered light brown scales; a diffused light pinkish cinnamon shade from apex to inner margin at two-thirds from base; a similar shade from its inner edge at vein 5 to middle of inner margin, the space between suffused with ochraceous buff; minute terminal cinnamon points on interspaces; cilia ochraceous buff. Hind wings whitish, the inner margin with light buff hairs. The underside of hind wing shows a faint subterminal shade from costa to vein 5.

Expanse 65 mm.

*Habitat.*—Volcan de Santa Maria, Guatemala.
*Type.*—Cat. No. 25572, U. S. N. M.
Near *D. spectabilis* Felder which I do not consider the same as *D. atrosparsellus* Walker; these two species were united by Hampson.

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## A NEW GENUS OF TWO-WINGED FLY WITH MANDIBLE-LIKE LABELLA

By J. M. Aldrich.

In the Dipterous family Dolichopodidae the adult insects are well known to be predaceous; they capture the smaller and weaker flies, and in their favorite haunts at the edge of water they pick up small Chironomid and other dipterous larvae, as well as oligochaete worms. These various animals they hold within or partly within the labella while extracting the juices.

In the present paper a new form is reported, in which the labella have undergone a striking specialization, the outer lobe forming an organ like the mandible of a carnivorous beetle.

That this actually functions as a mandible can not be doubted, but no exact information is at hand regarding the nature of its food; it is known however to live on the sea beach.

In describing this unique fly as a new genus and species, I am indebted to Mr. Snodgrass for his assistance in the morphological aspect, as well as for his drawings. His article with plate follows mine.

**Melanderia**, new genus.

First antennal joint bare above, third antennal joint short, arista dorsal. Palpi large and flat, resting upon the proboscis; proboscis greatly enlarged, its basal portion forming a very broad, short tube, the apical half fleshy, opening underneath in a longitudinal slit, each side bilobed, the outer side pieces extending forward in the form of mandibles; in the type species they are elongated and sharp. In the normal resting position of the mouth they are drawn up enough to be mostly concealed behind the inner lobes, which extend below the palpi for some distance. Head bulging behind, with numerous bristles below at the neck, a single row of which extend across the occiput above with only a slight interruption in the middle. Prothorax with spines around the neck except below. Pleura hairy or bristly in front of the posterior spiracle, acrostichal hairs in an irregular double row. Scutellum with a single pair of upright bristles; dorsocentral bristles 6 or 7; intraalar 2, one of which is directly on the suture; supraalar 1, postalar 1. Abdomen with 6 visible segments in the male, 5 in the female.

Hind cross-vein of the wing beyond the middle, about its own length from the margin. Genital segments of the male rather prominent, but not extending forward under the venter.

Type of genus, *Melanderia mandibulata* new species.

The genus is related to Hydrophorus, differing principally in the structure of the mouth. Beside the typical species it includes *Hydrophorus curvipes* Van Duzee.

**Melanderia mandibulata**, new species.

[Plate 14, figs. 1–6.]

Male.—Front dark purple, face of the same color; the face runs to a sharp median point below. Palpi black, with numerous long hairs; proboscis black with brownish gray dust except on the mandible-like organs, which are shining, black, curved and sharp, and when let down so as to be visible, have an astonishing resemblance to the mandibles of a carnivorous beetle. The basal segment of the mouth is almost as wide as the whole head and has two or three rows of hairs across its apex below. Back of head with black hairs partially arranged in rows, the lower hairs much the longer; antennae wholly black, very short, the arista thickened at base for a very short distance, slender for the rest of its length.

Mesonotum and scutellum green, sub-opaque, with brownish dust. The pleura rather pure green, but not very shining; in the side view the same color extends above the suture between the humerus and the wing; propleura of the same color with a tuft of coarse hairs; sternopleura on its posterior portion above the coxa with a similar tuft of hairs; pteropleura with a cluster of smaller hairs on its lower part, directly below the calypters; the latter brown with blackish cilia. Abdomen of the same color as the thorax, somewhat flattened rather than compressed. Hypopygium black, the lamellae brown with black hair, rather spatulate in form, longer than one segment of the abdomen.

Front coxae green with rather thick whitish dust, on their front side with numerous erect rather long hairs; front femora of the same color, on the inner side near the base with a slight protuberance bearing a close bunch of 6 or 8 bristles; on the under side of the femur, near the base, are scattered, erect hairs, which become bristle-like about the middle where they form a cluster not very dense; front tibia dark brown, on its flexor side slightly curved and bearing an irregular row of erect, small black spines, which begin at the second third of its length; the apex of the tibia does not have any conspicuous spines.

Front tarsi black from the base, the last four joints almost equally long; the first joint as long as the following three, slightly swollen on the under side, and bearing a few spines below. Middle and hind femora slender, subshining, green, the middle one with a row of erect bristles on the upper front side, beginning about the middle, and some rather long hairs below, not arranged in rows. Middle and hind tibiae and tarsi black.

Wing elongated, narrow, uniformly brown in color, the third and fourth veins parallel and rather far apart, ending in the apex; hind cross-vein at right angles to costa.

Female.—Head structure precisely as in the male except that the face is a little wider. Front legs of plain structure. Wing as in the male.

Length of male 4.6 mm.; of female 5.2 to 6.2 mm.

Described from 29 specimens of both sexes, collected by A. L. Melander on the beach of the Pacific Ocean at Ilwaco, Washington, in July, 1917.

*Type.*—Male No. 25240 U. S. Nat. Mus.

In 24 specimens out of 29 the proboscis is retracted so that the mandible-like organs are concealed by the inner lobes of the lobella: in the remaining five these organs are plainly visible as in the accompanying figure.

**Melanderia curvipes** Van Duzee.

*Hydrophorus curvipes* Van Duzee, Entomological News, Vol. 29, p. 49, 1918.

A paratype female is in the National Collection from San Diego, California, collected by Mr. Van Duzee; there are also one male and three females collected by the writer at Santa Barbara, California, July 6, 1917; one of the latter has the mouth let down sufficiently to show the anterior tips of the side pieces, but instead of being pointed, as in the other species, they are rounded; they are however shining black for a little distance and sharp enough so that they doubtless serve for grasping and holding animals of some size. This species has in front of the posterior spiracle a row of three or four well developed bristles, the male does not have the striking tuft on the inner side of the front femur and there are slight differences in the other peculiarities of the front legs. It is considerably smaller than the preceding species, the male measuring hardly more than 3 mm. and the female about 3.5 mm. The front and face are green instead of purple and the third vein runs closer to the second than in *mandibulata*, curving considerably backward, near the tip of the wing.

Paratype, Female No. 25241, U. S. N. M.

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## MANDIBLE SUBSTITUTES IN THE DOLICHOPODIDAE.

BY R. E. SNODGRASS.

A first view of the face of *Melanderia mandibulata* (pl. 14, fig. 1) gives one a decided shock, followed by a desire to discover by what morphological trick the fly so cleverly imitates the features of a mandibulate insect. But the disguise is a flimsy one. Each labellum of the proboscis (fig. 6) is divided into an upper and a lower lobe (*a* and *b*, *c*), free terminally, but united basally by an ample infolded membrane. The lower lobe is differentiated again into a basal part (*c*) and a terminal part (*b*), the latter of thick, polished chitin and produced into a large, sharp, free tooth turned inward toward the one on the opposite side (fig. 1). These are the "mandibles." The lobe (*c*) is movably articulated at its base to the basal plate (fig. 6 *Th*) of the labium. This sclerite, called the theca, as in most flies, presents a high median ridge on its inner or anterior surface which gives attachment to muscles diverging to the lobes of the labellum. The fibers on each side are separated into two bundles, the proximal ones being inserted on the upper outer angle of the basal lobe (*c*) of the labellum, and the distal ones on the inner, median angle of the same lobe, which is united internally to the lower margin of *Th* by a special median articular condyle. Thus the lobe (*c*), terminating in the strongly chitinized point (*b*), can be worked in and out in true mandibular fashion. Figure 2 shows the parts of the labellum in repose with the mandible-like lobes (*b*) concealed beneath the upper lobes (*a*). The insect now presents the aspects of an ordinary fly.

But *Melanderia* possesses, besides its pseudo-mandibles, other mouth structures of interest which, however, are not visible externally. These are four great prongs depending from the epipharynx (fig. 3, *Ephy*), in addition to the usual hypopharynx (*hphy*), which is a strongly-developed, decurved appendage projecting from the lower lip of the mouth within the anterior enclosure of the labium. These parts may be exposed as shown in figure 3 by dissecting off the rest of the head and the labium along the line *g*. This discloses the chitinous floor (*Phy*) of the sucking pharynx with its two posterior cornua, and the dilator muscles of the pharynx (*Phy Mcl*) stretched between the invaginated roof of the pharynx and the edges of the lower facial plate (*Clp*) which is apparently the clypeus. These muscles form two lateral sheets in the Dolichopodidae, between which is a large apodeme (*d*) from the epipharynx carrying another set of muscles. The true labrum (*Lm*) is somewhat membraneous in *Melanderia* but a basal plate (*x*) intervenes between it and the clypeus which might belong to either, though, judging from some other forms, it is probably the base of the labrum. A removal of the clypeus, as in figure 4, fully exposes the muscles (*Ephy Mcl*) attached to the epipharyngeal apodeme (*d*) and inserted on the plate (*x*). Figure 5 shows all parts removed except the epipharyngeal armature and its apodeme (*d*). It is here seen that the two sets of prongs (*Ephy*) are carried on two basal plates (*e* and *f*). Each plate is grooved and weakly chitinized along the median line, and the posterior plate (*f*) supports the great flat apodeme (*d*) between the bases of its prongs. The contraction of the muscles (fig. 4, *Ephy Mcl*), pulling forward and downward against the base of the labrum (*x*), turns the posterior prongs of the epipharynx backward. A lobe on the anterior angle of the posterior basal plate (fig. 5, *f*) on each side, pressing downward on the posterior angle of the anterior plate (*e*), turns the anterior prongs forward. At the same time the median flexibility of both plates (*e* and *f*) allow the prongs to flare outward. Thus the action of one set of muscles brings about a simultaneous diverging of all the prongs in four directions, forward, backward and laterally.

Such a complicated epipharyngeal structure as that of *Melanderia* has apparently not been noted before in any fly, though something similar is common to all or most of the *Dolichopodidae*. Langhoffer (1902) divided the genera of this family into four groups according to the development and character of the armature of the epipharynx, but he had only two-pronged species, and in a former paper (1888) he had described the processes as true mandibles. While we can not accept this idea Langhoffer's study of the organs themselves is interesting. In his first group of genera, typified by *Hydrophorus*, he includes forms in which two processes are well-developed and project as long hooks or tusk-like spikes beneath the labrum, recurved in some cases, decurved in others. In *Hydrophorus signatus* there is a prominent tooth at the base of each large anterior prong suggesting the quadruple structure of *Melanderia*. In this connection it is interesting to note the great development of the hypopharynx in *Aphrosylus venator*, which belongs to the *Hydrophorus* group, the organ forming a long beak-like rod projecting from between the lobes of the labellum and curving back to between the front coxae. The epipharyngeal prongs are also well developed, forming two decurved tusks extending beyond the labrum.

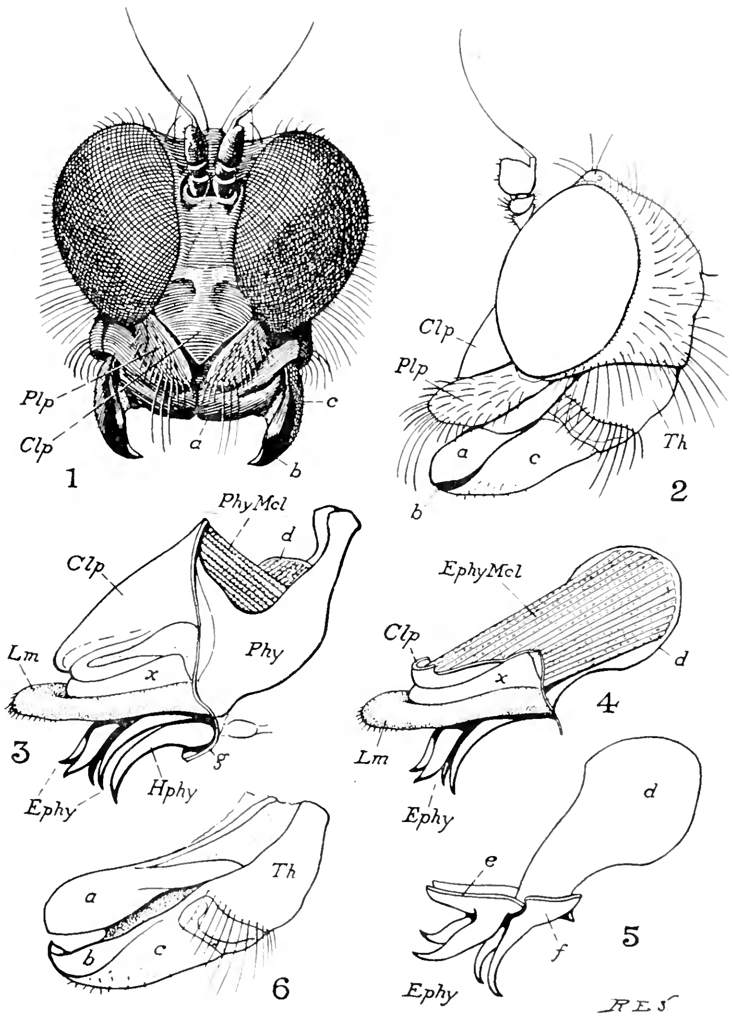
In Langhoffer's second group, including genera similar to *Dolichopus*, the epipharyngeal armature is less developed and consists of two ventral, longitudinal ridges beneath the labrum, ending anteriorly in free points. In the next two groups, including a smaller number of genera, *Porphyrops*, *Neurigona* and *Orthochile*, the armature is still weaker. In all four groups the presence and position of spines and teeth on the lobes constitute also distinguishing characters.

It is evident that Langhoffer was not acquainted with species having the characters of *Melanderia*, else he would have had to define a fifth group to include forms having *four* well-developed epipharyngeal prongs. In this he was fortunate, however, for such a discovery might have embarrassed his mandible theory.

*Melanderia mandibulata* does not stand alone as a unique thing; it culminates a small series of forms tending toward an excessive development of mouth armature, all of which live along ocean beaches where they probably feed on small animals stranded by the tide, as do other members of the family. We may suppose that their mouth hooks and prongs give them a special efficiency in ripping open the soft skin of the creatures from which they then suck out the body fluids. Dr. Aldrich, who has furnished the material for this paper, describes how he has seen shore-inhabiting species of *Dolichopus*, with the proboscis attached to one end of living prey, apparently sucking the b'ood, undisturbed by the squirming and writhing of the victim.

*Hypocharassus pruinosus*, from the beaches of Florida, Georgia and North Carolina, has an epipharyngeal armature of four thick, wide pieces, the anterior plates being especially deep and provided on the front edges with a series of small teeth above the principal hooks. This apparatus constitutes a lacerating implement probably quite as effective as the epipharyngeal parts of *Melanderia*. But this species has no labial "mandibles," though the general outlines of the lateral lobes of the labellum are very suggestive of those of *Melanderia* when its jaws are closed (fig. 2).

*Melanderia curvipes*, of the coast of Southern California, is distinctly of the *mandibulata* type. It was formerly placed in the genus *Hydrophorus*, but Dr. Aldrich would now transfer it to *Melanderia*. The labellum on each side is separated into a dorsal and a ventral division, and the tip of the lower one is prolonged and curved inward as a strongly chitinous, polished lobe, but with a rounded edge instead of a sharp point. The epipharyngeal armature is like that of *mandibulata*, but the plate ($x$) at the base of the labium, on which the epipharyngeal




SNODGRASS—MANDIBLE SUBSTITUTES.

muscles are inserted, is distinct all around from the clypeus, instead of being united mesially with this plate as in *mandibulata* (fig. 3).

*Melanderia mandibulata*, of the coast of Washington, boldly goes to the logical extreme and has the jaw lobes of its labella developed into well-formed, tapering, sharp-pointed organs of true mandibular form.

We have here, evidently, a case of species badly in need of jaws, but, mandibles having been lost by their ancestors, and irrevocably, the family has developed substitutes for these organs in the form of prongs and hooks on the epipharynx, while *Melanderia* has supplemented these with special jaw-like lobes of the labellum.

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1902. Langhoffer, A. Mandibulae Dolichopodidarum. Verhandlungen des V Internationalen Zoologen-Congresses zu Berlin, 1901, pp. 480–486, 4 figs.

## EXPLANATION OF PLATE 14.

*Melanderia mandibulata* Aldrich.

Fig. 1—Facial view of head with "mandibles" open.

Fig. 2—Side view of head with "mandibles" (*b*) closed and concealed beneath upper lobes (*a*) of labellam.

Fig. 3—The clypeus (*Clp*), labrum (*Lm*), epipharynx (*Ephy*) and hypopharynx (*Hphy*) removed from rest of head and labium along the line (*g*), exposing the sucking pharynx (*Phy*) and its dilator muscles (*PhyMcl*).

Fig. 4—The labrum and epipharynx, with clypeus, pharynx and hypopharynx removed, exposing the epipharyngeal apodeme (*d*) and its muscles (*EphyMcl*) attached to basal plate (*x*) of labrum.

Fig. 5—The epipharyngeal armature and apodeme (*d*) with muscles removed. The four epipharyngeal prongs (*Ephy*) separated and shown arising from two basal plates (*e* and *f*) beneath labrum, which is removed. The second plate (*f*) carries the apodeme (*d*) between bases of prongs.

Fig. 6—Side view of labium, showing basal plate (*Th*), and the three lateral divisions of the labellum (*a*, *b* and *c*), the middle one strongly chitinous and mandible-like.

*a*, upper lateral lobe of labellum; *b*, jaw-like lobe of labellum; *c*, lower basal lobe of labellum; *Clp*, lower part of face, probably the clypeus; *d*, epipharyngeal apodeme; *c*, basal plate of anterior epipharyngeal prongs; *Ephy*, epipharynx; *f*, basal plate of posterior epipharyngeal prongs; *g*, epipharyngeal apodeme; *Hphy*, hypopharynx; *Phy*, pharynx; *PhyMcl*, dilator muscles of pharynx; *Plp*, maxillary palpus; *Th*, theca; *x*, plate between labrum and clypeus, probably basal part of labrum.

# THE DERIVATION OF CERTAIN TYPES OF HEAD CAPSULE IN INSECTS FROM CRUSTACEAN PROTOTYPES.

By G. C. Crampton, Ph. D., *Massachusetts Agricultural College.*

The evolution of the mandibles (Journal N. Y. Ent. Soc., Vol. 29, p. 63) and of the paragnaths or "superlinguae" of insects (Psyche, Vol. 28, p. 84), and the derivation of the maxillae (Proceedings Ent. Soc. Washington, Vol. 24, p. 65) as well as the cerci (Ent. News, Vol. 32, p. 257) and other structures of insects, from crustacean prototypes, have been discussed in a series of articles dealing with each set of structures in detail. To the evidence of relationship drawn from these sources, I would add in the present paper, the further evidence of the head capsule, in support of the contention that the Crustacea, more nearly than any other known arthropods, represent the types ancestral to insects.

As this investigation has progressed, and the comparison of the various features in insects and Crus acea has been extended to include more and more structu es from different parts of the body, each additional study has merely served to strengthen and confirm the view that the Crustacea are the nearest known representatives of the types ancestral to insects. Furthermore, there is no possibility of being deceived by "convergent" development[1] in this instance, since the remarkable resemblance, both anatomical and embryological, present in so wide a series of structures from such different parts of the body, and extending even to the minutest details, in the two groups of arthropods, can be explained only as the result of consanguinity rather than of convergence! I would therefore maintain that all of the available evidence points unmistakably to a crustacean, or at least a "crustaceoid," ancestry for insects, although the Symphyla have also preserved many ancestral features from the common crustaceoid stock from which both they and insects were derived.

There are several very primitive types of head capsule occurring among the Apterygota and certain of the lower Pterygota; and apparently some of these types were developed at a very early stage of insectan evolution—possibly at the time the first insects were evolved. One of these types, such for example as that found in *Japyx* and *Campodea*, apparently harks back to a symphyloid origin, since it is remarkably similar to the

[1]Since convergent development is supposedly the result of the effects of similar environmental conditions, it is difficult to believe that the environment of a *marine* crustacean (or even a littoral one) can have enough in common with the environment of a *terrestrial* insect (in some cases mountain-dwelling ones) to produce the astoundingly close similarity one finds in the minutest structural details in the two groups of arthropods!

head capsule of *Scolopendrella*, and was apparently inherited from a similar source, for insects seem to have inherited certain traits from the "symphyloid" side of their ancestry, as well as more directly from their crustaceoid forebears—although those traits which the Insecta have in common with the Symphyla might possibly have been inherited from the common crustaceoid ancestors of both Symphyla and insects, rather than through the insertion of a purely symphyloid stage in the development of one phase of insectan evolution. The pearshaped head capsule of the Protura is also a very primitive type, and is very suggestive of that occurring in certain diplopods, so that this type and the symphyloid type in insects may have been inherited from the myriopodan side of insects' ancestry. The most important of the head types found in the Apterygota, and the types of head found in the great assemblage of winged insects, however, are clearly traceable directly to crustaceoid prototypes, as I shall attempt to show in the fo lowing discussion. Of the insectan types of head capsule derived from crustacean prototypes, the most important are the aselloid type, such as that found in *Lepisma* and its allies, and the oniscoid type occurring in most pterygotan insects, and it is with these two types that we are largely concerned in the following discussion.

In the isopod crustacean *Asellus* (Fig. 8), the head is flattened above, and is somewhat broader than long. The eyes, *e*, are widely separated, and the mandibles (labelled *md* in Fig. 8) extend backward to, or behind, the eyes. Since this type of head is typical of *Asellus* and its immediate relatives, I have referred to it as the aselloid type of head capsule. The head capsule of *Lepisma* (Fig. 7) and *Nicoletia* (Fig. 6) is markedly of the aselloid type. Thus in *Lepisma* (Fig. 7), as in *Asellus* (Fig. 8), the head is flattened above, is broader than long, and the huge mandibles labeled *md* in Fig. 7, extend backward to the eyes, *e*, in the peculiar fashion characteristic of *Asellus*. The eyes are wanting in *Nicoletia* (Fig. 6), but the mandibles, *md*, are huge, and extend backward in the aselloid fashion, although the head capsule of *Nicoletia* is somewhat intermediate between the true asselloid type of head capsule and the symphyloid type characteristic of the insects nearer the myriopodan side of the group. The head capsule of certain myriopods, such as the chilopods, is also rather suggestive of the aselloid type; but in all of the chilopods I have examined, the mandibles are reduced, and I have been unable to find any in which the mandibles are of the type found in *Asellus* and *Lepisma*.

In the insect *Machilis* (Fig. 5), the head capsule is longer than broad, and the eyes, *e*, have become approximated along the median line of the head. The mandibles, *md* (which are overlapped by the maxillae, *mx*) are large, and extend backward for some distance, but the space between the base of the mandibles and the eyes is much greater than in *Lepisma* (Fig. 7) and other forms of the true aselloid type. In some respects, *Machilis'* head capsule approaches the gammaroid type such as that shown in Fig. 4 of the amphipod crustacean *Talorchestia.* In *Talorchestia* (Fig. 4) the head is longer than broad, and in certain related forms there is a tendency for the eyes to approach one another along the median line of the head, thus suggesting the operation of a tendency which resulted in the approximation of the eyes in this region of the head in *Machilis* (Fig. 5). The mandibles, *md*, however, are not huge in *Talorchestia* (Fig. 4) and other gammaroids, and there is a considerable space between the base of the mandibles and the eyes in these forms.

The most important type of head capsule from the standpoint of the derivation of the types found in winged insects is the oniscoid type, exemplified by the isopod crustacean *Ligyda* (Fig. 1). The head of *Ligyda* (Fig. 1) is somewhat triangular in outline, and in this type, the head is usually slightly longer than broad, with the eyes, *e*, situated at the sides of the head. There is considerable space, *g*, between the bases of the mandibles, *md*, and the eyes, and the mandibles are not exceptionally large. A well defined labral suture demarks the labrum, *l*, from the clypeus, *cl*, behind it, and the posterior limits of the clypeal region, *cl*, are demarked by a clypeal suture extending from the base of one mandible to the other as in pterygotan insects (see Annals Ent. Soc. America, Vol. 14, p. 65). The head capsule of this type is usually more hypognathus, though this is not always the case. By comparing Fig. 3 of a typical winged insect (a psocid of the genus *Thyrsophorus*) with Fig. 1, it is at once apparent that the oniscid (or better ligydoid) type of head is the precursor of the type occurring in most winged insects, since the labrum, *l*, of Fig. 3 clearly corresponds to the labrum, *l*, of Fig. 1, and the clypeus, *cl*, of Fig. 3, clearly corresponds to the clypeus, *cl*, of Fig. 1. There is an anterior frontal region labeled *af* in both forms, the head is hypognathous in both, and the nature of the mandibles (which are not huge, and are separated from the eyes by a considerable space) is much the same in both forms. The location of the eyes in the insect shown in Fig. 3 is suggestive of that in the isopod shown in Fig. 1, and if a mantid (which usually has a triangular head) had been used instead of the insect shown in Fig. 3, the resemblance between the head of the isopod shown in Fig. 1, and a winged insect, would have been even more pronounced. The resemblance of the oniscoid type of head (Fig. 1) to the insect shown in Fig. 3, however, is sufficiently evident, and the resemblance is all the more striking when one takes into consideration the fact that (so far as I am aware) no other known arthropods than the isopods and insects have exactly this type of head capsule.

The evidence of the head capsule is thus seen to be in complete agreement with that drawn from other structures of the body, which in every case points very clearly to the Crustacea as the nearest known representatives of the types ancestral to insects; and, while the isopods themselves are not to be regarded as representing the actual ancestors of any insects, they, together with the insects and myriopods, were apparently descended from common ancestors related to the Mysidacea, Anaspidacea, and similar crustacean forms. As the three lines of descent emerged from this common ancestry, the line of descent of the "myriopods" paralleled that of insects for a short distance on the one side, while the line of descent of the isopods and higher Crustacea paralleled that of the insects on the other side for a much longer time (or greater distance) than is true of the myriopodan line of development. This dual relationship of insects to the higher Crustacea and to the "Myriopoda," however, has been fully discussed elsewhere (see Fiftieth Rpt. Ent. Soc. Ontario for 1919, etc.) and need not be further discussed here.

In the 1921 volume of the Transactions of the Entomological Society of London (p. 340) attention was called to the fact that the head of a higher crustacean is composed of one more segment than the head capsule of an insect, since in the higher Crustacea, the first maxilliped becomes closely associated with the head capsule—and even in chilopods, the "poison claws," which are homologous with the first maxillipeds of Crustacea, tend to become more closely associated with the head than with the trunk region. In the article in question, the paragnaths (also called superlinguae,[1] "maxillulae," or "paraglossae") were attributed to the first maxillary segment of the head in insects, Crustacea, etc., but, as I have pointed out in a subsequent paper published in these Proceedings, the embryological evidence points to a mandibular origin of the "superlinguae" (paragnaths) in insects and higher Crustacea, so that the appended table, in which the segments of the head are compared in insects, chilopods, and crustaceans, is more nearly in accord with the embryological evidence of the nature of the composition of the head, than is the case with the table given in the former article.

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[1] Dr. Folsom developed purely as a side issue of his classic monograph on the development of the head structures of Anurida, the view that the superlinguae (paragnaths) of insects represent the maxillulae of Crustacea, and in attacking the tenability of this view, I would most vigorously disclaim any intentions whatsoever of calling into question the correctness of the main features of Dr. Folsom's investigations, which were admirably executed, and were carried out in an exceptionally thorough manner.

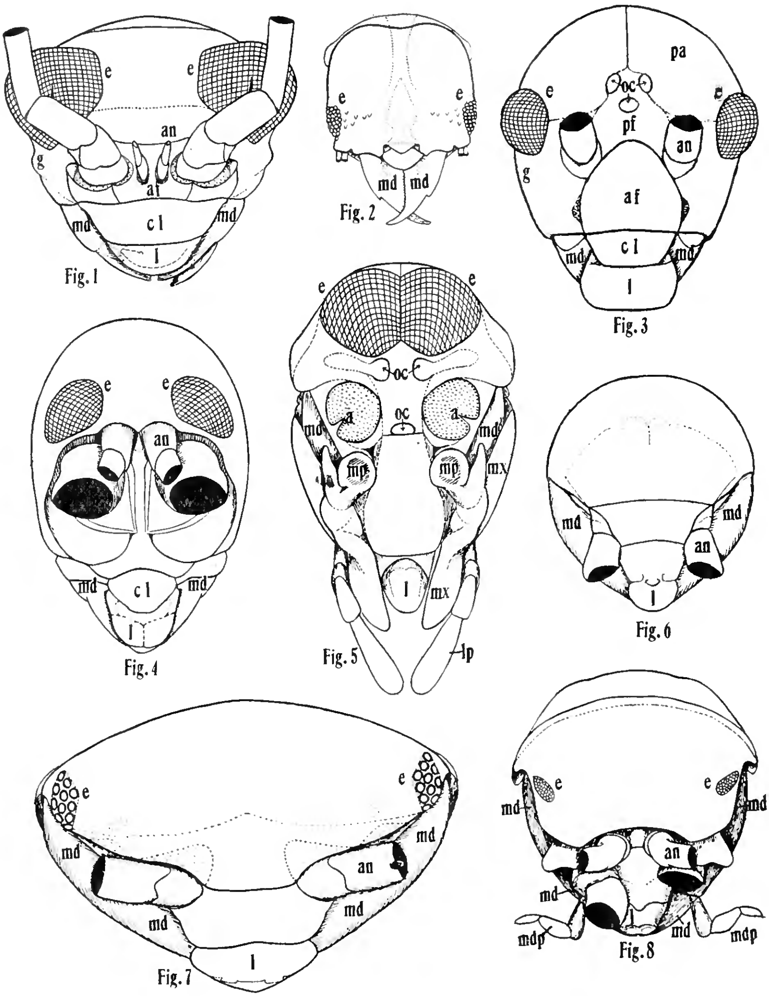
| INSECTS | CHILOPODS | HIGHER CRUSTACEA |
|---|---|---|
| Protocephalon. | Acron. Preantennal segment. | Protocephalon. |
| Antennal segment. | Antennal segment. | Antennular segment. |
| Intercalary segment. | Intercalary segment. | Antennal segment. |
| Mandibular segment, with paragnaths. | Mandibular segment. | Mandibular segment, with paragnaths. |
| First maxillary segment. | First maxillary segment. | First maxillary segment. |
| Second maxillary or labial segment. (Last segment of head.) | Second maxillary segment. (Last segment of head.) | Second maxillary segment. |
| First thoracic segment. | "Poison claw" segment. (Loosely associated with the head.) | First maxilliped segment. (Last segment of head.) |

## ABBREVIATIONS.

*a* —Antennafers.
*af* —Antefrons.
*an*—Antennules.
*cl* —Clypeus.
*e* —Eyes.
*g* —Genae.
*l* —Labrum.
*lp* —Labial palpi.
*md* —Mandibles.
*mdp* —Mandibular palpi.
*mp* —Maxillary palpi.
*mx* —Maxillae.
*oc* —Ocelli.
*pa* —Parietals.
*pf* —Postfrons.

## EXPLANATION OF PLATE 15.

Fig. 1.—Frontal view of head of isopod crustacean *Lygida exotica.*
Fig. 2—Same of isopod crustacean *Gnathia maxillaris* (male).
Fig. 3—Same of pterygotan insect (psocid) *Thyrsophorus speciosus.*
Fig. 4—Same of amphipod crustacean *Talorchestia longicornis.*
Fig. 5—Same of apterygotan insect *Machilis* sp. (*M. polypoda?*).
Fig. 6—Same of apterygotan insect *Nicoletia texana* (?).
Fig. 7—Same of apterygotan insect *Lepisma* sp.
Fig. 8—Same of isopod crustacean *Asellus communis.*




CRAMPTON—THE HEAD CAPSULE IN INSECTS.

*Actual date of publication, July 3, 1922.*

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## THE ENTOMOLOGY OF ENGLISH POETRY.[1]

By W. R. Walton.

"Nor shall the Muse disdain
To let the little, noisy summer-race
Live in her lay, and flutter through her Song."
—*Thomson.*

By "English poetry," I mean the poetry of the English language and the period covered in the following discussion is from the last of the fourteenth to the end of the nineteenth century, or approximately five hundred years.

In the choice of this somewhat odd subject as a title for the present paper, I offer no reasons other than those of curiosity and inclination. If an excuse for the perpetration of this paper should be demanded, however, it might be pleaded with some show of truth that although the prose writings on entomology have been well catalogued in this country, on the contrary, the poetic literature of entomology remains for the most part hidden away under titles not included in the libraries of science or buried under mountains of verse dealing with totally unrelated subjects.

Some few writers, it is true, have included in a decorative way, brief excerpts from famous poets in popular or general works on entomology. Such references may be found in Kirby and Spence,[2] the "Butterflies of the Eastern United States and Canada," by Samuel Scudder, and the "Moth" and "Butterfly" Books of W. J. Holland. The general subject has also been cleverly introduced by Harriette Wilbur[3] who treats it largely from a poetical standpoint, illustrating her discussion with copious excerpts from the poets, especially those of recent years.

In this comparatively brief paper it will be possible merely to skim over the subject somewhat hurriedly. Starting originally

[1]The writer desires to express his indebtedness to Mr. J. S. Wade for valuable aid in the bibliographical researches attendant upon the preparation of this paper and to Miss Susan Alexander for intelligent and sympathetic aid in the preparation of the manuscript.

[2]An Introduction to Entomology: Or, Elements of the Natural History of Insects. London, 1822, 1826.

[3]The Entomology of the Poets, Harriette Wilbur, American Catholic Quarterly Review, Vol. XLV, Oct. 1919, pp. 566–587.

with the idea that some material of interest would be found in poetry, the writer finds himself literally overwhelmed and seriously embarrassed by such an avalanche of excerpts as to render difficult the choice of material for discussion. Although the present paper is but a glance at the subject, nevertheless it has involved the scanning of approximately 650,000 lines and has resulted in the accumulation of more than 1200 separate excerpts and about 75 complete poems from the writings of 150 poets. Most of this work has been done during the leisure hours of the past year, but when completed, the collection will be deposited in the library of the Federal Bureau of Entomology, where, the author hopes, it may form the nucleus for a complete dictionary of the entomology of poetry. In the course of this investigation it has not been possible to examine very many of the minor poets because of the restrictions of time. Neither has the Bible been included in the field of endeavor, principally because the zoology of that greatest of epics has been rather fully investigated heretofore, and the necessity of excluding generally such works as are frankly translations from other languages. It is true, of course, that the writings of practically all the earlier English bards, down to the time of Wordsworth and Cowper, are composed quite extensively of paraphrastic excerpts or translations from the Latin or French poets. In point of fact, it is useless to attempt to read them intelligently without previous acquaintance with the history and mythology of ancient Greece. Most scholars of the period deemed indispensably necessary at least some slight allusion in their writings to the gods, goddesses and demi-gods of the Greeks as a demonstration of scholarship. A reflection of this habit is found in the works of the great pioneer zoologists and entomologists. Linneaeus and his pupil Fabricius, for instance, applied mythological names to many of the larger American butterflies and their example has been followed extensively by later writers on this subject. Thus there has been formed a more or less artificial link of sympathy between poetry and entomology.

It is said that in mediaeval times fragments of entomology and other sciences were memorized by incorporating them in verse or doggerel rhymes.

The "entomology of poetry"! At first blush this expression seems a contradiction in terms. What natural relation possibly can exist between poetry and "bugs"? As well mention "music and sauer-kraut" or "lilies-of-the-valley and garlic" as attempt to couple the mention of insects with the Muse. What has one of the most ancient forms of English literature to do with what is, perhaps, the very youngest of the natural sciences?

Absurd as this relationship may seem at first glance, an examination of the poets of the English language, from Chaucer to Longfellow, demonstrates beyond cavil the existence of a very intimate connection between these seemingly remote subjects.

When we consider the fact that insects are the most numerous of all visible creatures and that according to McAtee,[1] every four square feet of ordinary meadow land may contain approximately 1200 individual insects, or about 13,000,000 per acre, it does not seem remarkable that their presence has become apparent even to the poets.

It is not my purpose seriously to discuss the subject from the poet's point of view, as I do not pretend to competency in this respect, but rather to approach it principally from the standpoint of entomological interest. It should be realized, however, that your true poet must of necessity ever be a naturalist in the broader sense of the term and therefore possess at least an elementary knowledge of the familiar insect fauna of the home, the field and the wood. It is true, moreover, that there have been naturalists who might well lay claim to real poetic ability; David Thoreau was one of these.

The insects most commonly mentioned in poetry are, as might be surmised, those forms most familiar to man and especially the species domiciled near, with, or even upon his person, as will be shown when we proceed more deeply into the subject. By far the greater number of such references are embodied in lines dedicated to subjects utterly unrelated to entomology, where they occur merely by way of similitude, trope or metaphor.

When we come to inquire regarding the entomology of the earlier poets some curious facts are developed. Chaucer and Shakespeare bitten by fleas; Spenser grievously worried by flies; and even Milton, whose imagination soared to the very heights of heaven itself, could not escape entirely the influences of the class Insecta in his work! As it is in real life, so we find it in the realms of imagination; insects pervade all human affairs.

References to insects are introduced into poetry for a variety of purposes, some of which are as follows: First—by way of simile, which is by far the commoner way.

> "Here in her hairs
> The painter plays the spider; and hath woven
> A golden mesh to entrap the hearts of men,
> Faster than gnats in cobwebs."
>
> *Shakespeare—The Merchant of Venice.*

Second, in pastoral scenes as a part of rural life, like this from Gray:

---

[1]McAtee, W. L. Census of Four Square Feet, Science, Vol. 26, pp. 447-449, Oct. 4, 1907.

"Now fades the glimmering landscape on the sight,
And all the air a solemn stillness holds,
Save where the beetle wheels his droning flight,
And drowsy tinklings lull the distant folds."

—*Elegy.*

Third, for the purpose of impressing the reader with a sense of the supernatural or weird, and in this effort Thomas Hood has succeeded most admirably in the "Haunted House":

"The air was thick, and in the upper gloom
The bat—or something in its shape—was winging;
And on the wall, as chilly as a tomb
The death's-head moth was clinging."

Fourth, in distinguishing the insect's behaviour as a subject for philosophic comment or pointing a moral; the following is from Cowper:

"Dreams, empty dreams. The millions flit as gay
As if created only like a fly,
That spreads its motley wings in th' edge of noon,
To sport their season and be seen no more."

—*The Task.*

Fifth, in humorous verse as a means of accentuating the jest. In this relation Thomas Hood has given us many most amusing examples, as in "Hymeneal Retrospections":

"Your mouth, it was then quite a bait for the bees,
Such nectar there hung on each lip;
Though now it has taken the lemon-like squeeze,
Not a blue-bottle comes for a sip!"

There are of course countless variations of such poetical uses, but those mentioned above seem the commoner.

**Introduction to Discussion of Authors.**

Having arranged chronologically the entomological excerpts from the poets so as to enable us to gaze across the five centuries that have elapsed since Chaucer, we find here and there among these men, one who stands head and shoulders above his contemporaries in appreciation of insect life. The most conspicuous of these are: Shakespeare, Phillips, Gay, Thomson, Cowper, Rogers, Wordsworth, Montgomery, Hood and Tennyson. Many other poets during this period have sung of insects but these men above all others have given proof of real sympathy with the insect life about them. Although the early poets mention only the very familiar forms of insect life, the more nearly we approach our own era, the more special becomes the entomological knowledge displayed, until we find recent poets writing familiarly of forms which remained entirely unnoticed by the earlier bards. For instance, Bryant identifies the plum curculio in

"That pest of the gardens, the little Turk,
Who signs with the crescent his wicked work
And causes the half-grown fruit to fall."

Thus have the poets indicated unmistakably the advance of the natural sciences through the centuries. It is not my intention to bore you by attempting to review the works of all these writers, but there are certain outstanding facts with regard to a few of them which seem worthy of special comment. Although English poetry really began with Caedmon in the seventh century, Geoffrey Chaucer, who lived from 1340 to 1400, has been called the "father of English poetry," and an examination of his works discloses some twenty-five references to insects belonging to six different orders. Most of these are trivial similitudes, but the following indicates that the ubiquitous flea was a common and familiar pest in England even in the 14th century:

"Awake thou cook, quod he, god yeve thee sorwe,
What eyleth thee to slepe by the morwe?
Hastow had fleen al night, or artow drunke?"
—*The Manciple's Prologue.*

In an effort to inculcate the virtue of compassion, Chaucer has the following, the simple naïvete of which must amuse naturalists:

"And han on pore folk compassioun,
For lo, the gentil kind of the lioun!
For whan a flye offendeth him or byteth,
He with his tayl awey the flye smyteth,
Al esily; for, of his gentrye,
Him deyneth nat to wreke him on a flye,
As doth a curre or elles another beste."
—*The Legend of Good Women.*

One can not glance through the series of entomological references from the works of Edmund Spenser and fail to be impressed with the idea that the poet suffered personally from the onslaughts of swarms of flies. In the Faerie Queen, for instance, there occur no less than eight such references, of which the following is a typical example:

"And all the chamber filléd was with flies,
Which buzzed all about, and made such sound
That they encumbered all men's ears and eyes."

According to his biographers, Spenser was born in London, and doubtless spent a considerable portion of his boyhood (the most impressionable part of his life) in that great city. The period of his most active work was between 1570 and 1597, that is to say, five or six years previous to the first great outbreak of the Black Plague, which occurred in 1603, resulting in the loss of 38,000 lives. In that age the science of sanitary engineering was as yet unconceived in Britain, and consequently the conditions surrounding even the well-to-do were, of necessity, more squalid and filthy than is easily conceivable in these days of comparatively good sanitation. History pictures the streets as filthy, narrow and unlighted by the sun, because of the fact that most of the buildings overhung them. The soil, resultant upon the density of human habitation, stagnated in the gutters, or "kennels" as they were called, while the biological relations existing between the house fly and the domestic animals, with their train of sequelae pathogenic to man, were undreamed of until hundreds of years later. It seems an unavoidable concomitant of such conditions, therefore, that the coprophagous and sarcophagous flies of the Muscoidean group bred uninterruptedly and by millions, at the very doors of even the aristocracy of the time. In view of this it is not remarkable that poor Spenser, endowed with the poet's nervous irritability of temperament, should have reflected annoyance in his verse, nor does it seem any mystery, either, why the well-to-do enclosed their beds with heavy hangings, in spite of the partial asphyxiation which inevitably resulted.

According to Macaulay, even as late as 1685, "St. James's square was the receptacle for all the offal and cinders, for all the dead cats and dead dogs of Westminster,"[1] while Swift (1710) in "A Description of a City Shower," draws a similar and even less attractive picture:

> "Now from all parts the swelling kennels flow,
> And bear their trophies with them as they go;
> Filths of all hues and odors seem to tell
> What street they sailed from by their sight and smell."
> * * * * * * *
>
> "Sweepings from butcher's stalls,
> Guts, dung and blood,
> Drowned puppies, stinking sprats, all drenched in mud,
> Dead cats and turnip-tops come tumbling down the flood."

All this is reflected directly in the insect fauna of the writings of contemporary poets. Thus, we find in Spenser, Shakespeare, Herrick, Butler, and other poets of the period, abundant allusions to worms, maggots, the blow-fly, the fly-blow and the flesh-fly, couched in such familiar terms as to make it quite obvious that myiasis and its attendant phenomena were of common occurrence.

[1]See Macaulay, History of England, Chapter 3, London in 1685.

Next to the Bible, probably no poetic writings have been more thoroughly studied and scrutinized by students of various cults than those of Shakespeare. It is not surprising, therefore, to find that no less than three papers have been published in recent years on the entomology of Shakespeare.[1] It will therefore be unnecessary to discuss extensively the entomology of his works. The total number of references to insects in Shakespeare is given by Fyles as 168, but as he found none in "Much Ado about Nothing," in which there are two (in Act III), the correct number is doubtless about 170. Not a single play but contains at least one direct mention of insect life. Thus the comedy and tragedy of the drama alike, in the opinion of the master poet, (a very wizard in the use of words), require the aid of entomological allusion for completeness of expression.

Shakespeare and Spenser were contemporaries, although the former continued to write for nearly twenty years after Spenser's death. It therefore is not remarkable that the character of the insect life mentioned in their works is similar. The insects mentioned by these poets are the most familiar forms, and although Shakespeare contains numerous references to flies, he seems not to have been so afflicted by them as Spenser. Doubtless this was due to a difference in temperament, as the latter, who died at the age of 46, is shown by his portrait to have possessed a good head of hair, while on the other hand, the "Bard of Avon," although not so bald as the proverbial cue-ball, had shed the greater part of the thatching from his roof!

It should be remembered that zoology in Britain during the latter half of the 16th century was still in an extremely nebulous condition. To be sure, Dr. Thomas Mouffet had compiled his pioneer work on natural history, including insects,[2] during Shakespeare's time. But he wrote entirely in Latin, a language which, according to the biographers of the 17th century, was practically unknown to Shakespeare. Furthermore, Dr. Mouffet's work was not published until 1634, or 18 years after the death of the great poet. An English translation of it appeared

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[1]Natural history of the Insects mentioned in Shakespeare's Plays. Robert Patterson, London, 1838.

The Entomology of Shakespeare, Rev. Thos. W. Fyles, 21st Annual Report, Ent. Soc. Ont., 1890, pp. 78-87. Insects discussed ordinally and by plays. Summary of species by plays and orders, total number of references to insects given as 168.

Shakespeare and Insects, by Henry J. Turner, Proc. So. London Ent. Soc., Jan. 25, 1917. The insects are discussed according to the plays in which they occur and by ordinal arrangement. Pp. 24-42.

[2]Insectorum sive minimorum Animalium Theatrum, by Dr. Thos. Mouffet, London, 1634, printed by Thos. Cotes.

in 1658, embodied in a compilation made by Dr. John Rowland.[1] John Ray,[2] whom Cuvier has called the "first systematist of the animal kingdom," was not born until 1627 and accomplished his memorable work in the last quarter of the 17th century, while the great Linne was not to appear on the scene until 1707.

Thus it readily may be seen that the great poet's knowledge of insect life must have been largely the result of experience rather than reading. In spite of this, however, it is evident that he knew something of the biology of the flesh-flies, the blow-flies, the stomach-bot of the horse and the warble-fly of the domestic ox. It is equally obvious from a passage occurring in the first part of King Henry IV, Act II, that he was well informed regarding some of the larval habits of the house flea. This seems all the more remarkable when we realize that this play was written in 1597, while Van Leeuwenhoek's studies of the biology of the flea were not conducted until the latter half of the following century! Another remarkable entomological note occurs in Troilus and Cressida: "I had rather be a tick in a sheep than such a valiant ignorance," as this forms the only reference to *Melophagus ovinus* to be found in all English poetry.

Just as insects obtrude themselves into all sorts of unwelcome and unlooked for places in real life, so in poetry we find them occurring in the most astonishingly odd situations. For instance, who would look for such references in a lofty and solemn epic poem such as Milton's "Paradise Lost"? Yet we find nearly a dozen of them scattered through the work, the most important occurring in Book VII, in the account of the creation:

> "At once came forth whatever creeps the ground,
> Insect or worm. Those waved their limber fans
> For wings and smallest lineaments exact
> In all the liveries decked of summer's pride,
> With spots of gold and purple, azure and green."

While in Paradise Regained there occurs the only reference to the flies of the genus Drosophila which it has been possible to identify with certainty:

> "Or as a swarm of flies in vintage time,
> About the wine press where sweet must is poured,
> Beat off, returns with humming sound."
>
> —*Book IV.*

Possibly it may be contended that Izaak Walton, author of

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[1]The History of the Four-Footed Beasts and Serpents: by Edward Topsell, edited and compiled by Dr. John Rowland, London, England, 1658, printed by E. Cotes, at the Bible, Ludgate Hill, 1130 pages.

[2]Systematic Zoology: Its Progress and Purpose, Theo. Gill, Report Smithsonian Inst., 1907, p. 449.

the "Compleat Angler," was not a poet. If so, it easily may be shown that not only was he a poet, but an entomologist as well. The following quotation from his celebrated work will, I think, prove beyond a peradventure the contention that Walton was an entomologist and that he might have qualified as a taxonomist had such an undreamed-of profession then existed. He is describing a caterpillar:

"Nay, the very colors are, as one has observed, very elegant and beautiful. I shall for a taste of the rest, describe one of them, which I will sometime the next month show you feeding on the willow tree, and you shall find him punctually to answer this very description: his lips and mouth somewhat yellow, his eyes black as jet, his forehead purple, his feet and hinderparts green, his tail two-forked and black; the whole body stained with a kind of red spots which run along the neck and shoulder-blade, [Walton's terminology here is somewhat obsolete] not unlike the form of Saint Andrew's cross, or the letter X, made thus cross-wise, and a white line drawn down his back to his tail; all of which add much beauty to his whole body."

Please observe the ecological note at the beginning of this description which shows plainly that Walton not only knew his insects, but had made mental note of their food-plants, doubtless as an aid to piscatorial success. Indeed, it would be safe to assume that anglers in those days of primitive entomology were comparatively well-informed regarding the ecology of such forms as were valued in the "gentle art." In further proof of this assumption, the following is offered from "The Book of Saint Albans," published by Wynkyn de Worde, in 1496 (four years after the discovery of America), which contains the earliest known treatise in the English language on "Fysshynge Wyth an Angle." The author of this work, strange to relate, is said to have been one Juliana Berners or Barnes, the prioress of a convent at Sopwell, and Morely[1] says that Dame Berners wrote these papers about 1460.

Speaking of baits for the cheven or chub, the treatise says: "In May [place] ye bayte that bredyth on the osyer leyf and the docke-canker together upon your hoke. Also a bayte that bredyth upon a fern leyf; ye codworme and a bayte that bredyth on an hawthorn. In June taket the creket * * * and the bayte that bredyth in a dunghyll; and a grete greshop. In July the greshop and the humblybee in the medow. Also a grete brended flye that bredyth in pathes of medowes," etc.

Referring to the present divergence of practice as to the use of the term "grasshopper" and "locust," between the entomologists of the United States and their brethren of England and Canada when referring to the short-horned grasshoppers, the

[1]Manual of English Literature, Henry Morely, New York, 1879, p. 121.

quotation given above shows that the term "greshop" or grasshopper was the name in general use in England in the 15th century and practically all of the early English poets use the word "grasshopper" and not the Latin term "locust," which apparently came into popular use during more recent times.

Although William Cowper is known to have spent a considerable portion of his life in a madhouse, he has left us, among other delightful works, two fables in verse, namely, "The Nightengale and the Glow-worm," and "The Pineapple and the Bee," which certainly evince no sign of his malady. His masterpiece, "The Task," also contains several apt and charming allusions to insects, while his translations from the Latin of Vincent Bourne have given the English three of the most pleasing and genuine entomological poems in the language. These are dedicated to the Glow-worm, the Silk-worm, and the Cricket respectively. Vincent Bourne was a sub-master at Westminster in the early 18th century[1] and is said to have been the best Latin poet of his day. Subsequent to the publication of the "Theater of Agriculture"[2] in 1600, treating on sericulture, efforts were made from time to time toward the establishment of the craft in England, and for this reason Bourne doubtless had the opportunity of observing the silk-worm at first-hand.

In spite of the intensely subjective and even morbid character of many of Shelley's poems, they contain numerous pleasing allusions to insect life, notably to the glow-worm, the moths and fire-flies, as in the following:

> "Carvéd lamps and chalices, and phials which shone
> In their own golden beams—each like a flower,
> Out of whose depth a firefly shakes his light
> Under a cypress in a starless night."
>
> —*The Witch of Atlas.*

Quite different however is this, taken from a satirical drama called "Oedipus, or Swellfoot the Tyrant":

> "The gad-fly was the same which Juno sent
> To agitate Io, and which Ezechiel mentions
> That the Lord whistled for out of the mountains
> Of utmost Ethiopa, to torment
> Mesopotamian Babylon. The beast
> Has a loud trumpet like the Scarabee;
> His crooked tail is barbed with many stings,
> Each able to make a thousand wounds, and each
> Immedicable; from his convex eyes
> He sees fair things in many hideous shapes,
> And trumpets all his falsehood to the world.

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[1]Manual of English Literature, Henry Morely, New York, 1879, p. 551

[2]"Theatre d'Agriculture, d'Olivier de Serres," Vol. II, p. 158, Paris, 1600.

Like other beetles he is fed on dung—
He has eleven feet with which he crawls,
Trailing a blistering slime."

With all due allowances for poetic license and exalted ecstasies, it seems evident that the poet evolved this description entirely from the resources of his inner consciousness. In other words, it affords an example of what might aptly be termed "subjective entomology," less striking examples of which occur in the writings of certain modern, entomological taxonomists. The vision of a gad-fly which was at the same time a "beetle" possessing "eleven legs" is one calculated to convince an entomologist that the 18th amendment to the Constitution had become null and void, and that the heyday of the "high-ball" and the "gin-rickey" had indeed returned.

No English poet, early or recent, has made more effective, nor, from an entomological standpoint, more correct use of allusions to insects than Thomas Hood, 1798–1845. Hood is best remembered perhaps by his "Song of the Shirt," but his "Mid-summer Fairies" has been most frequently quoted by entomological writers. This latter poem contains no less than 17 references to insects of seven different species, including grasshoppers, ants, flies, gnats, the silk-worm, and of course the honey-bee. While none of Hood's verses is dedicated to insects, more than a score of his poems contain references to them. In his verse various forms of insect life and their behaviour are used as a means of expression, or of impressing the reader with the atmosphere of the scene described; as for instance, in "The Haunted House":

"The centipede along the threshold crept,
The cob-web hung across the mazy tangle,
And in its winding sheet the maggot slept,
At every nook and ingle.

* * * * *

"The wood-louse dropped and rolled into a ball,
Touched by some impulse occult or mechanic;
And nameless beetles ran along the wall
In universal panic."

In "Love Lane," the poet makes use of the familiar insect fauna of the field with comical effect throughout the poem:

"I vowed to give her all my heart,
To love her till my life took leave,
And painted all a lover's smart—
Except a wasp gone up my sleeve.

"But when I ventured to abide
Her father and her mother's grants—
Sudden she started up and cried,
'O dear, I am all over ants!'"

So amusing is Hood that there is a temptation to multiply quotations in his case. The following is from verses entitled "No":

"No warmth, no cheerfulness, no healthful ease,
No comfortable feel in any member—
No shade, no shine, no butterflies, no bees,
No fruits, no flowers, no leaves, no birds,
November!"

The wider the range of a poet's imaginative sympathy, the more apt he is to draw upon the resources of animate nature as an aid to expression. Thus it is with Tennyson, whose catholicity in this respect is well illustrated by such extremes as the tinkling, melodious absurdity of "The Goose," and the stately dignity of "In Memoriam" or that romantic epical series, "The Idylls of the King." In the full gamut of poetical expression run by this author there occur a score or more of allusions to insect life and at least one complete poem dedicated to "The Grasshopper." Even the prejudiced mind of the entomologist will not fail to appreciate the beautiful diction of these verses, in spite of the fact that he finds his hereditary enemy disguised as:

"Voice of the summer wind,
Joy of the summer plain,
Life of the summer hours,"

and farther on a description of the innocent life of the insect:

"What hast thou to do with evil
In thine hour of love and revel,
* * * *
Shooting, singing, ever springing
In and out the emerald glooms,
Ever leaping, ever singing,
Lighting on the golden blooms?"

In the opening lines of this poem, the following occurs, "No Tithon thou as poets feign." This alludes to the Greek legend of the demi-god Tithonus, who was granted immortality but who inadvertently omitted to request a grant of perpetual youth, and having grown old, was transformed into a grasshopper by his faithless wife, Eos, goddess of the dawn. Evidently she was a cruel woman who effected his transformation before breakfast, judging by the prodigious appetite transmitted to his descendants!

In Hiawatha, Longfellow has made generous use of insect life and perhaps the most interesting reference relates to the hero's conquest of Megissogwan, who was described by Nokomis as:

"He, the mightiest of magicians,
Sends the fever from the marshes,
* * * * *
Sends disease and death among us!"

and she urges Hiawatha to

"Slay this merciless magician,
Save the people from the fever
That he breathes across the fen-lands
And avenge my father's murder!"

Which injunction he proceeds to obey but in doing so encounters various dangers, among which is:

"All the air was white with moonlight,
All the water black with shadow,
All around him the Suggema
The mosquito, sang his war song."

thus correlating the insect vector of malaria with the disease itself, which seems almost prophetic in view of the fact that Hiawatha was written in 1855 and this relation was not finally established by Ross until 1897.

The poetry of entomology has previously been mentioned and to this category are referable all complete poems which have for their principal themes insects or insect life. There are many of these, some of them consisting of but a single verse while others run into hundreds of lines. Most of the "standard" poets have at one time or another apostrophized insects or sung of them in relation to nature. Thus we find Spenser, Cowley, Herrick, Parnell, Cowper, Gay, Montgomery, Clare, Keats, Moore, Rogers, Wordsworth and many more, all represented, while among the recent poets such verses are exceedingly numerous, Madison Gawein, the Kentucky poet, alone having written more than a dozen complete poems on various insects. Entomological poems are of several forms, but perhaps the most common is the apostrophe, or address directed to the insect by the poet, such as Wordsworth's and Rogers's "To a Butterfly," John Clare's "Sonnet to the Glow-worm," Tennyson's "The Grasshopper," and Emerson's "The Humble Bee." Another favorite form of entomological poem is the fable in which the insect holds converse with some other creature, as in Gay's "Turkey and the Ant," Cowper's "Nightingale and the Glow-worm," Wordsworth's "Star and the Glow-worm," and Caroline Leslie's "Meadow Talk." Still another form is the allegory, such as "The Periwinkles and the Locusts," and "The Bullock and the Fly" of Thomas Moore, Herrick's "Upon a Fly," and Spenser's "Fate of a Butterfly." The poetry of love, too, is not without its entomological phases. Witness, for instance, Thomas Moore's "What the Bee is to the Floweret," and "When the First Summer Bee," and Herrick's "Captivated Bee," all of which are love poems of the most fervent and saccharine character. Less common but more interesting to the entomologist, are the narratives in verse dealing with the natural history of the insect itself. Such are Cowper's Translations from Bourne, as "The Silk-Worm":

"The beams of April, ere it goes,
A worm scarce visible, disclose;
All winter long content to dwell
The tenant of his native shell.

"The same prolific season gives
The sustenance by which he lives,
The mulberry leaf, a simple store,
That serves him, till he needs no more."

Other verses of this character are quoted in various parts of the present paper. The longest poem in the language, devoted to an entomological theme, is Spenser's "Fate of a Butterfly" and perhaps the shortest is Burns's quatrain on the "Book-Worm," quoted elsewhere. One of the most amusing of poems depending upon insects for the point of the jest is Oliver Wendell Holmes's "Stethoscope Song," which relates the story of a young doctor:

"There was a young man in Boston town,
He bought him a stethoscope nice and new,
All mounted and finished and polished down,
With an ivory cap and a stopper too.

"It happened a spider within did crawl,
And spun him a web of ample size,
Wherein there chanced one day to fall
A couple of very imprudent flies.

"The first was a bottle-fly, big and blue;
The second was smaller, and thin and long;
So there was a concert between the two,
Like an octave flute and a tavern gong."

The poem then relates the lamentable errors into which this young disciple of Aesculapius was led, several of which were of quite as fatal a character as usual, but the spider drops out of the story and we are left to wonder why he did not eat the flies, and thus reduce the prevailing rate of human mortality.

A list of the more important entomological poems is appended below.

Araneida:

To the Little Spinners—Robert Herrick; To a Spider—Robert Southey; To a Spider—Samuel Low.

Suctoria:

The Flea—John Donne.

Siphunculata:

To a Louse—Robert Burns.

Orthoptera:

The Grasshopper—Abraham Cowley; On the Grasshopper—Willam Cowper; The Grasshopper—Alfred Tennyson; The Grasshopper and the Cricket—John Keats; To the Grasshopper and the Cricket—Leigh Hunt; A Soliloquy—Walter Harte; The Cricket—William Cowper (Translation from Vincent Bourne); To a Cricket—Wm. C. Bennett; Il Grillo—Thos. Augustine Daly; To a Cricket—Mary A. H. Dodd; To an Insect—Oliver W. Holmes; Fall Choristers—Jas. J. Montague; The Periwinkles and the Locusts—Thos. Moore; On Listening to a Cricket—Andrews Norton; The First Cricket—W. D. Howells; The Katy-Dids and the Moon, Numerous poems on the Grasshopper, The Cricket, etc.—Madison Cawein.

Coleoptera:

To the Burnie Bee—Robert Southey; The Glow-worm—James Montgomery; Sonnet to the Glow-worm—John Clare; The Nightingale and the Glow-worm—Wm. Cowper; The Glow-worm—Wm. Cowper (Translation from Bourne); The Lover to the Glow-worms—Andrew Marvell; The Star and the Glow-worm—Wm. Wordsworth.

Diptera:

To a Fly—John Wolcott; Upon a Fly—Robert Herrick; The Midges Dance Aboon the Burn—Robert Tannahill; Midges—Owen Meredith; The Fly—Wm. Oldys (Translation from Bourne); To a Troublesome Fly—Thos. MacKellar; To the Gnat—Samuel Rogers; To a Mosquito—W. C. Bryant; To a Mosquito—J. J. Montague.

Hymenoptera:

To a Bee—Robert Southey; The Captivated Bee, The Present, or the Bag of the Bee, The Bag of the Bee—Robert Herrick; The Honey-Bee's Song—Frances H. Green; The Honey-Bee—Anne C. Lynch; What the Bee is to the Floweret, When the First Summer Bee—Thos. Moore; Telling the Bees—John G. Whittier; The Bee—Henry Vaughan; The Pine-Apple and the Bee—Wm. Cowper; The Humble Bee—Ralph W. Emerson; Where the Bee Sucks—Ednah P. Clark; To a Honey-Bee—Philip Freneau; The Turkey and the Ant—Jno. Gay; King Solomon and the Ants—J. G. Whittier; The Ant and the Grasshopper—Joe. Lincoln; Why?—James J. Montgomery; The Wasp—Francis Hopkinson; King Solomon and the Bees, the Bee and the Cuckoo, the Hen and the Honey Bee—J. G. Saxe.

Lepidoptera:

To a Butterfly, the Redbreast and Butterfly—Wm. Wordsworth; The Fate of a Butterfly—Edm. Spenser; To the Butterfly—Saml. Rogers; A Butterfly in the City—Thos. Buchannon Read; Hugo's Flower to Butterfly—Eugene Field; The Butterflies' Fad—Ella Wheeler Wilcox; Butterfly Fancies—Albertine Ward; The Butterfly—Alice F. Palmer; A Chrysalis—Mary Emily Bradley; The Silk-worm and the Caterpillar—J. G. Saxe.

Odonata:

Old Snake Doctor, Dragon-Flies—Madison Cawein.

Miscellaneous:

The Book-worm—Thos. Parnell; The Stethoscope Song—O. W. Holmes; An Entomological Lyric—Anonymous; Meadow Talk—Caroline Leslie;

The Bullock and the Fly—Thos. Moore; It's an Ill Wind—Jas. J. Montgomery; The Hive at Gettysburg—J. G. Whittier.

Since the present paper is supposed to be of entomological purport, the insects of poetry will be discussed by ordinal arrangement although no attempt has been made to arrange the orders represented, in accordance with the usual sequence.

All the larger orders of insects have been found represented except those placed by recent systematists in the subclass Neuropteroidea. These forms are recognized by poets in a general way and referred to as "water flies," etc., but little or nothing of a specific character is to be found which will permit their identification. A sole exception seems to be this line from Shelley:

"Not a may-fly shall awaken,
From its crad'ling blue-bell shaken."

And even in this, there is nothing to denote that the poet realizes the entomological meaning of the term employed.

Madison Cawein, in the "Old Snake Doctor," has spoiled a perfectly good poem on the "ant-lion" by confusing the insect with the dragon-fly, when he could instantly have settled his doubts in the matter by referring to any good, general work on natural history

A few poets have endeavored to picture insect life at large and one of these, Thomas Montgomery, has been remarkably successful:

"Then insect legions, pranked with gaudiest hues,
Pearl, gold, and purple, swarm'd into existence;
Minute and marvellous creations these!
Infinite multitudes on every leaf,
In every drop, by me discerned at pleasure,
Were yet too fine for unenlightened eye,
* * * * * *
Some barely visible, some proudly shone,
Like living jewels; some grotesque, uncouth,
And hideous—giants of a race of pygmies
These burrow'd in the ground and fed on garbage,
Those lived deliciously on honey dews,
And dwelt in palaces of blossom'd bells;
Millions on millions, wing'd and plumed in front,
And armed with stings for vengeance or assault
Filled the dim atmosphere with hum and hurry."

—*The Pelican Island.*

The ferocity of the spiders has attracted the attention of many poets and their skill in weaving is a subject for frequent comment. The most notable of the passages relating to the former occur in the writings of James Thomson, John Phillips and James Montgomery; the former gives a most realistic and vivid description of the behaviour of the Arachnid:

> "But to heedless flies the window proves
> A constant death; where gloomily retired,
> The villain spider lives, cunning and fierce.
> Mixture abhorr'd! Mid a mangled heap
> Of carcasses, in eager watch he sits,
> O'erlooking all his waving snares around.
> Near the dire cell the dreadless wanderer oft
> Passes, as oft the ruffian shows his front;
> The prey at last ensnared, he dreadful darts,
> With rapid glide, along the leaning line;
> And, fixing in the wretch his cruel fangs,
> Strikes backward grimly pleased."
>
> —*Summer.*

Poets, in spite of their assumed wisdom, often make comical mistakes in interpreting the behaviour of insects. Thus Samuel Low, an American poet of the late 18th century, has turned his spider wrong-end-to in the following:

> "Thou villain insect! well do I perceive
> The treacherous web thy murderous fangs have wrought."

No particular species of spider ever is mentioned but frequent allusion is made to Arachne, a Lydian maiden, who, by superior skill in weaving, is said to have aroused in the goddess Pallas, the extremely ungoddesslike emotion of envy, and hence was transformed into a spider. But spiders are not the only Arachnids mentioned in poetry, as the mites have received appropriate attention; says Swift:

> "In bulk there are not more degrees
> From elephants to mites in cheese,
> Than what a curious eye may trace
> In creatures of the rhyming race."
>
> —*On Poetry.*

Mrs. Annie T. Slosson, a celebrated American collector of insects, wrote many humorous verses on insects among which is one on the red-bugs or "chiggers." These pestiferous mites were long supposed to enter the sweat glands of the human species but the recent work of Dr. H. E. Ewing has shown this supposition to be entirely erroneous. The opening lines of Mrs. Slosson's verse are:

> "I sing of the red bug
> You know that this said bug
> Doth e'en as a dead bug
> Sting, tease and inflame;
> A sweat pore doth enter
> And dive to its center."

Chaucer, Pope, Montgomery and many later poets contain passages mentioning mites, but there is no hint in any of these allusions which would indicate a recognition of their relation to the spiders. Only the web-making spiders have been noticed by poets and although Samuel Butler was renowned as a very learned man in his day, he makes this statement:

"As spiders never seek the fly,
But leave him of himself to apply,"

thus ignoring the numerous "wolf spiders" which make their living by hunting flies. The Phalangidae appear in poetry only during very recent days, as exemplified by Joe Lincoln in "Cape Cod Ballads":

"Then the girls they'll be a-yippin', 'cause a bug is in the cream;
And a 'daddy-long-legs' skippin' round the butter makes 'em scream."
—*The Sunday School Picnic.*

In a consideration of the insects of poetry by ordinal arrangement, it becomes immediately evident that for frequency of mention, the Hymenoptera must be awarded the primacy. This is true, however, solely because a single member of the order, and man's chief domestic servant among insects, the honey bee, has ever been the favorite of poets in all ages. Previous to the introduction of the silkworm into Sicily from Greece, in the twelfth century, the honey bee was man's sole servitor among insects in the Occident and still remains as such in most portions of the globe. The reasons for its popularity among poets are not far to seek, as they doubtless reside in the intimacy existing between the insect and the flowers; as the only source of sweets known to man during many centuries, to its musical hum, its industry and social habits, and above all to its familiarity to man since time immemorial. No poetic portrayal of the pastoral beauties of nature, or of that peaceful and placid state of being, toward which man is ever reaching out but seldom attaining, is complete without its bee. Most people have heard the time-worn story of the city man who aspired to become a suburbanite in order that he might "keep a bee"! In like manner almost every poet has kept his bee, not, however, for the sake of its honey, but in order that it might caper and buzz throughout his verse whenever the spirit moved him. Thus we find the insect "bee" adjectived unmercifully by rhymsters and poets both modern and ancient, literally without end and on all occasions. In point of fact, the verses of some poets (Ethel Louise Cox, for instance) are so swarming with bees, that only an experienced bee-keeper is safe in turning the pages.

The bee of poets is, above all things, busy, laboring, diligent, industrious, toiling, laden, sedulous, and although sometimes "painful" and even "stinging" is generally referred to in a distinctly complimentary way. It seems obvious that among the hundreds of bees humming throughout poetry, at least 99 percent are the honey-bee. Occasionally we find reference to the "wild-bee," but there is no evidence that this refers to the Andrenidae or related families but rather to the honey-bees which have taken up their residence in some tree or wood. Whittier has expressed this specifically in the "Witch of Wenham":

> "They say that swarming wild bees seek
> The hive at her command."

The identity of the "mountain-bee" (a species peculiar to the poets) also seems difficult of determination, although in the following:

> "'Twas transport to inhale the bright sweet air;
> The mountain-bee was revelling in its glare,
> And roving with his minstrelsy across
> The scented wild weeds, and enamell'd moss."
>
> —*Thomas Campbell.*

the behaviour of this insect leads us to suspect that it is a female humble-bee looking for a place in which to build, in spite of the supposed gender of this particular bee! In fact, it has been the habit of poets to refer to the honey-bee in the masculine gender as:

> "O velvet bee, you're a dusty fellow."

of Ingelow and,

> "Thus in a thousand wax-erected forts
> A loitering race the painful bee supports;
> From sun to sun, from bank to bank *he* flies,
> With honey loads *his* bag, with wax *his* thighs."
>
> —*Parnell.*

and it is only in very recent verse that we find any recognition of the fact that the worker bees are females. The error of mistaking the pollen baskets on the hind legs of bees for wax organs, as indicated in the last line of this verse, is another fallacy which poets have shared; but this is excusable, because it is only within comparatively recent years that the manner in which the wax of bees is secreted has been at all well understood. An error of omission which is less explicable, is the complete oversight by the poet of the important agency of the bees in the pollination of blossoms, in view of the fact that Sprengel had discovered the main facts regarding it as early as 1793. That this relation between the bee and the flower is capable of infinitely charming and effective poetic treatment is obvious, and future poets, in their efforts to keep abreast with science, doubtless will utilize these facts with good effect. Of the poems for which the bee furnishes the principal theme, perhaps none is more quaint and interesting than Whittier's "Telling the Bees," which immortalizes a legend to the effect that, when the master or mistress of the house dies, unless the bees are specifically informed of the sad event, they will immediately swarm and be lost to the farm. The last two stanzas of this poem contain the gist of the matter:

> "With his cane to his chin,
> The old man sat; and the chore-girl still
> Sung to the bees stealing out and in.
>
> And the song she was singing, ever since
> In my ears sounds on:—
> 'Stay at home, pretty bees, fly not hence!
> Mistress Mary is dead and gone!'"

There are of course innumerable poetic references to the honey-bee which might be discussed at great length, but the literature of the insect is a voluminous one and there remain many other insects of poetry still to be mentioned.

In view of their conspicuous appearance and booming voices, it seems rather curious that the humble-bees have not come in for more general notice among the poets. In recent years Emerson has apostrophized the insect with excellent effect, but it is seldom that the earlier poets mention these beautiful and interesting bees. Shakespeare is an exception to this rule, as he alludes to the humble-bees several times; the most specific reference is:

> "—kill me a red-hipped humble-bee on the top of a thistle."
> —*Midsummer Night's Dream.*

According to Fyles this refers to *Bombus lapidarius*, a common British species, although in this country there are several species which might be called "red-hipped." Unique in the field of entomological poetry is Dr. L. O. Howard's humorous contribution of 40 lines, describing the habits and tragic end of a certain Psithyrid bee. This was published anonymously in Entomologica Americana for March, 1890, and subsequently reprinted in his "Insect Book" where its authorship is acknowledged. With regard to the Vespidae, poets apparently have noticed but two facts; first, that they sting readily, as in Longfellow's Hiawatha:

> "Ah! the singing fatal arrow;
> Like a wasp it buzzed and stung him!"

and second, that they are fond of ripening fruit, as shown by William Sharp's verse:

> "Where the ripe pears droop heavily,
> The yellow wasp hums loud and long,
> His hot and drowsy autumn song;

A yellow flame he seems to be,
When darting suddenly from on high,
He lights where fallen peaches lie."

The methods used in the 18th century to protect choice fruits from wasps are given in John Phillips's didactic poem entitled "Cyder":

"—let every bough
Bear frequent vials, pregnant with the dregs
Of Moyle, or Mum, or Treacle's viscous juice;
They by the alluring odor drawn, in haste
Fly to the dulcet cates, and crowding sip
Their palatable bane; joyful thou'lt see
The clammy surface all o'erstrown with tribes
Of greedy insects that with fruitless toil
Flap filmy pennons oft to extricate
Their feet, in liquid shackles bound, till death
Bereave them of their worthless souls."

The earliest American poet of the wasp seems to have been Francis Hopkinson (1737–1791), signer of the Declaration of Independence and treasurer of the American Philosophical Society, who penned a poem of 32 lines in the form of a fable entitled "The Wasp."

Whittier has the following in the "Barefoot Boy":

"Of the black-wasp's cunning way,
Mason of his walls of clay,
And the architectural plans
Of gray hornet artisans."

but apart from this, little of interest is to be found regarding the social wasps, or their wonderful organizations and beautiful paper nests, although Erasmus Darwin also sings of them. Of the Sphecoidea the poets are silent, nor indeed have they recognized in any way the innumerable solitary wasps with their interesting, predaceous habits and variety of architecture. Erasmus Darwin in "The Origin of Society" has pointed the way to still another opportunity in:

"The wing'd Ichneumon for her embryon young
Gores with sharp horn the caterpillar throng,
The cruel larva mines its silky course,
And tears the vitals of its fostering nurse."

Here among the truly parasitic forms is a whole world as yet unknown to poets, replete with tragedy and comedy, which in some dim and distant day will furnish rhymsters with many a pithy line.

The ants, mentioned frequently by the early poets as the "emmet" and sometimes by a less euphonious name, are celebrated in poetry as in prose, chiefly for their industry and providence. Whittier wrote a didactic poem of 42 lines entitled "King Solomon and the Ants," inculcating magnanimity, while Ben Jonson, Prior, Milton, Thomson, Rogers and Young, not to mention later poets, have all sung to some extent of the insects. Among these, however, there is really very little of entomological interest, as the object usually is to point a moral, as:

"O mortal man, who livest here by toil,
Do not complain of this thy hard estate;
That like an emmet thou must ever moil,
Is a sad sentence of an ancient date."
—*Thomson.*

Robert Herrick, who is full of odd conceits, shows us a beggar supplicating the fairy queen thus:

"Black I'm grown for want of meat;
Give me then an ant to eat."

and Butler, in Hudibras, emphasizes the medical use of the insect in the following:

"Till purging comfits and ant's eggs
Had almost brought him off his legs—"

Ants' eggs, or rather their pupae, were administered by physicians of the 17th century, as a cure for the lovesick, while tincture of "Formica rufa" or red ants, is still to be found in some modern pharmacopæas as a remedy for rheumatic pains, paralysis and epilepsy.

As the author was for some years a student of the Diptera, the poetical references to that order have been of more than passing interest to him. Arranging these according to the usual family succession, the first group is the Tipulidae:

"Nay, when beginning to beseech
The cause that led to my rebuff,
The answer was as strange a speech—
'A Daddy-Longlegs, sure enough!'"
—*Thomas Hood—Love Lane.*

Daddy-Long-Legs is the vulgar name applied to *Tipula oleracea* in England, according to Harold Bastin.

In view of the widespread damage done in America by a notorious member of the Cecidomyiidae, the Hessian fly, it is not surprising to find that our poets have recognized it; although the sentiment expressed in the following of Whittier's will hardly find favor with our orchardists and winter-wheat growers:

"Let earth withold her goodly root,
Let mildew blight the rye,
Give to the worm the orchard's fruit,
The wheatfield to the fly."
—*The Corn Song.*

Prophecy was ever a dangerous calling, and Bryant has suffered the prophet's usual cruel fate in the following:

"The army worm and the Hessian fly
And the dreaded canker-worm shall die,
And the thrip and the slug and the fruit-moth seek
In vain to escape that busy beak,
And fairer harvests shall crown the year,
For the Old-World sparrow at last is here."

If the poet could have lived to observe the results of this experiment, he might have been moved to add a postscript to this verse, not, of course, in the diction of George Ade, but somewhat as follows:

Alas for the sparrow's vaunted "pep";
He has fallen down and lost his "rep";
And the army-worm and the Hessian fly
Ne'er cease to gnaw as he flutters by;
And tho' fair harvests garnered be
This is not due to such as he;
But science with her helping hand
Has put to flight this robber band.

References to the "mosquito" under that name do not seem to occur until James Montgomery, during the second decade of the 19th century:

"These giant fowlers snapt them, like musketoes
By swallows hunted through the summer sky."
—*The Pelican Island.*

Under the term "gnat," however, there are many references running back to Chaucer and Spenser. The following passage, which is of interest as showing the progress of biological science, is from Matthew Prior, written during the second decade of the 18th century, while Linneaeus was still but a boy:

"Fix they corporeal and internal eye
On the young gnat or new-engendered fly.
* * * * * *
Laying their eggs, they evidently prove
The genial power, and full effect of love.
Each then has organs to digest his food,
One to beget and one to receive the brood;
Has limbs and sinews, blood and heart, and brain,
Life and her proper functions to sustain;
Though the whole fabric smaller than a grain."

References to the mosquito's song are many and amusing, much more so, in fact, than the song itself!

"Now near and nearer rush thy whirring wings,
Thy dragon scales still wet with human gore.
Hark, they shrill horn its fearful larum flings!
—I wake in horror, and dare to sleep no more!"
—*Samuel Rogers.*

Bryant, no doubt, had ample opportunity of observing the insect in all its maritime lusciousness, as the following shows:

"Fair insect that with threadlike legs spread out
And blood-extracting bill and filmy wing,
Dost murmur as thou slowly sail'st about
In pitiless ears full many a plaintive thing,
And tell how little our large veins would bleed,
Would we but yield them to they bitter need."

But most of us will agree with Edward Sanford:

"Our vein's pure juices were not made for thee,
Thou living, singing, stinging atomy."

Butler's Hudibras, which abounds in curious passages, has this:

"For as the fly that goes to bed
Rests with his tail above his head."

These lines apply accurately to the mosquitoes of the genus Anopheles and perhaps may have been inspired by them.

While it is impossible positively to identify members of the Chironomidae in poetry, the following passage may, from circumstantial evidence, be assumed to refer to them:

"Meanwhile, there is dancing in yonder green bower
A swarm of young midges. They dance high and low,
'Tis a sweet little species that lives but one hour,
And the eldest was born half an hour ago."
—*Owen Meredith.*

There are lines which suggest strongly the presence of the Tabanidae, such as the following:

"But he them all from him full lightly swept,
As doth a steer, in heat of summer's day,
With his long tail the brizes brush away."
—*Spenser.*

When we consider the great abundance and comparatively large size and brilliant colors of many Diptera in the families between the Culicidae and the Muscoidea, it seems remarkable that poetry is silent regarding them. Such families, for instance, as the Asilidae, the Stratiomyiidae, and the Syrphidae so rich in beautiful forms, seem to be largely unknown except to entomologists. That the warble-fly of cattle, and very probably *Hypoderma bovis*, was familiar even to Shakespeare is shown by the following:

"The breeze upon her, like a cow in June
Hoists sails and flies."
—*Antony and Cleopatra.*

This refers beyond a doubt to the well-known habit of cattle in stampeding at the approach of the warble-flies. The biting flies of the Muscoidea are referred to by the earliest of British poets and probably Spenser had Haematobia or that curse, *Stomoxys calcitrans*, in mind in the following passage:

"How many flies, in hottest summer's day
Do seize upon some beast whose flesh is bare,
That all the place with swarms do overlay
And with their little stings right felly fare."
—*Faerie Queen.*

The Calliphorinae of the Muscoidea are freely referred to by the British poets usually as the blow-fly, the commonest species of which in Europe is *Calliphora erythrocephala* Meig. Perhaps this species is responsible for Chaucer's remarks in the Canterbury Tales:

"Of many a pilgrim hastow Cristes curs
For of they parsly yet they farethe wors
That they han eten with they stubbel-goos;
For in thy shoppe is many a fly loos."
—*The Cook's Tale.*

And Shakespeare's:

"I would not so!—and would no more endure
This wooden slavery than to suffer
The flesh-fly blow my mouth."
—*The Tempest.*

A certain type of morbid, melancholy poet seems to be singularly attracted by the insect fauna of the mortuary, and refuses to profit by the salutary advice contained in the negro folk song which warns us to

"Keep away from the grave yard, it's nasty old place,
Where dey lay yo on yo' back an' shovel dirt on yo' face."

These poets, of whom Shelley is an excellent example, refer copiously to the worm of the grave; for instance:

"We decay
Like corpses in a charnel; fear and grief
Convulse us and consume us day by day,
And cold hopes swarm like worms within our living clay."
—*Adonais.*

in fact, his are the most maggoty and worm-eaten verses in the language.

In view of the investigations of Doctor Murray G. Motter, all such passages may unhesitatingly be referred to the Diptera, although there are references to the "worm of conscience," etc., which can not be referred accurately to any order. Shakespeare contains several famous references to the worm of the grave, and among them is this:

> "A man may fish with the worm that hath eat of a king,
> And eat of the fish that hath fed of that worm."
>
> —*Hamlet.*

The maggots of the Muscoidean diptera are not much used as bait by anglers in this country, but in England it has long been the custom to employ them for this purpose. Izaak Walton calls them "gentles" and describes the technique of rearing them to best advantage so that they may be available all winter. He adds: "These will last until March and about that time turn to be flies." When we consider that this was written about the middle of the 17th century, it seems to argue a remarkably advanced knowledge of insect biology on the part of "honest Izaak."

There still remains to be considered the ubiquitous, filthy, house-fly which, of course, is not mentioned under that name by the earlier poets, who refer to it simply as "the fly." Sometimes, however, the circumstances are such as to identify the insect almost certainly as in Shakespeare:

> "Thus smiling, as some fly had tickled slumber,
> Not as death's dart, being laughed at."
>
> —*Cymbeline.*

Or the following:

> "Rouse him; make after him, poison his delight,
> * * * * * *
> Plague him with flies."
>
> —*Othello.*

Later poets have apostrophized the insect, usually in the protesting tones of Thomas MacKellar:

> "What! here again! indomitable pest?
> Ten times I've closed my heavy lids in vain
> This early morn to court an hour of sleep;
> For thou, tormentor, constantly dost keep
> Thy whizzing tones resounding through my brain,
> Or lightest on my sensitive nose, and there
> Thou trimmest thy wings and shakest thy legs of hair."
>
> —*To a Troublesome Fly.*

Thomas Hardy pictures him in a familar act:

> "While mid my page there idly stands
> A sleepy fly, that rubs his hands."

Although Holmes calls the insect by name in the following verse, it seems more than likely that the fly whose behaviour is mentioned is the cluster-fly (*Pollenia rudis* Fabr.) which hibernates as an adult:

> "The House-fly, stealing from his narrow grave,
> Drugged with the opiate that November gave,
> Beats with faint wing against the sunny pane,
> Or crawls, tenacious, o'er its lucid plain."
>
> —*Spring.*

In point of numbers the poetic references to the Lepidoptera come next.

The esthetic appeal of the diurnal Lepidoptera is strongly reflected in the writings of the poets, and more than one half of their references to this order relate to the butterflies. These are the most conspicuous and brilliantly colored of insects, and for this reason alone might be expected to claim the attention of the poet, but when we consider their apparently happy and care-free lives, their intimate relations with the flowers and the fact that a butterfly was anciently regarded as the symbol of the soul, it is readily understood why these insects are among the favorites of the poets.

Of the numerous excerpts in the present collection, 55% refer to butterflies, and of the remainder about 20% relate to the moths and the rest to caterpillars, canker-worms, or "worms" obviously of Lepidopterous origin. Regarding the symbolism of the butterfly Coleridge says:

> "The butterfly the ancient Grecians made
> The soul's fair emblem, and its only name."

and Browning refers to the same fact in:

> "Look at the woman here with the new soul,
> Like my own Psyche's,—fresh upon her lips,
> Alit, the visionary butterfly."
>
> —*Psyche.*

Lepidopterous larvae are often mentioned merely as "worms":

> "—the small worm that crept abroad at midnight
> To sip the cool dews, and feed on sleeping flowers
> Then slunk into its hole, the little vampyre!"
>
> —*Montgomery.*

Beginning with hibernation, it is possible to follow the larva through its transformations to the adult insect, in poetry:

> "What penetrating power of sun or breeze,
> Shall e'er dissolve the crust wherein his soul
> Sleeps, like a caterpillar sheathed in ice?"
>
> —*Wordsworth.*

> "Thus are my blossoms blasted in the bud,
> And caterpillars eat my leaves away."
>
> —*Shakespeare.*

"—caterpillars dangling under trees
By slender threads and swinging in the breeze,
Which filthily bewray and sore disgrace
The boughs in which are bred th' unseemly race."
—*Cowper.*

"And there lay visions swift, and sweet, and quaint,
Each in its thin sheath like a chrysalis."
—*Shelley.*

Having arrived at the pupal stage, next in order is the emergence of the adult:

"Straight from the filth of this low grub behold!
Come fluttering forth a gaudy spendthrift heir,
All glossy, gay, enamelled all with gold,
* * * * * *
See her bright robes the butterfly unfold
Broke from her tomb in prime of May!
What youthful bride can equal her array?"
—*Thomson.*

Until recently poets have been satisfied to allude to these insects simply as the "butterfly" but we find them mentioned rather abundantly by their vulgar specific names, thus: Alfred Noyes has:

"Now they roam these mortal dells
Wondering where that happy glade is,
Painted Ladies,
Admirals and Tortoise-shells."

And John Burroughs:

"The mourning cloak takes up her clew
And dances through the sunny glades."
—*April.*

There are many such, but space forbids their mention.

Although poets usually mention the butterflies with admiration or at least in approbation, this is not always the case, as shown by the following, from Chaucer:

"Your tale annoyeth all this companye:
Swych talking is nat worth a boterflye."
—*Canterbury Tales.*

Thus, having belittled the insect, the poet proceeds to take a shot at the collector:

"The virtuoso thus at noon,
Broiling beneath a July sun,
The gilded butterfly pursues
O'er hedge and ditch, through gaps and mews:

> And, after many a vain essay
> To captivate the tempting prey,
> Gives him at length the lucky pat,
> And has him safe beneath his hat."
> —*Cowper.*

The poet then permits the insect to escape and mock the collector, but the latter is entitled to at least a quiet smile, to think of a "virtuoso" collecting butterflies with his hat! But the professional entomologist is not allowed to go entirely unscathed either, as Edward Young has singled him out for ridicule:

> "But what in oddness can be more sublime
> Than Sloane, the foremost toyman of his time?
> His nice ambition lies in curious fancies,
> His daughter's portion a rich shell enhances,
> And Ashmole's baby-house is, in his view,
> Britannia's golden mine, a rich Peru!
> * * * * * *
> 'Was ever year unblest as this?' he'll cry,
> 'It has not brought us one new butterfly!'"
> —*Love of Fame.*

The Sloane mentioned by the poet is Sir Hans, founder of the British Museum, a famous surgeon and naturalist, who, when a young man, collected much natural history material in the West Indies; while "Ashmole's baby-house" is nothing less than the Ashmolean Museum at Oxford University, founded by the celebrated English antiquary, Elias Ashmole, who died in 1592. Many of the earlier English poets pose as men of science, but as a rule the cult has been antagonistic toward the development of the natural sciences, which they ridiculed unmercifully.

But enough of the Rhopalocera; we have yet to mention the Heterocera, or moths. The "moth and the flame," of course, come in for their share of notoriety, and the "death's head moth," *Acherontia atropos*, which Hood calls:

> "That mystic moth, which, with a sense profound
> Of all unholy presence, augurs truly."

has been instrumental in securing immortality for the Sphingidae. However, as the moths are mostly creatures of the night, whose origin and movements were largely a mystery, poets usually have been content to refer to them in general terms; hence they are "spotted moths," "painted moths," or merely "soft moths that kiss the sweet lips of the flowers," etc.

There is, however, one notable exception, and this is the silkworm. This strictly domestic insect we find mentioned in English poetry beginning with Shakespeare: "Thou owest the worm no silk, the beast no hide, the sheep no wool, the cat no perfume."—King Lear. The last reference does not, as might be supposed, refer to the pole-cat, but to the civet-cat, an animal of the genus Viverra, related to the hyena.

After Shakespeare we find Butler, Waller, Bourne, Cowper, Shelley, Young, Hood and others singing of the silk-worm at considerable length, but the most complete account of the insect is Bourne's poem, mentioned previously.

Erasmus Darwin, grandfather of the famous naturalist, Charles Darwin, attempted, in "The Temple of Nature," a philosophical poem, to use the biology of the insect to illustrate his theme, with somewhat unfortunate results:

"Erewhile the changeful worm with circling head,
Weaves the nice curtains of his silken bed;
Web within web involves his larva form,
Alike secured from sunshine and from storm;
For twelve long days he dreams of blossom'd groves,
Untasted honey, and ideal loves."

So far there has been nothing unusual transpire, but listen to the sequel:

"Wakes from his trance, alarmed with young desire,
Finds his new sex, and feels ecstatic fire;
From flower to flower, with honeyed lip he springs,
And seeks his velvet loves on silver wings."

The insect referred to undoubtedly is the true silk-worm (*Bombyx mori*), but the male of this species takes little or no food and is utterly unable to fly even a short distance, not to mention flitting "from flower to flower."

Doubtless, because of the musical quality of their songs, the Orthoptera of poetry occupy a prominent place. Considered taxonomically, several groups and even a few species are clearly recognizable; for instance, there is no mistaking the following for a member of the Acridiidae:

"The russet grasshopper at times is heard,
Snapping his many wings, as half he flies,
Half hovers in the air."

—*Carlos Wilcox.*

Strange to say, poets are wont to ascribe all the injury occasioned by the Orthoptera to the "locust," which many of them evidently know chiefly through Biblical mention, as the following:

"What it devours not, herb, or fruit, or grain,
A darksome cloud of locusts swarming down
Must eat, and on the ground leave nothing green."

—*Milton: Paradise Lost.*

On the other hand, the poet's delineation of the grasshopper persistently depicts it as the very happiest and most care-free of created beings, absolutely devoid of harm or potential injury, as expressed by Cowley:

"Happy insect! what can be
In happiness compared to thee?
* * * * *
Man for thee does sow and plow;
Farmer he and landlord thou!
Thou dost innocently joy;
Nor does thy luxury destroy."
—*Anácreontics.*

Cowper sings in the same strain:

"Herald of the genial hours,
Harming neither herbs nor flowers.
Therefore man thy voice attends
Gladly—thou and he are friends.

A clue to the mystery is given by Dr. Frank Cowan,[1] who identifies the insect of whom Anacreon sang as the Cicada, which was called Tettix by the ancient Greeks. Evidently the first English translator of Anacreon erred in identifying the Tettix of the ancients as a grasshopper, and subsequent poets (as is often the case with prose writers) accepted his identification unquestioningly and thus perpetuated the error. Certainly the lines of Moore bear out this assumption:

"Oh thou of all creation blest,
Sweet insect, that delightst to rest
Upon the wildwoods leafy tops,
To drink the dew that morning drops.
Nor yet art thou the peasant's fear,
To him thy friendly notes are dear."

But Keats, who was nothing if not original, adds his opinion to the rest, in a totally different meter:

"When all the birds are faint with the hot sun
And hide in cooling trees, a voice will run
From hedge to hedge about the new-mown mead;
That is the grasshopper's—he takes the lead
In summer luxury,—he has never done
With his delights; for, when tired out with fun,
He rests at ease beneath some pleasant weed."
—*The Grasshopper and the Cricket.*

But the entomologist knows better! His more accurate view of the grasshopper shows it hunted to the death by every bird, beast, and creature of the field! Murdered by wasps, suffering

[1]Curious Facts in the History of Insects, Frank Cowan, J. B. Lippincott & Co., Philadelphia, 1865.

a living death under the tortures of parasitic maggots; the victim of insidious fungous diseases and the prey of "horse-hair snakes" and other hideous enemies, from the moment it emerges from the sheltering earth until the insect falls exhausted to it again, after an existence of but a few short months! Not that its fate evokes any particular feeling of pity in the bosom of the entomologist, who knows the villain for a greedy robber, a bandit and a glutton, and it is safe to say that a public reading of these enthusiastic poets of the grasshopper, if given in Kansas or the Dakotas, would elicit about the same amount and character of response as would the singing of "The Battle of the Boyne" at an Irish wake! In point of fact, the following lines of Moore regarding the locust apply quite as well to the grasshopper:

> "Of all the beasts that ever were born,
> Your locust most delights in *corn;*
> And though his body be but small,
> To fatten him takes the devil and all!"
>
> —*The Periwinkles and the Locusts.*

But the Acridiidae do not monopolize all the attention of the poets, as other groups such as the Locustidae are noticed, although they are not always recognized as such:

> "—chirps the grasshopper one good-night carol more.
> He is an evening reveller, who makes
> His life an infancy and sings his fill."
>
> —*Byron.*

As the Acridiidae do not sing at night, the poet doubtless alludes in these lines to the longhorned grasshoppers. Philip Freneau, who has been called "the first national poet of America," undoubtedly was the first poet to celebrate the song of the "katy-did":

> "In her suit of green arrayed,
> Hear her singing in the shade—
> Caty-did, Caty-did, Caty-did!"

It may be noticed that he spells the proper noun with a "C" instead of a "K" and it seems more than likely that Freneau was the first person to describe the song of the insect in these syllables. Philip Freneau was born in 1770, graduated at Princeton and was a college-mate of James Madison. He had a checkered career, having been successively a privateersman, a journalist and was appointed by President Jefferson as a translator for the Department of State. He was found dead in a swamp, near Freehold, N. J., December 18, 1832.

Oliver Wendell Holmes, whose poem on this insect is well known, was led through his slight knowledge of entomology into the following error:

"Thou art a female, Katydid!
I know it by the trill
That quivers through thy piercing note
So petulant and shrill."

Reasoning by analogy is not always a safe procedure, and so it is in this case, because the female katy-did does not sing this song, and the females of most stridulating insects, including the Orthoptera, are practically or quite voiceless!

Of the Gryllidae, the house and field-crickets are the subject of many passages and not a few complete poems. Of the latter, Cowper's translation of Vincent Bourne's poem dedicated to "The Cricket" is not by any means the worst.

"Little inmate, full of mirth,
Chirping on my kitchen hearth,
Whereso'er be thine abode,
Always harbinger of good,
Pay me for thy warm retreat
With a song more soft and sweet;
In return thou shalt receive
Such a strain as I can give."

This refers, of course, to the European House-cricket, *Gryllus domesticus*.

A pleasing variation from the ordinary is Thomas Augustine Daly's clever Italian dialect poem, called "Il Grillo":

"How comes he to dis colda clime
To seeng so far from homa?
I catch him manny, manny time
W'en I am boy in Roma.
I catch heem een da fields an' tak'
Heem back eento da ceety,
Where reecha people try to mak'
Deir gardens fine an' pritty.
Dey are so glad for hear heem seeng
Dey no can gat too manny
An' so for evra wan I breeng
Dey geeva me a penny.
Dough here hees song ees justa same,
Hees name I no ca'n speak eet—
Eh? w'at you call hees Anglaice name?
Ah! 'creecket,' yes, 'da creecket.'
Sh! nevva mind da snow,
An' how da weend ees blow:
Hoo-woo! Hoo-woo! Hoo-wee!
For here eet's warm, an' O!
Il grillo seenga so:
Cher-ree! cher-ree! cher-ree!"

The Gryllidae of the field are also abundantly mentioned by both Old World and American poets. A sample of the latter is:

"The cricket to the frog's basoon
His shrillest time is keeping;
The sickle of yon setting moon
The meadow-mist is reaping."
—*Whittier.*

The genus Oecanthus is clearly recognizable in Keats's lines:

"Hedge-crickets sing; and now with treble soft
The red-breast whistles from the garden-croft."
—*To Autumn.*

Even more specific are the passages occurring in more recent poets:

"Pale tree-cricket with his bell
Ringing ceaselessly and well,
Sounding silver to the brass
Of his cousin in the grass."
—*Bliss Carmen.*

and Madison Cawein has positively identified the genus in these few lines:

"I see thee quaintly
Beneath the leaf; thy shell-shaped winglets faintly—
(As thin as spangle
Of cobweb rain)—held up at airy angle."
—*The Leaf Cricket.*

The same author has furnished the only lines so far discovered, referring to Gryllotalpa:

"And in the grass-grown ruts—where stirs
The harmless snake—mole-crickets sound
Their fairy dulcimers."

An Orthopterous family strangely missing in poetry is the Blattidae, in view of the abundance of the roaches throughout the world. It seems possible that among the English poets the term "beetle" may in some cases refer to these insects, as the oriental roach is known in Britain as the "black beetle" and thus we have in Shakespeare:

"Weaving spiders, come not here;
Hence, you long-legged spinners, hence:
Beetles black, approach not near."
—*Midsummer Night's Dream.*

The earwigs represent the Dermaptera in poetry, and Thomas Hood with his usual accuracy alludes to the care with which the common ear-wig of Europe watches over its eggs:

"The key-hole lodged the ear-wig and her brood.
The emmets of the steps had old possession,
And marched in search of their diurnal food
In undisturbed procession."

—*The Haunted House.*

In Love Lane, he voices the age-old superstition, which is responsible for the vulgar name of this insect:

" 'Tis vain to talk of hopes and fears
And hope the least reply to win,
From any maid that stops her ears
In dread of ear-wigs creeping in!"

Of the scores of excerpts in the present collection referring to the Coleoptera, more than one half relate to the glow-worm and the fire-fly. The mysterious, light-giving powers of the glow-worms especially, seem to have stirred the imaginations of the poets to their very depths. At least twenty poets, most of them of the highest renown, sing at greater or less length, of these luminous insects. There are also some half dozen complete poems for which the glow-worm furnishes the principal theme. The most extensive of these doubtless is Wordsworth's "Star and the Glow-worm," consisting of 72 lines, and Cowper's translation from Bourne of 42 lines. But the most interesting, from an entomological standpoint, is that by James Montgomery, contemporary with Thomas Say, who explains very charmingly the purpose of the glow-worm's beacon-light:

"When Evening closes Nature's eye,
The glow-worm lights her little spark,
To captivate her favorite fly,
And tempt the rover through the dark.

Conducted by a sweeter star
Than all that deck the fields above,
He fondly hastens from afar,
To soothe her solitude with love."

Wordsworth, who was essentially a poet of nature, affords numerous references to these insects, and this probably is due to his long residence in the humid "lake regions" of North England where glow-worms no doubt were numerous and conspicuous.

It is somewhat disappointing to an admirer of Tennyson to see him entering the lists of the "grave-yard poets," in the following lines:

"Chant me now some wicked stave,
Till thy drooping courage rise,
And the glow-worm of the grave
Glimmer in thy rheumy eyes."

—*The Vision of Sin.*

No one will deny the power of the lines, but the expression "glow-worm of the grave" is misleading from an entomologist's point of view, although no doubt some unfortunate glow-worms are compelled, through the carelessness of their forebears, to dwell in graveyards. Fortunately, however, most of the references to these harmless insects are of a much more sane and pleasing kind, such as this, which recalls our childhood days:

> "Oft has she taught them on her lap to play
> Delighted, with the glow-worm's harmless ray
> Tossed light from hand to hand; while on the ground
> Small circles of green radiance gleam around."
> —*Wordsworth: An Evening Walk.*

Although the winged Lampyridae or fireflies are not so frequently mentioned as the glow-worm, several passages are famous and frequently quoted, such as this from Tennyson:

> "Many a night I saw the Pleiads, rising thro' the mellow shade,
> Glitter like a swarm of fire-flies tangled in a silver braid."
> —*Locksley Hall.*

A single reference to the luminous Elateridae occurs in Whittier:

> "Star-like, beneath whose somber shade,
> The fiery-winged cucullo played!"
> —*Voices of Freedom.*

Another group of beetles which has appealed strongly to poets is that of the family Ptinidae,[1] known popularly as "the death-watch." These insects are common in old houses both in this country and Europe, living within the woodwork, where the adult males have the habit of producing a ticking sound, probably by a sharp movement of the head against the surrounding woodwork. This sound is vulgarly supposed to portend the death of some inmate of the house, and poets have introduced both the insect and the legend in such scenes as the "Dirge of Wallace":

> "And the lady of Elderslie wept for her lord,
> When a death-watch beat in her lonely room,
> When her curtain had shook of its own accord;
> And the raven had flapped at her window-board,
> To tell of her warrior's doom!"
> —*Thomas Campbell.*

The same insects, in most cases, constitute the "book-worm" of poets, although these gentry have not recognized this fact, and Thomas Parnell, a 17th century bard (unable to identify the creature), apparently has created a mythical composite, for public edification:

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[1]Ptinus fur Linn., P. brunneus Dufts. and Sitodrepa panacea Linn.

"Come hither, boy, we'll hunt today,
The bookworm, ravening beast of prey,
*　*　*　*　*
Dreadful his head with clustering eyes
With horns without, and tusks within,
And scales to serve him for a skin."

and so on, for a hundred lines. It seems possible, however, that the poet had in mind *Lepisma saccharina*, a figure and account of which was published previous to Parnell's time, by Robert Hooke in his "Micrographia" (London, 1665). Entomologists of the present day, of course, recognize the Lepismae as important enemies of books and paper goods.

An amusing quatrain on the book-worm is by Robert Burns. It seems the poet had entered a splendid library, wherein he found an uncut but beautifully bound copy of Shakespeare, in a badly worm-eaten condition, which elicited the following:

"Through and through the inspired leaves
Ye maggots, make your windings,
But, oh! respect his lorship's taste,
And spare his golden bindings."

Every child is familiar with the rhymes warning the lady-bird of imminent and disastrous conflagration, but what seems to be the earliest mention of a similar verse among English poets occurs in John Gay, who wrote this in 1714:

"This lady-fly I take from off the grass,
Whose spotted back might scarlet red surpass,
'Fly, lady-bird, north, south, or east, or west,
Fly where the man is found that I love best.'"
—*The Shepherd's Week.*

Numerous versions of this occur throughout Europe and the following is said to be from the Chinese, but sounds like a "Mother Goose Melody":

"Ladybug, ladybug, fly away, do,
Fly to the mountains and feed upon dew.
Feed upon dew, and sleep on a rug,
And then run away like a good little bug."

An entirely original and different poem is by Southey, who apostrophizes a Coccinellid under the title of "burnie bee," a provincial vulgar name for the insect:

"Blithe son of summer, furl thy filmy wing,
Alight beside me on this bank of moss;
Yet to its sides the lingering shadows cling,
And sparkling dews the dark-green tufts emboss."

Then the poet proceeds to offer liquid refreshments:

"Here mayst thou freely quaff the nectar's sweet
That in the violet's purple chalice hides."

which, in view of the beetle's well-known hankering for fresh meat in the form of aphids, could hardly be acceptable to the insect!

The familiar cock-chafer of Europe, which takes the place of our June-beetles in that country, was formerly known in the North of England as the "Buzzard clock" and Tennyson has celebrated it as such in his poem in dialect on the "Northern Farmer" (old style). The farmer is speaking of the parson in church:

"An' I hallus comed to 's church afoor my Sally wur dead,
An' 'eerd un a bummin' away loike a buzzard clock ower my yead,
An' I niver knaw'd what a mean'd but a thowt a 'ad summut to saay,
An' I thowt a said whot a owt to'a said an' I comed awaay."

In view of the abundance and familiarity of the Hemiptera, it is remarkable that these insects have been consistently neglected in the songs of practically all the English poets.

It seems inexplicable, too, that, although most of the other familiar insects of the household, such as the flea, the house-fly, the house-cricket, and even that unspeakable creature, the "cootie" of recent renown, have all been duly celebrated in poetry; the bed-bug (anciently known in England as the "wall lowse"), has almost entirely escaped poetic mention, if we except the well-known doggerel quatrain which gloats over the fact that, even lacking the undeniable advantages of aerial propulsion, the insect invariably arrives at the psychological moment. The sole exception is the neo-omniscient Butler, who, in ridiculing the use of talismans or amulets, says in Hudibras:

"Swore you had broke and robbed his house,
And stole his talismanique louse,
* * * * *
His flea, his morpion, and punese,
He had gotten for his proper ease,
And all in perfect minutes made,
By th' ablest artists of the trade;
Which he could prove it since he lost,
He has been eaten up almost."

"Punese" is an obsolete term for the bedbug, possibly derived from the French (punaise), and morpion is the equivalent of crab-louse, from the same language. In the Middle Ages, which had come to a close but a hundred years previous to Butler's birth, knowledge of the virtues of amulets and talismans formed a very important branch of medicine and doubtless these superstitious practices still prevailed commonly in the first half of the 17th century.

It seems obvious that Lowell himself would have been the last to contend that most of the rhymes included in the "Bigelow Papers" were poetry; especially those signed "Birdofredum Sawin" describing some experiences of an American soldier in the Mexican war:

"You never see sech darned gret bugs (it
may not be irrelevant
To say I've seen a Scarabaeus pilularius
big ez a year old elephant).
The ridgiment come up one day in time
to stop a red-bug
From runnin' off with Cunnle Wright,
—'t wuz jest a common Cimex lectularius."

Longfellow apparently had the water-striders in mind, when in Hiawatha he says:

"Insects glistened in the sunshine,
Insects skated on the water."

as no other aquatic insects can be said to "skate" on the water, although the Gyrinidae of the Coleoptera may almost justify the term.

One would also expect the Cicadae of the Homoptera to have received abundant attention by the British poets because of the vociferous qualities of their songs, but this is not the case. As noted elsewhere, the grasshopper has received the lion's share of praise in this respect. The few references to the Cicadae in British poetry occur chiefly under the Italian name of cicala or cicale. The reason for this becomes plainly evident when we learn that the cicada is an uncommon insect in Britain, being represented by a single species, which is said to be a "great rarity."[1] Our American bards, on the other hand, have been more attentive to these songsters which are so abundant both in species and numbers throughout the length and breadth of the land. It is not always easy, because of the confusion existing in the popular mind regarding the use of the word "locust," to determine whether an American poet refers to a grasshopper or a cicada. The following, however, dedicated to the "locust," without question really refers to the cicada.

"Sitting with ripeness 'neath the orchard-tree
Trying repeatedly the same shrill phrase."
—*Cawein.*

[1]Harold Bastin, British Insects and How to Know Them: "Of these, the Cicadas, so numerous in tropical countries, are represented in Britain by a single species. As a nymph, it is said to feed at the roots of bracken. The adult is occasionally captured in the New Forest and elsewhere; but it is a great rarity."

Other poetical passages in recent authors are readily referable to the cicada, as:

"The harvest-fly with sudden jingling sound,
Rings his triangle in the drowsy trees,
He bids us note wan Summer drifting by,
Her robe scarce stirring in the languid breeze."
—*Belle A. Hitchcock.*

Chas. G. D. Roberts, Mrs. J. G. Wilson and other recent American poets have noticed the Cicadae in poetry.

Although the Aphids swarm in countless numbers over nearly all the common plants of the field during summer, it has remained for Erasmus Darwin to raise a lone and albeit somewhat quavering voice in their behalf:

"The countless Aphides, prolific tribe
With greedy trunks the honey's sap imbibe;
Swarm on each leaf with eggs or embryons big,
And pendant nations tenant every twig."
—*Origin of Society.*

Because of their amazingly swift flight and ferocious habits, perhaps it is not to be wondered at that the dragon-flies have ever been regarded by country folk with a species of superstitious awe. In the 16th century the vulgar name for the insects in England was "adder's boulte" and to this day they are "devil's-darning-needles" to many people of intelligence; while in Pennsylvania they are "snake-doctors" or "snake-feeders," and to be avoided as one would a pestilence! The poets, however, have seen nothing but their beautiful colors and aerial maneuvers, and only the poets of comparatively recent times have sung of them. Thomas Moore apparently is the first poet who notices them and he mentions the Agrionidae:

"The beautiful blue damsel-flies
That flutter'd round the jasmine stems
Like winged flowers or flying gems."

And Jean Ingelow, who was contemporary, sings of the Libellulidae:

"And forth on floating gauze, no jewelled queen
So rich, the green-eyed dragon-flies would break,
And hover on the flowers—most aerial things,
With little rainbows flickering on their wings."

Longfellow, Browning, Meredith, MacDonald, Whittier, Bryant, and many others have done likewise, but the finest lines of all, at least from an entomological point of view, are those of Tennyson's in The Two Voices:

"Today I saw the dragon-fly
Come from the wells where he did lie;
An inner impulse rent the veil
Of his old husk; from head to tail,
Came out clear plates of sapphire mail.
He dried his wings: like gauze they grew;
Thro' crofts and pastures wet with dew
A living flash of light he flew."

That the mendacious and detestable house-flea, still so common in some European countries, which are supposed to rest on the very crest of advanced civilization, was equally common there from three to five hundred years ago, seems evident from the testimony of Chaucer, Shakespeare, Butler and Swift. As fleas are now known to be vectors of bubonic plague, this is most significant when we consider that the first three of these poets existed before or during the period of the great plague of London, and Swift was born two years after the most terrible outbreak of the disease that ever occurred in Britain. Perhaps the best known poetical passage relative to the flea is that occurring in Jonathan Swift's Rhapsody, but which is often credited to his critic, Dr. Johnson. There are numerous versions of this but the original is:

"So, naturalists observe, a flea
Has smaller fleas that on him prey;
And these have smaller still to bite 'em,
And so proceed ad infinitum.
Thus every poet in his kind
Is bit by him that comes behind."

There can be but little doubt that Swift received the inspiration for this idea from the announcement by Anthony Van Leeuwenhoek, a Dutch contemporary naturalist, that the house flea is parasitized in the pupal stage, and so was able to make use of it in this witty and humorous way.[1]

A less known passage occurs in Butler's Hudibras, where he is telling of the great wisdom of one of his characters and that he knew:

"How many scores a flea will jump,
Of his own length, from head to rump,
Which Socrates and Chaerephon
In vain assayed so long agone;
Whether his snout a perfect nose is
And not an elephant's proboscis."

This appertains to Aristophane's comedy of the "Clouds," in which a flea jumps from Socrates's forehead to the head of

[1]See Dr. D. F. Harris, Scientific Monthly, Feb. 1921.

Chaerephon, thus precipitating an argument as to how far a flea could jump! They did not, however, attempt to measure in terms of the length of body of the insect as Butler infers, but dipped the feet of the flea in melted wax which presently hardened into shoes, which they took off and used as a unit of length in measuring the leap.

Imagination is the poet's stock-in-trade, and, although the occurrence of parthenogenesis, pedogenesis, and polyembryony among insects have prepared the entomologist for almost anything in the way of biological phenomena, it has remained for Owen Meredith to "go all of these one better," in a poem called "Small People":

> "The Wasp told the Midge and the Gnat,
> And the Gnat told the Flea and the Nit.
> The Nit dropped an egg as she sat;
> The Flea shrugged his shoulders and bit."

We were quite prepared for the bite of the flea, that was to be expected, but the astounding action of the nit leaves us entirely flabbergasted!

According to Shakespeare:

> "A dozen white louses do become an old coat well;
> It is a familiar beast to man, and signifies love."
> —*Merry Wives of Windsor.*

Fortunately the opinion expressed in the first line of this passage no longer prevails, but that the insect again became "a familiar beast to man" during the Great War, many an American soldier will testify. He learned to know, however, that it signifies not love, but death, and that in a horrible form! Illustrative of the vagaries of the poets is the reaction produced in the mind of Robert Burns by the sight of a louse (filthy vector of a terrible disease), on the bonnet of a lady in church! This vision inspired a poem which culminates in one of the wittiest and most sapient passages in all poetry, now famous the world over:

> "O, wad some pow'r the giftie gie us
> To see oursels as ithers see us!
> It wad frae monie a blunder free us."

Sometimes the nit or egg of the louse is mentioned, as in Shakespeare:

> "And his page on the other side, that handfull of wit,
> Ah, heavens, it is a most pathetical nit!"

The nit of the louse at that time was recognized as in some way related to it, but was not identified as the egg of the pest until long afterwards.

In Butler's day it was quite the thing to ridicule the embryonic beginnings of Natural Science, just as it has until recently been the fashion to regard the study of "bugs" as unworthy the attention of serious-minded people. The following lines of that author's Hudibras are directed against the Royal Society of London, which was then but recently founded:

"He knew whats'ever's to be known,
And much more than he knew would own.
* * * * *
Whether a pulse beat in the black
List of a dappled louse's back;
If systole or diastole move
Quickest when he's in wrath or love;
When two of them do run a race,
Whether they gallop, trot or pace."

Fortunate indeed for the welfare of mankind is the fact that the day for ridiculing entomology is gone, never to return.

The saying that a "little nonsense now and then" is relished by even the elect, is familiar to all, but Solomon seems to express the opposite view in:

"The tongue of the wise adorneth knowledge;
But the mouth of fools bubbleth out folly!"

Those who side with the patriarch would better withdraw their attention for the present, as what follows pretends to be nothing but nonsense! The rhymes and jingles relating to insects are almost endless and, to those who can smile without undue effort, are often amusing. The following, whose authorship is unknown, appeared in Entomological News some years since:

"A flea and a fly in a flue
Were imprisoned so what could they do?
Said the flea, 'Let us fly,'
Said the fly, 'Let us flee,'
So they flew through a flaw in the flue."

A similar verbal see-saw recently has appeared in the "Yale Record":

"If flies are flies because they fly,
And fleas are fleas because they flee,
Then bees are bees because they be."

Frequently these entomological jests take the form of fables, such as the following:

"*Double, Double Toil and Trouble.*"

An ant, a wasp and a bumble-bee
Were met one day beneath a tree;

"Alas," said the wasp; "the wood these days
Is so very tough, I am nearly crazed,
And they've plastered the posts with creosote
It has given me such a pain in my throat!"

"Pooh, pooh!" quoth the ant, "your troubles are mean,
Why, they've slaughtered my aphids with nicotine,
And filled my halls with a poison gas
So that even our workers can not pass;
Such a horrible odor you never sniffed,
I've a racking cough and am terribly miffed!"

The bumble-bee hummed in his contra-bass,
As he wiped the pollen from his face,
"This farmer of mine is exceedingly rude,
He has cut his clover and starved my brood!"
Then they groaned in chorus, to disappear,
In the circumjacent atmosphere.

James J. Montague, whose clever rhymes appear daily under the caption "More Truth than Poetry," in numerous newspapers throughout the land, is fond of entomological themes. Recently there appeared in his column an amusing discussion on the fable of the grasshopper and the ant, in which, as usual, the industry of the latter is contrasted with the vagrancy of the grasshopper. This terminates as follows:

"Yet grasshoppers swarm from the north every year
And feast on the ripening grain;
They eat every blade, every leaf, every spear,
Again and again and again."

Evidently Mr. Montague had read the First Report of the Entomological Commission, but failed to learn the sequel!—but he goes on:

"While the ants have to work or they don't get along
Which seems to establish that something is wrong.
You may know the moral to this little song,
To me it is not very plain!"

However, Joe Lincoln, in "Cape Cod Ballads," takes an entirely different view of this enigma and perhaps he has solved the mystery:

"But, mind you, the ant, all summer long,
Had heard the grasshopper's merry song,
And had laughed with the rest of the happy throng
At the bubbling notes of glee;
And said to himself, as his cash he lent,
Or started out to collect his rent,
'The shif'less fool don't charge a cent—
I'm getting the whole show free!'"

The famous physician, Edward Jenner, discoverer of vaccination as a preventive of small-pox, wrote a rhyming letter to a friend giving forty reasons for declining an invitation to make an excursion. Among these were the following:

"The soot falls down, the spaniels sleep,
And spiders from their cobwebs peep,
* * * * *
How restless are the snorting swine,
The busy flies disturb the kine,
* * * * *
Low o'er the grass the swallow wings,
The cricket, too, how sharp he sings!
* * * * *
Through the clear streams the fishes rise,
And nimbly catch the incautious flies.
* * * * *
The glow-worm, numerous and light
Illumed the dewy dell last night.
* * * * *
'T will surely rain; I see with sorrow
Our jaunt must be put off tomorrow.'

—*Signs of Rain.*

Entomological fables like other varieties are perennial, but what is believed to be a new one is this:

A hungry sparrow chanced to spy
A brightly painted dragon-fly;
This gaudy fly, who was most vain,
Bespoke the sparrow with disdain;
"Just gaze upon my turquoise wings,
Are they not resplendent things?
And then my slender, graceful tail,
Admire it, you cannot fail."
But the sparrow cast a cynic's eye
Upon this boastful dragon-fly;
"I think this tail is much too long":
Then snapped it off—and so do I!

## TWO NEW GENERA OF APHIIDAE[1] (HOMOPTERA).

By Ryoichi Takahashi,
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### Neophorodon new genus.

*Wingless form.*—Body provided with many distinct capitate hairs. Frontal tubercles conspicuous, lacking tubercles on the inner side. Antennae 6-jointed, spur of the 6th joint longer than the base, the 1st joint provided with a prominent tubercle on the inner side. Eyes normal. Dorsal and lateral tubercles absent. Cornicles long, gradually swollen on the distal half. Cauda stout, shorter than the cornicle, longer than wide, tapering. Anal plate and tarsi normal.

*Winged form.*—Body lacking capitate hairs. Frontal tubercles short. Antennae provided with circular or oval sensoria, the 1st joint with a small tubercle. Wing veins normal.

*Type.*—*Neophorodon rubi* new species.

This new genus is closely allied to *Phorodon* Passerini and *Acanthaphis* Matsumara, but differs from the former in lacking projections on the frontal tubercles, and from the latter in having no tubercles on the dorsum of the abdomen.

### Neophorodon rubi new species.

*Wingless viviparous female.*—Pale yellow. Eyes black. Antennae mostly black. Cornicles pale brown, with black apices. Cauda yellow. Legs pale brown; apices of tibiae, and tarsi black.

Body oblong, provided with many rather long capitate hairs. Frontal tubercles conspicuous, almost as long as the 2d antennal joint; the inner side very slightly convex, lacking projections, but provided with 2 capitate hairs.

Antennae provided with a few short capitate hairs; the 1st joint much larger than the 2d, with a broad blunt tubercle, which does not reach the apex of the 2d joint and provided with two capitate hairs, on the inner side; the 2d joint lacking tubercles; the 3d joint slightly imbricated, lacking sensoria; the 4th joint imbricated; the relative length of joints as follows: III–33, IV–22, V–21, VI–61 (15 + 46).

Rostrum reaching middle legs. Eyes normal. Body lacking dorsal and lateral tubercles. Cornicles long, as long as the 6th antennal joint, almost reaching the base of the cauda, almost not imbricated, somewhat swollen on the distal half, expanded at the base, about 4.2 times as long as wide, about 4 times as long as the cauda. Cauda short, stout, triangular when seen from above, longer than wide, with the apex rounded, provided with 2 pairs of moderately long lateral bristles. Legs slender, furnished with many capitate hairs; hind tarsi a little shorter than the cauda. Length of body, 2.2 mm.; cornicle, 0.4 mm.; antenna, 1.3 mm.

*Winged viviparous female.*—Yellowish brown. Head, antennae, and thorax black. Abdomen somewhat dusky at the middle of the dorsum. Cornicles slightly dusky. Cauda yellow. Wings hyaline; stigma gray; veins dark

[1]Takahashi's spelling Aphididae amended by the editor.

brown. Legs yellowish brown, apices of tibiae slightly dusky, tarsi blackish. Body lacking capitate hairs; head provided with some short normal bristles. Frontal tubercles very short, somewhat projecting on the inner side. Antennae lacking hairs; the 1st joint larger than the 2d, with a short blunt tubercle on the inner side, the 3d joint not imbricated, provided with 27 large oval sensoria scattered over the whole length; the 4th joint somewhat imbricated, provided with 14 large circular or oval sensoria scattered over the whole length; the 5th joint provided with 5 large sensoria in a row over the whole length, the apical sensoria large and oval, the relative length of joints as follows: III–49, IV–29, V–26, VI–67 (15 + 52). Rostrum reaching the middle legs. Subcosta provided with 7 small sensoria on the distal two thirds; the 2d branch of the 3d oblique rather short, hind wings with 2 almost parallel obliques; hooklets 3. Cornicles almost similar to those of the wingless form, moderately swollen on the distal two thirds, expanded at the base, 5 times as long as wide, as long as the spur of the last antennal joint, almost 4 times as long as the cauda. Cauda triangular when seen from above, almost as long as wide, provided with 2 pairs of lateral bristles. Legs slender, provided with many bristles; hind tarsi as long as the cauda. Length of body, 2.25 mm.; fore wing, 3.4 mm.; antenna, 1.5 mm.; cornicle, 0.37 mm.

*Host.*—*Rubus sp.* (*Rubus fraxi nifolius?*), attacking the leaf and the young shoot.

*Hab.*—Formosa (Kagi). Collected by the author in March, 1921.

Described from specimens preserved in alcohol.

*Type.*—Retained by the writer.

**Trichosiphonaphis** new genus.

*Wingless form.*—Body wide, provided with some short capitate hairs. Frontal tubercles large, with a short blunt tubercle on the inner side. Antennae 6-jointed, spur longer than the base, the 1st joint slightly convex on the inner side. Dorsal and lateral tubercles absent. Cornicles cylindrical, somewhat swollen near the apex, provided with some prominent capitate hairs. Cauda large, longer than wide, somewhat constricted at the base, shorter than the cornicle. Tarsi and anal plate normal.

*Winged form.*—Body lacking capitate hairs. Frontal tubercles very short, slightly convex on the inner side. Antennal sensoria circular. The 3d oblique of the front wings twice forked; hind wings with one oblique. Cornicles cylindrical, slightly swollen near the apex, provided with some bristles which are not knobbed.

*Type.*—*Myzus polygoniformosanus* Takah.

This new genus is closely related to *Myzus* Passerini, but differs from it in the following characters.

1. Hind wings with only one oblique. 2. Cornicles provided with normal or capitate hairs.

**Trichosiphonaphis polygoniformosanus** Takah.

*Myzus polygoniformosanus*, Takahashi, Aphididae of Formosa, 1, Agr. Expt. St. Formosa, p. 18, pl. XIV, 1, figs. 1–3. (1921).

*Winged viviparous female.*—Body lacking hairs. Head provided with a few normal hairs. Frontal tubercles very short, somewhat convex on the inner side. Antennae imbricated, lacking hairs; the 1st joint almost straight on the inner side; the 3d joint provided with about 45 very small circular sensoria scattered over the whole length; the 4th joint provided with 18 similar sensoria; the 5th joint provided with about 8 sensoria almost in a row, the apical sensoria larger; the relative length of joints as follows: III–61, IV–37, V–32, VI–91 (13 + 78). Rostrum reaching the middle legs. Fore wings with the 3d oblique twice forked; subcosta provided with about 10 small circular sensoria on the distal half; stigmatic vein not strongly curved; hind wings with one oblique, hooklets 4, wing veins rather stout. Cornicles cylindrical, imbricated, very slightly dilated on the basal and apical portions, 25 times as long as the cauda, reaching almost to its base, 6 times as long as wide, provided with some moderately long hairs which are not knobbed. Cauda short, stout, broadened on the basal half, longer than wide, provided with 2 pairs of lateral bristles near the apex. Legs long and slender, provided with many setae; tarsi rather slender; hind tarsi as long as the cauda. Length of body, about 1.8 mm.; cornicle, 0.3 mm.; antenna, about 1.8 mm.; fore wing, 2.5 mm.

*Host.*—*Polygonum perfoliatus*, attacking the leaf and the stem.
*Hab.*—Formosa (Taihoku, Kagi); Japan (Tokyo).

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# PROCEEDINGS

OF THE

# ENTOMOLOGICAL SOCIETY

OF WASHINGTON



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DAVID SHARP

PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

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# David Sharp

DR. DAVID SHARP, the only honorary member of the Entomological Society of Washington, died August 27, 1922, at Brockenhurst, England, at the age of 82. Although primarily a very distinguished Coleopterist, he was not only a very broad entomologist, but in general zoology, especially in the matter of nomenclature and its principles, he was one of the foremost of English workers. It is not too much to say that at the time of his death he was the most distinguished of all living entomologists, a fact which was recognized not only by our own Society but by practically all of the prominent entomological societies of the world.

Beginning with 1865, several hundred papers by Sharp have been published, the most important being his great monograph of the aquatic beetles (Dytiscidae) and the remarkable work by himself and his son-in-law, Frederick Muir, on the comparative anatomy of the male genital tube in Coleoptera, which opened a new vista in the study of the phylogeny of the beetles.

His full bibliography will no doubt be published by his English colleagues, but as ours is an American society we should mention some of his contributions to the knowledge of the Coleoptera of the New World. In 1876 his monograph of the Staphylinidae of the Amazon Valley was published; in 1885 "On the Coleoptera of the Hawaiian Islands by the Rev. T. Blackburn and Dr. D. Sharp," more fully extended in the "Fauna Hawaiiensis"; a large and important portion of the "Biologia Centrali-Americana" comprising several families. He also was the chief organizer of the British Exploration of the Lesser Antilles of which he published as a sort of introduction the Zoological Bibliography of the Lesser Antilles (1888).

In the North American entomological literature only a small but interesting paper can be found (Journal N. Y. Ent. Soc., 1918), "On the New York Weevil (*Ithycerus noveboracensis*)," and there is also an extract from a letter by him on the reputed occurrence of the Palm Weevil (*Rhynchophorus palmarum*) in California. From this latter note we learn that in 1867 or 1868, in connection with the late Mr. E. Brown and his friend Mr. G. R. Crotch, he financed a small coleopterological exploration by sending an experienced collector, Mr. J. R. Hardy, to California.

His noteworthy services as Editor of the *Zoological Record*, and his two wonderful volumes on the Insecta, published in the *Cambridge Natural History* and which are to be found in almost daily use in every entomological laboratory in America, have given him an enduring fame among biologists. His death has left a gap which will probably never be filled by any single man.

## NOTES ON THE NEOTROPICAL EPIPASCHIINAE WITH DESCRIPTIONS OF NEW GENERA AND SPECIES.

By W. Schaus.

The types of the new species are in the National Museum, except three which are at Cornell University and are represented in the National Collection by cotypes. The new forms from Central America, Cuba and French Guiana were collected by Barnes and Schaus; otherwise, where known, the collector's name is given.

### **Milgithea,** new genus.

*Male.*—Antennae fasciculate with a thickly scaled process reaching middle of thorax, bent back, its end downturned, and at base is laterally covered with long broad scales. Palpi upturned reaching well above vertex, the second joint thick, long, smooth, with a furrow on its inner side, the third joint short, acute. Fore wings: vein 2 from before angle of cell; 3 from angle; 4 and 5 from angle, approximated at base; 6 from upper angle downcurved; 7, 8, 9 stalked; 10 from cell usually anastomosing with 8; 11 free. Hind wings: vein 2 from before angle; 3 from angle; 4 and 5 shortly stalked or approximated, in the female sometimes from a point; 7 anastomosing with 8.

*Type of genus.—Pococera melanoleuca* Hampson.

Differs from *Paranatula* Dyar in the much thicker palpi and the very different antennal process.

### **Milgithea suramisa,** new species.

*Male.*—Palpi chestnut, tipped with white, the process cacao brown with white scaling behind at tip. Head and patagia white. Collar clay color. Thorax white and gray irrorated with iridescent pinkish scales. Abdomen above black with light buff segmental lines. Body below mostly white, the legs inwardly opalescent, outwardly black with white rings. Fore wings white; a triangular black spot on costa at base with some olive brown scales on it, and a fine line of black scales from its apex, outbent and expanding on inner margin; a black antemedial line from costa outangled in cell with only a few black and ochreous scales below cell, this line preceding a large black costal spot and an olive green spot in cell; a wavy inbent medial black line from below cell to inner margin; an oblique black spot on discocellular suffusing with an elongated black spot on costa; a waved postmedial black line with a white spot at costa; terminal space purple drab suffused with black at apex; a fine terminal black diffused line; cilia whitish with black spots. Hind wings whitish, the termen suffused with mouse gray; a postmedial blackish line angled on vein 2 near termen; a dark terminal line; cilia divided by a black line towards apex. Fore wings below white suffused with fuscous, the white costal spot at postmedial line very prominent; the postmedial line on hind wing not approaching termen.

Expanse, 27 mm.

*Habitat.*—Poas, Costa Rica; a female from Jalapa, Mexico.

*Type.*—Cat. No. 25648, U. S. N. M.

Near *M. melanoleuca* Hampson and *M. albimedialis* Hampson. *Arnatula circumlucens* Dyar is better placed under Milgithea.

**Paranatula vincentia,** new species.

*Male.*—Palpi light buff. Head, collar and thorax white, the collar shaded medially with pinkish cinnamon. Abdomen white shaded dorsally with cinnamon, also with a few black scales on terminal segments. Fore wings white shaded with pearl gray on interspaces; some light pinkish cinnamon scales at base; a subbasal black point below cell overlaid with raised pinkish scales; some dark gray scales at base of inner margin; an elongated pinkish cinnamon medial patch on costal margin entering cell and touching a velvety black spot of raised scales and a small dark gray spot beyond it at end of cell; a similar quadrate patch from above submedian to inner margin, the two connected by a fine pinkish cinnamon line; a diffuse postmedial line of raised white scales tipped with black from below costa, outangled at vein 5; an outer line, fine, white, defined by the pearl gray shading, preceded by tiny dark gray streaks on veins 2–5, preceded on costa by a small pinkish cinnamon spot, and followed by a similar larger spot; irregular marginal pinkish cinnamon shading from below vein 5 to tornus; an interrupted terminal black line; cilia yellow buff with black spots. Hind wings suffused with smoky drab, the inner margin and a streak below cell and vein 2 yellowish white; a dark terminal line and a similar line on cilia near base. Hind wings below whitish, the apex and termen narrowly smoky; traces of a subterminal line from costa.

Expanse, 19 mm.

*Habitat.*—Cayuga, Guatemala.

*Type.*—Cat. No. 25649, U. S. N. M.

The antennal process is only moderate in length. Veins 4 and 5 on both wings very closely approximated at base.

Paranatula Dyar is closely allied to Apocera Schaus differing in the longer antennal process.

Besides *Apocera costata* Schaus, the genus includes *Arnatula colorata* Dyar.

**Oneida mejona,** new species.

*Male.*—Palpi light buff, the third joint white tipped with fuscous. Head whitish. Collar salmon color, the scales behind tipped with white. Thorax light grayish vinaceous. Abdomen above grayish buff, with segmental brown shading. Fore wings: base to near middle cinnamon, its outer edge obliquely curved, some black scales on it from submedian to inner margin; a short black streak at base of inner margin; an antemedial oblique line of raised black scales from cell to near inner margin, some darker cinnamon scales above it in cell and on costa, followed in cell by a black point; a medial white shade from costa to below cell; postmedial space gray-white darker on inner margin; a short black medial line on inner margin; cinnamon suffusion on costa, and irroration beyond cell; an oblique white lunule on discocellular; an outbent line of black and cinnamon scales from fold to inner margin; a subterminal white line, incurved below costa, outcurved below vein 5, and incurved below vein 3, preceded between veins 5 and 8 by an irregular quadrate spot edged with some black scales; termen gray, veins 4 to 8 cinnamon; apex cinnamon, the costal edge at apex black; a black terminal line; cilia whitish divided by a gray line. Hind wings white, the costal margin red; a narrow terminal smoky shade; cilia white divided by a gray line toward apex. Fore wings below dark red overlaid with deep neutral gray scales, the termen dull gray; a yellowish streak on costa beyond middle and subterminal yellow spot. Hind wings below white; costal margin to median, and base of veins 3 and 4 dark red; apex yellowish white.

Expanse, 22 mm.

*Habitat.*—Volcan Sta Maria, Guatemala.
*Type.*—Cat. No. 25650, U. S. N. M.

**Tioga egvina,** new species.

*Female.*—Palpi white irrorated with fuscous. Head whitish; collar reddish brown; patagia vinaceous buff; abdomen brownish with white segmental lines and darker dorsal spots on last three segments. Fore wings: base black followed by a large round white spot extending from costa to near submedian, edged behind with black scales; an antemedial fuscous shade from costa to below cell followed by a large triangular white space from costa to just below vein 2 edged with black scaling, its outer edge irregularly dentate and cut on costa by the postmedial line; a small dark spot on costa at middle; postmedial line outcurved from vein 7 to vein 2, fine, dark, lunular, inbent on vein 2 to dark edging of white space, then indistinctly double and outbent to inner margin; inner margin broadly vinaceous fawn; the space preceding postmedial line between veins 6 and 2 shaded with light vinaceous fawn; terminal space white irrorated with drab; a terminal black line interrupted by white spots at veins; apex suffused with fuscous; cilia white with fuscous spots at veins. Hind wings whitish suffused with fuscous; cilia white with fuscous spots from apex to vein 2, then divided by a dark line to anal angle. Wings below suffused with fuscous, the hind wings less so than above.

Expanse, 25 mm.

*Habitat.*—French Guiana.
*Type.*—Cat. No. 25651, U. S. N. M.

**Tetralopha vanenga,** new species.

*Male.*—Palpi avellaneous, the third joint streaked in front and tipped with black. Head white mottled with buff and gray. Collar white shaded with buff. Thorax and patagia white mottled with fuscous. Abdomen above whitish buff with dark irrorations. Legs whitish irrorated with brown, the fore tarsi fuscous with white rings. Fore wings with anterior half mostly grayish with some black irrorations; a white spot at base; antemedial black streaks on costa, in cell, and a small spot below cell partly overlaid with broad white scales; furrow in cell rather large, a black streak below it, a black patch on costa above it, and a small patch of black and white scales below vein 2; a black point at origin of veins 4 and 5; a vinaceous buff spot on costa before postmedial line which is outcurved, deeply dentate, black, not traceable below vein 3; inner margin antemedially broadly shaded with vinaceous cinnamon; similar shading terminally from inner margin to vein 5; a subterminal black shade from costa to vein 6; a thick terminal black line interrupted at veins; cilia silvery gray with darker shading and a buff line at base. Hind wings thinly scaled, whitish suffused with fuscous, the veins dark. The fringe of large scales on costa below iridescent from light to dark steel gray.

Expanse, 17 mm.

*Habitat.*—Cayuga, Guatemala.
*Type.*—Cat. No. 25652, U. S. N. M.
This species has no process from base of antennae.

**Tetralopha aelredella,** new species.

*Male.*—Palpi fuscous thinly irrorated with white; a fine white circle around eyes. Collar white overlaid with pinkish cinnamon. Thorax mottled brown and pinkish cinnamon. Abdomen banded with black and cinnamon buff. Fore wings: base whitish with dark irrorations; a black basal spot on costa and subbasal streak in cell; antemedial line excurved on costa, outangled on median, inangled below cell, not reaching inner margin; medial space from cell to inner margin clay color; a black line from costa medially, outbent and angled at end of cell, then downbent and not reaching submedian; terminal half whitish irrorated with fuscous and clay color; post-medial line black, vertical on costa, outcurved and lunular dentate beyond cell, slightly incurved between veins 2 and 1; a subterminal dark shade almost parallel with postmedial, more heavily marked and black from costa to vein 6; a terminal black line interrupted at veins; cilia finely buff at base followed by a dark line and tipped with white. Hind wings thinly scaled, whitish at base, then suffuesd with fuscous, the veins dark; cilia as on forewing. Fore wings below fuscous, the inner margin whitish; the large scales on costa iridescent gold and pale green.

Expanse, 19 mm.

*Habitat.*—St. Jean, French Guiana.
*Type.*—Cat. No. 25653, U. S. N. M.
This species has no process from base of antennae.

**Tetralopha sabbasa,** new species.

*Male.*—Antennae with well developed process. Palpi mottled white and fuscous; vertex with cinnamon scaling. Collar white with cinnamon and fuscous scaling laterally. Thorax mottled brown and dark gray, the patagia tipped with broad iridescent pale purplish gray scales. Abdomen buff thickly irrorated with fuscous gray above, leaving whitish segmental lines. Fore wings: basal half blackish slate irrorated with white, the outer half grayish suffused with brown; a faint whitish streak below cell at base; an antemedial outcurved black line across cell to submedian, followed by an outbent whitish line from cell to inner margin, twice outcurved; a small cinnamon spot below vein 2; veins from cell to beyond postmedial fuscous; an indistinct postmedial fuscous shade slightly outcurved and outbent below vein 2; terminal area irrorated with white on interspaces; cilia dark gray partly tipped with white and with a fine buff line at base. Hind wings whitish faintly suffused with brown, the veins and termen narrowly darker; cilia brownish tipped with white. Fore wings below with costal scales silvery neutral gray, the inner margin broadly white. Hind wings below whitish' the costal margin dark.

Expanse, 24 mm.

*Habitat.*—Guadalajara, Mexico.
*Type.*—Cat. No. 25654, U. S. N. M.

**Tetralopha basilissa,** new species.

*Male.*—Palpi fuscous black. Head white with some fuscous mottling on vertex behind. Collar pale drab gray irrorated in front with fuscous and white. Thorax whitish gray with subdorsal black spots posteriorly, the patagia pale drab gray with a few black irrorations. Abdomen above drab gray with darker segmental lines, the basal segment white. Body below white with some black scales. Legs inwardly white, outwardly mostly chestnut brown with white spots on tarsi. Fore wings mostly light cinnamon drab; base irrorated with black, also with white in cell and on costa; antemedial line fuscous on costa, black from subcostal, thick and outcurved in cell and again below median, outbent from submedian fold to inner margin, followed on costa by some white scaling; a medial outbent white line from cell to inner margin, distally finely edged with black, proximally more heavily so, the space between it and antemedial from cell to inner margin clear cinnamon drab with black irrorations only on fold, submedian and margin; a postmedial shade, fuscous on costa, black, vertical from cell and inwardly edged with white scaling, the space before it below cell pale drab gray; postmedial space irrorated with white from vein 5 to costa; outer line fuscous, outcurved below costa, incurved below vein 4; termen shaded and irrorated with whitish; a fuscous subterminal shade below costa; a terminal black line with white points on veins; cilia mottled whitish and smoky gray. Hind wings white, the costa cinnamon drab; a faint drab terminal line.

Expanse, 18 mm.

*Habitat.*—Guerrero, Mexico.
*Type.*—Cat. No. 25772, U. S. N. M.

**Tetralopha cuthmana,** new species.

*Female.*—Head, collar and thorax white irrorated with large black scales. Abdomen above white with transverse black bands anteriorly on each segment and black irrorations posteriorly; underneath white with only a few black scales. Legs white densely irrorated with black, the tarsi black with white rings. Fore wings white thickly irrorated with black except along outer edge of medial line from subcostal to inner margin; a thick antemedial black line from costa to submedian; medial line double, mottled with fuscous, filled in with white, slightly sinuous and outbent; a black point on discocellular; a fine postmedial line followed from vein 6 to inner margin by a fuscous shade which is narrow on costa, broad below vein 6, its outer edge dentate, outcurved beyond cell, slightly incurved below vein 4 and again outcurved across submedian; a faint subterminal fuscous, macular, line; terminal trigonate black spots; cilia whitish at base followed by a black line, the tips grayish. Hind wings ochreous white, the termen rather broadly shaded with fuscous; cilia with a light buff line at base, followed by a black line, the terminal half white. Fore wings below fuscous, some white irrorations on costa, on termen, and as a postmedial line; inner margin white. Hind wings below whitish, the termen suffused with fuscous especially at apex; a postmedial fuscous shade with black streaks on veins.

Expanse, 20 mm.

*Habitat.*—Tucuman, Argentina.

*Type.*—Cat. No. 25792, U. S. N. M.

The type specimen has been kindly given to me by Mr. P. Dognin who retains in his collection a cotype, slightly smaller, from La Rioja, Argentina. Allied to *T. basilissa* Schaus.

**Tetralopha agnesa**, new species.

*Female.*—Palpi cinnamon mottled with white. Frons white; vertex and collar white shaded with buff and cinnamon. Thorax gray; patagia white with a few drab and black scales. Abdomen sorghum brown. Fore wings sayal brown suffused with white at apex; a large white patch at base from costa to submedian with a few brown irrorations; a double medial line, black on costa and inner margin, slightly inangled on submedian fold; veins postmedially streaked with black, the line on submedian heavier, nearly reaching termen; an outer curved line indicated by thicker streaks on veins; subterminal brown suffusions on the white shading; an interrupted terminal dark brown line. Hind wings fuscous, the veins almost black, the cilia somewhat lighter. Fore wings below fuscous, the inner margin broadly grayish buff. Hind wings below grayish buff; a broad subterminal and terminal fuscous shade.

Expanse, 27 mm.

*Habitat.*—Chejel, Guatemala.

*Type.*—Cat. No. 25656, U. S. N. M.

As the type is a female, it may belong to some other section of Pococera.

**Tetralopha iogalis**, new species.

*Female.*—Palpi laterally white. Head, collar, and thorax white or pearl gray according to light. Abdomen whitish buff irrorated with brown except on segmental lines, underneath white. Legs white, the mid and fore tarsi with fine brownish rings. Fore wings white irrorated with light drab except medially, the inner margin and termen suffused with light drab; an antemedial line of raised black scales from subcostal to near inner margin; a double medial black line outbent from costa, filled in with white, the inner line much less distinct than the outer; some black scaling postmedially from vein 3 to 1; subterminal line black, outwardly edged with clear white, slightly outcurved between veins 5 and 3; terminal black spots on interspaces; cilia white. Hind wings white, the costa, apex and termen narrowly suffused with fuscous; cilia white.

Expanse, 21 mm.

*Habitat.*—Santiago, Cuba.

*Type.*—Cat. No. 25655, U. S. N. M.

Closely allied to *T. floridella* Hulst. and *T. polialis* Hampson.

**Tetralopha jovita,** new species.

*Male.*—Palpi russet in front, whitish behind. Head, collar, and thorax white. Abdomen above whitish buff with drab segmental lines, underneath whitish. Legs whitish, the fore legs grayish; fore and mid tarsi with dark rings. Fore wings whitish mostly suffused with drab gray; a small subbasal black spot on subcostal and black irrorations below cell; an outcurved antemedial drab line with raised black scales on costa, in cell, and below cell to vein 1 where it is slightly outbent; a medial drab line outbent on costa, inangled in cell, where it is connected with antemedial by a short black streak, then obliquely outcurved, fine, consisting of minute black streaks to vein 1 where it is again outcurved, from below cell edged on both sides with clearer white; a black point at end of cell; raised white scales, a few tipped with black from angle of cell to inner margin; a postmedial, sinuous, mouse gray line, partly darker shaded; a sinuous subterminal drab shade defined by clear white and crossed by dark streaks on veins; terminal black spots; cilia light mouse gray tipped with white. Hind wings white; veins from cell, apex and termen narrowly light drab. Fore wings below with the broad scales on costa light mouse gray.

Expanse, 18 mm.

*Habitat.*—Santiago, Cuba.
*Type.*—Cat. No. 25770, U. S. N. M.
Near *T. iogalis* Schs, differing in the direction of the lines.

**Tetralopha cyrilla,** new species.

*Female.*—Palpi fuscous irrorated with white. Head and collar vinaceous buff, some white and black spots on frons. Patagia white with gray spots. Abdomen above vinaceous buff, underneath whitish. Legs chiefly pale drab gray. Fore wings whitish; basal and basal third of costa suffused with drab; an outbent antemedial white line from median to inner margin, distally edged by some velvety black scaling; a velvety black point in middle of cell, below it a grayish and rufous cinnamon shade terminating in a black line below submedian; a medial fuscous, sinuous line, incurved across a white patch below cell to submedian and followed from vein 2 to submedian by an outcurved black line; postmedial space irrorated with drab gray; subterminal line clear white slightly outcurved, its inner edge above vein 3 defined by some crenulate black lines and from vein 4 to costa by a wood brown shade, and is followed throughout by a wood brown shade mottled with white on margin; terminal black points almost forming a line; cilia white. Hind wings light cinnamon drab, somewhat whitish at base.

Expanse, 17 mm.

*Habitat.*—Baracoa, Cuba.
*Type.*—Cat. No. 25771, U. S. N. M.

**Auradisa fechina,** new species.

*Female.*—Palpi fuscous, the second and third joints tipped with white. Head white, mottled with dark olive buff. Collar dark olive buff. Patagia pearl gray, the shoulders dark olive buff. Abdomen above white at base, otherwise buff with dark segmental lines. Fore wings white below cell and beyond to subterminal line; inner margin iridescent light to dark gray; costal margin fuscous from base to medial line, then paler; some reddish scales above submedian antemedially; medial line fuscous slightly outcurved, irrorated with reddish brown from subcostal to submedian, closely followed by another straighter line with a dark shade from it below vein 2 to inner margin at subterminal; a short black streak on discocellular, followed by a dark point on vein 6, and below it a short outbent fuscous shade forming part of a nebulous postmedial line; subterminal line fuscous, sinuous, outwardly edged by a narrow white shade, followed by a fuscous shade, broad on costa narrowing to a point at vein 4, expanding slightly below vein 2; terminal black spots on interspaces. Hind wings semihyaline white faintly tinged with yellow; termen narrowly suffused with fuscous; cilia on both wings white with some dark mottling.

Expanse, 24 mm.

*Habitat.*—St. Jean, French Guiana.
*Type.*—Cat. No. 25658, U. S. N. M.

**Auradisa soteris**, new species.

*Male.*—Palpi testaceous with some white irrorations at base. Head and collar mottled vinaceous pink and buff white, the fringe around eyes, except behind, white. Thorax testacaceous with some fuscous gray shading behind medially and subdorsal tufts of broad white scales; patagia mignonette green. Abdomen above testaceous with white segmental lines, and lateral green scaling towards anal segment; underneath white, the two last segments green. Legs inwardly white, outwardly purplish irrorated with white; tarsi with white rings. Fore wings glossy mignonette green; a darker green oblique line from costa near base to inner margin near middle where it is preceded by some purplish scales; a small darker green spot on discocellular; outer line fine, yellowish olive, dentate and parallel with termen, followed on costa by a small white spot; a narrow terminal dark shade with minute white points on veins; cilia silky mouse gray. Hind wings white, the veins and narrow terminal shade drab; cilia drab gray tipped with white. Fore wings below white suffused with vinaceous drab except from submedian fold to inner margin; the veins with long dark streaks postmedially, on termen white; the outer line well indicated followed by white scaling on costa.

Expanse, 28 mm.

*Habitat.*—St. Jean, Maroni River, French Guiana.
*Type.*—Cat. No. 25773, U. S. N. M.

**Auradisa tresaina**, new species.

*Male.*—Palpi tea green. Collar and thorax yellowish citrine. Abdomen above olive lake, with fine black segmental lines, underneath pinkish buff. Legs light buff, the tarsi fuscous black with pale rings. Fore wings yellowish citrine; base of costa finely black; a few black subbasal scales on costa and inner margin; a faint whitish green medial line edged on either side with biscay green, preceded below submedian fold by a streak of velvety fuscous black scales; a fine black lunule on discocellular; outer line whitish green edged on inner side with biscay green, slightly outbent from costa to vein 5, outcurved to vein 2, and again outcurved to inner margin terminating in a black spot on cilia; apex suffused with dull citrine; a few black irrorations subterminally from veins 5 to 7; terminal black spots; cilia tinged with dull citrine towards apex. Hind wings semihyaline whitish slightly suffused with vinaceous buff; costa apex and termen fuscous, also the veins terminally.

Expanse, 22 mm.

*Habitat.*—St. Jean, Maroni River, French Guiana.

*Type.*—Cat. No. 25774, U. S. N. M.

A female in Collection Dognin has the black streak below discocellular shorter, only a black point on discocellular and no subterminal black irrorations; its expanse is 25 mm.

**Auradisa remberta,** new species.

*Male.*—Palpi light ochraceous buff laterally irrorated with tawny. Head, collar, patagia and abdomen above pinkish buff faintly tinged with green; thorax whitish; abdomen above with some darker irrorations, underneath white irrorated with drab. Fore wings light dull green yellow, probably brighter green when freshly caught; a few black irrorations, denser on basal third of inner margin; a small tawny spot at base of cell, and some similar antemedial irrorations; a few tawny scales on discocellular and a postmedial line from subcostal to vein 2 where it expands into a tawny spot extending to below submedian fold; a pale subterminal line defined by darker shading with dark streaks on veins before it; some tawny irrorations on veins 4 to 6 beyond postmedial line; an interrupted terminal dark line; cilia whitish green spotted with tawny towards apex. Hind wings white, the inner margin pale drab gray; costa and termen narrowly shaded with drab; cilia white shaded with drab and tawny at apex.

Expanse, 21 mm.

*Habitat.*—St. Jean, Maroni River, French Guiana.

*Type.*—Cat. No. 25775, U. S. N. M.

There is a specimen of this species in Collection Dognin.

**Auradisa corumba,** new species.

*Male.*—Palpi tilleul buff behind, the front light grayish olive with a few black scales. Head, collar, and thorax tilleul buff shaded with olive buff. Abdomen above light ochraceous buff with fine glack segmental lines on the last four segments, underneath white. Legs light buff irrorated with testaceous. Fore wings: from basal half of inner margin a tilleul buff shade extends obliquely to costa at outer line where it is irrorated with deep olive buff; basal half of costa and cell to near end deep olive buff, the end of cell being tilleul buff; a subbasal black point below cell, and a larger black point antemedially below cell; a black point at middle of cell followed by a fine black medial line, outcurved on costa, inangled on median, vertical to submedian, then outbent to inner margin; a black line on discocellular; outer space from middle of inner margin obliquely to costa near apex wood brown; outer line fuscous, slightly outcurved beyond cell, dentate from vein 6 to inner margin, somewhat outangled on submedian;

the outer margin irrorated with white; a terminal black line with white points on veins; cilia light vinaceous fawn tipped with white and with deep mouse gray spots opposite veins followed by a similar shade to tips. Hind wings white suffused with cupreous avellaneous becoming darker on termen; cilia with a light buff line at base followed by a fine dark line expanding and dark spotted towards apex, the outer half of cilia white. Fore wings below hazel, the inner margin broadly white; interspaces beyond cell streaked with whitish; a fine black line on discocellular; the dark outer line followed by a light buff spot on costa; a terminal black line. Hind wings below light cupreous buff, the costa finely and a spot at apex hazel; a dark point at upper angle of cell, and traces of a postmedial line.

The female usually has an antemedial black streak below the cell in place of the spot, and a small cluster of scales on submedian. An interesting female variety, taken by the Cornell University Expedition, has a large triangular fuscous spot from base of costa to medial line.

Expanse, 22 mm.

*Habitat.*—Corumba, Brazil.

*Cotype.*—No. 25790, U. S. N. M.

Type at Cornell University to which we are indebted for specimens; these were collected by Dr. W. T. M. Forbes, entomologist for the Cornell University Expedition.

The species is nearst *A. pagchryson = deras* Dyar.

**Tancoa,** new genus.

*Male.*—Palpi upcurved, slender, reaching well above head scaled behind with rather long hairs especially on third joint. Antennae fasciculate; a short tuft of hair from basal joint. Fore wings long and narrow, the outer margin oblique. Vein 3 from near lower angle of cell; 4 and 5 from lower angle or stalked; 6 from upper angle; 7, 8, 10 stalked, 9 coincident with 8; 11 from cell. Hind wings: vein 3 from near lower angle of cell; 4 and 5 stalked; 6 from upper angle; 7 anostomosing with 8. Anal segment of abdomen with long tufts. Hind tibiae hairy.

*Type of genus.*—*Deuterollyta calitas* Druce = *Pococera sphaeophora* Dyar.

Distinguished from all groups of Pococera by the absence of vein 9 on fore wing.

In *Tancoa* (Macalla) *attenualis* Hampson veins 4 and 5 on fore wing are very shortly stalked; in *Tancoa* (*Pococera*) *crinita* Schaus veins 4 and 5 on fore wing are well stalked.

*Tancoa goanta* Schaus differs in having aborted palpi, the antennae serrate and shortly fasciculate.

**Tancoa erlupha,** new species.

*Female.*—Palpi whitish buff irrorated with black, densely so beyond base and tufted above with long fine black hairs, the third joint naked, vinaceous pink. Head mottled fuscous and light buff. Collar medially and thorax steel color, the patagia buffy brown and fuscous. Abdomen above hair brown, underneath light buff. Fore wings: base whitish irrorated with benzo brown and fuscous; a fine lunular fuscous line inwardly edged with whitish and preceded by a small fuscous black spot in cell, a larger spot below cell, and one on inner margin separated by white lines; outer space benzo brown; a postmedial fuscous black shade from subcostal outangled at vein 4, inbent to vein 2, then less oblique to inner margin; a subterminal white line deeply outcurved, its inner edge crenulate from below vein 4; terminal black spots on interspaces; cilia tawny at apex, white at base and tips near tornus, divided by a fuscous line. Hind wings white; costal margin broadly, termen narrowly suffused with drab, also veins 2 to 5; cilia at apex tawny. Fore wings below fuscous, the costa and apex tawny. Hind wings below as above, but the costal margin tawny.

Expanse, 23 mm.

*Habitat.*—Cayenne, French Guiana.
*Type.*—Cat. No. 25778, U. S. N. M.

**Tancoa quiriguana,** new species.

*Male.*—Palpi tawny olive mixed with cinnamon buff, the third joint tipped with white hairs. Head whitish buff with some rufous hairs. Collar light pinkish cinnamon, also the tips of patagia; thorax behind whitish buff. Abdomen above whitish buff shaded with cinnamon buff. Fore wings with costa at base and below cell to inner margin, also antemedial line, pinkish buff, the base of cell white; antemedial line very indistinct whitish, vertical, wavy, defined from cell to inner margin by raised fuscous scales, sometimes absent or very faint; wing otherwise to subterminal line fuscous from below subcostal, also the apex; costa grayish with black irrorations, the costal edge cinnamon buff; veins beyond cell to subterminal darker streaked, but only a short streak on vein 2; subterminal white, deeply outcurved between veins 6 and 3, preceded between veins 3 and 1 by a diffuse whitish shade with pale olive gray shading on inter; spaces; inner margin on outer half olive gray; an interrupted terminal black line-cilia white with grayish spots. Hind wings semihyaline whitish, the veins brown; costal margin broadly, termen narrowly suffused with brown; cilia white divided by a dusky line.

Expanse, 23 mm.

*Habitat.*—Quirigua, Guatemala; also from Chejel.
*Type.*—Cat. No. 25660, U. S. N. M.
Nearest *Tancoa calitas* Druce=*Pococera sphaeophora* Dyar.

**Tancoa goanta,** new species.

*Male.*—Antennae with thick pectinations becoming serrate at tips, a moderate process from base. Head, collar, and thorax light mouse gray with some slightly darker tinged scales. Abdomen light mouse gray with white segmental lines. Legs white mottled with drab gray, the tarsi with drab rings. Fore wings light drab from base to near medial line; a velvety black, thick, antemedial line from subcostal to near submedian vein; medial line fine, black, preceded by a narrow white shade, the wing beyond white irrorated with drab; a fine black line on discocellular with drab shades at angles and above on costa; costal margin beyond to vein 6 suffused with drab; interspaces between veins 2 and 5 suffused with light drab, these veins being white; an outer series of black points or short streaks on veins, outcurved between veins 5 and 2; an interrupted dark terminal line; cilia white tipped with dark gray. Hind wings semihyaline white, the veins, inner margin, and termen narrowly drab; cilia white tipped with dark gray. Fore wings below drab, the veins darker. Hind wings below white, the veins dark streaked on termen only.

Expanse, 24 mm.

*Habitat.*—Quirigua, Guatemala.

*Type.*—Cat. No. 25657, U. S. N. M.

The fore wings are rather narrow and remind one of the species of Oneida.

**Wanda nocturna**, new species.

*Male.*—Antennae fasciculate with well developed process. Palpi upturned, straight, fuscous above, white with dark irrorations below. Vertex with some white scaling. Collar olive brown in front, white behind. Abdomen above fuscous black with fine whitish segmental lines, underside and legs whitish with brown and gray irrorations, the tarsi fuscous with pale rings. Fore wings silky deep mouse gray with whitish irrorations on costa and on terminal half from costa to vein 3; some white scaling on inner margin antemedially; an antemedial black point in cell, and small spot below cell; a trigonate black spot in cell medially, and thick dentate line below it to near inner margin; a fine postmedial dentate fuscous line, outcurved between veins 6 and 3; a faint subterminal fuscous shade; terminal fuscous spots on interspaces; cilia silvery light mouse gray. Hind wings dark cupreous; some metallic green shading on costal half, not reaching apex; terminal silvery irrorations between veins 5 and 2; cilia silvery white divided by a dark shade. Wings below silky fuscous, the inner margin of fore wings whitish.

Expanse, 24 mm.

*Habitat.*—St. Jean, French Guiana.

*Type.*—Cat. No. 25659, U. S. N. M.

In this species the fore wings are long and narrow, the hind wings broad. The Museum is indebted to Cornell University for a male and female of this species taken at Manaos on the Amazons.

**Wanda sadotha**, new species.

*Male.*—Palpi whitish shaded at base with snuff brown, the third joint fine, acute, with dark streaks. Frons whitish; vertex with brown scaling. Collar clothed with broad pallid brownish drab scales. Patagia pale brownish drab. Abdomen brownish drab above with pale segmental lines, underneath white. Legs pallid brownish drab. Fore wings light cinnamon drab, the medial area, base below cell, and costa whitish with black irrorations; an antemedial black point in cell, and a short streak below cell; a medial dark line from costa to inner margin, slightly incurved below discocellular; postmedial line black slightly bluntly outcurved from below vein 6 to vein 3, inbent to vein 2, angled and vertical to inner margin; the postmedial space somewhat brownish; termen shaded with gray and crossed by an indistinct dark subterminal shade; terminal black spots; cilia long, drab gray with a cinnamon drab shade along base. Hind wings whitish suffused with drab, veins 2 to 5 with blackish streaks.

Expanse, 14 mm.

*Habitat.*—St. Jean, Maroni River, French Guiana.

*Type.*—Cat. No. 25776, U. S. N. M.

The antennae are fasciculate and without process; the palpi upturned, slender.

Can be placed near *Wanda* (*Pococera*) *capnodon* Dyar.

**Wanda agatha**, new species.

*Male.*—Palpi vinaceous tawny, slightly whitish at base. Process long, tufted at and with dilated scales, vinaceous tawny. Head, frontal tufts, collar and thorax light pinkish cinnamon. Abdomen above white irrorated with fuscous, underneath white. Legs pale pinkish cinnamon irrorated with black. Fore wings: basal area ecru olive outwardly crossed by an antemedial obliquely incurved black line, and limited by a finer parallel black line from subcostal; some tawny scaling at base of cell, and a subbasal black point in cell; space beyond to termen white with a few drab irrorations, the costa and space above vein 3 to costa slightly suffused with ecru olive; a black line from costa across discocellular; subterminal line light brownish olive, defined by some black points from vein 5 to costa, finely dentate and slightly outcurved opposite cell; termen suffused with fuscous; an interrupted terminal black line; cilia fuscous at apex, partly white towards tornus. Hind wings whitish suffused with drab, the veins fuscous, also the termen and cilia partly.

Expanse, 18 mm.

*Habitat.*—Cayuga, Guatemala.

*Type.*—Cat. No. 25777, U. S. N. M.

**Calybitia**, new genus.

*Male.*—Palpi upturned, very long and slender reaching beyond middle of thorax, smoothly scaled, grooved and filled with long silky hairs. Antennae fasciculate; a long slender process from base, its upper side hairy. Fore wings: vein 3 from before angle of cell; 4 and 5 from angle; 6 from upper angle of cell; 7 to 10 stalked. Hind wings: vein 3 from lower angle; 4 and 5 stalked; 6 from upper angle; 7 and 8 anostomosing.

*Type of genus.*—*Calybitia picata* Schaus.

Distinguished from all sections of Pococera by the very long palpi and process.

**Calybitia picata**, new species.

*Male.*—Palpi deep mouse gray mottled with black; process from antennae white irrorated with black. Head and thorax white; collar cinnamon buff, white posteriorly; patagia irrorated with cinnamon buff. Abdomen above olive buff, the segments anteriorly shaded with grayish brown. Fore wings whitish overlaid with gray striae suffused on basal third and beyond on inner margin with ochreous; black striae on base of inner margin; a subbasal black streak below median and an antemedial black streak in cell; a black spot at end of cell; an oblique fascia of black irrorations from below vein 2 to inner margin, preceded by a dentate white line; a postmedial, dentate, fuscous line deeply outcurved, inbent at vein 3 and oblique to inner margin near tornus; a subterminal fuscous shade, suffusing with postmedial between veins 3 and submedian fold, extending on vein 5 to termen; a terminal black line with white spots at veins; some silvery white irrorations on outer part of wing, especially on gray portions; cilia mouse gray tipped with white and with a fine white line at base. Hind wings semihyaline smoky white suffused with golden buff, the termen shaded with fuscous. Fore wings below glossy fuscous, the inner margin white; a dark discal point and postmedial line. Hind wings below whiter; a discal lunule and postmedial line; termen broadly fuscous.

Expanse, 20 mm.

*Habitat.*—Cayuga, Guatemala.
*Type.*—Cat. No. 25647, U. S. N. M.

**Pococera limalis,** new species.

*Female.*—Palpi mouse gray irrorated with white, the third joint black tipped with white. Head, collar and thorax white with mouse gray and black irrorations and some pale grayish vinaceous shading on collar, patagia, and metathorax. Abdomen above whitish buff, shaded with wood brown forming transverse bands; underneath white with a few dark scales, the anal segment wood brown. Fore wings: base and medial space white finely irrorated with black and wood brown; antemedial and postmedial space wood brown thinly irrorated with black; an antemedial fuscous spot in cell, and an incurved line below cell, both consisting of raised fuscous scales tipped with black; a faint fine medial line with better defined spots on costa and inner margin, followed in cell by a small round black spot; black irrorations forming a vague postmedial line with points on veins 6 and 5, slightly inbent below 5; a sinuous whitish subterminal line preceded by fuscous points or streaks on veins; black streaks on veins 5 and 6 before termen; a terminal interrupted black line; cilia white at base followed by a broken deep mouse gray line, the tips iridescent white or gray. Hind wings semihyaline white, the veins finely wood brown; termen narrowly shaded with fuscous; cilia white partly divided by a dark line.

Expanse, 17 mm.

*Habitat.*—Lima, Peru.
*Cotype.*—Cat. No. 25678, U. S. N. M.

The type at Cornell University to which we are indebted for the cotype. This species was taken by Dr. W. T. M. Forbes on the Cornell University Expedition.

It is allied to *P. insularella* Ragonot.

**Pococera vedastella,** new species.

*Male.*—Palpi, head, collar, and thorax whitish irrorated with drab gray. Abdomen irrorated and shaded with clay color. Legs white irrorated with drab gray. Fore wings finely irrorated with drab gray; a small black spot at base of costa; a drab shade at base of inner margin; an antemedial almost vertical velvety black line, the space preceding it clear white from costa to submedian vein, a rather broad drab shade following it; a wavy fuscous medial line with a black point on discocellular; a finely wavy black postmedial line from vein 3 to inner margin; subterminal line drab, double, faintly sinuous, the outer line diverging near costa to apex; a terminal black line, interrupted at veins; cilia white divided by a smoky line. Hind wings white faintly suffused with light buff, the costal margin apex and termen narrowly suffused with drab; some dark postmedial streaks on veins 2 to 6. Fore wings below and costa of hind wings dark shaded.

Expanse, 14 mm.

*Habitat.*—Santiago, Cuba.
*Type.*—Cat. No. 25779, U. S. N. M.
Near *P. atramentalis* Lederer.

**Pococera baradata,** new species.

*Male.*—Palpi cinnamon buff, the third joint fuscous. Head cinnamon buff, the frons suffused with white. Collar cinnamon irrorated with black, posteriorly edged with light drab. Patagia light drab. Abdomen above fuscous with transverse whitish buff lines; anal tufts fuscous or silvery drab gray; underneath silvery white. Fore wings mostly drab; costa shaded with drab gray; a deep grayish olive streak at base below submedian; a thick antemedial fuscous streak with blunt ends below cell; a few black scales on inner margin to outer line; a fine upright white medial line on inner margin; traces of a dark postmedial shade on costa and dark spot on discocellular; some black irrorations on postmedial space; outer line black, slightly outbent, inset on vein 2, outwardly edged with whitish and light ochraceous buff; a fuscous black subterminal shade from costa ot vein 6 and a similar shade on termen at tornus; the termen medially shaded with light ochraceous buff; terminal black spots; cilia silvery mouse gray tipped with white. Hind wings semihyaline whitish, the veins fuscous, the termen shaded with fuscous black.

Expanse, 15 mm.

*Habitat.*—Port of Spain, Trinidad.
*Type.*—Cat. No. 25780, U. S. N. M.
Collected by A. Busck.
The antennae are ciliated and without process.

**Pococera lamonti,** new species.

*Male.*—Palpi ochraceous with a black spot in front near end of second joint. Head whitish buff. Collar ochraceous. Thorax vinaceous buff. Abdomen above with basal segment white, then buff irrorated with black and orange cinnamon on next two segments, the other segments black with pale segmental lines. Fore wings with basal half mostly light purplish gray, irrorated with some black scales; base from costa to vein 1 ochraceous cinnamon; inner margin at base with a deep mouse gray patch divided by a subbasal whitish line; an antemedial black point in cell and raised sayal brown scales below cell; an outcurved finely wavy black line, broader on costa and suffusing with a black bar on discocellular, outwardly edged with ochraceous, and closely followed by a similar parallel black line with some outbent black scaling from it at vein 2 to inner margin; outer portion of wing ochraceous with slightly darker shading; an outer fine blackish line, slightly excurved on costa, outcurved and dentate below vein 6, upbent towards cell below vein 3, acutely angled and outcurved to inner margin; some black marginal shading from vein 5 to costa; an interrupted terminal black line; cilia ochraceous buff, streaked with black towards apex. Hind wings semihyaline whitish, the termen shaded with brown; traces of a postmedial line defined by dark streaks on veins; cilia narrowly buff at base, then fuscous tipped with white except on black spots towards apex. Fore wings below brown, the cell suffused with black; inner margin broadly white; costa ochraceous cinnamon. Hind wings below whitish, the costa ochraceous with dark irrorations; a black discal spot; the postmedial streaks on veins better defined; the apex fuscous.

Expanse, 20 mm.

*Habitat.*—Cayuga, Guatemala; also French Guiana.
*Type.*—Cat. No. 25661, U. S. N. M.

**Pococera fabianalis**, new species.

*Male.*—Palpi and head ochraceous green, the vertex tinged with light vinaceous cinnamon. Collar and thorax light vinaceous cinnamon. Abdomen above vinaceous tawny with fine whitish segmental lines. Fore wings ochraceous green at base limited by a fine antemedial black line; base of costa and cell narrowly vinaceous cinnamon; some black scales on inner margin at base; antemedial line followed by a vinaceous tawny fascia with some black scales on its outer edge; space following below subcostal to inner margin white crossed by a fine medial black line on its proximal side and outwardly by a similar postmedial line, both wavy and starting from subcostal; a fine black line on discocellular; costal margin ochraceous green, also a broad space following the postmedial line; subterminal black shading parallel with termen, incurved below vein 2; termen ochraceous green from apex to vein 5, then silvery whitish gray to tornus, with short dark streaks on interspaces; terminal trigonate black spots becoming larger towards apex; cilia white suffused with roseate from vein 3 to apex and then spotted with black. Hind wings semihyaline white, the termen suffused with fuscous; cilia white with a fuscous line near base and two dark spots at apex. Hind wings below with traces of a postmedial line from costa.

Expanse, 19 mm.

*Habitat.*—St. Jean, French Guiana.
*Type.*—Cat. No. 25662, U. S. N. M.

**Lepidogma modana**, new species.

*Female.*—Palpi light buff, the third joint black except at base and tip. Collar and patagia light buff; a few black scales medially on collar. Thorax white with some black irrorations posteriorly. Abdomen light buff thickly irrorated with black and drab, less so below; fine black segmental lines. Fore wings light dull green yellow suffused with olive lake; some black scales on basal third of costa, below cell, and on inner margin; a black medial line from cell, expanding towards base on inner margin, followed by a finer line from costa, interrupted by subcostal and median, forming a spot with raised scales on discocellular; a faint black postmedial line, outwardly defined by white, incurved and sinuous below vein 3, well marked from vein 2 to inner margin; veins on termen somewhat tawny, the interspaces streaked with black except on costa; an interrupted terminal black line; cilia grayish olive at base with paler tips. Hind wings fuscous, slightly paler at base.

Expanse, 20 mm.

*Habitat.*—Chejal, Guatemala.

*Type.*—Cat. No. 25781, U. S. N. M.

Probably in fresh specimens the light buff and yellow greens of the description are different shades of green.

*Incarcha aporalis* Dyar = *Macalla argentilinea* Druce I cannot separate from Jocara; an allied species is *Jocara* (*Deuterollyta*) *ragonoti* Moschler from Porto Rico and Cuba. Several species of Jocara display considerable variation in venation. Some specimens of *Jocara elegans* Schaus, a beautiful and conspicuous species, could be placed in *Pococera* or *Stericta*, but the genitalia show them to be identical; it is common in Central America and its range extends to Venezuela.

*Jocara* (*Macalla*) *mira* Druce has been redescribed by Dognin as *Oxyalois ovifera*.

**Jocara ansberti,** new species.

*Male.*—Palpi brownish vinaceous mottled with buff scales. Antennal process brownish vinaceous in front, whitish behind; a few black scales laterally at base. Collar and patagia light vinaceous buff, the latter partly darker shaded; thorax white, the metathorax with some black scales and edged behind with vinaceous. Abdomen above whitish thickly irrorated with dark vinaceous, less so towards base; fine black segmental lines. Fore wings silvery pallid neutral gray with fine darker irrorations and striae; base vinaceous fawn limited by a subbasal black line, outbent from costa, slightly inangled at median; an antemedial black point below cell, and slightly beyond a black point in cell; a black point near end of cell; termen broadly silky drab with traces of a deeply dentate subterminal line; termen narrowly shaded with fuscous; cilia whitish buff divided by a smoky line. Hind wings white suffused with light drab, darker on termen; median and veins 2–5 finely dark with postmedial fuscous streaks, the streak on vein 2 preceded by an ochraceous buff shade. Wings below with short dark postmedial streaks on veins.

Expanse, 17 mm.

*Habitat.*—St. Jean, French Guiana.

*Type.*—Cat. No. 25782, U. S. N. M.

Near *J. elegans* Schaus, but the dark base is very small.

**Jocara thilloa,** new species.

*Male.*—Palpi silvery white with a few black and ochraceous buff irrorations. Head, collar, and thorax light buff shaded with pale pinkish buff; some cinnamon brown and black scales on collar medially; two velvety fuscous black tufts on thorax posteriorly. Abdomen above light buff with fine fuscous lines posteriorly on each segment; underneath white with pinkish buff irrorations and three black points with vinaceous scales across fourth segment. Legs buff, the tibiae streaked with vinaceous, the coxae white. Fore wings light buff, cinnamon brown shading on inner margin and at apex; an antemedial minute brown spot below cell and a black point in cell; a small black spot on costa medially; a small tuft of raised brown scales on discocellular; costa postmedially ochraceous and tawny; vein 2 from near cell to termen cinnamon brown; the other veins with dark streaks terminally, vein 6 dark near cell; two short oblique white streaks on inner margin near tornus; terminal black spots from vein 5 to apex; cilia brownish with large black spots, tipped with white from vein 4 to tornus. Hind wings white; a fine terminal cinnamon brown shade expanding at vein 2 to form a spot, with a subterminal point above it. Wings below white, the costal margins narrowly tawny.

Expanse, 19 mm.

*Habitat.*—Cayuga, Guatemala.
*Type.*—Cat. No. 25663, U. S. N. M.
A very distinct species.

**Jocara martinia**, new species.

*Female.*—Palpi whitish buff, the third joint streaked with fuscous. Head, collar, patagia and fore wings buffy citrine, probably bright green when fresh. Abdomen light drab shaded with green. Tarsi with brown rings. Fore wings: basal half of costa and cell with white shading; some black irrorations at base of inner margin, antemedially on costa and below cell to inner margin with a short streak of raised scales below cell; a black point in cell before discocellular; a faint postmedial line of black irrorations forming in one specimen a cluster of scales beyond cell and below vein 2, followed by a better defined black line, vertical to vein 6, then outcurved and dentate; terminal black lunules on interspaces and black points on base of cilia at veins; cilia vinaceous tipped with white. Hind wings drab; cilia white divided by a drab line. Fore wings below white on inner margin, otherwise suffused with drab except on costa; a darker postmedial line. Hind wings below whitish buff, the termen drab; a dark point at upper angle of cell and a distinct dark outcurved postmedial line.

Expanse, 19 mm.

*Habitat.*—Quirigua, Guatemala.
*Type.*—Cat. No. 25783, U. S. N. M.
Comes near *J. claudalis* Möschler.

**Jocara anastasia**, new species.

*Female.*—Palpi, head, collar and thorax buffy citrine, probably greener when fresh; below patagia buff tufts tipped with black upturned to dorsum. Abdomen buffy citrine irrorated with fuscous and black, with faint whitish segmental lines. Fore wings ochreous green, the inner margin to postmedial line broadly purple brown; black scaling forming an indistinct outbent line from base of costa to inner margin; some dark antemedial raised scales below cell; a slightly sinuous black medial line inwardly edged with whitish green; a fine, black, postmedial dentate line outbent from costa, slightly inbent below vein 5; a few black irrorations subterminally; a terminal black line interrupted by veins; cilia ochreous green. Hind wings light drab; a dark terminal line; a faint postmedial whitish line; cilia whitish buff with a drab line near base. Wings below tinged with vinaceous, the costal margins whitish buff with dark irrorations; a distinct postmedial line on both wings.

Expanse, 36 mm.

*Habitat.*—Volcan Sta. Maria, Guatemala.

*Type.*—Cat. No. 25664, U. S. N. M.

Veins 7 and 8 on hind wing anostomose very shortly and in a male they do not anostomose so the species could as well be placed in Stericta but the general maculation agrees better with several species of Jocara; it is nearest *J. translinea* Schaus.

**Jocara abachuma**, new species.

*Male.*—Palpi and antennal process yellow green, the process with lateral black irrorations. Collar and thorax white thickly mottled with yellow green. Abdomen above whitish buff with dark irrorations on terminal segments, probably light green when fresh. Fore wings citrine, the medial space to postmedial suffused with light vinaceous fawn; costal edge black on basal third; a black basal point below submedian; subbasal black points above subcostal and on median; antemedial indicated by a small brown spot on costa, a black spot below cell overspread with broad white and fuscous scales, and some black scales below submedian; black scaling along inner margin; traces of a medial line on costa and from cell to inner margin, twice lunular; a fine curved black line on discocellular; postmedial faintly indicated by some black scales outangled on vein 5, then incurved to submedian; an outer well marked dentate black line, outcurved beyond cell; a few black irrorations subterminally; terminal black spots on interspaces; cilia green at base tipped with whitish gray. Hind wings white; termen from apex to vein 2 grayish brown; a fine terminal fuscous line; subterminal dark streaks on veins. Fore wings below white, the apical area suffused with fuscous; orange vinaceous scaling above vein 7 from end of cell; costa white with a few dark irrorations. Hind wings below white, the costa with dark irrorations; a fuscous spot at upper angle of cell and a fine terminal line.

Expanse, 26 mm.

*Habitat.*—Castro, Parana.

*Type.*—Cat. No. 25665, U. S. N. M.

Very near *J. chlorisalis* Schaus, the female of which has fuscous hind wings, whereas the female of this species has the hind wings as in the male.

**Jocara conrana**, new species.

*Male.*—Body and fore wings evidently turtle green when fresh. Antennae thickly fringed with long cilia; the antennal process long and hairy. Collar dorsally mottled with broad black and white scales; a few similar scales on patagia; thorax with long lateral tufts, tipped with black scales, meeting over metathorax which is whitish irrorated with black; basal segment of abdomen white; abdomen underneath white irrorated with black. Tarsi outwardly with fuscous streaks. Fore wings with black markings; a spot at base of costa followed by a short streak; a subbasal point below cell; a faint streak along inner margin to near antemedial line; antemedial and medial spots on costa and parallel lines from median outcurved to vein 1 and again to inner margin, the antemedial line the heavier; a streak on discocellular; postmedial faint, minutely wavy, outcurved beyond cell, almost obsolete on inner margin; subterminal double, the inner line more heavily marked, minutely lunular dentate, inbent on costa, slightly outcurved, somewhat incurved below vein 2; terminal streaks almost forming a line; cilia with dark spots at veins. Hind wings thinly scaled, white; a terminal grayish olive line with similar suffusion at apex and on cilia.

Expanse, 32 mm.

*Habitat.*—Carabaya, Peru.
*Type.*—Cat. No. 25784, U. S. N. M.
Near *J. chlorisalis* Schs. and *J. abachuma* Schaus.

**Jocara aidana**, new species.

*Female.*—Palpi green scaled with black in front. Head and collar green. Thorax and patagia drab gray. Abdomen above buff brown with fuscous segmental lines. Fore wings: costal margin from base to medial line drab gray irrorated with black; cell and below to submedian fold, space to postmedial tufts, and termen olive green; inner margin to medial line drab gray with some avellaneous irrorations at base; a small tuft of scales in cell antemedially, and a small tuft below cell inset, both fuscous overlaid with drab scales; medial line fine, very indistinct, defined by black scales on costa and inner margin; a streak of black brown raised scales on discocellular, and a reddish brown streak of scales beyond cell, also a similar streak from base of vein 2 to inner margin; outer line fine, black, distinct, very slightly curved shaded on either side with whitish; a faint terminal darker line; cilia drab gray with small dark spots at veins. Hind wings brownish drab. Hind wings below whitish, the termen broadly dark shaded; a faint postmedial line.

Expanse, 23 mm.

*Habitat.*—São Paulo, S. E. Brazil; also from Castro, Parana.
*Type.*—Cat. No. 25667, U. S. N. M.

**Jocara luciana**, new species.

*Female.*—Palpi, collar and patagia yellow green; vertex mottled green and white; collar shaded in front with vinaceous. Abdomen above greenish with fuscous shading anteriorly on segments. Legs whitish, tarsi fuscous. Fore wings: costal margin to outer line, cell and a space below it yellow green, the median vein fringed medially with broad, green, downturned scales; some black scaling at base of median and inner margin; antemedial line fuscous and green on costa, outcurved, black below median, mostly covered by the green fringe, broad and diffuse to inner margin, closely followed by a fine sinuous black medial line; postmedial space whitish green along medial line from near cell to inner margin, above it yellow green with a black streak on discocellular; the space beyond to near termen suffused with fuscous; the outer line black, double, finely dentate, outbent from costa, curved and inbent below vein 5; termen green with black spots on interspaces; cilia drab tinged with vinaceous. Hind wings fuscous narrowly darker on termen. Hind wings below whitish; the costa with vinaceous irrorations; a dark discal spot; a curved postmedial line; termen broadly shaded with fuscous.

Expanse, 27 mm.

*Habitat.*—Quirigua, Guatemala.
*Type.*—Cat. No. 25666, U. S. N. M.

**Jocara theliana,** new species.

*Male.*—Palpi and antennal process mignonette green. Vertex and collar whitish shaded with lime green. Thorax with lateral white tufts behind, the patagia mottled with deep mouse gray. Abdomen dark olive gray with whitish segmental lines, the basal segment white. Fore wings mostly hellebore green; a large whitish space from inner margin to cell, not reaching base or postmedial line; a subbasal black line from costa, outbent below cell to a small velvety black antemedial spot below cell; a green antemedial spot on white space at inner margin, this spot containing some black scales; an outcurved line of tawny scales connecting the two antemedial spots; a fine medial line, bifurcating above median to blackish spots on costa, below median lunular across the white space to inner margin; a black spot containing a few white scales on discocellular; postmedial line fine, black, dentate, slightly outcurved shaded proximally with cameo brown, broadly so from vein 3 to inner margin; a narrow smoky black subterminal shade; a terminal black line interrupted at veins; cilia vinaceous fawn tipped with white. Hind wings whitish suffused with mouse gray becoming darker on termen; cilia vinaceous fawn. Fore wings below deep mouse gray, the costa neutral red; inner margin whitish; the outer markings of upper surface indicated.

Expanse, 17 mm.

*Habitat.*—Quirigua, Guatemala.
*Type.*—Cat. No. 25786, U. S. N. M.
Closely allied to *J. luciana* Schaus and possibly a diminutive male of that species.

**Jocara agathoa,** new species.

*Male.*—Palpi ochraceous at base, whitish irrorated with black towards tip. Head ochraceous. Collar ochraceous in front, purplish vinaceous behind. Thorax whitish buff crossed by a black bar posteriorly, the patagia deep livid brown. Abdomen above fuscous with buff and ochraceous segmental lines, the base white; underneath buff with brownish irrorations. Legs ochraceous buff, the tarsi almost entirely black. Fore wings saccardo's umber; costal margin and cell to medial line olive buff; short downturned hairs in cell and on median, the space below with striated scaling; a black spot on inner margin at base; medial line lunular, vertical from costa to submedian fold then slightly inbent, olive buff, edged outwardly with black, inwardly with black across cell, this black line being inbent below cell; from medial line on costa a black line crosses discocellular enclosing a small olive buff spot at end of cell; obliquely from discocellular to outer line at vein 3 the postmedial space to inner margin is suffused with fuscous except a faint narrow olive buff line adjoining the medial line; the outer line is outcurved from vein 7 to vein 2 and is defined by dentate fuscous edging, darkest on proximal side; small terminal black spots; cilia blackish gray. Hind wings suffused with avellaneous becoming fuscous on termen; traces of a postmedial line more distinct on the whitish underside. Fore wings below cupreous fuscous, the costa reddish; a silvery white streak in cell; the inner margin silvery white to beyond middle.

Expanse, 26 mm.

*Habitat.*—St. Laurent, French Guiana.
*Type.*—Cat. No. 25668, U. S. N. M.
Near *J. tenebrosa* Schaus.

**Jocara raymonda,** new species.

*Female.*—Palpi whitish buff, streaked above with brownish vinaceous. Head, collar and patagia mottled white and russet vinaceous, the thorax posteriorly white edged and crossed by black brown scales. Abdomen above white at base, then dark vinaceous brown with some fine, pale, segmental lines; underneath whitish with fine light russet vinaceous transverse lines. Fore wings russet vinaceous with a few black irrorations on basal half and a few white scales on inner margin; costal margin citron green from base to postmedial line, its extreme edge russet vinaceous between the medial and postmedial lines; a small cluster of black scales below cell near medial line which is slightly outcurved on costa, suffusing with a green patch on discocellular, from lower angle of cell vertical, lunular, white, followed by some green shading at submedian; postmedial line remote, green on costa then defined on either side by faint dark scaling, outcurved, minutely dentate and white from below vein 5 to inner margin; small terminal black spots; cilia pale russet vinaceous. Hind wings smoky fuscous. Hind wings below whitish suffused on costa and termen with russet vinaceous; a dark discal point and postmedial line defined by darker edging.

Expanse, 23 mm.

*Habitat.*—St. Jean, French Guiana.
*Type.*—Cat. No. 25670, U. S. N. M.
Allied to *J. tenebrosa* Schs.

**Jocara longistriga,** new species.

*Male.*—Palpi ochraceous in front with some fuscous scaling, laterally white, a fuscous streak behind. Head, collar and thorax mottled ochraceous buff and white. Abdomen ochraceous buff irrorated with dark brown laterally and on terminal segments. Fore wings mostly light mouse gray to outer line; cell darker shaded with some black irroration; subcostal irrorated with black and white expanding at outer line; a fuscous and black streak below cell with a long white streak below it edged posteriorly with fuscous and black, interrupted subbasally; inner margin slightly tinged with buff to medial line, with a short white streak on marginal edge; medial line defined by light brown partly edged outwardly with white scales, and with black brown raised scales from vein 2 to inner margin; on postmedial area vein 1 is white with black irrorations, veins 2 and 3 black towards outer line, vein 4 white from cell to outer line, vein 5 pinkish cinnamon and white at cell, then black to outer line, vein 6 white with black irrorations; outer line well marked, fuscous, deeply outcurved from costa to vein 2, then inbent and sinuous, outwardly edged with white and isabella color, widest at costa; termen snuff brown becoming darker at apex where it is irrorated with white; terminal fuscous spots and shading; cilia with a fine whitish line at base followed by dark tawny olive, tipped with dark gray, the two latter colors mixed with darker shading. Hind wings semihyaline whitish, the veins beyond cell with dark streaks; terminal space faintly shaded with brown forming a dark terminal line; cilia white shaded near base with cinnamon buff. Fore wings below fuscous, the inner margin at base whitish, the costa and apex purple red; outer line pale. Hind wings below white, the costal margin purple red; a dark discal spot and postmedial line from costa to vein 2.

Expanse, 21 mm.

*Habitat.*—Quirigua, Guatemala.
*Type.*—Cat. No. 25669, U. S. N. M.
Can be placed near *J. discalis* Hampson.

**Jocara maroa,** new species.

*Male.*—Antennae pectinated, densely covered below with flocculent cilia, the process fairly long, densely scaled with longer scales on upper edge, whitish irrorated below with dark olive buff. Collar and thorax whitish buff, the shoulders shaded with vinaceous fawn. Abdomen above pale pinkish buff with dorsal segmental black lines, underneath whitish. Fore wings vinaceous buff to near middle limited by a black medial line forming three lunules from costa to inner margin, and crossed by a double antemedial lunular black line from costa to median, all the lines interrupted in cell; some black scales at base of costa and a short black streak in base of cell; outer area whitish suffused with light drab; an outer drab line outcurved and dentate on veins beyond cell; the veins terminally streaked with drab and black streaks on interspaces, towards apex only subterminal; an interrupted terminal black line. Hind wings white at base and to near termen between veins 2 and 4; inner area buff white; costa and apex broadly, the termen narrowly suffused with drab; cilia white.

Expanse, 19 mm.

*Habitat.*—Baracoa, Cuba.
*Type.*—Cat. No. 25785, U. S. N. M.
The only Jocara I know with pectinated antennae.

**Jocara marchiana,** new species.

*Female.*—Palpi green becoming buff at tip. Head white mottled with cinnamon rufous. Collar buff in front, cinnamon rufous behind crossed by a line of black scales. Thorax mottled white, drab, and pale vinaceous. Abdomen above cinnamon drab with whitish buff segmental lines, the anal hairs cinnamon rufous; underneath white with ochraceous shading. Legs mostly buff white; tibiae shaded with ochraceous; terminal joints of tarsi black. Fore wings russet vinaceous, the costal margin and cell javel green; a fine dark streak below cell to a small antemedial cluster of raised black and white scales; a medial white line from cell, outcurved from fold to submedian and again to inner margin outwardly edged by some blackish scales; a black point on discocellular; outer line from below costa, outcurved, lunular dentate, black followed by greenish white scaling, becoming pure white from fold to inner margin; terminal black spots; cilia russet vinaceous with some black mottling at base. Hind wings semihyaline suffused with light cinnamon drab becoming fuscous on termen; cilia tipped with white at anal angle. Fore wings below fuscous, the inner margin white; costa yellow buff; apex and tips of veins russet vinaceous. Hind wings below white, the costa, apex broadly and termen narrowly suffused with russet vinaceous; a fine subterminal dark line.

Expanse, 26 mm.

*Habitat.*—Quirigua, Guatemala.

*Type.*—Cat. No. 25673, U. S. N. M.

Can be placed near *J. majuscula* Herrich-Schaeffer.

**Jocara cononalis**, new species.

*Male.*—Palpi and body greenish ochraceous; base of abdomen above whitish, the terminal segments with dark irrorations. Fore wings isabella color; costal margin to outer line greenish ochraceous; a whitish shade above submedian from base to beyond middle with some black scaling at base and subbasally on inner margin; a black streak below cell followed by a black point; some black scaling beyond extending on to veins 2 and 3, and below vein 4 near cell; a black point at end of cell and some black scales on vein 6 near cell; black scaling forming an indistinct double, lunular, medial line; some postmedial reddish scales forming an indistinct double dentate line; outer line, black, dentate, outcurved from vein 7 to vein 2; an interrupted terminal black line; cilia shaded with gray. Hind wings semihyaline whitish suffused with fuscous except at base, darkest on termen. Wings below with the costal margin shaded with rufous, the hind wings with a dark streak on discocellular; traces of a subterminal line from costa and the apex fuscous.

Expanse, 21mm.

*Habitat.*—Cayuga, Guatemala.

*Type.*—Cat. No. 25671, U. S. N. M.

Nearest *J. nigripuncta* Schaus, and also allied to *J. ferrifusalis* Hampson = *obscuralis* Schaus.

**Jocara vimina**, new species.

*Male.*—Palpi mouse gray in front with some fuscous scales, laterally white; a black band across second joint near middle. Head, collar and thorax light quaker drab. Abdomen above yellowish white, the terminal segments with dark brown and black scaling. Body below yellowish white, the legs pale gray, the fore coxae with a large black spot. Fore wings: the costal half light mouse gray irrorated with black; a streak on median and submedian dark mouse gray, the space between as on costa; an antemedial black point below cell; a medial line from subcostal to inner margin, slightly outcurved, isabella color with a few black scales on it; space beyond between veins 6 and 1 deep mouse gray, the veins irrorated with black and white; some black scales on discocellular mottled with isabella color scales, these latter extending on vein 7 and there are a few on costa subterminally; outer line faint, deeply outcurved, indicated by short black streaks on veins, and by some whitish streaks and shading from vein 3 to inner margin; an interrupted terminal fuscous line; cilia mottled mouse gray and black. Hind wings semihyaline white, veins mostly buff white, but with dark streaks towards apex, the costal margin being suffused with fuscous, the termen very narrowly so; cilia tipped with white. Wings below with apex of fore wings and costa of hind wings reddish.

Expanse, 22 mm.

*Habitat.*—Cayuga, Guatemala.
*Type.*—Cat. No. 25672, U. S. N. M.

**Jocara crinitalis**, new species.

*Female.*—Palpi white with a few dark scales and black rings at base and tip of second joint. Head white, collar white shaded with vinaceous buff in front. Thorax white with a black transverse line posteriorly, the patagia mottled with vinaceous buff. Abdomen white, dorsally shaded beyond second segment with olive buff and brown. Legs white, the tarsi with black rings. Fore wings silvery white with some vinaceous buff irrorations; an outbent subbasal black line from costa to submedian; a fine broken antemedial black line, followed in cell by a black spot, outcurved below cell partly consisting of raised fuscous scales, preceded and followed by vinaceous buff shading; a fine sinuous black medial line; a bar of raised black scales at end of cell and a black spot above it on costa from which the fine black postmedial line is outbent and irregularly dentate and curved, below vein 5 incurved with raised black scales from vein 3 to inner margin, followed by a vinaceous buff shade to outer line; outer line fuscous, double, incurved below vein 3 and partly filled in with white and partly with vinaceous buff, the distal line macular towards apex; large semilunar terminal black spots almost united; cilia white shaded with vinaceous buff at base. Hind wings buff white, the termen with darker suffusion and a dark terminal line.

Expanse, 20 mm.

*Habitat.*—Cayuga, Guatemala.
*Type.*—Cat. No. 25674, U. S. N. M.

Very distinct, somewhat reminiscent of the whitish species of Tetralopha.

**Macalla finstanalis**, new species.

*Male.*—Palpi cinnamon buff, the base white. Head white, the tuft behind antenna cinnamon buff. Collar white edged in front with fuscous. Thorax white mottled with cinnamon buff. Abdomen orange cinnamon with segmental white bands. Fore wings aniline yellow to postmedial line; a black streak on inner margin near base; a subbasal black point below median followed by a large semihyaline iridescent white spot; smaller spots between veins 2 and 4 close to cell, a large spot beyond cell, and a small spot above vein 6; a fuscous antemedial line inbent below vein 1; a black spot on discocellular preceded by a smaller spot below subcostal with a cinnamon streak above it on costa; postmedial line black, outbent from costa, outcurved between veins 4 and 2, then dentate and vertical to inner margin; terminal space purplish cupreous; terminal dark spots on interspaces; cilia iridescent gray and fuscous. Hind wings semihyaline white, the inner margin fuscous; termen broadly fuscous at apex and on vein 2, narrowly fuscous below vein 2. Wings below white; fore wings with the costa yellowish; a fuscous streak in cell and bar on discocellular; the termen broadly fuscous. Hind wings below with the costa broadly yellowish to beyond middle, the termen as above, the inner margin grayish.

Expanse, 30 mm.

*Habitat.*—Quirigua, Guatemala.

*Type.*—Cat. No. 25675, U. S. N. M.

Near *M. pallidomedia* Dyar which has no process from base of antennae.

**Macalla glastianalis,** new species.

*Male.*—Palpi mouse gray, a whitish gray shade behind. Antennal process mouse gray. Collar and thorax pallid mouse gray. Abdomen above pale ochraceous buff with minute brown irrorations and black segmental lines; underneath whitish buff with some brown irrorations. Fore tibiae white irrorated with black, mid and hind tibiae buff; fore tarsi black with white rings; other tarsi brown with white rings. Fore wings: base to medial line mouse gray suffused with sayal brown on antemedial space above and below submedian; a black streak below median followed by some broad pearl gray downturned scales; some black scaling on costa forming a diffuse shade, outbent and suffusing with medial line, and a similar shade from medial above vein 1 curved towards base of inner margin; medial line from subcostal, outbent, thick, consisting of black and dark brown scales; terminal half pallid mouse gray with a few drab irrorations; a black brown streak from costa across discocellular; black streaks on veins 3 and 5 to outer line; outer line fine, black, deeply outcurved between veins 6 and 3, incurved to submedian fold, and again outcurved; apex black shaded; a terminal black line with white points on veins; cilia white. Hind wings white; minute brown subterminal points on veins; a narrow terminal brown line; cilia white. Wings underneath white, the costal margin and apex of fore wings light mouse gray.

Expanse, 20 mm.

*Habitat.*—Oaxaca, Mexico.

*Type.*—Cat. No. 25676, U. S. N. M.

**Macalla furseyalis,** new species.

*Male.*—Palpi white with a few dark scales. Head, collar and thorax white with some pale yellow suffusions, the neck fuscous. Abdomen whitish with transverse fuscous bands dorsally. Fore wings: the base mostly antimony yellow, irrorated with fuscous and limited by a fuscous line; medial space semihyaline white with some antimony yellow irrorations; a fuscous spot on discocellular; terminal third fuscous its inner edge dentate; cilia dark gray with a whitish line at base. Hind wings: basal half semihyaline white; outer half silky fuscous, darkest towards apex. Wings below without the basal marking, the hind wing with the costa to beyond middle creamy white, the marginal shading narrowing to a point at anal angle.

Expanse, 18 mm.

*Habitat.*—Quirigua, Guatemala.

*Type.*—Cat. No. 25677, U. S. N. M.

Related to *M. ochrotalis* Hampson, which has no black at base of fore wing, and still more similar to *Macalla mesoleucalis* Hampson, described as a Pococera.

**Macalla pegalis,** new species.

*Male.*—Palpi vinaceous cinnamon, first joint fringed below with white, the second joint with a lateral triangular white spot, the third joint tipped with fuscous. No long process from base of antenna. Head white shaded with light vinaceous cinnamon; vertex with cluster of scales reaching over collar in front. Collar and thorax light pinkish cinnamon, with a rufous central spot on collar. Abdomen light pinkish cinnamon with transverse dark shading above. Fore wings pinkish buff shaded with pinkish cinnamon in and below cell; base of inner margin darker, irrorated with black scales; a rufous shade and black streak on costa about middle; a short black streak on submedian fold antemedially, and a small cluster of scales below vein 1; a medial dark line from fold to inner margin with a black streak from it towards base on vein 1, closely followed by a parallel line forming part of the postmedial; postmedial consisting of an oblique black and rufous series of scales extending to near subterminal above vein 4, incurved from the same line below vein 2; some reddish scaling at end of cell below subcostal, on median towards end of cell, and on interspaces from vein 2 to vein 5; a double subterminal dentate black line filled in with whitish buff, slightly outcurved from costa to vein 2, then incurved and again outcurved; termen shaded with purplish fuscous from vein 4 to apex, below vein 4 grayish; terminal black spots almost forming a line; cilia pinkish buff with black spots. Hind wings semihyaline smoky white, darker shaded along termen, broadly towards apex. Fore wings below smoky, the costa vinaceous cinnamon, the inner margin broadly white; a fuscous subterminal line. Hind wings below as above, the costa vinaceous cinnamon; a subterminal fuscous line on costa.

Expanse, 27 mm.

*Habitat.*—Cayuga, Guatemala.

*Type.*—Cat. No. 25679, U. S. N. M.

Near *M. marginata* Schaus.

**Macalla valstana,** new species.

*Female.*—Palpi wood brown, irrorated in front with whitish gray. Head, collar and patagia buffy olive, the thorax whitish mottled with buffy olive. Abdomen mouse gray with brownish segmental lines; a fuscous dorsal tuft at base, underneath buff with transverse drab lines. Fore tarsi brownish olive with ochraceous rings. Fore wings isabella color irrorated with olive ochre; a subbasal black point in cell; antemedial line black and olive, inbent to a black point below cell, then outcurved to inner margin, followed in cell by a black point; a black spot on discocellular; postmedial coarse, black, outbent on costa, finer, outcurved and dentate between veins 5 and 3, inset at vein 3 and somewhat macular the spot on submedian fold inset; some subterminal darker shading; a thick black terminal macular line; cilia cupreous olive. Hind wings semihyaline white, the termen broadly fuscous at apex narrowing towards anal angle; buff hairs on inner margin. Fore wings below to postmedial white, the cell filled in with light brownish olive scales, the costa buff; termen from postmedial fuscous. Hind wings below as above, the costa to beyond middle broadly buff.

Expanse, 37 mm.

*Habitat.*—Yahuarmayo, Peru.

*Type.*—Cat. No. 25681, U. S. N. M.

This species looks very much like *Homura nocturnalis* Lederer, which I think is a Macalla, though Hampson placed it in Locastra, but he could not have known Lederer's species as he made *H. trisulcata* Warren a synonym of it. *H. trisulcata* is quite a different species and has priority over *Locastra viriditincta* Schaus, the latter having been described from a very fresh and heavily marked specimen.

**Macalla afflicta**, new species.

*Male.*—Palpi laterally vinaceous rufous, slightly mottled with black near tip. Vertex vinaceous cinnamon with some white mottling; collar similar with considerable black scaling. Thorax mottled in the three colors, the white predominating. Abdomen above white at base, then olive gray, with brown shading on terminal half, but varying considerably in different specimens. Fore wings mostly silvery whitish gray; a basal darker line outbent on inner margin; subbasal space whiter in cell and on inner margin, with broad scales tipped with salmon buff; whiter scales forming a fine, vertical, antemedial line; a medial brown line slightly outcurved mottled with fuscous below cell to inner margin; a brown spot on costa above discocellular, from it a fine black line curved around end of cell, broader below cell, shaded with brown almost suffusing with medial line, outbent on inner margin; sometimes these two lines are clearer, without the brown shading; subterminal line double, slightly outbent on costa and finely dentate, inbent on vein 2 and downturned to inner margin, preceded from costa to vein 4 by a brown shade, and followed by a similar shade to termen and apex; a brown and fuscous spot before the subterminal from vein 2 to below vein 1; terminal fuscous spots on interspaces; cilia buff white with fuscous spots at veins. Hind wings semihyaline yellowish white; termen fuscous from apex narrowing to a line below vein 2. Fore wing below silky fuscous, the inner margin broadly whitish; a darker subterminal shade; a terminal black line; cilia white with black spots; costa shaded with rufous. Hind wings below whiter; a fuscous shade at apex; the costa shaded with rufous; traces of a subterminal punctiform line to vein 2.

Expanse, 22 mm.

*Habitat.*—Quirigua and Cayuga, Guatemala.
*Type.*—Cat. No. 25680, U. S. N. M.
Near *M. rufilinea* Druce = *M. contortilinealis* Dognin.

**Chloropaschia mennusalis**, new species.

*Male.*—Palpi mottled brown and white, the third joint black. Head and collar brown and white, the latter with a few black scales. Thorax mottled white and drab with some black scales. Abdomen above ochraceous buff, underneath white. Throat black; fore coxae white with a black spot at throat; fore tibiae vinaceous; fore tarsi fuscous with fine buff rings. Fore wings mostly white irrorated with drab gray, cinnamon, and black scales; basal half of costa suffused with light vinaceous cinnamon; small clusters of black scales form an indistinct antemedial line slightly incurved at submedian fold; a fine black streak on discocellular; faint traces of a fine, double, postmedial line, sinuous beyond cell, inbent at vein 2; the outer line is the most conspicuous character being velvety brown black well marked from costa to vein 3, slightly oblique and almost straight, inwardly shaded with mikado brown, below vein 3 finer, slightly incurved below submedian fold, and is followed closely by a fine indistinct line the space between pinkish brown towards costa, white from vein 3 to inner margin; apical space mikado brown mixed with gray on termen; terminal black spots; cilia vinaceous cinnamon, paler towards tornus and spotted with black. Hind wings semihyaline tinged with pale cinnamon pink; costal margin with opalescent greenish scaling, the termen narrowly fuscous; cilia drab gray tipped with white. Fore wings below cupreous ferruginous, the inner margin whitish. Hind wings below buff white, the costa ferruginous, the apex fuscous.

Expanse, 27 mm.

*Habitat.*—St. Jean, French Guiana.
*Type.*—Cat. No. 25682, U. S. N. M.
Near *C. canities* Schaus.

**Chloropaschia brithvalda**, new species.

*Male.*—Palpi cinnamon, the third joint black. Frons pale pinkish cinnamon; vertex and collar cinnamon; patagia whitish shaded with pale drab gray, and with a few black tipped scales; abdomen buff gray with some darker shading and pale segmental lines; legs whitish gray, the fore tibiae streaked with cinnamon, the tarsi black with white rings; throat cinnamon. Fore wings shaded on basal half with gray; some cinnamon at base; antemedial line macular consisting of black and white raised scales forming an incurved line below cell; a medial cinnamon spot on costa and incurved line from lower angle of cell; some black scales on discocellular; postmedial line cinnamon, close to medial from vein 3, followed on veins by some white scaling and dentate black lines; a double outer line, cinnamon, filled in partly with white and with some black marks on veins, forming streaks towards termen on veins 5 to 7; termen gray suffused with cinnamon, the veins irrorated black and white; terminal black spots; cilia buff at base with black spots, tips white, but darker shaded at spots. Hind wings semihyaline tinged with pinkish, the costa and termen smoky; faint subterminal streaks on veins, forming a fuscous and white spot on vein 2; some terminal white points at veins; cilia drab tipped with white.

Expanse, 28 mm.

*Habitat.*—Carabaya, Peru.
*Type.*—Cat. No. 25683, U. S. N. M.
Probably the cinnamon color is green in fresh specimens.
Near *C. thermalis* Hampson.

**Chloropaschia letharda,** new species.

*Female.*—Palpi dark olive buff, a black spot at end of second joint. Head olive buff, the frons shaded with white, the throat black. Collar, thorax and abdomen olive buff, the patagia with some vinaceous buff scales. Body below whitish, some dark irrorations on venter. Legs outwardly deep olive buff. Fore wings dark olive buff, a broad streak through cell, one below cell, and one on inner margin vinaceous fawn mottled with pale vinaceous fawn; a streak of black irrorations on costal margin from base to above discocellular; faint traces of antemedial black scaling; medial line well defined only on costa, median and submedian, outbent on costa, outcurved in cell, inangled on median, outcurved to submedian where it is inbent along vein to near antemedial; a black spot at upper and lower angle of cell followed by a russet shade between veins 5 and 6, and a similar shade inbent from vein 4 to submedian, these shades limited by some black points and irrorations forming the postmedial line which is deeply outcurved beyond cell, touching on vein 6 a larger black point, one of a slightly outcurved series from costa to inner margin; a faint parallel subterminal lighter russet line with black irrorations on veins; terminal velvety black spots; cilia vinaceous tipped with white with a medial line of black points. Hind wings semihyaline white on basal half, light grayish vinaceous on outer half, the termen narrowly drab with a faint subterminal line from costa to vein 2; cilia drab with a fine buff line at base, and broad white tips.

Expanse, 29 mm.

*Habitat.*—Cabima, Panama.
*Type.*—Cat. No. 25787, U. S. N. M.
Comes nearest *C. thermalis* Hampson.
The fore wings are rather narrow in proportion to their length.
*Epipaschia consimilis* Dognin is a Chloropaschia.

**Stericta nolasca,** new species.

*Male.*—Palpi buff white shaded in front with brown. Head and body whitish buff, the abdomen dorsally with some drab scaling. Fore wings whitish buff, the costal and inner margins ochraceous buff, probably light green when fresh; some fuscous scaling antemedially on costa and in cell; medial space suffused with drab limited by some fuscous scaling beyond cell and from vein 3 at cell to inner margin; a fuscous bar on discocellular and fuscous scaling above it on costa; an outer cinnamon drab line slightly outcurved from subcostal to vein 2, then sinuous; termen broadly cinnamon drab with darker shading on veins, expanding into spots at tips; cilia avellaneous. Hind wings buff white, the termen darker;

a faint postmedial line. Fore wings below suffuse with drab, the inner margin white; the outer line distinct. Hind wings below as above; cilia buff white.

Expanse, 20 mm.

*Habitat.*—Orizaba, Mexico.
*Type.*—Cat. No. 25684, U. S. N. M.

**Stericta canutusa**, new species.

*Male.*—Palpi whitish buff. Head whitish and buff pink. Thorax fuscous; patagia and collar buff pink. Abdomen above whitish irrorated with black and buff pink; underneath buff. Thorax below and throat white. Fore wings drab gray; a black basal spot on costa; a subbasal black point below cell; a streak of black scales along base of inner margin; an antemedial black spot on costa and a long thick streak below submedian, outwardly joined by some dark curved scaling, closely followed by the black outcurved medial line; base of costal margin whitish buff; costa beyond medial line olive brown; faint traces of a postmedial brownish shade; subterminal line brown streaked with black, excurved on costa followed by a white spot, outcurved to close to termen between veins 5 and 3, then incurved, barely indicated, edged by a white line at inner margin; a black spot follows the line between veins 6 and 9; some black on termen. Hind wings white, the costa and apex suffused with smoky brown, and the termen with narrow suffusions; cilia white divided by a smoky line.

Expanse, 18 mm.

*Habitat.*—St. Jean, French Guiana.
*Type.*—Cat. No. 25685, U. S. N. M.
The fore wings are rather narrow, the termen obliquely curved.

**Stericta maidoa**, new species.

*Female.*—Palpi ferruginous, the second joint whitish at base and tip. Head and collar ferruginous. Thorax salmon buff, the patagia green on shoulders, tipped with black and mouse gray. Abdomen hazel, with raised dark dorsal tufts beyond middle; underneath buff irrorated with black. Tibiae mostly ferruginous; fore tarsi ferruginous at base, then black with white rings. Fore wings cosse green; base of inner margin ferruginous; a black basal spot; a subbasal black line on costa; antemedial line black, double, outbent on costa, inversely curved below cell, the outer line followed on inner margin by a partly black space its upper edge curved to vein 2; some black scales on discocellular; postmedial line velvety black brown, minutely lunular, outbent from costa to vein 3 then inbent, macular, closely followed by the more heavily marked blacker subterminal which nearly touches termen at vein 4 is downbent to vein 3, then finer and macular; the large apical space is cinnamon rufous shading to salmon buff on termen; small terminal black spots; cilia hazel with black and buff mottling, tipped with green at apex and tornus. Hind wings prout's brown, the veins and termen black brown; a terminal white point at vein 2. Wings below fuscous, the costal and terminal margins ferruginous; a yellow streak on costa of fore wings and some yellow spots towards apex; a postmedial black line better defined on hind wing.

Expanse, 29 mm.

*Habitat.*—St. Jean, French Guiana.

*Type.*—Cat. No. 25686, U. S. N. M.

On fore wing vein 9 is stalked with 8 before 7.

**Stericta teffealis,** new species.

*Male.*—Palpi avellaneous shaded behind with buffy brown. Head and the frons mottled with white. Thorax tilleul buff, collar vinaceous buff, mottled with mouse gray and white. Abdomen above white with warm buff transverse bands, underneath white. Legs white with some dark scaling, the tarsi avellaneous; throat deep mouse gray. Fore wings avellaneous, the markings chiefly fuscous; a streak on basal half of costa and one in cell faintly whitish gray; an antemedial black point in cell, and a short fine streak below cell of raised black scales; an outcurved double medial line, the inner line rather broad; a line of raised black and fuscous scales on discocellular; small postmedial spots on veins 4, 5, and on submedian fold; an outer macular line, slightly outcurved from vein 6 and closely followed by a subterminal continuous line; terminal round black spots on interspaces; cilia whitish crossed by a macular brown line. Hind wings silvery white; veins 2–7 streaked with wood brown terminally, and a narrow dark shade at apex; a very fine terminal dark line; cilia white with dark mottling at veins. Fore wings below suffused with fuscous, the inner margin white, the costa light buff. Hind wings below white; a few dark scales and subterminal spot on costa; apex narrowly fuscous.

Expanse, 29 mm.

*Habitat.*—Mouth Rio Teffé, Brazil.

*Cotype.*—Cat. No 25791, U. S. N. M.

The type at Cornell University to which we are indebted for a specimen.

The antennae are bipectinated. Vein 10 is from the cell and apparently anostomoses with 9 to form a long narrow areole.

**Stericta alnotha,** new species.

*Male.*—Palpi whitish shaded with ochraceous buff, the third joint fuscous. Antennal process pale ochraceous buff. Collar white overlaid with broad salmon buff scales. Thorax and patagia white with a few scattered black scales. Abdomen above whitish irrorated with vinaceous except on basal segment; fine transverse segmental lines; underneath white. Legs white, the tarsi with fuscous rings. Fore wings cream color with a faint greenish tinge; a black point on vein 1 at base; subbasal black spots on costa and below cell, also a streak of irrorations below vein 1; an oblique white fascia limited by the antemedial black line which is very fine, outcurved from costa to near vein 1, followed in cell by a black point; medial line more heavily marked from a black spot on costa, incurved, almost touching antemedial below cell, then straight and outbent to inner margin, followed below cell by black irrorations; a fine black line on discocellular; some black irrorations on veins 2–5 near cell; outer line obliquely incurved from costa to below vein 5 near termen, then inbent, lunular, with projecting lines on distal side; a subterminal fuscous spot from costa to vein 7, and salmon color spots on interspaces, forming a large spot at tornus; a fine terminal black line; cilia white spotted with drab. Hind wings white; costa, apex and termen narrowly suffused with cinnamon drab; veins terminally dark streaked with subterminal points.

Expanse, 21 mm.

*Habitat.*—Porto Rico.
*Type.*—Cat. No. 25788, U. S. N. M.
Fresh specimens are probably greener.

**Stericta emerantia,** new species.

*Female.*—Palpi cinnamon buff with some black scaling in front and a white shade below. Head, collar and thorax light pinkish cinnamon, the collar shaded in front with vinaceous cinnamon. Abdomen cinnamon buff, a whitish buff dorsal shade at base, the terminal segments whitish buff irrorated with black. Fore legs and tarsi vinaceous fawn, the tarsi with whitish rings. Fore wings: basal half cinnamon buff limited by a series of black scales, inangled in cell; terminal half white thickly irrorated with black with grayish shadings on either side of postmedial line from veins 2 to 7; postmedial black, outcurved between veins 6 and 3 with projecting streaks on veins 3 to 5; traces of a subterminal line with streaks on veins 3 to 5; termen narrowly fuscous; cilia white with black spots. Hind wings semihyaline white faintly tinged with pale pinkish cinnamon; costal margin cinnamon buff; some slight fuscous shading on termen; cilia white with some black tipped hairs near apex. Wings below with costal margins vinaceous cinnamon, the fore wings suffused with black except from cell and vein 2 to inner margin.

Expanse, 28 mm.

*Habitat.*—Carabaya, Peru.
*Type.*—Cat. No. 25687, U. S. N. M.

**Stericta ildefonsa,** new species.

*Female.*—Palpi whitish buff, shaded behind with avellaneous, some fuscous scaling in front at end of second joint. Head white. Collar and thorax white shaded with pale cinnamon pink. Abdomen above cinnamon buff; underneath and legs whitish buff, the fore and hind tarsi with large black spots. Forewings: the basal half cinnamon buff with whitish shading below cell and on inner margin, limited by an outbent line of raised black and fuscous scales from subcostal to submedian; the buff color extends a bit further above subcostal; an antemedial small cluster of black scales below cell; terminal half of wing drab thickly irrorated with white; some raised brown scales on discocellular; postmedial line outcurved, dentate, defined by some whitish buff scaling on its outer edge; traces of a subterminal line parallel with postmedial, both of ground color with fewer irrorations; a terminal dark line; cilia mottled dark smoky gray and whitish buff. Hind wings semihyaline white suffused with pale pink; costa, apex and termen narrowly silky fuscous; cilia gray brown tipped with white.

Fore wings below suffused with fuscous, the costa and apex tinged with vinaceous, the inner margin whitish. Hind wings below white, the costa and apex vinaceous; a small discal spot.

Expanse, 22 mm.

*Habitat.*—Cayuga, Guatemala.

*Type.*—Cat. No. 25688, U. S. N. M.

Very close to *S. emerantia* Schaus.

## ERRATA.

Note.—The following errors should be corrected in part 6 of this volume:

On page 132 *Argyria tunuistrigella* should be *tenuistrigella*.

On page 140 the end of the description of the new genus *Xubida* should be: Hind wing with vein 3 from before angle, 4 and 5 from angle or stalked; 6 and 7 from upper angle.

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## THE IDENTITY OF ICHNEUMON COCCINELLAE SCHRANK (HYM.).

By R. A. Cushman, *Bureau of Entomology*.

In 1802 Schrank described a parasite of an adult coccinellid beetle, of which description the following is a free translation:

"Lady-bird killer 2155. Deep black; eyes green; head, front legs, and apex of the petiolate abdomen mussel-brown. ♀

*Ichneumon coccinellae.*

*Habitat:* in the already matured lady-bird.

Observations. The larva emerges from an adult lady-bird through the anus, makes a loose irregular web at the point on the leaf where it emerged, and there assumes the pupal stage. After about three weeks the parasite emerges. The one that I saw was a female, and its ovipositor was half as long as the petiolate egg-shaped abdomen."

The only subsequent reference to this species under Schrank's name is in Dalla Torre's catalog, where it is allowed to stand under *Ichneumon* with an expression of doubt as to its properly belonging there.

In 1811 Nees described his *Bracon terminatus*, later (1834) erecting for it and one other species the genus *Perilitus*. Nees' species was subsequently transferred by Wesmael (1835) to his genus *Microctonus*, and Foerster (1862) erected for it the genus *Dinocampus*. In 1872 Cresson described his *Euphorus sculptus* and in 1889 Riley his *Perilitus americanus*. Timberlake (1918) called attention to the synonymy of the two American species with *terminatus*.

Schrank's description of the adult insect together with his observations on the biology leave, I think, no room for doubt that *terminatus* Nees is the same insect.

The synonymy is therefore as follows:

**Dinocampus coccinellae** (Schrank).

*Ichneumon coccinellae* Schrank, Fauna Boica, vol. 2, part 2, 1802, p. 310, ♀.

*Bracon terminatus* Nees, Mag. Ges. Naturf. Fr. Berlin, vol. 5, 1811, p. 26, ♀.

*Perilitus terminatus* Nees, Ichn. Affin. Monog., vol. 1, 1834, p. 30, ♀ ♂.

*Microctonus terminatus* Wesmael, Nouv. Mem. Acad. Sc. Bruxelles, vol. 9, 1835, p. 63, ♀.

*Dinocampus terminatus* Foerster, Verh. Naturh. Ver. Preuss. Rheinl., vol. 19, 1862, p. 252.

*Euphorus sculptus* Cresson, Can. Ent., vol. 4, 1872, p. 227, ♀.

*Perilitus americanus* Riley, Insect Life, vol. 1, 1889, p. 338, ♀.

*Perilitus terminatus* Dalla Torre, Cat. Hym., vol. 4, Braconidae, 1898, p. 122.

*Ichneumon coccinellae* Dalla Torre, loc. cit., vol. 3, part 2, 1902, p. 875.

*Dinocampus terminatus* Timberlake, Proc. Hawaiian Ent. Soc., vol. 3, 1918, p. 401.

*Actual date of publication, December 30, 1922.*

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