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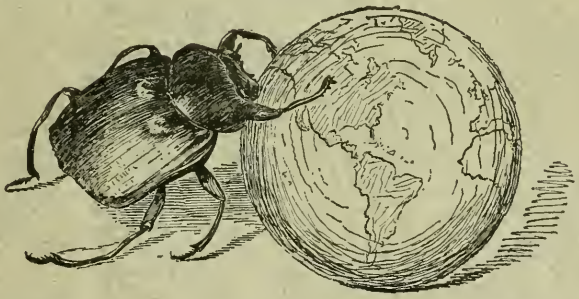

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CONTENTS.

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THE PHYLOGENETIC ORIGIN AND THE NATURE OF THE WINGS OF INSECTS ACCORDING TO THE PARANOTAL THEORY.[1]

By G. Crampton,

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Within the past century, various and conflicting theories concerning the origin of the wings of insects have been proposed. In order to choose one of these as a "working basis" for further investigation, it is necessary to subject them all to a critical examination, in order to determine which of them is in accord with the greatest number of known facts, or is the least open to objection—and is therefore the most probable and acceptable. It is with this in view that the different theories, together with the available evidence upon the subject, have been brought together in the following discussion.

The theories dealing with the origin of wings in insects, may be grouped into two classes, one of them containing those theories in which it is maintained that the wings are entirely new structures (or organs "*sui generis*"), while the other group contains those theories in which it is maintained that the wings were evolved from preëxisting structures. As an example of the first type, may be mentioned the views of Kirby, who compares the wings of insects to the lateral expansions of the flanks, strengthened by the ribs and used as gliding planes, in the flying lizard *Draco*. Kirby appears to regard the wings

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

of insects as new structures, although he is not so outspoken in the matter as Audouin (1824) and Lacordaire (1834), who regard insects' wings as organs "*sui generis.*" Lacordaire in particular, seems to regard further discussion of the subject as unprofitable, in view of the fact that, since the wings are (as he thinks) entirely new organs, they can have no relation to any previously existing structures.

It is possible that Audouin and Lacordaire are correct in their contention that the wings are organs "*sui generis,*" although they were doubtless influenced in their belief by the then prevalent idea of "special creation," whose adherents maintained that each species (and hence the organs peculiar to it) was created quite independently of other organisms, and consequently the idea of structures arising as modifications of preëxisting structures, was precluded by the very nature of the hypothesis. In accordance with the modern conception of the method and factors of evolution, however, it is difficult to conceive how wings of sufficient size and development to be of any use to the organism could have arisen, save through the predominance of some new function, or use, in organs which had some prior function or significance.

It is not always necessary, however, to suppose that the preëxisting structures originally served any useful purpose, since an *inherent* tendency toward the greater development of certain structures (projections of the body-wall, etc.) might find opportunity for fuller expression, so long as such a development did not lead to a condition detrimental to the organism—in which case natural selection would operate to prohibit further progress along this line, while the persistence of such structures would be assured, if they reached a stage wherein they were capable of furnishing their possessors with a means of successfully coping with their competitors or enemies, or would be of assistance in maintaining the life of the organism. The latter view would seem to be more in accord with our present knowledge of the method of evolution, and is therefore more acceptable than the view that the wings are organs "*sui generis.*"

The theories contained in the second group (in which it is maintained the wings have developed from preëxisting structures) are of several types. Thus, the adherents of one theory would derive the wings of insects from the "elytron"-like appendages, or the gills, of Annelidan ancestors; others regard the wings as modified legs, or other appendages; while others regard the wings as modified respiratory organs (gills or spiracles); and still others think that the wings have developed from the lateral expansions of the tergal region (not necessarily concerned with respiration) which occur in numerous Arthropods. These theories may be briefly reviewed as follows.

Among those who maintain that the wings of insects arose from some preëxisting structures, may be cited the views of Rathke (1834) who compares the foliaceous appendages which appear in the posterior region of the cephalic lobes of the embryo of the Crustacean *Asellus aquaticus,* to a first transient indication of the wings of insects (*teste* Plateau, 1871); and Carus (1839) likewise accepts this view—although he also maintains that the wings have developed from respiratory organs. Dohrn (1881) refers both wings and tracheal gills to the "elytra" of the Annelidan ancestors of insects, apparently influenced by the suggestion of Owen (1848–1855) who regards the wings of insects as metamorphosed tergal branchiæ of the Annelidan ancestors of insects.

The theories dealing with the derivation of the wings from the branchiæ of worms, will be taken up under the discussion of the origin of wings from respiratory organs. It may be remarked, however, that those theories in which it is sought to derive the wings from the gills of worms (or from the parapodial and other structures of the Annelids) take a great deal for granted; and until we have a wider knowledge of more intermediate forms, and their development, any attempts to trace the wings, or any other Insectan structures, to organs which are supposed to be their forerunners in the Annelids, must be regarded as speculative in the extreme.

Latreille (1820) compares the wings to legs; MacLeay considers the wings as greatly modified limbs; Leukart (1848) thinks that wings are repetitions of the legs on the dorsal surface of the body; and Carus and Gerstaecker (1863) regard the wings as limbs arising from the back.

Jaworowski (1896–1897) derives the wings and legs from a common origin, and states that both arise as a simple hypodermal outgrowth within a peripodial depression corresponding to the "lung-like" structure from which he derives the limbs of all Arthropods; the limbs, according to him, being to all intents and purposes, modified protruding respiratory lamellæ. Jaworowski's theory would thus come under the discussion of the origin of wings from respiratory structures, but has been taken up at this point, since he brings out certain features having a bearing upon those theories in which it is maintained that the wings are, to all intents and purposes, modified legs.

On page 183, Jaworowski, 1897, mentions that legs and wings can be substituted for one another, in certain insect montrosities, and cites the description by Nelson, 1889, of a *Zygæna* in which a wing had grown in the place of a leg, and also cites the case of an East Indian fig-insect (described by Simroth, 1891) which has segmented appendages instead of wings (see also Fig. 11 of wing of *Zopherus*, by Brues, 1903). I have also observed that in certain Diptera, the halteres may appear to be composed of three segments, but I do not think that the apparently segmented condition of such highly modified structures can be interpreted as the retention of a primitive condition, although I would not utterly deny this possibility; and, since those insects in which the wings arise as hypodermal evaginations within a peripodial cavity are highly specialized forms, I am rather inclined to regard this also as a secondary modification, rather than as a retention of a primitive condition.

Jaworowski (1896) although at first inclined to accept the view that the wings are modified tracheal gills, finally repudiated this view, upon having his attention called by Heider, to Heymons's investigations which demonstrated that in *Sialis* and *Ephemera,* the gill appendages are not homodynamous with the wings, thus disproving Gegenbauer's contention that wings are developed from tracheal gills.

From the preceding discussions, it is evident that the foregoing theories may also imply or expressly include the idea of the derivation of the wings from respiratory structures, in addition to the central idea of the theory; so that it is impossible to divide these theories into sharply defined classes, since they merge into each other through having several ideas in common. The discussion of these theories, therefore, leads up to that of the theories in which it is maintained that wings are modified respiratory organs.

Among those who maintain that the wings are to be derived from organs having a previous respiratory function, may be mentioned the views of Plateau, 1871. Plateau's theory differs from those in which it is maintained that the wings had a respiratory origin, in that he regards the wings as highly modified spiracles.

In support of his contention, Plateau (1871) cites a number of observations, which are, unfortunately, incorrect; and, since his premises are unsound, his conclusions are naturally false also. Thus, he points out that Blanchard (1868), quoting De Blainville, states that no respiratory orifice, or spiracle, is ever found in either the mesothorax or metathorax, and concludes that this absence of respiratory orifices in the segments which bear, or should bear, the wings, gives weight to the hypothesis (long prevalent even in Blanchard's day) that the wings are largely composed of outgrowing tracheæ which have become imprisoned between two integumental lamellæ—a theory accepted by Girard, and many others.

As a matter of fact, the mesothorax and metathorax (*i. e.*, the wing-bearing segments) are usually the only thoracic segments supplied with spiracles, which were either overlooked by the earlier investigators, or were ascribed to the wrong segment, due to the fact that it was not then known that the thoracic spiracles might migrate (during ontogenetic development) from the segment in which they were formed during embryological development, and, taking up a position in the intersegmental region, appear to belong to the segment in front rather than to the segment behind them.

Plateau goes on to say that it is a significant fact that the wing is always located between the epimeron and the tergum, which he thinks is the typical situation of the spiracle. The thoracic spiracles of adult insects, however, almost invariably occur in the intersegmental membrane, or occupy an intersegmental position so that Palmen's premises and conclusions in these matters are wholly incorrect.

Plateau's conception of the wing as an hypertrophied spiracle which has become widened and flattened to form the wing lamellæ, while the "supporting rods" (tænidia ?) of the trachea become enlarged to form the wing nervures, is entirely fanciful, as is his idea that the halteres of the Diptera (which he rightly identifies as modified wings) are modified spiracles. Indeed, the only semblance of proof offered by him in support of his theory, is in the observations of Weismann (1866) which he cites, pointing out that Weismann's investigations concerning the development of *Corethra* would indicate that in this insect, the dorsal prothoracic cell-islands, or "imaginal disks," form the pupal spiracles, while those of the mesothorax form the wings, and those of the metathorax form the halteres. It is by no means certain, however, that the prothoracic islands are homodynamous with the wing disks, and the proof offered by Plateau in support of his theory seems rather inadequate.

The observations of Pratt (1899), Tower (1903) and Verson (1890–1894) might, in some measure, be taken as upholding Plateau's theory that the wings are modified spiracles. Thus Tower (1903) states that when the mesothoracic spiracle migrates forward, "the spiracle alone migrates, and the thickened area of the hypodermis remains and probably becomes the fundament of the elytron." Powell (1905), however, combats the idea that the wings develop from the discs of the degenerated spiracles of the meso- and metathorax, and, in opposing Tower's statements, asserts that in some Coleoptera the spiracles have not migrated forward, and that the wing primordia (or fundamentals) arise distinctly above or below the positions occupied by the thoracic and abdominal spiracles. He therefore concludes that Tower's conclusions in this matter are incorrect, and the fact that his investigations were made in the same order of insects (Coleoptera) studied by Tower, should have considerable weight, especially since he sought to verify Tower's work in carrying out his own investigations.

Many investigators, even in modern times, have advocated the derivation of wings from tracheal gills. Owen (1848) supports the idea promulgated by Oaken (1831) that the wings are modified gills, such as are born on the tergal region of Annelids, and Ganin (1869) asascribes a respiratory function to the wings.

Carus (1839) states that in the "immature *Agrion puella,* the blood circulates in the forming wings exactly as in gill plates, and it would be difficult to find a more perfect demonstration of the fact that the wing is a modified gill" (*teste* Plateau, 1871).

Enderlein (1902) suggests that since the ancient pterygote insects lived in an atmosphere of great humidity, they may have used their wings as a sort of "gill" (since the wings are supplied with tracheal branches in the early stages of development), but does not enter into the controversy as to whether the wings were derived from the tracheal gills of Ephemerid nymphs, or not.

Gegenbauer (1870–1878), who regards the wings of insects as derived from the dorsal gills of their Annelidan ancestors, has done so much to clearly formulate the theory that the wings are modified tracheal gills (such as those found on the abdomen of immature Ephemeridæ), that his name is usually associated with the theory ascribing the origin of the wings to the tracheal gills. Many subsequent investigators have accepted his views, wholly or in part, and have endeavored, with varying success, to overcome the objections to the theory in question. Among the supporters of the theory of the tracheal-gill origin of the wings of insects may be mentioned Landois (1871), Lubbock, (1873), Graber (1877), Palmen (1877), Hofmann (1879), Adolph (1879–1881), Brauer (1885), Cholodkovsky (1886), Redtenbacher (1886), Lang (1888), Verson (1890), Simroth (1891), Pratt (1899), Osborn (1905), Woodworth (1906), J. A. Thomson, and many others. Cholodkovsky (1886) also thinks that the wings are homologous with the prothoracic patagia[1] (not the tegulæ) of the Lepidoptera, and Walton (1901) even goes so far as to regard the tegulæ as wings in the process of formation!

Some investigators, perceiving the difficulties inherent in the attempt to derive the wings from tracheal gills, have attempted to avoid the difficulty by suggesting that the wings may not have been derived from gills, but gills may themselves have been derived from wings, or both wings and gills may have had a similar origin. Thus, Redtenbacher (1886) thinks that wings and tracheal gills are homodynamous, but "it is questionable whether the wings were derived from tracheal gills, since the converse may be true; and that wings may have become metamorphosed into gills, is not beyond the realm of possibility." He likewise compares both wings and gills to the pronotal expansion of Mantids, etc.

Lang (1888) was impressed with the fact that aërial respiration is clearly the primitive one in insects, and in order to derive the wings from tracheal gills, suggested that insects, at first terrestrial, became adapted for aquatic life; respiratory folds of the integument into which tracheæ penetrate, being modified into gills, and these eventually becoming metamorphosed into wings—which thus are ultimately derived from integumental folds.

Grassi concludes that wings and gills may be homodynamous (*i. e.*,

[1] It is perhaps unnecessary to mention, in this connection, that the elytra of Coleoptera, etc., are not homologous with the patagia or tegulæ, as some writers have erroneously stated is the case. Their structure and development clearly shows that they are modified fore wings and nothing else.

of the same series), but that wings are not derived from gills. He goes on to show that in certain Lepismatidæ there occur tergal folds (well supplied with tracheæ) which serve to protect the sides of the thorax and the base of the legs. These lateral tergal expansions he compares to the lateral folds of the carapace of Crustacea (*teste* Henneguy, 1904), and suggests that they became transformed into gills in those insects which became adapted for aquatic life, while they were metamorphosed into wings in the aërial forms.

Graber (1875) suggests that the wings of insects may have arisen in two ways. Thus in the terrestrial forms (*e. g.,* Termites) they may have been derived from tergal outgrowths, while in the aquatic forms (*e. g.,* Ephemerids) they arise as metamorphosed tracheal gills. He also clearly points out that the lateral expansions of the Locustid pronotum are homodynamous with the wings.

The foregoing views lead up to the discussion of those theories in which it is maintained that the wings arose as lateral expansions of, or near, the tergal region, and were not necessarily connected with a respiratory function primarily. Since they are always borne "alongside" of the nota, or tergal plates, for the sake of convenience, in the following discussions, I would refer to these lateral folds as the "*paranota,*" regardless of whether they are entirely tergal in origin, or entirely pleural, or a combination of both. The theories dealing with this origin of the wings may therefore be referred to as the paranotal theories.

Among the earliest of the theories advocating a paranotal origin of the wings may be mentioned the views of Mueller, 1875. From his studies on the development of the wings of the Termite *Calotermes,* Mueller concluded that the wings did not arise from tracheal gills, but from lateral tergal expansions (paranota) similar to those found in the pronotum of *Calotermes,* which greatly resemble the wings in their mode of development. Pancritius (1884) also supports this view, and likewise lays stress upon the fact that the tracheæ enter the forming wings at a comparatively late stage in certain immature insects—as Mueller had pointed out was the case in *Calotermes.* Bugnion (1911) has also called attention to the prothoracic structures of *Coptotermes flavus,* "whose larvæ bear rudiments of prothoracic wings."

The investigations of Mueller (1875) on the development of the

Termites' wings, and of Woodward (1876), who pointed out that the aliform lateral expansions (paranota) of the pronotum in the fossil insect *Lithomantis carbonaria* are homodynamous with the wings, have furnished a firm foundation for the paranotal theory of the origin of the wings, and this view has been accepted wholly, or in part, by many subsequent investigators, among whom may be mentioned Huxley (1877), Haase (1886), Korschelt and Heider (1891), Zacharias (1892), Krueger (1898), Packard (1898), Comstock and Needham (1899), Powell (1904–1905), Duerken (1907), Lameere (1900–1908), Handlirsch (1906–1908), McMurrich, and others.

From the foregoing discussion, it is evident that the two theories which have received the most widespread acceptance, are the tracheal gill theory and the paranotal theory of the origin of the wings—and opinion seems to be pretty evenly divided between the two. The evidence brought forward in support of the other theories seems insufficient to warrant their acceptance, nor does it appeal as strongly as the two mentioned above do, to our ideas of the factors and method of evolution; so that it is preferable to suspend judgment upon the other theories (until more evidence has been accumulated) and to select as a "working basis" one of the two theories which appear to be in accord with the greatest number of known facts—in other words, we must (for the time being, at least) choose between the tracheal-gill theory and the paranotal theory of the origin of the wings of insects.

Unfortunately, all of the evidence bearing upon the subject is not accessible to me at this time; but such of the arguments as were available have been brought together in the following comparison of the two theories. In addition, such evidence as has suggested itself as having a bearing upon the subject under discussion, has been added to strengthen either side of the question impartially; and I feel convinced that sufficient evidence is at hand, to make an unbiased decision in favor of one theory or the other.

It must be admitted that the tracheal gill theory is a fascinatingly clever one, and if the premises of its arguments be granted as correct, the logic of its appeal is almost irresistible; but if the rival theory is fully in accord with the same facts (or even more of the known facts) which have been cited as evidence of the tracheal gill theory, and is not open to the same objections as might be raised against this theory, we have no alternative other than to choose the more probable and acceptable theory.

Some of the arguments which may be advanced in favor of the tracheal gill theory of the origin of the wings of insects may be summarized as follows:

1. Wings cannot have suddenly sprung into being (like Minerva from the brain of Jove!) fully formed and immediately functional, but the process of their development must have been a gradual one; and in their early stages they could not have been of use as flying organs, but must have served some other purpose while becoming wing-like. In other words, the locomotor function must have gradually become predominant in structures having a prior function or significance.

2. Wings, in their immature stages, contain tracheæ, and this indicates that their prior purpose was respiratory—either in an intensely humid atmosphere, or in water.

3. If the successive segments of an insect's body are mutually homologous, we should expect to find structures which are homodynamous (*i. e.*, of the same developmental series) with the wings, on the other segments. Superficially, at least, the tracheal gills on the abdominal segments of certain immature Ephemerids appear to fulfil this requirement.

4. The tracheal supply of the tracheal gills appears to be somewhat similar to that of the immature wings (see Plate I, Fig. 4).

5. The tracheal gills of some Ephemerid nymphs are remarkably similar, in outline, to the wings of certain insects (see Plate I, Fig. 2).

6. The gills may be bordered with hairs similar to those of certain wings, and are even stiffened by structures strongly suggestive of nervures (Plate I, Fig. 2).

7. The gill plates of immature Ephemerids are capable of very rapid movements for setting up currents to keep the water in contact with the respiratory surfaces pure.

8, Through their movements, the gill plates have become articulated to the tergum, after a fashion, thus "paving the way" for the articulation of the wing-like structures to be developed from them.

9. The muscles involved in the movements of the gill plates could eventually become modified to form muscles of flight.

10. Certain gill plates of immature Ephemerids (*e. g., Tricorythus*), and especially the anterior ones, or those nearest the thorax, may become very large, and serve as coverings for the gills, thus indicating an inherent tendency to increase in size on the part of the anterior gill plates, and making it readily conceivable that similar structures might increase to the size of wings.

11. If the gills grew large enough or powerful enough, and became properly adapted, it is conceivable that such organs, already capable of rapid movement, might develop into structures capable of propelling the insect through the water, and would eventually enable it to glide over the surface of the water.

12. As the locomotor function gradually predominated, it did so at the expense of the respiratory function, which became of less and less importance until the wings became practically entirely locomotor and those which were situated on the thoracic region, being the nearest to the center of gravity, were the ones eventually retained when aërial locomotion was achieved.

13. Some insects (*e. g.,* the aquatic Hymenoptera described by Lubbock, 1863) even now use their wings for propulsion through the water, and thus make it more readily comprehensible that wings might have originated from structures formerly adapted for propulsion through the water (such as the modified wing-gills might have been).

14. It is a very significant fact that the Plecoptera, which are in some ways the most primitive of winged insects now living, are water dwellers in their immature stages. The Ephemerids and Odonata which are also very primitive in many respects are likewise water dwellers in their immature condition. If ontogeny is a recapitulation of phylogeny, this might be taken as an indication that winged insects at one time passed through a water-dwelling stage.

15. The Neuroptera, which occupy a position intermediate between the very primitive and the very highly specialized winged insects, and even some of the very highly specialized insects, such as the Diptera, Coleoptera, etc., have aquatic larvæ, so that the tendency toward an adaptation to aquatic life is still quite widespread, cropping out as it does in the most diverse forms, and might have been inherent in the Pterygote stem.

16. Some members of groups which are very primitive, such as

the Blattidæ (Shelford, 1907), Phasmids (Murray, 1866, Wood-Mason, 1878, and denied by Gahan, 1912), etc., have retained the power of adaptation to aquatic life even in the adult stages.

17. Certain very ancient fossil Pterygote insects, which must be considered as near the ancestors of modern winged forms, have retained even in the adult condition, what appear to be abdominal gills homodynamous with the wings (see Plate II, Figs. 8 and 12). If these are really gills, we must consider that the wings are homodynamous with, and hence homologous with, the tracheal gills.

18. Even present-day Apterygota, which are considered by many as having departed but little from the condition of the forms preceding winged insects, show a marked tendency to select damp locations as their dwelling places (*e. g.*, under stones, places near the coast, etc.), and we can thus more readily understand that there was a tendency on the part of the precursors of winged insects, to select damp locations to live in, and eventually become adapted for aquatic life.

19. Embryology and the ontogenetic development of certain Ephemerids would indicate that aërial respiration is the more ancient one, but this does not preclude the possibility that although originally air-breathing, the ancestors of winged insects became *temporarily* adapted for aquatic life (in accordance with the widespread tendency) at one stage of this development (*i. e.*, before wings arose) and afterward became aërial breathers once more.

20. It is also possible to regard wings and gills as homologous structures, without maintaining that wings were developed from gills, or gills from wings; but both may have been derived from a common origin (*e. g.*, lateral folds of the body wall, into which tracheæ later penetrated).

21. As a final point, it has been brought out that it is very difficult to see how rigid expansions of the tergal region could have acquired an articulation with the tergum (or how they could have become capable of the movements of flight) in the air alone. On the other hand, since the tracheal gills already have an articulation with the tergal region, after a fashion, and are capable of rapid movements, the difficulty of acquiring the ability to perform the movements of flight would not be as insurmountable.

It is thus very evident that the arguments in favor of the tracheal-gill origin of the wings are apparently very forceful, and it must be admitted that they exert a subtly fascinating appeal; but there are certain seemingly insurmountable objections to the acceptance of the tracheal-gill hypothesis, as will be pointed out in the following discussion of the paranotal theory. The paranotal theory, on the other hand, is not open to these objections, and is even more in accord with the observed facts, as will be shown later, so that for the present, at least, it is the more probable and acceptable theory.

The principal points in favor of the paranotal origin of the wings, and the objections to the tracheal-gill theory may be briefly reviewed as follows:

1. Since the successive segments of an insect's body are mutually homologous, we should expect to find structures homologous with the wings, on the other segments. Now in order to derive the wings from such structures, it must be shown that they are homologous with them, and in order to be homologous with the wings, these structures must be homodynamous (*i. e.*, of the same developmental series) with the wings—otherwise, it would be impossible to derive the wings from them. If then, it can be shown that the wings are not homodynamous with the tracheal gills, the theory that the wings are modified tracheal gills immediately becomes untenable.

In his embryological studies of Ephemerids, Sialids, etc., Heymons (1896) has clearly demonstrated that wings do not arise similarly to tracheal gills, and that the tracheal gills are not homodynamous with the wings—and these investigations alone, are sufficient to entirely refute the tracheal gill theory of the origin of the wings! Furthermore, Heymon's conclusions based upon the embryology of the Ephemeridæ, etc., are fully borne out by the work of Duerken (1907) who has shown that the structure and musculature of the gills of Ephemerids are not comparable to those of the wings, and Boerner's (1909) studies on the tracheal gills of Ephemerids have shown that the gills are not homodynamous with the wings. Indeed, as Fernald (1890) and others have pointed out, the gills may occur in various localities, and even between the wings, so that under these conditions, it is not surprising that embryological and anatomical investigations have demonstrated that the gills are not homodynamous with the wings.

2. If it could be shown that, in certain immature Ephemerids

which have both gills and paranotal structures, the paranota are homodynamous with the wings, while the tracheal gills are not, this would be a heavy blow to the tracheal gill theory, and a correspondingly weighty argument in favor of the paranotal theory. Fortunately, we have just such an insect, in the "larva" of the singular New Zealand Ephemerid *Oniscigaster wakefieldi* described by MacLachlan (1876). In the immature stages of this insect, the paranota are borne along the *sides* of the tergal region (see Plate II, Fig. 15) in the position characteristic of the wing location, while the tracheal gills are borne high up on the dorsal region, and are not of the same series as the wings. The abdominal paranota and the wings are both retained in the adult condition, while the gills are lost when the insect becomes mature, showing that they are merely temporary adaptational structures, unlike the more lasting paranota.

3. The paranota are borne along side of the tergal region in the location characteristic of the wings, while the tracheal gills are attached in a very different position, thus indicating that they are not homologous with the wings. One has but to glance at Figs. 1, 6 and 7 of Plate I, or at Figs. 8 and 12 of Plate II, to see that the wings are always attached along the lateral margin of the principal tergal plate, and the paranota (*p* of Figs. 9, 12, 14, 15, etc.) are attached to the tergal region in exactly the same location; while the tracheal gills are attached either to the posterior portion of the tergal region (as in Fig. 4, Plate I) or to the dorsal region of the tergum (as in Fig. 15 of Plate II), or occupy positions unlike that of the wings!

4. The posterior margin of the principal tergal plate is always continued in the posterior margin of the wing as the so-called spring vein, ligament or axillary cord (Figs. 4, 6, and 7 of Plate I). The posterior margin of the tergum is continued in the posterior margin of the paranota (Figs. 9, 14, 15, etc., of Plate II) while the posterior margin of the tergum is not continued in the tracheal gills (Figs. 4 and 15). The inference is obvious!

5. In *Stenodictya* (Plate II, Fig. 8), *Corydaloides* (Fig. 12) and other fossil insects, there occur lateral expanded structures on either side of certain of the abdominal terga, which are homodynamous with the wings and the prothoracic paranota. Certain palæontologists have erroneously maintained that these abdominal structures are gills, and since these structures are homodynamous with the

wings, it has been claimed that this would prove that the wings are modified gills.

The structures in question, however, are not gills at all, since, as we have seen, the gills are never borne along the lateral width of the abdominal terga (as the structures in question are borne), but are attached by a narrow constricted region to the tergum, at different locations (see Fig. 4, Plate I, and Fig. 15, Plate II). The paranota on the other hand, are always attached along the lateral width of the tergal plate (as the wings are also attached) in exactly the same manner as these fossil structures! The adult of *Oniscigaster* would have shown this much better, but Fig. 15 (Plate II) depicting the condition of the immature *Oniscigaster,* if compared with *Stenodictya* (Fig. 8) will very clearly demonstrate that the lateral abdominal appendages of the fossil insect are paranota, not gills; and if we compare the abdominal paranota of the Phasmid (Figs. 11 and 14, Plate II) with the abdominal structure of *Corydaloides* (Plate II, Fig. 12), it is at once apparent that the abdominal structures of the fossil insect are not gills, but are paranota very like those of the Phasmid, and are even bordered by a similar fringe. It is evident, therefore, that the lateral abdominal appendages of these fossil insects (which are homodynamous with the wings and prothoracic paranota) are not gills, but are paranota! Since they are homodynamous with the wings, this is a clear proof of the paranotal origin of wings of insects.

6. Comstock & Needham (1898–1899), Packard (1898), Handlirsch (1906–1908) and others have pointed out that the tracheation of the wings differs from that of the tracheal gills, and this, although not in itself a strong argument against the origin of the wings from gills, is nevertheless a point in favor of those who would derive the wings from some other source, especially when taken into consideration with the other objections to the tracheal gill theory.

7. In the ontogenetic development of the wings, these arise as projections into which the tracheæ subsequently penetrate, and in many immature insects the developing wings are not penetrated by the tracheæ until comparatively late in their development, so that if the ontogenetic sequence has any meaning, the wings must first have arisen as projections (paranota) not having a respiratory function, but later the tracheæ grew out into them. It is possible to avoid this

objection by saying that both wings and gills may have been derived from a common source (*e. g.,* integumental folds) which was not originally respiratory; but this savors too strongly of an attempt to avoid the issue, and, as been shown in point (1), the wings and gills are not homodynamous—so cannot have originated in a common source!

8. Comstock & Needham (1898–1899) have shown that the wing nervures of all insects are reducible to one common "ground-plan," and a glance at Figs. 1, 6, and 7, of Plate I, will show that the little plates (ossicles) by means of which the wings are articulated to the tergum are practically identical in all. The wings are always borne in the same location, alongside the principal tergal plate, and the posterior margin of this plate is always continued in the posterior margin of the wings as the so-called spring vein, ligament, or axillary cord as may be seen from the preceeding figures. From these, and other facts, it is logical to suppose that the wings of all insects originated in a common source (*i. e.,* did not have separate origins), and probably arose in a common group of ancestral insects. It is not possible therefore to suppose that the wings of some insects arose from paranota, while others arose from tracheal gills and other structures, since the great uniformity of structure and location, etc., would make such a supposition extend too far beyond the laws of probability! On this account, we are justified in rejecting the suggestion that the wings of aquatic insects arose from tracheal gills, while those of terrestrial forms arose from paranota, or similar structures, as will be discussed in the next paragraph.

9. Since the wings of all insects had a common origin, if all wings are to be derived from tracheal gills, all winged insects are all descended from ancestors which breathed by means of tracheal gills, and should show traces of such an ancestry in their individual development. The very opposite is the case, however, for even in those insects which are supposed to best illustrate the transition from gills to wings (*i. e.,* the Ephemerids), the primordia of the "open respiratory system" (for aërial respiration) are laid down at an early stage of embryological development, long preceding the development of the "closed respiratory system," for aquatic respiration. Even in the water-dwelling immature Ephemerid, the spiracles of the open system may become temporarily open to the exterior, at the time of molting, but quickly become closed again, since the insect is not yet

ready for aërial respiration; and the investigations of Palmen (1877) have clearly shown that the open respiratory system is the more ancient, and therefore the original one, while the closed one for aquatic respiration is evidently the product of a process of adaptation to aquatic life which was subsequently acquired.

Since the open respiratory system for aërial respiration is clearly the more ancient, and hence the original one even in aquatic forms, it is evident that all insects are descended from terrestrial forms, which could not have borne tracheal gills; and we can therefore state with conviction that the wings of modern insects could not have been derived from tracheal gills. The adherents of the tracheal gill theory, however, would attempt to avoid this difficulty by suggesting that although the ancestors of all insects were originally air breathers, the ancestors of the winged forms became *temporarily* aquatic, and thus acquired the gills which were to develop into wings when they became air breathers once more! This argument is clearly an attempt to again avoid the issue, but is also unavailing! If the ancestors of winged insects were all gill breathers at one time (which must have been rather recent), why do no fossil forms show traces of such "wing-gills," and why do we have no recent forms which have retained structures suggestive of this common origin of the wings? The Ephemerids cannot be taken as examples of this, since it has been shown (point (1)) that the wings of Ephemerids are not homologous with the gills, and the ontogenetic development of no other winged insect offers any hint of such a common origin for the wings in gill-like structures!

10. Palæontology shows that the earliest fossil insects had wings, yet these have retained no series of abdominal gills homodynamous with the wings, the only abdominal structures which are homodynamous with the wings being paranota, as has already been pointed out (see point (5)).

11. The great mass of lower pterygote insects are not aquatic, but are terrestrial, whereas if all pterygote insects passed through an aquatic stage, we would expect that the great majority of the lower winged forms would still be aquatic, at least in the immature stages. On the other hand, numerous lower pterygote insects have retained paranota in the prothoracic region, at least, while tracheal gills occupying the typical wing location are wanting in all of them.

12. None of the apterygote forms, which have departed but little from the ancestral condition (and the Lepismids may be taken as forms "annectent" between the Apterygota and lower Pterygota), show indications of a tendency to develop tracheal gills, while many of them bear paranotal expansions of the pronotum and other tergal projections (see Fig. 16, Plate II).

13. Unlike the tracheal gills, the paranota have been retained in the most diverse insects, being preserved in the prothorax of certain Mantids (Fig. 9, Plate II), Heteroptera (Fig. 10, Plate II), Coleoptera (Fig. 13, Plate II), Lepismids (Fig. 16) etc., as well as in the abdominal region in certain Phasmids (Figs. 11 and 14, Plate II), etc., and the paranota also occur on many of the segments in numerous "larval" forms (*e. g.*, in immature Plecoptera and Ephemerids, as shown in Figs. 15 and 18 of Plate II) and are specially well developed in certain Coleopterous larvæ such as those of the Sylphidæ, of *Psephenus lecontei,* and many others. This would indicate an *inherent tendency* in the insect stem, toward the formation of lateral integumental expansions, or paranota, and the fossil forms also exhibit this tendency (see Figs. 8 and 12, of Plate II).

14. Unlike the tracheal gills, the tendency toward the formation of paranotal expansions is apparently inherent in the Arthropod stem—at least in those Arthropods whose lines of development parallel that of the Insecta—and finds opportunity for expression in the most diverse forms. We thus find paranota developing in the Diplopods (Fig. 17, Plate II), in the Crustacea (Fig. 19, Plate II), in the Trilobites (Fig. 20, Plate II) and many other groups, and even in Arthropods more remotely removed from the Insectan stem, this inherent tendency may find opportunity for expression—although in certain of these more remote forms, I am not certain that we are dealing with structures strictly homologous with the paranota. Thus Berlese (1906–1909) has figured a series of Acarina (Oribatidæ) in which can be traced the gradual development of lateral "pteriform" expansions of the dorsal region, which are small in *Oribatula plantivaga* and *caliptera,* but become greatly developed in *Oribates latipes,* while in *Oribates alatus* these "pteriform" appendages actually become articulated with the tergal region. Furthermore, they do not have to pass through a tracheal gill stage in order to develop an articulation with the tergite—as Woodworth would claim that integumentary ex-

pansions which are eventually to become wings, must do, in order to develop an articulation with the tergum! I have not examined these "pteriform" expansions of the Acarina, however, and would not attempt to state whether or no they are homologous with the wings of insects.

15. The fact that paranotal expansions can become large enough to act somewhat after the fashion of a parachute, or gliding planes, to break the fall of the insect, is shown by the pronotal development of the Mantid *Chœradodis* (Plate II, Fig. 9). The dried specimen will "sail" for a considerable distance, if dropped from a height, and I imagine that the living insect could do the same. Tracheal gills of such a size are unknown.

16. In order to function as a gliding plane, the paranotal expansions should be developed in insects which have a tendency to leap into the air, otherwise the expansions would not have much of an opportunity of functioning, unless the insect were to drop from a height.

Since the Mantids such as *Rhombodera, Chœradodis* (Fig. 9, Plate II), etc., have developed such large pronotal paranota, I have asked Mr. A. N. Caudell (to whom I am indebted for the determination of the Mantid and Phasmid depicted in Figs. 9, 11, and 14, Plate II) whether the Mantids exhibit any tendency to leap, and would quote the following from his reply. "I have seen our native species leap a couple of inches, and *Yersinia,* a western species, can leap half a foot. *Ameles,* from Portugal, is reported by Wood-Mason as being able to leap nearly a foot straight upwards. In all cases it is the nymphs that leap and in some cases the hind femora are distinctly enlarged as in the saltatorial groups."

It is thus evident that forms having large paranota may also exhibit a tendency to leap, but I have been unable to find an instance of nymphal Ephemerids (or forms with flat tracheal gills) exhibiting a tendency to leap.

17. It might be further remarked that the leaping tendency "crops out" in the most diverse forms, such as the Apterygota (*e. g., Machilis,* etc.), the Psyllids, Flea-beetles, etc., and may possibly indicate an inherent tendency in the insect stem, which finds opportunity for expression in certain forms, and would of course be especially useful in those insects which have developed large paranota.

18. The leaping habit appears in the most diverse Arthropods (*e. g.*, Arachnids, Talitridæ and other Crustacea, etc.) and may indicate a stem tendency in a group which also exhibits the tendency to the formation of paranotal expansions.

19. It is possible for certain forms closely allied to the Insecta (such as the Crustacea) to develop the power of gliding through the air for several rods, thus making it more readily comprehensible that insects could have developed the power of a gliding "flight" in a somewhat similar fashion.

Worcester (1914) observed the "flight" of such a Crustacean, while boating near the coast of Palavan, at the edge of the shoal off East Island (in the Philippines), and describes the creature as follows: "It looked more like a crayfish or shrimp with one or two pairs of much flattened legs directed forward and others curving backward, the legs and the lobes of the tail making the supporting planes . . . it was unquestionably a very transparent crustacean from fifteen to twenty centimeters in length . . . and there remains no doubt of the existence in the Philippines of a marine crustacean from fifteen to twenty-five centimeters in length, which has the power of rising rapidly from the water and flying after the fashion of a flying fish, for several rods." The specimens observed invariably rose against the wind.

We know of no parallel case in which tracheal gills have been used as gliding organs!

20. If ontogeny in a measure recapitulates phylogeny, the forming wings of the lower pterygote insects should pass through a paranotal stage, if the wings were derived from paranota—and conversely, if they were derived from tracheal gills, they should pass through a stage comparable to tracheal gills. If we observe the forming wings of the most primitive winged insects, such as the Plecoptera (Fig. 18, Plate II) or the Blattids and Mantids (Fig. 9, Plate II) it is clearly evident that the upper surface, at least, of the wings arise as paranotal expansions of the tergum, rather than as tracheal gills! Furthermore, since the wings of all insects must have had a common origin (as was brought out in the previous discussions) the wings of insects with a complete metamorphosis should show traces of a tergal origin, and this Heymons, 1896, has shown to be the case in the beetle *Tenebrio*.

21. As to the argument that the wings could not have acquired an articulation with the tergal region, save through first becoming a tracheal gill (the tracheal gills have already acquired such an articulation), I fail to see the logic of such reasoning.

If an expansion of the integument can acquire an articulation with the body when it develops into a tracheal gill in the water, why can not a similar expansion acquire an articulation with the tergum when it becomes a wing in the air? It is surely no harder to conceive of a rigid outgrowth becoming an articulated appendage in the air, than to conceive of a similar rigid outgrowth becoming an articulated appendage in the water! When the forming wing of a Blattid develops from an immovable outgrowth near the tergal region, it does not first become a gill before acquiring an articulation with the tergum, and if this can take place during the ontogenetic development of the insect, why can it not occur in the phylogenetic development of the race?

Furthermore, in the series of Acarina, described in point 14, these forms have acquired appendages articulated with the dorsal region, without having these appendages pass through a tracheal gill stage in either ontogenetic or phylogenetic development, and if such an articulation can occur in the air, in such forms, why can it not occur in the wings also, without their first passing through a tracheal gill stage?

On page 242 of his "Cours d'Entomologie," Latreille, 1831, has described a Coleopteron *Acrocinus longimanus,* whose prothorax bears articulated lateral processes (*teste* Cholodkowsky, 1886). If these can become articulated to the prothorax without first passing through a tracheal gill stage, why can the wings not do the same? To demand that the wings must pass through a tracheal gill stage in order to become articulated to the tergum, is asking far more than the facts would warrant, and in the light of the foregoing instances, this objection to the origin of the wings from paranota, is not valid.

In a footnote to page 360, Walton, 1901, makes the following statement. "The prothoracic appendages of certain fossil insects (*Homoioptera woodwardi, Stenodicta lobata, Lithomantis goldenbergi, carbonaria,* etc.) so excellently figured by Brongniard (1894) cannot be homologized with the expanded margin of the prothorax in exsting Mantidæ, as Woodward, 1879, suggested. Brongniart, 1890, has already pointed this out." Walton gives no reason for this statement, and Brongniart's work is not now accessible to me, so that I do not know what evidence he has adduced in support of this contention. If one will compare Fig. 8 (Plate II) of *Stenodictya* with that of the Mantid, *Chœradodis,* depicted in Fig. 9, however, it will be apparent that the paranota of the Mantid's pronotum occupy exactly the same location as the prothoracic paranota of the fossil insect (*Stenodictya*), and why they are not to be considered homologous is not apparent. It is not evident that the paranota of the fossil insect's prothorax are articulated or movable, and even though they were, the case of the beetle *Acrocinus* cited above, would indicate that pronotal paranota may be articulated even in existing forms.

In reply to the argument that the precursors of wings must have served some useful purpose while developing, one might state that when we are dealing with an inherent stem tendency (as the development of paranotal projections seems to be) it is unnecessary to postulate that the products of such a tendency must serve some useful purpose—so long as the result is not detrimental to the organism, whereupon natural selection would operate to check further development along such lines. It is not beyond the realm of possibility, however, that the paranota may have served a useful purpose (before becoming adapted for gliding flight) in that they may have served to shield the flanks and basal portions of the legs, as Grassi has pointed out.

It is evident from the foregoing discussions, that the objections which might be raised to the paranotal theory are not insurmountable. On the other hand, there are certain insurmountable difficulties in the way of accepting the tracheal gill theory, as were shown in points (1), etc., although these difficulties do not apply in the case of the paranotal theory. Furthermore, the paranotal theory is in full accord with all of the known facts—which is more than can be said for the tracheal gill theory!

In making a choice between two rival theories, our selection should not only be free from insurmountable objections (or should not be incompatible with any of the known facts), but should also have the positive quality of being in full accord with all of the known facts. If we apply this criterion in selecting one of these theories, the paranotal theory, being the only one which fulfils the conditions, must therefore be chosen, and has been here adopted as a provisional working hypothesis, in the following discussion of the nature of the wings:

Despite the contentions of Landois, 1874, Ganin, 1876, and Graber, 1889, practically all embryologists have accepted the view that the wings of insects are of hypodermal origin, but whether they are tergal, or pleural (or both) in nature, is still an undecided question. In the paranota of Arthropods in general, these integumental outgrowths appear to be of a tergal nature—at least the dorsal lamella of the paranota is apparently a continuation of the surface of the tergum. So too, the upper surface of the developing wing of the Blattidæ and other primitive winged insects appears to be a direct continuation of the tergum. The view that the wings are merely lateral expansions of the tergum has been strongly combated, however, and it is necessary to appeal to the evidence afforded by embryology. The following views have been put forth by those who have studied the development of the wings.

According to Tower, 1903, Rehburg, 1886, and Palmen, 1887, the wings are pleural in origin. Mayer, 1876, also states that the wings are not purely dorsal, but are lateral outgrowths of the body wall.

Powell, 1905, states that in the Coleoptera "the wing arises on the pleurum at or near the future position of the dorso-lateral suture (*i. e.*, the suture between the tergum and pleuron) as a thickening of the body wall which in the simplest type begins as a simple projecting outward and downward of this thickening." He also states that "wings have been derived as lateral outgrowths or folds of the hypodermis of the pleurum or tergum or both."

Comstock and Needham, 1898–1899, state that the wings "appear at a time when the tergum and pleura are very little chitinized and are hardly more identified with one than with the other," and that they arise "at the point where the suture between the tergum and pleura later develops." Calvert, 1893, thinks that in the Odonata, the upper lamina of the wing is tergal, and the lower one pleural.

Marshall (1913) states that in the Trichoptera, "each wing rudiment is situated under the dorsal plate (*i. e.*, tergum) a little above its lateral margin," and would thus indicate that the wing is tergal in origin. Later, however, "it would appear that when the wing becomes external, its position would be between the tergum and pleurum." Packard (1898) from his observations on the development of the Hymenoptera, and other studies, concludes that the wings "are outgrowths of the scutal region of the notum" (or tergum). He also states that "in the house fly, the wings are evidently outgrowths of the meso- and metanotum," as shown by his earlier studies of the development of these Diptera (Packard, 1874); and further remarks that "the wings in all hemimetabolous insects are outgrowths from the notum, and not from the flanks or pleurum of the thorax." The numerous embryological studies of Heymons, 1895–1899, have clearly shown that the wings are tergal structures, even in Coleoptera (*Tenebrio,* etc.), and Heymon's observations, including as they do such diverse forms, should have considerable weight, aside from his acknowledged ability as a keen observer. The view that the wings are tergal structures is supported by a great number of other investigators, among whom may be mentioned Duerken (1907), Voss (1905), Kruger (1898), Haase (1891), Simroth (1891), Cholodkowsky (1886), Pancritius (1884), Dohrn (1881), Hofmann (1879), Mueller (1875), Huxley (1877) and others.

As pointed out by the writer (Crampton, 1908–1914) and others the posterior margin of the principal tergal plate is continued in the hind border of the wing, as the so-called spring-vein, axillary cord, or ligament (see Figs. 1, 6 and 7, of Plate /—), and this fact, together with the mode of development of the wings in the Blattidæ and other primitive insects, would indicate that the wing (or at least its dorsal lamella) is tergal in nature. The wings, as we have seen, are entirely homologous in all insects, so that all have a common origin, and what is true of one, holds for all. The foregoing facts would therefore indicate that the wings of all insects are, at least in part, of a tergal nature, and the studies of Heymons (1895–1899) and others cited above would substantiate the view that the wings are tergal in origin; so that for the time being, this view may be accepted as being as probable as any; although subsequent investigation may show that the lower lamina of the wing, or its basal portion, may be pleural in nature.

The wings, then, are organs of paranotal origin, and are wholly or partially tergal in nature. In other words, they arose as paranotal expansions of the tergum, although the lower lamella of the integumentary fold forming them may be in part pleural.

As to the articulation of the wings with the body, there are three principal fulcra, or pivots, used in the movements of flight. Two of these fulcra are dorsal, and one is ventral (with regard to the attachment of the wing). The anteriormost dorsal wing fulcrum (or suralar fulcrum) is formed by the small sclerite *sur* of Figs. 1, 6, and 7, of Plate I (compare also Figs. 4 and 6 of Diptera and Hymenoptera by Crampton, 1914 c, *i. e.,* the sclerite designated as "*sur*"; and sclerite similarly labeled in Fig. 1 by Crampton, 1914 a), which is always situated immediately behind the tegula (*tg* of the above-mentioned figures). The posterior dorsal wing fulcrum (or adanal fulcrum) is formed by a projecting region *apt* of Figs. 1, 6, and 7 (Plate I) which extends toward the anal veins (hence the name adanal), which usually articulate with it. In some forms this region may become detached to form a distinct sclerite, or plate. Between these dorsal wing fulcra, is a small plate *npt* which is present in practically all winged forms. From its location, and close connection with the notum, I think that this articulatory ossicle is a detached portion of the notum or tergum, and have therefore designated it as the notopterale (the term pteralia having been applied to the alar ossicles in general by Groeschel, 1911). The other dorsal ossicles, are, for the most part, detached portions of the basal region of the wing veins. The tegula (*tg*), however, is possibly merely a thickening of the membrane. The sclerite *m* (Figs. 6 and 7) is the only other dorsal ossicle of interest, and is mentioned because it dips downward and unites with a plate on the lower surface of the wing, as will presently be described. The various modifications of the dorsal ossicles may be readily seen by comparing Figs. 1, 6, and 7, of Plate I, with Figs. 4 and 6 of Plate VII by Crampton, 1914 c, homologous ossicles being designated by the same lettering in both instances.

The ventral fulcrum of the wing is formed by a dorsal projection of the episternum and epimeron extending upward (along the suture dividing the two pleural sclerites) as a narrow projecting region figured in Fig. 5 of Plate I. This narrow neck-like region may become detached to form a distinct plate in certain insects, but is usually more or less rigid to form the pleural fulcrum of the wing (pleuro-alar fulcrum).

Immediately in front of this fulcrum, at the base of the wing are two basalar plates (Fig. 5, *aba* and *pba*), which are sometimes incorrectly called "paraptera." The term paraptera, however, should be applied only to the tegulæ, as was pointed out by the writer (Crampton, 1914 c); the argument that Audouin, 1824, intended that his designation "paraptere" should be applied to the plates *aba* and *pba*, being entirely unfounded. In all probability, the basalar sclerites *aba* and *pba* are detached portions of the episternum.

Just behind the pleural wing fulcrum, there may occur one or two small plates called the subalar sclerites (*sa* of Fig. 5), from their situation immediately below the wing. Whether the subalar plate is a detached portion of the epimeron or not, is questionable. In the Blattidæ, the dorsal sclerite designated as "*m*" in Fig. 7, is connected with a subalar sclerite homologous with "*sa*" of Fig. 5.

Just above the pleural alar fulcrum, is a small detached plate "*ia*" (Fig. 5), or intralar sclerite. It is connected with a dorsal sclerite homologous with that labeled "*m*" in Fig. 7. From its location, one might be led to infer that it is a detached portion of the pleural fulcrum of the wing, but the fact that it is connected with the dorsal sclerite homologous with that labeled "*m*" in Fig. 7, would indicate that this is not the case. The other wing plates are largely formed as detached portions of the bases of the wing nervures.

From the foregoing discussion, it is evident that the alar ossicles do not furnish any serviceable clues as to the nature of the wings—so far as our present knowledge of them extends, and the fact that in some insects there is a pre-alar bridge (Fig. 1, *pal*) and a post-alar bridge (Fig. 1, *poa*) extending between the tergum and pleural region, also throws no further light upon the subject. The fact that the pleuro-alar membrane (or membrane between the wing and pleural region) extends upward into the wing as a continuation of the surface of the pleural region, suggests that the basal portion of the wing, at least, might be of a pleural nature, but the evidence in the matter is insufficient to draw any trustworthy conclusions from this alone. Embryology, then furnishes the only reliable evidence at present available, and the embryological evidence, such as it is, indicates that the wings are tergal in nature.

The conclusions to be drawn from the foregoing discussion may be briefly summarized as follows.

1. The wings of all insects are homologous, and had a common origin, so that the same principles apply to the wings of insects with

complete metamorphosis, and those with incomplete metamorphosis, alike.

2. The wings of insects can not be derived from tracheal gills, since the two types of structures are not of the same developmental series (*i. e.* are not homodynamous), and are therefore not homologous.

3. The paranota, or integumental outgrowths borne alongside the tergum, or notum, are homodynamous with the wings, and wings were doubtless derived from them, since they occur in the most diverse forms (and there is an inherent tendency toward the formation of such structures in the Arthropod stem).

4. The embryological evidence would indicate that wings are of a tergal origin. We may therefore conclude that the paranota from which the wings were developed were (wholly, or in part) lateral expansions of the tergum or notum.

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ABBREVIATIONS.

aba ....Anterior sclerite at base of wing (anterior basalare).
aes ....Upper region of episternum (anepisternum).
apt ....Adanal projection to anal veins (adanale).
em ....Epimeron.
es ....Episternum.
f ....Pleural fulcrum of wing.
g ....Gill plate, or branchial lamella.
ia ....Intra-alar sclerite (intralare).
it ....Tergite in intersegmental membrane (intertergite).
m ....Median pterale (medipterale).

npt ....Notal pterale (notopterale).
p ....Paranotum, or paranota.
pba ....Posterior sclerite at base of wing (posterior basalare).
poa ....Bridge behind wing (postalare), connecting tergal and pleural regions.
pot ....Posterior tergal sclerite (postergite).
pra ....Bridge in front of wing (prealare), connecting tergal and pleural regions.
prt ....Anterior tergite (pretergite).
psc ....Prescutum.
psl ....Postscutellum.
sa ....Subalar sclerite (subalare).
san ....Sclerite at base of anal veins (basanale).
sl ....Scutellum.
sur ....Suralar sclerite (suralare).
tg ....Tegula, or parapteron.

EXPLANATION OF PLATES.

(All figures are somewhat diagrammatic.)

PLATE I.

Fig. 1. Dorsal view of typical Plecopterous mesonotum, showing articulation of wing base.

Fig. 2. Gill plate (lamella) of *Rithogena* (Ephemerid) nymph, based on a figure by Woodworth, 1906.

Fig. 3. Lateral view of head, prothorax and mesothorax of immature *Coptotermes,* pronotum bearing wing-like organs described by Bugnion, 1911, on whose figures this is based. (Immature Termite.)

Fig. 4. Gill plate of immature *Heptagenia* (Ephemerid).

Fig. 5. Lateral view of upper portion of metathoracic pleuron and wing base of a grasshopper (*Rhomaleum*).

Fig. 6. Dorsal view of mesonotum of *Corydalis,* showing articulation of wing.

Fig. 7. Dorsal view of metanotum and wing base of *Periplaneta.*

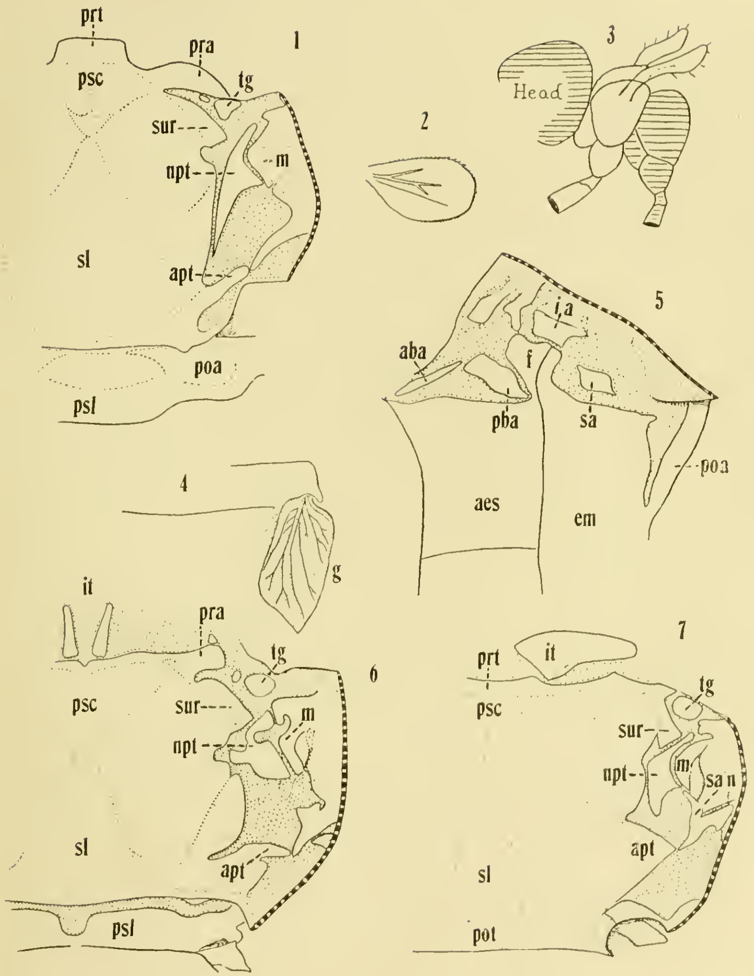
PLATE II.

Fig. 8. Dorsal view of head, thorax and part of abdomen of the fossil insect, *Stenodictya lobata,* based on several drawings by Handlirsch, Brongniart and others. The wings are represented as though partly cut off.

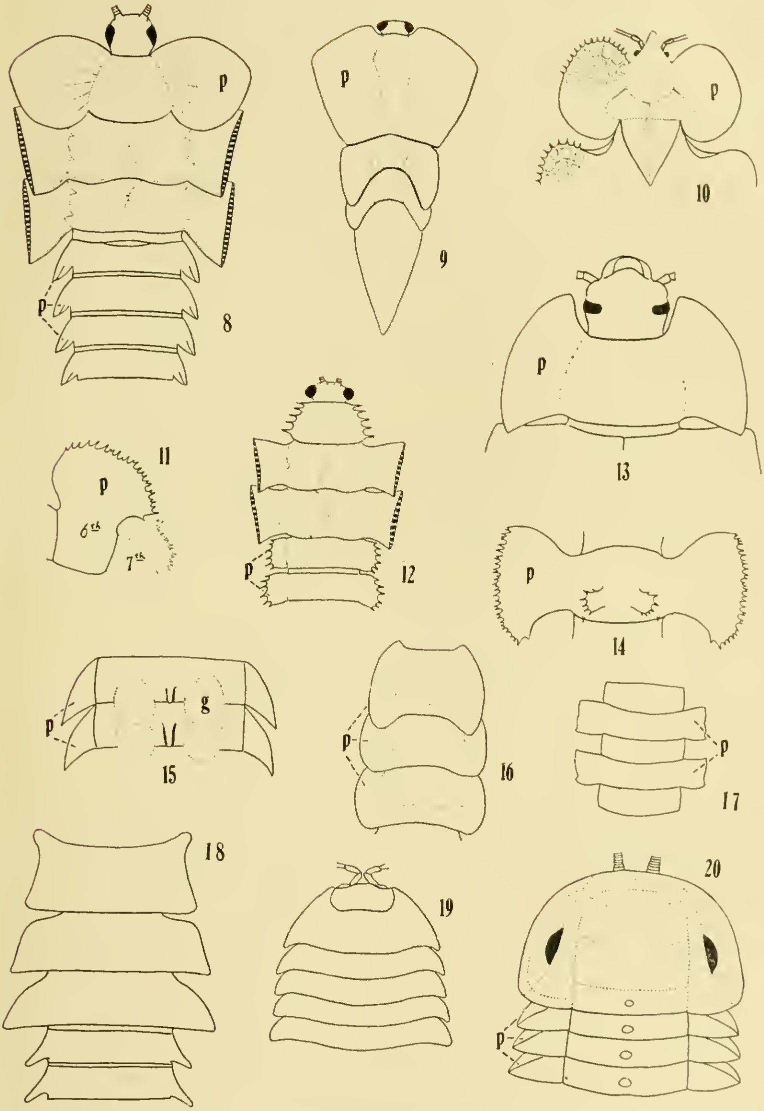
Fig. 9. Dorsal view of an immature Mantid (*Chœradodis*), showing developing wings and prothoracic paranota.

Fig. 10. Dorsal view of pronotum and basal portion of fore wings of a Tingitid (*Corythuca*).

Fig. 11. Lateral view of segments 6 and 7 of the abdomen of the Phasmid *Ectatosoma popa.*



Origin of Wings.



Origin of Wings.

Fig. 12. Dorsal view of head, thorax and basal abdominal segments of the fossil insect, *Corydaloides scudderi.* Wings shortened. Figure based upon material from various sources.

Fig. 13. Head and pronotum of the Coleopteron *Embaphion,* dorsal view.

Fig. 14. Dorsal view of the sixth and seventh abdominal segments of the Phasmid *Ectatosoma,* shown from the side in Fig. 11.

Fig. 15. Dorsal view of two abdominal segments of a nymph of the New Zealand Ephemerid, *Oniscigaster* based on figures by MacLachlan, 1876.

Fig. 16. Dorsal view of pro-, meso-, and metanotum of *Lepisma.*

Fig. 17. Dorsal view of five segments of a Diplipod.

Fig. 18. Dorsal view of thorax and two abdominal segments of a nymphal Plecopteron (*Pteronarcys*).

Fig. 19. Dorsal view of head and five segments of an Isopod (*Porcellio*).

Fig. 20. Dorsal view of anterior portion of a Trilobite (*Triarthrus*), based on figures by Beecher and others.

For the identification of the immature Ephemerid depicted in Fig. 4, I am indebted to the kindness of Dr. Morgan, of Mt. Holyoke College, and for the identification of the immature Plecopteron depicted in Fig. 18, I am indebted to the kindness of Dr. Smith of the some institution.

NOTES ON CYCHRINI.

By Charles W. Leng,

West New Brighton, N. Y.

In a letter from the late Frederick Blanchard on the subject of Dr. Hans Roeschke's "Monographie des Carabiden-Tribus Cychrini" this sentence occurs: "I was very much impressed with the thoroughness of the treatment and also with the feeling that it was almost presumptuous to consider it critically or to comment." All must concur in the sentiment thus expressed; and it is only because the subject matter of these notes has been long under consideration and discussion with Mr. Schaeffer as well as Mr. Blanchard that they are printed.

The locality cited on page 267, "Washington, D. C. (Charleroi)," should probably be Charleroi, Washington Co., Pa. A number of specimens of several species have been distributed from that locality and there is no connection known between "Charleroi," either as the name of a collector or of a locality, and Washington, D. C. By thus eliminating Washington, D. C., from the distribution data for the species *Sphæroderus nitidicollis,* the phrase "vom Atlantischen Ozean" loses part of its foundation.

The treatment of this species as one occurring from the Atlantic Ocean to West Virginia and northward to Hudson Bay, with but one sub-species in its range of variation is contrary to the descriptions of Chevrolat, Chaudoir, and Leconte; and cannot be satisfactorily applied to the specimens at hand. The catalogue on page 274 should read:

1. **nitidicollis** Chevrolat, 1848.
Subsp. **brevoorti** LeConte, 1848.
    granulosus Chaudoir, 1861.
    nitidicollis G. H. Horn, 1878, ex parte.
2. **schaumii** Chaudoir, 1861.

The first was described from Newfoundland and occurs there only. In recent years many specimens have been collected by W. S. Genung, L. P. Gratacap, P. G. Bolster, G. P. Engelhardt and myself; they are uniform in size and color and show no tendency to intergrade with the other two.

The second was described from Maine, and occurs at Lake Superior, according to Mr. Blanchard's report on the Leconte collection, and near the summit of Whiteface Mt., in northern New York, where it has been found by the writer. It is highly probable that *granulosus* of Chaudoir is identical, as stated by Dr. Roeschke, and that all the northern localities, Hudson Bay, White Mts. of New Hampshire, perhaps even Canada, cited by him, are inhabited by this species. As to the more southerly localities cited, I have never seen any *brevoorti,* correctly determined, from such; and, being convinced that Dr. G. H. Horn confused the more roughly sculptured forms of *lecontei* with *brevoorti,* as indicated by his remark that every intergrade of sculpture could be found, I suspect that the specimens on which Dr. Roeschke's citations of Virginia, West Virginia, and Charleroi were based were not *brevoorti* at all, but rough forms of *lecontei* erroneously identified by Horn or his followers.

The third (*schaumii*) was described from Ohio, and has been found in recent years by R. J. Sims in the northern part of that state and distributed by him or by Charles Dury. The citations of

Canada, West Virginia, Virginia (Roeschke), and Indiana? (Leconte coll. fide Blanchard) are plausible; but the "Washington, D. C.," locality is contrary to probability and to all the information I can gather, and is possibly also based on the "Charleroi" confusion mentioned above.

It is useless to repeat here the minute descriptions of these three forms, which have been well written by their respective authors; but briefly it may be said that *brevoorti* is a comparatively small (about 12 mm.) dark æneous insect, while *nitidicollis* and *schaumii* are both larger (about 18 mm.) and more brilliantly colored, differing between themselves in form of thorax and in punctuation. The main object of these notes is to point out that *brevoorti* is not a synonym of *nitidicollis;* and that no one of the three forms under discussion is an Atlantic coastal plain insect or ordinarily liable to be found at Washington, D. C.

There are other criticisms on Dr. Roeschke's paper which are, however, more matters of opinion than of fact, and may therefore be merely mentioned for the guidance of future students of the tribe. In the subgenus *Irichroa;* for instance, *germari* is more nearly related to *guyoti* than to *andrewsii;* in *Sphæroderus, bicarinatus, stenostomus* and *lecontei* are valid species; the former varies indeed in the development of the elytral carinæ and is in that character approached by some examples of *lecontei,* but it never loses the peculiar parallel sided form, of which no examples of *lecontei* present any suggestion; the two latter are separable by any number of characters, and, since their range is in part the same territory, it is impossible to regard them as geographical races one of the other.

In regard to *Sphæroderus canadensis,* it may be mentioned that Mr. Blanchard in his letters points out that this species is represented in the White Mts. of New Hampshire as well as in the localities given by Dr. Roeschke, but by a race not identical with the typical form; the interstitial erect setæ noted in the typical form are lacking and the elytral striæ are impunctate. This race was called *blanchardi* in our correspondence and may be described as follows:

Sphæroderus canadensis subsp. **blanchardi** n. subsp.

Similar to *canadensis* in size, form and color, but with the margins less blue, the marginal and epipleural punctures less deep and coarse, the elytral margin less strongly reflexed, the elytral striæ almost impunctate, the first and second only showing feeble punctuation, and with the disk of the elytra destitute of the setigerous punctures that occur on the fourth and seventh intervals in *canadensis*. In *canadenis* the fourth interval bears six to eleven setæ, the seventh interval five to eight setæ; in *blanchardi* no setæ or setigerous punctures are found on these intervals. The submarginal interval also usually bears fewer setæ in *blanchardi* (about 12) than in *canadensis* (about 16). Length, 11 to 13 mm.

Occurs in White Mountains of New Hampshire and near the summit of Mt. Watatic in Massachusetts, very near the New Hampshire Line. Type from Randolph N. H., in my collection; other specimens in Mr. Blanchard's collection.

In regard to the subgenus *Pseudonomarctus,* it may also be added that the tendency toward a loss of the elytral striæ is carried further in a specimen in Mr. Blanchard's collection from North Carolina (Highlands) than in any of the described species in that only one sutural stria remains. It probably represents a new species, though additional specimens might show intergrading forms. The rarity in collections of most of the species of *Nomarctus* inhabiting the Allegheny Mts. makes their study difficult especially in determining the limits of individual variation.

NOTES ON CICADAS FROM THE UNITED STATES WITH DESCRIPTIONS OF SEVERAL NEW SPECIES.

By Wm. T. Davis,

New Brighton, Staten Island, N. Y.

While the writer has a rather large collection of Cicadas from the United States, more material may cause the opinions here expressed to be considerably modified. Especially is this the case regarding those species originally described without locality, such as *swalei, olympusa, viridifascia* and *sex-guttata.* More specimens are also to be desired from the type locality of what is here considered as Say's *Cicada vitripennis.*[1]

[1] The author is indebted to Mr. Chris. E. Olsen for making a number of drawings of genitalia, and to Mr. Howard H. Cleaves for taking the photographs from which the plates have been made.

Cicada figurata Walker.

This species was described in 1858 in List of the Specimens of Homopterous Insects in the collection of the British Museum, Supplement, p. 19. Unfortunately no locality was given. The description in part is as follows: " Black, mostly tawny beneath. Head with a large tawny spot on each side in front between the eyes. . . . Prothorax reddish, black in front and behind, with a double tawny stripe; border tawny, with a black streak on each side. Mesothorax with four oblique tawny stripes; the middle pair recurved inward; the lateral pair enclosed at each of their tips by a lateral tawny streak; sides and hind ridges tawny. Legs tawny. Wings vitreous. Fore wings narrow, much acuminated testaceous at the base, and with a testaceous streak along the sixth discoidal areolet; primitive areolet black; veins piceous; costa testaceous to the tip of the front areolet; first and second transverse veins slightly curved, clouded with black. . . . Length of the body 17 lines; of the wings [expanse] 44 lines."

As far as the writer is aware the insect has not been recognized since it was described and the name has been placed as a synonym of *Cicada auletes* or *grossa* by Distant and of *Cicada marginata* by Uhler. Lately seven specimens have been examined that are well covered by the above description. They are as follows:

Logansport, DeSoto Co., Louisiana, August 1905, male. (Received from W. Dwight Pierce.) Coll. U. S. National Museum.

Verda, Grant Co., Louisiana, July, 1915, male. (Received from Prof. R. W. Harned.) Coll. Agri. College, Miss.

Alabama, female. Coll. Brooklyn Museum of Arts and Sciences.

Mobile, Alabama, female (H. P. Loding). Davis collection.

Mississippi, female. (Received from Prof. R. W. Harned.) Coll. Agri. College, Miss.

Meridian, Lauderdale Co., Miss., Sept. 10, 1915, female. (Rehn & Hebard). Davis collection.

Gainesville, Florida 1915, male. (J. R. Watson.) Davis collection.

All of the above mentioned are dull, tawny colored insects, with narrow and much acuminated fore wings with the primitive aerolet black. In the considerable number of specimens that we have of *Cicada resonans* and *Cicada similaris,* the fore wings are not as acuminate, and the primitive or basal aerolet is not black. The membranes or flaps at the base of both the fore and hind wings are dark gray in both *resonans* and *similaris,* also in *lyricen,* whereas in what we take to be *figurata* they are yellowish in color, especially those of the fore wings, with a pinkish tinge. In *similaris* the uncus when seen in profile is shaped something like the head of a snake with expanded jaws; in what we have identified as *resonans,* the uncus when viewed in profile is broad at the tip and shaped somewhat like a horse's hoof, and when viewed from the back the extremity is broad and truncated and not notched. In what we consider *figurata* the uncus is simple. When it is seen in profile it is scoop-shaped, and from behind it is obtusely rounded with the extremity not as broad as in *Cicada lyricen* which it somewhat resembles. We formerly expressed the opinion (this JOURNAL, March, 1915, p. 8) that *Cicada figurata* might be either *Cicada lyricen* or *Cicada similaris,* but since we have seen the male from Louisiana referred to above and which we figure, we think that Walker's species has been rediscovered. Mr. Charles Schaeffer, of the Brooklyn Museum, has had, for some time, the female belonging to that institution set aside as a distinct species.

Cicada aurifera Say.

Thomas Say described this species in 1825, but recent authors have failed to identify it. Say says in part: "Body covered with golden pubescence; beneath hairy. Inhabits Missouri . . . the two particular anastomoses are strongly marked with blackish . . . thorax but little varied with black: scutel [mesonotum] black, with the usual testaceous lines: tergum black, densely covered with golden hair: beneath pruinose. Length one inch and a half nearly to the tip of the hemelytra. Found near the Konza village."

When Smith and Grossbeck wrote their paper "Studies in Certain Cicada Species," published in Entomological News, for April, 1907, they examined the specimens in the collection of the U. S. National Museum at Washington and noted on a label placed below two females from Kansas, "New Species." From lack of material they refrained from describing the insect which is here identified as *Cicada aurifera.* In 1914 the writer received a male of this species from Mr. J. C. Warren of Wakefield, Kansas, and more recently he has had the privilege through the courtesy of Prof. S. J. Hunter and Mr. R. H. Beamer of examining forty-nine additional specimens from the collection of the University of Kansas. We think that the species represented by this extensive material is Say's long lost *Cicada aurifera*. It is of the right size; fresh specimens are pubescent; beneath hairy; the first and second cross veins conspicuously blackened, almost spot-like; the pronotum is almost wholly green and "little varied with black"; the mesonotum is black with the "usual tectaceous lines"; the tergum is black covered with golden hair in fresh specimens; beneath pruinose, and lastly most of the insects came from near the type locality, for Franklin Co., Kansas is not far from the site of the Konza Indian village visited by Thomas Say.

Uhler states in his Preliminary Survey of the Cicadidæ of the United States, Antilles and Mexico, Transactions Maryland Academy of Science, 1892, that *Cicada aurifera* was known only from the original description and adds: "It seems to be a pale variety of *C. canicularis,* which inhabits that state, but the size given is smaller than that of any specimens thus far brought to our notice." He was nearly correct in this, for *Cicada aurifera* is related to *Cicada canicularis* Harris, but still more closely to *Cicada davisi* Smith and Grossbeck. We figure a male *Cicada aurifera* from Franklin Co., Kansas, a male *Cicada canicularis* from Lake Mahopac, New York, and a male *Cicada davisi* from Manson, N. C. It will be seen that in *canicularis* the eyes are not set as obliquely as they are in *davisi,* and in *aurifera* they are still less prominent. In examples of the same expanse of wing, *aurifera* measures less across the head than does *davisi.* The uncus when seen from behind is broader in *canicularis* than in *davisi* and *aurifera,* but in *aurifera* the tip is more gradually rounded in either of the other two. Beneath the opercula are about of the same shape in all three species. The color pattern of the three species is similar. The pronotum is all green in *aurifera* with the exception of the triangular black spot contiguous to the anterior margin and enclosing a wedge-shaped spot of green. In *davisi* the pronotum is usually more black, but the hind margin or collar is green. In *canicularis* the collar is green with its front margin often edged with black. The mesonotum is blacker in *canicularis* than in either of the other two; the usual W-mark and elevated X of a lighter color, is present in all three. The tergum is black in the three species, but in *aurifera* the hind margins of the segments are often edged with testaceous. The wings of *canicularis* and *davisi* are of the same shape, but in *aurifera* they are proportionately shorter and broader. The first and second cross veins of the fore wings are but slightly infuscated in *canicularis* and sometimes not at all; in *aurifera* the infuscation is sharply defined, while in *davisi* it is generally more indefinite and the ends of the fore wings are often clouded as well. Beneath, all three species are pruinose when fresh. *Canicularis* has the central area shining black and extending in the form of an irregular band to the end of the abdomen; in *davisi* this band is more green, especially along the sides and still less definite, while in *aurifera* the band is almost obsolete, in rubbed specimens there being usually an oblong black spot at the base of each segment on the under side.

The following specimens of *Cicada aurifera* have been examined:

Franklin Co., Kans., 895 ft., 23 males, 15 females (R. H. Beamer). Collection University of Kansas.

Anderson Co., Kans., 1047 ft. 1915, 2 males, 1 female (R. H. Beamer). Collection University of Kansas.

Allen Co., Kans., 962 ft., 1915, 3 males, 1 female (R. H. Beamer). Collection University of Kansas.

Riley Co., Kans., Sep., 1 female (Marlatt). Collection U. S. National Museum.

Kansas, 1 female (Marlatt). Coll. U. S. Nat. Museum.

Wakefield, Clay Co., Kans., Aug. 25, 1914, 1 male (J. C. Warren). Davis collection.

Seward Co., Kans., 2,600 ft., August 18, 1911, 2 males, 2 females (F. X. Williams). Collection University of Kansas.

Cicada townsendi Uhler.

In the collection of the United States National Museum there is a male cicada marked "Las Cruces" on one label, and "*Cicada Townsendii*, Uhler, New Mex." on the other. This is supposed to be one of the specimens from which Uhler drew up his original description, for he says that four of them came from the vicinity of Las Cruces, New Mexico. Mr. Otto Heidemann, in charge of the cicadas in the National Museum, has kindly permitted my having a figure made of the specimen, which is here presented. In addition to this typical specimen, we figure through the courtesy of Dr. Henry Skinner a smaller and more pruinose male from Alamogordo, New

Mexico, May 10, 1902. Other material examined has been as follows:

Southern California. A female in the U. S. Nat. Museum bears the label "Southern Cal. (not Lower Cal.)."

"Texas." A rather small male and female. Coll. U. S. Nat. Museum.

Marfa, Tex. June 5, 1908, male and female (Mitchell and Cushman). Coll. U. S. Nat. Museum.

Marathon, Tex. June 7, 1908, female (Mitchell and Cushman). Coll. U. S. Nat. Museum.

In Utah, Colorado and Kansas there is another cicada that greatly resembles *townsendi*, but is a little smaller and has a very differently shaped uncus. It may be described as follows:

Cicada bifida new species.

Type male, Clear Creek, Colorado, July 23, 1914. Davis collection.

Allotype female, St. George, Washington Co., Utah (Engelhardt and Doll). Davis collection.

A black and yellow green colored species; fresh specimens conspicuously pruinose.

Head black, with the following yellowish tinged with green: a spot above the base of each antenna, a central triangular spot in front of the ocelli, an irregular spot of a little lighter color on each side near the eye and contiguous to the hind border, and a small spot on the front above the transverse rugæ. Pronotum yellowish green with a large central black spot which is broadened near the front margin, and to a very much less extent on the hind margin where it extends on to the collar. In some of the paratypes this black spot contains one of a yellowish green color. On either side the grooves are blackened, and the hind margin or collar is blackened in the center, as mentioned above, and has a black spot each side at the humeral angles. Mesonotum black with the central W-shaped mark near the front margin yellowish green in color; behind this is the elevated x also yellowish green and with the anterior marks extending well forward and nearly touching the W-mark. The sides near the base of the fore wings are also yellowish green. Tergum black with an indication of a dorsal row of pruinose spots faintly defined; sides of the abdomen irregularly bordered with yellowish green, the last segment being nearly all of that color except the central area which is darkened. The fore wings have the costal margins yellowish green nearly to the extremities of the wings and the subcostal veins are blackened; the first and second cross veins are darkened, but not conspicuously so. The basal areole of each fore wing contains a short darkened dash of color, otherwise they are nearly clear; the flaps of both the fore and hind wings are grayish white. Beneath lighter and nearly of a uniform yellowish color, with a little black about the eyes and on the legs which are more or less streaked, the fore tibiæ and tarsi being nearly all blackened. Opercula slightly lighter colored than the segments; overlapping for more than half of their length; about half as long as the abdomen and symmetrically narrowed from each side to a rounded point. Uncus when viewed in profile slender and much curved, and when seen from

C. townsendi. C. bifida.

behind widened and deeply cleft at the extremity. It somewhat resembles in form the iron claw often used in pulling tacks. The insect is quite pruinose beneath, especially on the fore parts, and above, the pruinose areas often cover the lighter markings.

MEASUREMENTS (IN MILLIMETERS).

	Male Type.	Female Allotype.
Length of body	27	25
Width of head across eyes	9.5	9.5
Expanse of fore wings	71	72
Greatest width of fore wing	12	12
Greatest width of operculum	6	
Greatest length of operculum	9	

In addition to the type which is figured, and allotype, the followlowing specimens have been examined:

St. George, Washington Co., Utah, July, male (Engelhardt and Doll.) Davis collection.

Golden, Colorado, July 18 and 20, 1909. Male and female. Collection W. J. Gerhard.

Morton Co., Kans., 3,200 ft., June, 1902, one male and three females (F. H. Snow). Collection University of Kansas and Davis collection.

Hamilton Co., Kans., 3,350 ft., June, 1902, three males (F. H. Snow). Collection University of Kansas and Davis collection.

Garden City, Finney Co., Kans., June, 1895, male and female (H. W. Menke). Collection U. S. Nat. Museum.

Arizona, male. Uhler collection, U. S. Nat. Museum.

As has been stated *Cicada bifida* greatly resembles *Cicada townsendi* which, however, appears to range somewhat further to the south. It may be readily distinguished from that species by being smaller, by the less prominent front; by having the basal cell of the fore wings less black and the collar or hind margin of the pronotum of a nearly uniform color, that is it has not about the frontal half blackened as in *townsendi*. The uncus in *Cicada bifida* is deeply cleft at the tip, and simply rounded in *townsendi*. Further in *townsendi* the penis is armed with a chitinous pair of thorns dark in color and bent inward, which are not present in *Cicada bifida*.

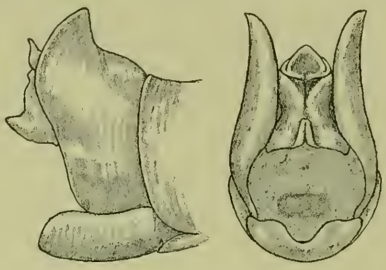
Cicada castanea new species.

Type male, Jerome, Arizona, June (Oslar). Davis collection.

Allotype female, Prescott, Arizona (Oslar). Davis collection.

The triangularly shaped opercula of this species are proportionately much longer than they are in *Cicada cinctifera* from the same region, and they are also more rounded at the tips.

Head with the front ochraceous tinged with black and a small, brighter spot at apex. A broad, irregular black band connects the eyes, behind which, each side, are two ochraceous spots, and an oblong one of the same color is above the base of each antenna. Pronotum castaneous with a central longitudinal dark band dilated both anteriorly and posteriorly (in some of the paratypes enclosing a castaneous streak); the front margin narrowly lined with a streak of a lighter color. The posterior margin or collar clouded with black near the humeral angles, and yellowish on anterior angles, otherwise of the same color as the main portion of the pronotum. Mesonotum shining black with a faint castaneous W-shaped line outlining two obconical spots on the central part of the fore margin; the sides and the cruciform elevation custaneous with two black depressed dots near the upper extremities of the latter. Tergum castaneous with the tympanal areas lighter and each segment faintly clouded at base; last segment with a conspicuous pruinose spot each side. Fore wing with the costal margin green to the end of the radial cell, beyond darkened. Subcostal vein dark brown. The marginal cells down to the cubital cell slightly clouded with brown, but each cross vein heavily clouded, also an indication of several small, dark spots along the outer margin. One of the female paratypes constitutes a variety having the fore wings suffused entirely with brown, as well as about two thirds of the area of the hind wings. At base the fore wings are darkened, also a dark spot in each basal cell; the membranule orange with a pinkish tinge. Hind wings orange at base, clouded beyond, the color spreading out over nearly all of the area of the last two anal cells. Beneath yellowish with a black spot contiguous to each eye and a few conspicuously black spots near the base of the legs, particularly those of the median pair. The triangularly shaped opercula are long and rather blunt at the lower extremities and extend about one half the length of the abdomen.



Cicada castanea

The uncus when seen in profile has at the extremity a projection like an upturned nose; when viewed from behind it is seen to be divided longitudinally through this nose; the ends are expanded and truncate. The last ventral segment of the female is doubly notched at its extremity, that is, it is broadly notched and this notch in turn has a central one.

MEASUREMENTS (IN MILLIMETERS).

	Male Type.	Female Allotype
Length of body	19.5	20
Width of head across eyes	8	8
Expanse of fore wings	63	64
Greatest width of fore wing	10	10
Greatest width of operculum	4.5	
Greatest length of operculum	6	

In addition to the type which is figured, and allotype, the following specimens have been examined:

Jerome, Arizona, three males, two females (Oslar). Davis collection.

Prescott, Arizona, nine males (Oslar). Davis collection.

Baboquivari Mts., Arizona, male (F. H. Snow). Collection Univ. of Kans.

Santa Rita Mts., Arizona, female. Collection Brooklyn Museum of Arts and Sciences.

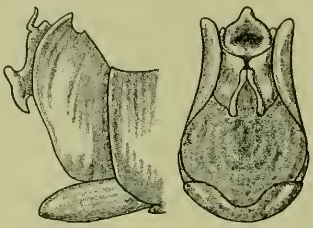
This species resembles somewhat *Rihana virgulata* Distant, from Mexico, figured in Biol. Centr.-Amer., Rhynch Hom. 1, p. 140, but in that insect the opercula are short, and the eyes are more prominent. It resembles still more closely *Rihana swalei* Distant, described without locality but supposed to come from Central America. The figure in Ann. Mag. Nat. Hist. (7), xiv, p. 427 (1904), shows a more robust-bodied species than *castanea* with more prominent eyes. There also appears to be differences in color pattern in the head, pronotum and mesonotum. *Castanea* from its form and character of genitalia, belongs near to *delicata* Osb., *reperta* Uhler and *sordidata* Uhler, that is in the genus *Cicada* as defined by Distant, and not in his genus *Rihana*. This species in time when more collecting has been done, may prove to be a variety of *swalei,* but the name *castanea* can still apply, especially to the variety with the fore wings entirely suffused with brown, as shown in the female from the Santa Rita Mts., Arizona, and included in the description.

Cicada arizona new species.

Type male, Santa Rita Mts., Arizona, 5,000 to 8,000 ft., June (F. H. Snow). Davis collection.

In form resembling *Cicada castanea,* but smaller with clear wings and short rounded opercula.

Head black with a greenish yellow spot above the base of each antenna and one each side at posterior margin; median sulcus on front also greenish yellow. Pronotum greenish yellow with a central longitudinal dark band dilated both anteriorly and posteriorly; grooves narrowly lined with black; posterior margin or collar greenish yellow but clouded at the extremities. Mesonotum shining black with two curved lines in the form of parenthesis near the front margin and the cruciform elevation greenish yellow in color. There are two black, depressed dots near the upper extremities of the cruciform elevation. Tergum dark chestnut colored with the relatively large and protruding tympanal areas slightly lighter in color. Wings clear, with the costal margin yellowish to beyond the middle of the wing and then clouded; the subcostal vein is dark brown. First and second transverse veins clouded. Membranule of the fore wings pinkish at base; those of the hind wings more gray. Beneath yellowish and more or less pruinose; black about the eyes and pink on each side of the transverse rugæ; a few black spots near the base of the legs. The opercula are short, do not touch and have the extremities obliquely rounded. The uncus viewed in profile has a relatively large protuberance extending backward from its central portion, below which the extremity is bent inward in the form of a claw. Viewed from behind, it is seen that the uncus is divided longitudinally and that it ends in two claws separated considerably and from between which the penis protrudes.



Cicada arizona

Measurements (in Millimeters).

	Male Type
Length of body	17
Width of head across eyes	7
Expanse of fore wings	52
Greatest width of fore wing	7.5
Greatest width of operculum	4
Greatest length of operculum	3

In addition to the type which is figured, five males have been examined, all from the Santa Rita Mts., Arizona, collected by Prof. F. H. Snow and in the collection of the University of Kansas.

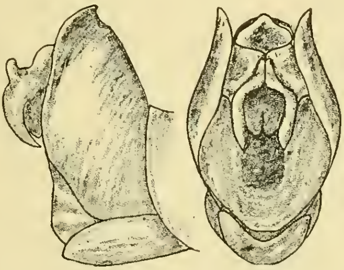
Cicada eugraphica new species.

Type male, Albuquerque, Bernalillo Co., New Mexico. Davis collection.

Allotype female, Barstow, Ward Co., Tex., July 20, 1905 (J. C. Crawford). Collection U. S. National Museum.

An orange and black species with clear wings.

Head black with an orange spot above the base of each antenna and a larger one each side nearer the eyes; also one each side contiguous to the hind margin. The transverse rugæ are blackened, orange at the sides and an orange spot on the front; no longitudinal impressed line. Pronotum orange and black, the central longitudinal stripe conspicuously orange, with a dissected black band each side which is widened anteriorly and posteriorly; grooves blackened; collar orange, irregularly blackened along the front margin, also at the humeral angles. Mesonotum with four obconical black spots, the inner pair short, the outer pair longer and extending backward to the elevated x; there is also a black stripe extending along each side from the x to the base of each fore wing. Between the x and the two central obconical spots there is an irregular cross-shaped spot, and the two depressed black points, common to many species, and near the anterior extremities of the x, are also present. The x and lighter lines on the mesonotum are orange. The tergum is a very dark brown; the segments narrowly edged with orange posteriorly, and the lateral grooves extending down the sides from the dorsal line are noticeable. The fore wings have their costal margins orange for about half of their length, beyond which they are blackened; the subcostal veins are very dark brown. The first and second cross veins of the fore wings are not clouded; both pairs of wings are orange at the base with the flaps grayish white. Beneath lighter colored, the legs orange, streaked and spotted with testaceous. The abdomen with the segments darkened along each side. Opercula light orange, a little less than half as long as the abdomen, and rounded



Cicada eugraphica

at the extremities, the inner edges touching or nearly so. Uncus when viewed in profile showing a considerable protuberance extending backward from its central portion, below which it terminates as a curved claw bent inward; when seen from behind of the wish-bone shape, stouter and with the extremities more bent toward each other than in the next species.

MEASUREMENTS (IN MILLIMETERS.)

	Male Type.	Female Allotype.
Length of body	22	23
Width of head across eyes	8.5	9.5
Expanse of fore wings	62	70
Greatest width of fore wing	9.5	11
Greatest width of operculum	5.5	
Greatest length of operculum	5	

In addition to the type, which is figured, and allotype, the following specimens have been examined:

Marfa, Presidio Co., Tex., June 5, 1908, three males (Mitchell and Cushman). Coll. U. S. Nat. Museum.

Van Horn, Culberson Co., Tex., June 19, 1909, male (F. C. Bishopp). Coll. U. S. Nat. Museum.

Barstow, Ward Co., Tex., July 22, 1905, male (J. C. Crawford). Coll. U. S. Nat. Museum.

Mesilla, Dona Ana Co., New Mex., July 1, 1897, male and female. Coll. Prof. A. P. Morse.

Alamogordo, Otero Co., New Mex., seven males (G. v. Krockow). Coll. Am. Museum Natural History.

Graham Mts., Ash Creek, Arizona, alt. 3,200 ft., May 30, 1914, male (E. G. Holt). Coll. U. S. Biological Survey.

Graham Mts., Arizona, June 29, 1914, male (E. G. Holt). Coll. U. S. Biological Survey.

San Bernardino Ranch, Cochise Co., Arizona, 3,750 ft., Aug., male (F. H. Snow). Coll. University of Kans.

Douglas, Cochise Co., Arizona, Aug., male (F. H. Snow). Coll. University of Kans.

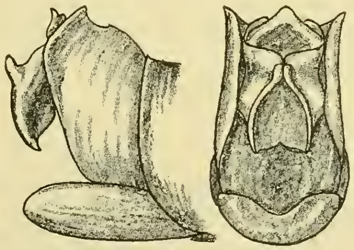
Cicada eugraphica is sometimes labeled in collections *Cicada vitripennis* Say which it resembles, but this last is a much lighter colored and greener insect with the fore wings narrower, and the uncus, when seen in profile, with the curved claw more slender. *Cicada vitripennis* also occurs more to the eastward.

This is not the Mexican *Cicada crucifera* Walker, in which the second marginal areolet is very much longer than the first, whereas in *eugraphica* the first is much longer than the second.

Cicada texana new species.

Type male, Lyford, Cameron Co., Texas, Aug. 6–7, 1912 (Rehn and Hebard). Davis collection.

Head with the black band that extends between the eyes in many species here broken up into spots as follows: the region about the ocelli is black, there is a black spot on each side of this and there is black about the eyes. The transverse rugæ are streaked with black and there is a green spot centrally on the front. The remainder of the head is greenish or yellowish green. Pronotum yellowish green with a central, longitudinal broad stripe of a lighter green. On either side of this are two interrupted black stripes with their extremities broadened at the anterior margin. Beyond this the furrows are blackened. The hind margin or collar is uniformly green in color in the type and three of the paratypes; in the fourth there is a brownish point each side near the humeral angles. Mesonotum with two short obconical black spots at the fore margin, on either side of which there is a much dissected dark band, broadest anteriorly and extending backward to the extremities of the elevated x; there is also a dark stripe extending along each side from the x to the base of the fore wings. There is an irregular cross-shaped spot between the x and the two central obconical spots, and the two depressed black points, common to many species, and near the anterior extremities of the x are also present. The x and lighter lines on the mesonotum are yellowish in the type, but the x is greener in the paratypes. The tergum is testaceous; the tympanal areas lighter, each darkly clouded near its center, and the segments are lighter in color along their posterior margins. The dorsal surface is more or less covered with a short, silken, light-colored pubescence. The fore wings have the costal margins greenish yellow for about half of their length, beyond which they are blackened; the subcostal veins are dark brown. The first and second cross veins of the fore wings are clouded, and the flaps at the base of both fore and hind wings are whitish or grayish white. Beneath lighter colored and pruinose, blackened about the eyes, the legs yellowish, streaked and spotted with testaceous. The abdomen nearly uniformly colored except the darker spot on the last ventral segment and a linear one on the valve; segments slightly darkened along the base. Opercula yellowish, a little less than half the length of the abdomen and rounded at the extremities, the inner edges almost touching. Uncus when viewed in profile with the inner edge not



Cicada texana

deeply notched, as in some species, but more rounded with the extremities bent inward, and when viewed from behind the hard raised portion resembles in shape a widely arched wish-bone. In *Cicada sordidata* Uhler the uncus, when viewed in profile, has the claw-like extremities freer and bent inward to a greater extent, and when viewed from behind the wish-bone arch is not as wide.

MEASUREMENTS (IN MILLIMETERS).

	Male Type.
Length of body	22
Width of head across eyes	8.5
Expanse of fore wings	58
Greatest width of fore wing	9
Greatest width of operculum	4.5
Greatest length of operculum	5

In addition to the type, which is figured, and which is a rather small individual, the following specimens have been examined:

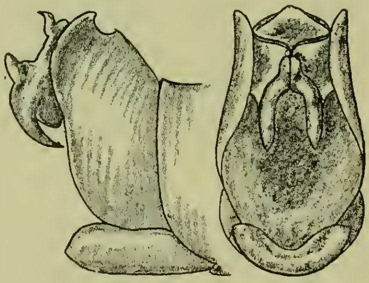
San Benito, Cameron Co., Tex., fifteen males. Davis collection.

Brownsville, Cameron Co., Tex., three males (F. H. Snow). Coll. University of Kans.

Cicada texana closely resembles *Cicada sordidata* Uhler from Florida and Georgia, but may be separated from that species by the differently shaped uncus, by the less prominent grooves extending laterally down the sides of the abdominal segments and by having a somewhat brighter color pattern. There also seems to be, judging from the material at hand, some constant differences in color.

Cicada olympusa Walker.

Cicada sordidata Uhler, was described in the Transactions of the Maryland Academy of Sciences, 1892, p. 175, from two males from Southern Florida. We figure a male from Big Pine Key, Fla., Sept.



Cicada sordidata

19, 1913, that has been compared with one marked "S. Fla." in Uhler's collection in the United States Nat. Museum, and labeled in his handwriting "*Cicada sordidata*." This was no doubt one of his types. His published description is very full and among other things he says that the first three apical areoles of the fore wings "including the veins and cross veins smoke-brown." This is subject to some variation, though the first and second cross veins are always clouded in mature specimens. He says: "Opercula short, pale, but little more than one-third the length of the abdomen, narrowing toward the tip, and rounded there; the tips widely separated by a wedge-shaped space; the drums completely covered by an inflated segent, with a wide interval between, which is occupied at the outer end by a smooth hump. The raised smooth line thus begun is continued back upon the succeeding tergal segments, and from each prominence a grooved line extends outwards to the border of the segments."

Cicada olympusa Walker was described in 1850, but no locality was given. It has been credited to North America by Distant. The description would seem to cover *Cicada sordidata* which is of the same size and we have been unable to find any other species in collections that fits it so well. Walker says in part: "scutcheon of the fore-chest [prothorax] adorned with four black stripes; the middle pair long, widened on the fore border and on the hind border; the outer pair short and slightly curved; furrows and sides blackish; hind scutcheon [hind margin or collar] green, widened, rounded and adorned with a large pitchy mark at the base of each fore-wing, nearly straight on each side: scutcheon of the middle chest [mesonotum] adorned with four obconical black stripes; inner pair short with tawny borders; outer pair much longer, excavated into eight separate parts; a large black spot with a black dot on each side between the inner pair and the cross-ridge . . . fore borders of the [abdominal] segments adorned with pitchy interrupted bands; overduct ferruginous: drums pale tawny, very small, far apart; inner sides pitchy."

If it is meant that the extremities of the opercula are far apart then the above description agrees with *sordidata,* in which, however, the upper and inner edges of the opercula touch or nearly so.

Cicada milvus was described by Walker in 1858 from a single female from the "United States" and has been placed by Distant as a synonym of *Cicada olympusa*. Walker describes *milvus* as reddish tawny and says in part: "Prothorax with four black stripes, the inner pair approximate, connected by a short black band in front, the outer pair very near the borders; two black discal dots; hind border greenish. Mesothorax with four conical black stripes, the inner pair short, the outer pair much intersected. Abdomen with an interrupted black band on each segment. Wings vitreous; veins pale green, black towards the tips. Fore wings with the first and second transverse veins clouded with dark brown." The wings are said to expand 27 lines, that is about 57 mm.

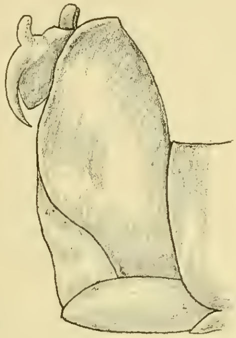
Cicada viridifascia Walker.

Cicada sordidata has been placed by Distant as a synonym of *Cicada viridifascia,* but this last is a larger insect, about the size of *Cicada reperta* Uhler. *Cicada viridifascia* was described in 1850 without locality. Walker says in part: "wings colorless; fore border tawny for half the length, black from thence till near the tip; veins tawny; cross-veins and adjoining parts of the longitudinal veins tawny; primitive areolet partly brown; fore-flaps whitish, as are also the hind-flaps at the base. Length of the body 11–12 lines [24–26 mm.]; of the wings [expanse] 33-34 lines [70–72 mm.]." This as well as the remainder of the description covers fairly well *Cicada reperta* Uhler, which has been found along the Atlantic coast from North Carolina to Southern Florida, but it does not cover *Cicada sordidata,* which has the first and second cross veins in the fore wings clouded and expands about 60–65 mm.

Cicada vitripennis Say.

What we have identified as this species is an insect with green in its coloring as mentioned by its describer; not entirely orange and black as in *Cicada eugraphica* from further west. Say says that the insect was presented to him by Mr. Nuttall "from the Arkansaw," and we figure a reddish green female collected by Mr. Alanson Skinner, July, 1914, at Perkins, Oklahoma, as probably from somewhere near the type locality. We have three additional specimens, all males and a little smaller of what appear to be of the same species, collected by Mr. W. J. Gerhard in July at Miller, Indiana, and Clark Junction, Indiana. Though a number of collections have been examined no species that so well fits Say's description has so far been found, but future collecting in the region from which the type came, may add to our knowledge in this particular.

A male *Cicada erratica* from Shreveport, La., kindly loaned by Prof. Herbert Osborn, its describer, is also figured. It is one of the seven males from which the original description was made and the figure here given of the genitalia will further serve in identifying the species. The genitalia of this insect is like that of the three much



Cicada erratica

smaller males from Indiana, mentioned above. We have a number of specimens of *erratica* from Logtown, La., June (E. S. Tucker, La. Agri. Exp. Sta.); Palmyra Island, about thirty miles below Vicksburg, Miss., June (R. N. Lobdell); Agri. College, Miss., July (H. E. Cox), and Scotts, Ark., August (John M. Moose, Jr.). The last three were kindly sent to me by Prof. R. W. Harned, to whom I am indebted for many cicadas. In the collection of the U. S. National Museum there is a female from Alexandria, La., June 22, 1910 (E. S. Tucker), and Prof. Harned has a specimen collected at Rosebloom, Miss., in August, 1915.

From present information we think that these related insects should be arranged as follows:

Species with first and second cross veins infuscated.

- **Cicada olympusa** Walker, 1850.
  - *Cicada milvus* Walker, 1858.
  - *Cicada sordidata* Uhler, 1892.
- **Cicada texana** Davis.

Species with clear wings.

- **Cicada eugraphica** Davis.

Cicada viridifascia Walker, 1850.
Cicada reperta Uhler, 1892.
Cicada vitripennis Say, 1830.
Cicada erratica Osborn, 1906.

It will be noted that the above arrangement is not in accord with that to be found in Genera Insectorum where some of the species mentioned are in the genus *Rihana* and others in *Cicada*. However, all of the species mentioned above have a general likeness, and if the uncus is examined it will be found to be of the wish-bone pattern. We think that all the species with the uncus simple, as for example *linnei, lyricen, similaris, pruinosa, sayi, canicularis, davisi, marginata, auletes, resh, figurata, resonans, superba* and others might well be placed in *Rihana*, or in some genus to separate them from those with the wish-bone shaped uncus, which we have here placed in *Cicada*. This would necessitate the removal of *Cicada dorsata* Say, as it appears in Genera Insectorum, to the genus *Rihana*, for it has a simple uncus and we think that this should be done. It is a very easy matter to relax a male cicada and pull out the genitalia with a pin so that part will dry in a position where it can be examined. In this way the genera *Rihana* or *Tibicen*, and *Cicada*, can be separated more satisfactorily than by comparing the relative length of the head with the space between the eyes.

Cicada delicata Osborn.

We figure one of the five typical males of this distinct species, from Cameron, Cameron Co., La., which Prof. Herbert Osborn has kindly sent to us for comparison.

The following records may be added:

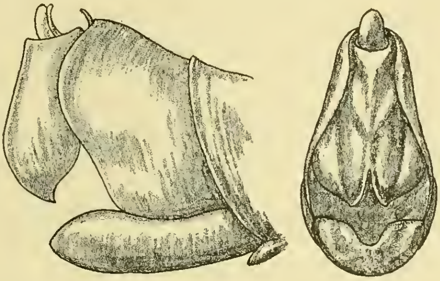
Brownsville, Tex., June, four males, one female (F. H. Snow). Coll. University of Kans., and Davis collection.

Katherine, Willacy Co., Tex., Aug. 8, 1912, female (Rehn and Hebard). Davis collection.

Del Rio, Valverde Co., Tex., 900–1,100 ft., Aug. 22, 23, 1912, male (Rehn and Hebard). Davis collection.

Cicada hieroglyphica Say.

This species was described in 1830 by Say, who says that it "Inhabits Pennsylvania and New Jersey," but is "rather rare." There are localities in the Pine Barrens, however, as for example Lakehurst, N. J., where in late June and in July it is often very common, and on warm days the songs of the numerous individuals constitute an almost continuous performance. We figure a male from Lakehurst, which will give a good idea of its size, form and wing pattern. The head, pronotum and mesonotum are tawny, tinged with green and marked with black as mentioned by Say; the abdomen tawny, narrowly lined between the tympana with black; a short longitudinal line on the dorsum of the second segment, the basal half of the last segment and most of the supra-anal plate, are also black. There is a conspicuous black spot behind each eye, not mentioned by Say, and



Cicada hieroglyphica

the black marks on the head, pronotum and prothorax are well defined. In the writer's collection there are specimens of this species, in form and markings like those from New Jersey, from Southern Pines, N. C., Clayton, Ga., Grand Bay, Mobile Co., Ala., and Osyka, Pike Co., Miss.

E. F. Germar in Thon, Entomologisches Archiv, II, 2, p. 4 [should have been p. 40], 1830, gives a description of *Cicada characterea*, which he says inhabits Georgia, America. The description is short but it covers *Cicada hieroglyphica*, and from the locality given there seems to be no doubt but what that was the species intended. This description has been overlooked of late years and has not been brought to the attention of entomologists, the name not appearing in Genera Insectorum. The question arises which name has priority as both *Cicada hieroglyphica* and *Cicada characterea* are recorded as having been proposed in 1830. Say's description appeared in the Journal of the Academy of Natural Sciences of Philadelphia and pages 179–244, which include his paper, were not published until August 1830, or later.

Cicada johannis Walker.

This was described in 1850, and St. John's Bluff, Florida, is given as the type locality. *Johannis* has been placed by Distant as a synonym of *Cicada hieroglyphica* and it probably is only a race. It, however, presents some differences and the writer for some time has regarded specimens from Florida as separable from typical *hieroglyphica*. In specimens otherwise of the same size the distance across the head at the eyes is generally greater than in New Jersey individuals, and the marks on the head, pronotum and mesonotum are more in the nature of black spots and dashes than of continuous lines. The black spot behind each eye is reduced to a narrow basal line in *johannis* and below the transverse black band on the front the region of the rugæ is unicolorous. In *hieroglyphica* there is usually a dark line running down the median groove of the transverse rugæ. There are a number of other color differences that are quite constant. We have a male from Carrot Island, near Beaufort, N. C., June 23, 1913 (F. Harper), that is marked like the specimens from Florida, showing that we may expect *johannis* along the coast. A male of *Cicada johannis* from La Grange, Brevard Co., Florida, is figured.

A few pages further on in the same publication where *Cicada johannis* was described, namely in the "List of the Specimens of Homopterous Insects in the Collection of the British Museum," Part 1, Walker describes *Cicada sex-guttata* without locality. He says the wings expand 30 lines instead of 26–28 lines as in *johannis* and that the tympana (he calls them opercula) are small instead of large as in *johannis*. His lengthy description of the color pattern fits the Florida species quite as well as any of the others here considered and many specimens from Florida are also of the size of his *sex-guttata*. This species has been placed by Distant as a synonym of *hieroglyphica*, but when large collections have been made some locality may yield specimens to fit the description.

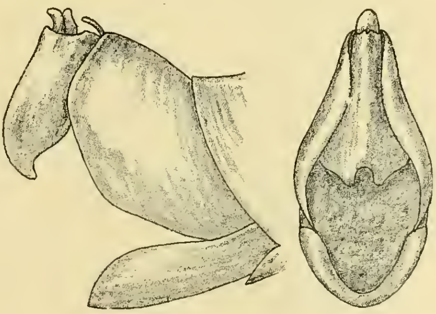
Cicada chisos new species.

Type male, Chisos Mts., Brewster Co., Texas, June 10–12, 1908 (Mitchell and Cushman). Collection U. S. Nat. Museum.

Allotype female, same locality and date. Davis collection.

Closely resembles *Cicada hieroglyphica* in markings, but is larger and has differently shaped fore wings, opercula and genitalia.

Head greenish tawny with a black spot each side slightly above the base of each antenna and adjoining the upper transverse rugæ. Front without any median groove at the upper portion of the transverse rugæ, its place being taken by an oblong greenish orange spot, rounded at the top and pointed at the bottom; each side the ridges of the rugæ are greenish orange and the grooves blackened. The region about the ocelli is included in a broad, somewhat U-shaped black mark, each side of which there is a large, curved, black spot extending toward the eye. There is a black mark on the inner side of each eye which extends backward so that the area behind each eye is wholly black. Pronotum greenish tawny, the central area occupied by two parallel black irregular marks widened before and behind until they meet, leaving a central dart-shaped area of a lighter color, the point of which points backward and extends to the collar. Each side of the two central marks there is a short, parallel irregular black stripe and the grooves are blackened. The hind margin or collar has on each side on its anterior edge, but nearer the humeral angles, a short black mark and on each humeral angle there is a broad curved black band extending to the eye. The mesothorax has extending backward from its fore margin seven black marks, the central one a narrow stripe extending backward nearly to the x. The next two marks on either side of the central one extend backward for nearly one half of the length of the pronotum; next comes a short spot with posterior end pointed and then the outer broad, black stripe extending backward nearly to the x and having a curved spot adjoining it at almost right angles. The x has a spot at each of its anterior extremities, otherwise it is greenish tawny like the rest of the mesonotum. The hind border is slightly more excavated at the x than in either *hieroglyphica* or *johannis*. Abdomen tawny, narrowly lined between the tympana with black; the basal half of the last segment and the supra-anal plate also black. The region of each spiracle is slightly clouded. The tympana are small with their anterior margins rounded and not covering the openings as



Cicada chisos

completely as in *hieroglyphica* and *johannis*. Beneath lighter, nearly unicolorous; black about the base of the rostrum; also at the base of the abdomen and each side near its tip. There are a few dark spots on the legs. The opercula are small and are more fully rounded out, that is, the outer margin of each one forms more nearly a part of a circle than in *hieroglyphica*. The uncus, which is figured, when seen from behind is broadly notched with the upper part of the notch rounded, and not narrowly notched as in *hieroglyphica*.

MEASUREMENTS (IN MILLIMETERS.)

	Male Type.	Female Allotype.
Length of body	27	22
Width of head across eyes	8	8
Expanse of fore wings	68	67
Greatest width of fore wing	11	10
Greatest width of operculum	3.5	
Greatest length of operculum	3	

In addition to the types the male of which is figured and will show the wing pattern, two paratypic males of the same date and locality have been examined. There are also many more specimens from the same locality in the collection of the U. S. Nat. Museum.

From *Cicada sex-guttata* of unknown locality, *Cicada chisos* differs in being larger, and in having a different color pattern on the head, pronotum and mesonotum. In Biol. Centr.-Amer., Rhynch. Hom. 1. Tab. 3, Figs. 2, *2a* and *2b*, a Mexican specimen is figured under the name of *Tettigia hieroglyphica* Say. With the exception of the shape of the opercula, which are fully rounded in *Cicada chisos*, the illustrations represent quite well the species under consideration.

EXPLANATION OF PLATES.

PLATE III.

Fig. 1. *Cicada figurata* Walker.
Fig. 2. *Cicada canicularis* Harris.
Fig. 3. *Cicada davisi* Smith and Grossbeck.
Fig. 4. *Cicada aurifera* Say.

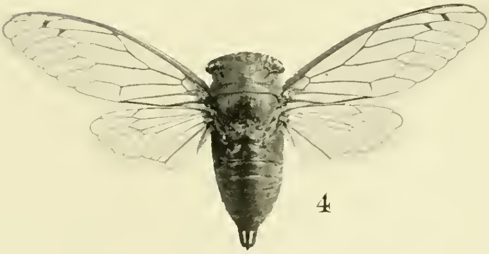
PLATE IV.

Fig. 1. *Cicada townsendi* Uhler. Type.
Fig. 2. *Cicada townsendi* Uhler.
Fig. 3. *Cicada bifida* Davis. Type.
Fig. 4. *Cicada bifida* Davis, enlarged.
Fig. 5. *Cicada castanea* Davis, enlarged.

1

2

3



4

Cicadidæ.

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2

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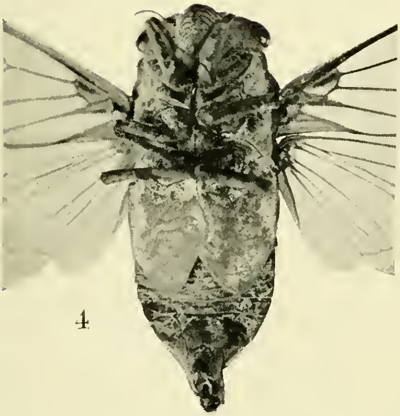

4

5

Cicadidæ.

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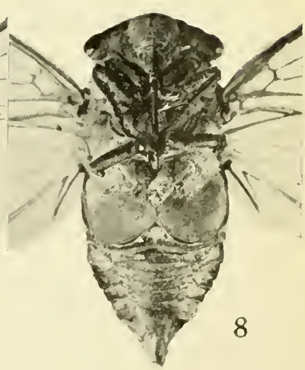
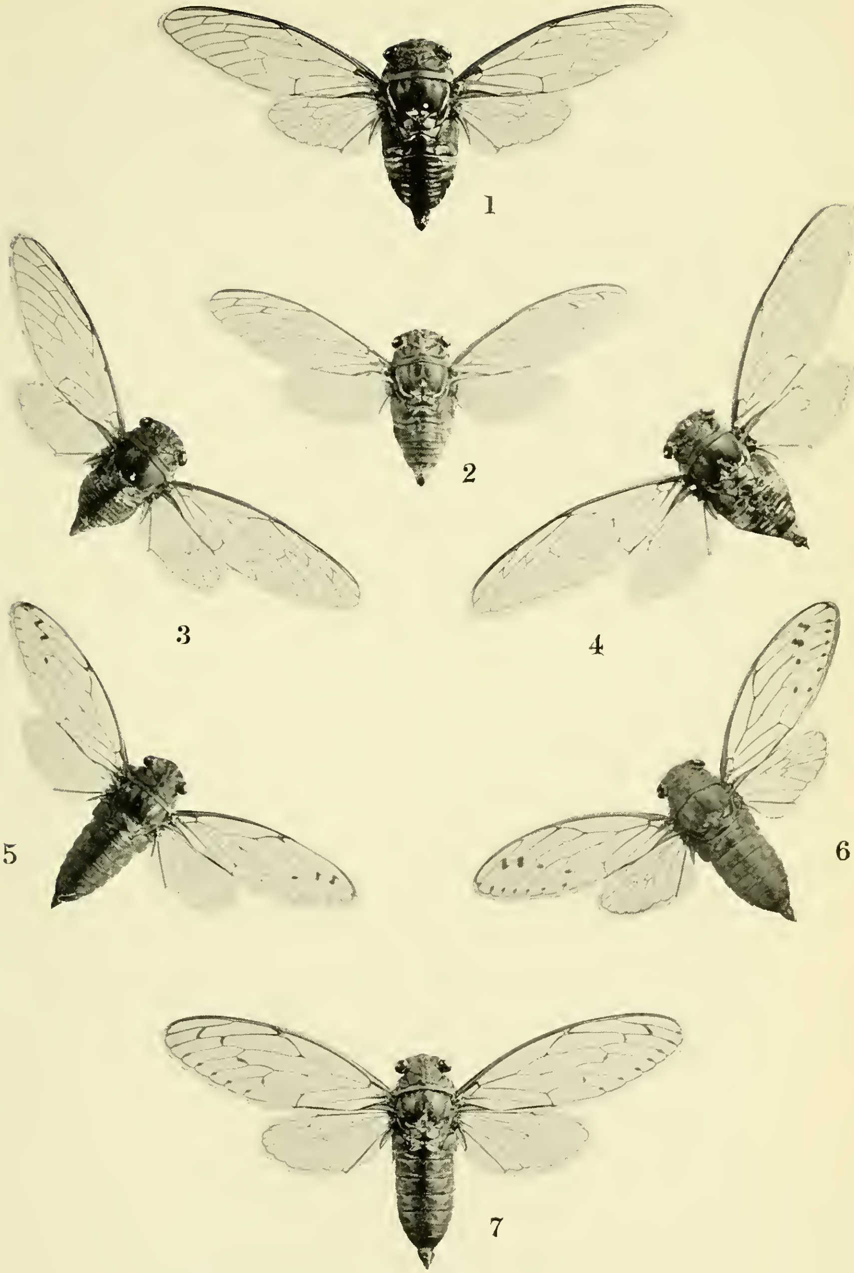


8

Cicadidæ.



Cicadidæ.

PLATE V.

Fig. 1. *Cicada castanea* Davis. Type.
Fig. 2. *Cicada arizona* Davis. Type.
Fig. 3. *Cicada eugraphica* Davis. Type.
Fig. 4. *Cicada texana* Davis. Type.
Fig. 5. *Cicada sordidata* Uhler.
Fig. 6. *Cicada arizona* Davis, enlarged.
Fig. 7. *Cicada eugraphica* Davis, enlarged.
Fig. 8. *Cicada texana* Davis, enlarged.

PLATE VI.

Fig. 1. *Cicada reperta* Uhler.
Fig. 2. *Cicada delicata* Osborn.
Fig. 3. *Cicada vitripennis* Say.
Fig. 4. *Cicada erratica* Osborn.
Fig. 5. *Cicada hieroglyphica* Say.
Fig. 6. *Cicada johannis* Walker.
Fig. 7. *Cicada chisos* Davis. Type.

NEW DIPTERA OF THE FAMILY ASILIDÆ WITH NOTES ON KNOWN SPECIES.

BY CHAS. SCHAEFFER,

BROOKLYN, N. Y.

While rearranging the museum material of the dipterous family Asilidæ, the following species were found among the unidentified material which appear to be new.

Stenopogon tenebrosus Coquillett.

The type of this species is not in the National Museum as Back[1] erroneously states, but in the Museum of the Brooklyn Institute. The specimen has the type label in Coquillett's handwriting.

Lasiopogon arizonensis new species.

Mystax white, pubescence of head anteriorly white, posteriorly yellowish. The usual median and lateral stripes of thorax brownish, median stripe very feebly divided by a paler line and not extending to the base, elsewhere the vestiture is gray; surface with a few short, white hairs, longer hairs poste-

[1] Trans. Am. Ent. Soc., XXXV, 207.

riorly white, two laterally brownish. Scutellum covered with a very fine gray pubescence, posterior margin with a few white bristles. Pleuræ and coxæ densely covered with white pubescence. Abdomen black, first segment with dense gray pubescence, following segments with a blackish-brown dust, posterior margins gray, the few hairs white, ventral segments grayish-white. Wings glossy-hyaline, veins brownish. Legs black, except fron tibiæ in about basal two thirds and middle tibiæ narrowly at base yellowish; hairs not very abundant, white, bristles white. Length 8.5 mm.

Huachuca Mts., Arizona. (Schaeffer). One male in excellent condition.

This neat little species differs principally from those so far known by the coloration of the abdomen and legs.

Eccritosia amphinome Walker.

Of this handsome species I have taken a female in the Huachuca Mts., Arizona. It is reported in the Aldrich catalogue from Lower California, Mexico, Guatemala and Honduras.

Erax subcupreus new species.

Head grayish-white pollinose, except the facial tubercle, which is almost without pollen and shows the brownish-submetallic ground color; mystax with white and black hairs and bristles; occipito-orbital and ocellar hairs and bristles black; beard white; palpi black, with black hairs and bristles. Thorax brownish-metallic, with grayish-white and brownish-gray pollen; median line with a rather dense crest of erect, black hairs, which does not extend to the scutellum, between the crest and the scutellum are moderately long, white hairs, intermixed with some black bristles. Scutellum somewhat densely clothed with moderately long white hairs and along the apical margin with some black bristles. Pleuræ feebly pollinose and with sparse darker and white hairs. Abdomen black with very faint brownish-metallic tint, segments one to five with long white hairs, parted at middle and directed outwards, those on the first segment are only on the thickened apical margin and on the second covering about apical third of the segment; segments six and seven grayish-white pollinose and covered with shorter white hairs. Hypopygium black with sparse gray and blackish hairs. Venter clothed with long white hairs which become shorter on the apical segments. Wings hyaline, slightly smoky towards the tip; costa distinctly thickened and dilated. Femora black with brownish submetallic tint, tibiæ brownish, at tip black, tarsi black; femora and tibiæ clothed with moderately long, white and gray hairs. Length 18 mm.

A single male from Prescott, Ariz., received from George Franck.

Apparently related to *E. costalis* Will. but with abdominal segments one to five, with long, white hairs. Williston, in his synoptic table of the species of Erax[1] gave the name *costalis* but neglected to

[1] Trans. Am. Ent. Soc., Vol. XII, p. 64.

give a description of the species. The species is not given in Aldrich's catalogue of North American Diptera, but is sufficiently characterized in the table to entitle it to recognition.

Erax subpilosus new species.

Head grayish-white pollinose, beard and mystax white, occipito-orbital bristles white. Thorax black, faintly grayish-brown pollinose, middorsal stripe faint; dorsum sparsely covered with short, black hairs, which are longer apically. Scutellum with black hairs and bristles, some of which are white apically. Pleuræ faintly pollinose, covered not densely with moderately long, white hairs. Abdomen black, first to third segments with black hairs, longer at sides, fourth segment with long white hairs intermixed with black hairs, which are directed outwardly, fifth segment white pollinose and with shorter white hairs, sixth and seventh segments densely white pollinose; apical margins of segments two to five grayish pollinose. Venter grayish-white pollinose covered with long, white hairs. Hypopygium black, clothed with shorter, white hairs. Wings pure hyaline. Legs entirely black, clothed with shorter and longer white hairs. Length 22 mm.

Beaver Creek Hills, Beaver Co., Utah, two males. (Doll and Engelhardt.)

The first three segments of the abdomen are clothed with black hairs, the fourth and fifth with white hairs, the hairs on the fourth segment are longer and more numerous than in most of the species but not as dense as in *stamineus, rapax* or *pallidus*.

Erax californicus new species.

Male.—Head grayish-white pollinose, mystax yellowish-white, beard white, occipito-orbital bristles black. Thorax black, dark grayish pollinose, dorsal stripes faint, dorsum with short, black hairs, which are longer apically. Scutellum with white hairs, apical bristles black. Pleuræ dark gray pollinose as the thorax and with moderately long, white hairs. Abdominal segments widely pale-grayish pollinose at sides, black and feebly shining along the middle, segments one to three with longer white hairs at sides, segments four to seven with sparse, shorter white hairs. Hypopygium black, clothed with sparse, short white hairs. Wings with a very slight yellowish-brown tinge. Legs black except the tibiæ which are at base reddish, densely clothed with rather long, white pile.

Female.—Colored as the male but the white hairs on the legs are shorter. The ovipositor is moderately long. Length 25–28 mm.

Shasta Co., Cal., male and female received from George Franck.

Another specimen, a smaller male from the same locality, has the abdominal segments four to seven almost entirely uniformly greyish-pollinose, otherwise it agrees with the larger specimen.

Promachus nigropilosus new species.

Head grayish-white pollinose, beard and mystax white, the latter with a few black hairs intermixed; occipito-orbital bristles black. Thorax black, somewhat shining, very faintly grayish pollinose; one brownish median and on each side a more or less distinct lateral stripe; dorsum clothed sparsely with short, black hairs, bristles black. Pleuræ very faintly pollinose and with sparse, black hairs; humeri reddish. Abdomen black, shining, sides of the segments rather feebly gray pollinose, apical margins even more faintly grayish pollinose; dorsum and venter with sparse, short, black hairs, at sides of the first few segments the hairs are longer. Hypopygium densely covered with silky white hairs. Wings pure hyaline. Legs black, except the outer surface of the front and middle femora, the upper side of hind femora and the greater part of the tibiæ which are reddish, covered with short, sparse, black hairs and bristles, except the front femora, which has the hairs mostly grayish-white. Length 21 mm.

One male, Shasta, Co., Cal., received from George Franck.

In Hine's key to the species of *Promachus*[1] this new species would go near *minusculus* from which it differs in being more shining and having no white hairs on thorax and abdomen, except on the hypopygium. The pollinosity of thorax and abdomen is also much more feeble than in any other species.

Asilus hypopygialis new species.

Head white pollinose, facial gibbosity moderately large, not reaching to the antennæ, mystax black above, white below, beard white; ocellar and occipito-orbital bristles black; third joint of antennæ a little longer than the two preceding joints, arista nearly as long as the third joint. Thorax covered with yellowish-gray dust; brown median stripe prominent and divided narrowly; pleura covered rather densely with a paler gray dust and with very few white hairs. Scutellum almost without hairs, two apical bristles black. Abdomen covered with grayish-brown pollen, venter, sides and base of the second to fourth segments with gray pollen; hairs on the dorsum blackish, bristles and hairs at sides and venter white. Hypopygium thickened, at middle distinctly wider than the abdomen, black, at apex reddish, covered sparsely with white hairs. Wings hyaline, slightly clouded towards apex. Legs reddish-brown, except the outer side of the femora, tip of tibiæ and tarsal joints thre to five, which are black; femora and tibiæ sparsely hairy. Length 15 mm.

One male, Beaver Canon, Utah (Doll and Engelhardt).

This species belongs in the subgenus or group *Heligmoneura.* the male genitalia are nearly two milimeters wide at apex.

[1] Ann. Ent. Soc. Am., Vol. IV, p. 165.

Asilus fulviventris new species.

Head densely clothed with yellowish-gray pollen; beard white; mystax yellowish-white with a few black hairs above; ocellar bristles white; occipito-orbital bristles black; palpi black with white hairs. Thorax densely covered with yellowish-gray pollen; dark median stripe prominent, divided by a narrow line; pleuræ densely grayish-white pollinose and with a few white hairs. Scutellum almost without any hairs, four apical bristles pale. Wings glassy hyaline. Abdomen, except the first and second segment, which are grayish-white pollinose, densely and uniformly covered with fulvous pollen, apical margins paler, hairs and bristles at sides concolorous; last segment and hypopygium shining black, the latter with a few white hairs. Legs uniformly black, covered sparsely with white hairs and white bristles. Length 11 mm.

One male, Huachuca Mts., Arizona (Schaeffer).

The uniformly colored fulvous abdomen, contrasting with the greyish-white pleuræ and the entirely black legs with white hairs and bristles ought to make this neat little species easy recognizable.

Ommatius parvulus new species.

Head white pollinose, beard white, mystax yellowish-white with a few black hairs above; antennæ black; palpi black with white hairs. Thorax dull blackish-brown and marked nearly as in *marginellus*. Pleuræ densely white pollinose with a few white hairs. Wings hyaline, apex slightly smoky, costa not thickened nor dilated. Abdomen black, sides and apical margins of segments gray pollinose and very sparsely covered with short, white hairs. Hypopygium black, claspers truncate at apex. All the femora black, covered sparsely with white hairs, which are a little longer on front and middle than on hind femora, the latter beneath with a few white, spine-like bristles; tibiæ yellowish, at tip black, tarsi, except the first joint, black. Length 9 mm.

Huachuca Mts., Arizona (Schaeffer).

This species differs from *O. maculatus* Banks in having the thorax dull, not shining and the hypopygium black, and from *O. pretiosus* Banks by the blackish abdomen and the hind femora of the male with spine-like bristles beneath.

A STUDY OF THE SPECIES OF THE GENUS STENOPELMATUS FOUND IN THE UNITED STATES.

By Morgan Hebard,

Philadelphia, Pa.

Brief examinations of the constantly increasing series of the genus in the Philadelphia collections have shown the futility of attempting to apply to these, with any satisfaction, the numerous names which have been proposed. Adding to these series the specimens in the United States National Museum, Museum of Comparative Zoölogy, Cornell University and other available collections, there is now before us sufficient material to undertake a revisionary study of the forms found north of the Mexican boundary.

Though little revisionary work of such character has been done since the erection of the present genus, the number of specific names, in the majority of cases based on few or unique specimens, has been constantly increasing. Scudder alone appears to have had before him series of any size, and his study of "The Stenopelmatinæ of the Pacific Coast"[1] is clearly superficial.

With the undetermined material before us, we have nearly all which has been recorded by Scudder, Rehn, Caudell and Bruner. As a result, it is now possible to locate the specific units involved, and, in the accomplishment of this task, a number of interesting facts have become apparent, which should prove of decided value to subsequent work.

On the whole, however, the genus presents possibly the greatest number of difficulties to be found in any of the North American genera of Orthoptera. These may be summarized as follows:

In the species here considered, differential genitalic characters do not exist. In the males, from the nearly adult condition to maturity, a small stout incurved chitinous hook is found on each side of the supra-anal plate just proximad of the cerci (plate VII, fig. 16), this been represented in earlier instars by a low and rounded chitinous ridge[2] (plate VII, figs. 14 and 15). The supra-anal and subgenital

[1] Can. Ent., XXXI, pp. 113 to 117 (1899).

[2] This ridge is particularly conspicuous in the last of the instars in which the subgenital plate does not wholly conceal the inner genitalia. In the sub-

plates show no other specialization and are in general similar, while the structures within the anal orifice are soft, unmodified and in the different species always become greatly shrivelled in drying. In the females the supra-anal and subgenital plates show no specialization and are likewise in general similar, while the ovipositor is very short, simple, without teeth or roughened surface, and curved upward to the sharp apex of the dorsal valves.

Great dissimilarity in the sexes is shown in *S. longispina*. With little available material, the description of the male and female as distinct species can be readily understood. This feature is shown to a much less degree in the other species here considered.

The spination of the caudal tibiæ, a feature slight variations in which have constituted the basis for descriptions of a number of nominal species, shows decided variability in *S. fuscus* and *S. longispina,* though respectively different averages are found in the number of spines and length of the distal spurs. Moreover, particularly in *longispina,* sexual differences are found in the caudal tibiæ.

In all of the species here considered, as in the genotype, the tegmina and wings are absent. It is, partially due to this fact, exceedingly difficult to separate adults from individuals in the last instars preceding maturity.

A megacephalic condition is developed in certain species, of those before us much the strongest in *S. fuscus,* different individuals showing this feature to varying degrees. In the maximum of this condition found in *fuscus,* more usually encountered in the male sex, the head is enlarged out of all proportion to the body, this being particularly pronounced in the occipital region (plate VII, fig. 2). The eyes in such specimens sometimes differ in being decidedly protruding

sequent stages to the adult condition, in all of which the subgenital plate is fully developed, these hooks are likewise fully developed. In consequence, the last stages of the immature condition, as is true also for the female sex, can only be distinguished through familiarity with the adult condition, which may be differentiated only through the more robust build and heavier structure particularly of the head, pronotum and limbs.

Brunner evidently compared an immature male of *S. talpa* with an adult male of *S. longispina,* at the time he described the latter species. (1888. Verh. zoöl.-bot. Gesellsch. Wien, XXXVIII, p. 260.) A male specimen of *S. talpa* before us, from Mexico, shows the fully developed chitinous hook exactly as in the species here studied.

and bead-like, while the abnormal development of the head causes them to be unusually widely separated.

Very decided size variation frequently occurs, this is not geographic, though in series from the same general region, those from high elevations show shorter and heavier limbs to varying degrees. Certain individuals appear to be fully adult, but if so are astonishingly small. Other immature specimens, with genitalia showing them to be in early instars, are surprisingly large. It is evident from the series before us, that almost every instar may be found at the same time in the same locality. Until careful breeding experiments are made it will be impossible to determine exactly the life cycle of these singular insects,[1] to explain the great disparity in size frequently found in apparently the same instar and to distinguish readily the adult condition.

As to the Mexican species, we may state from examination of small series, that a number are extremely distinctive; that probably the most widely distributed of the species, *S. talpa,* should without doubt have a number of synonyms, and that, though the majority of the more northern species are certainly distributed southward beyond the Mexican boundary, none of the more southern species reach northward as far as that line.[2]

Stenopelmatus Burmeister.

1838. *Stenopelmatus* Burmeister, Handb. der Entom., II, abth. II, pt. I, p. 720.

The genus was based on five species. GENOTYPE: *St*[*enopelmatus*] *talpa* Burmeister, selected by Kirby, 1906.[3]

KEY TO THE SPECIES OF THE GENUS STENOPELMATUS FOUND IN THE UNITED STATES.

(Vertex without carinæ. Head and pronotum not decidedly punctate. Tegmina and wings absent. Caudal limbs with tarsi much shorter than tibiæ. General coloration never black.[4])

1 The great preponderance of immature material in the collections before us suggests the possibility that more than a year is required in the transition from the egg to the adult condition.

2 Records of *S. histrio* from the United States by Scudder and Rehn are all misidentifications, applying rightly to *S. fuscus* and *S. longispina.*

3 Synon. Cat. Orth., II, p. 111.

4 These features variously occur in certain Mexican species; some of them probably showing sufficient differentiation to warrant generic separation.

A. Size medium to very large. Occiput normally unicolorous, never heavily banded.

B. Size medium to large. Head less elongate, megacephalism frequently striking. Caudal limbs proportionately shorter. Caudal tibiæ broadening regularly without well-defined distal point of greatest width; dorsal margins normally armed with three external and five internal spines, none being deflexed and the more distal being usually longest; longest distal spur much shorten than, to nearly as long as, the metatarsus.

fuscus Haldeman.

BB. Size medium large to very large. Head more elongate, megacephalism not pronounced. Caudal limbs proportionately longer. Caudal tibiæ not broadening in male, broadening distad with well-defined point of greatest width in female; dorsal margins normally armed with two external and five internal spines, the broadening of the limb in the female causing the second external and fourth and fifth internal spines to be deflexed, the external and fifth internal spines being usually decidedly the smallest in both sexes; longest distal spur nearly as long as, to much longer than, the metatarsus......**longispina** Brunner.

AA. Size small. Occiput heavily marked with broad dark longitudinal bands. (Pronotum normally narrowing but little caudad. Caudal tibiæ showing a greatly modified development of the condition found in *longispina;* dorsal margins normally armed with two external and three internal spines; longest distal spur distinctly shorter than, to nearly as long as, the metatarsus).........................**pictus** Scudder.

In using this key it is necessary to understand fully the difficulties presented by these species, these are considered both in the introduction and further discussed under each species in the present study. As we have remarked in other generic studies, no single character can be relied on for specific determinations. This is particularly true in the present genus, in which an unusual complexity of features is encountered. Differences in the number of caudal tibial spines, or slight variations in their position and relative length, are certainly unworthy of specific distinction; much of the past synonymy being mainly due to overestimation of the importance of variations in these features.

In addition to over 50 specimens previously recorded and some 40 now before us with insufficient data, all of which have been examined, we here record 195 specimens of the genus.

Stenopelmatus fuscus Haldeman. (Plate VII, Figs. 1 to 5.)

1852. *Stenopelmatus fuscus* Haldeman, Stansbury's Expedition to the Great Salt Lake, p. 372. [1 juv., Santa Fé, New Mexico; 1 juv., Chihuahua, Mexico.]

1869. *Stenopelmatus cephalotes* Walker, Cat. Dermapt. Saltat. and Suppl. Blatt. Br. Mus., p. 195. [♂, west coast of America.]

1872. *Stenopelmatus fasciatus* Thomas, U. S. Geol. Surv. Montana and adjacent Terr., 1871, Hayden (5th Ann. Rept. of Progress), p. 434. [♂, ♀: Wyoming; Utah; southern Idaho; Texas.]

1876. *Stenopelmatus oculatus* Scudder, Bull. U. S. Geol. Geogr. Surv. Terr., II, p. 261. [♂: Utah.]

1888. *Stenopelmatus hydrocephalus* Brunner, Verh. zoöl.-bot. Gesellsch. Wien, XXXVIII, p. 261. [♀, California.]

1897. *Stenopelmatus comanchus* Saussure and Pictet, Biol. Cent. Amer., Orth., I, p. 290. [♂, ♀: Durango, northern Mexico.]

We here select as type locality of *fuscus,* Santa Fé, New Mexico. The types have been destroyed, but before us are series from both Albuquerque and Jemez Hot Springs, New Mexico, nearby localities which safely prove the identity of Haldeman's species.

Though Walker's description of *cephalotes* is virtually worthless, Kirby has, through study of that type, placed Scudder's *oculatus* and Brunner's *hydrocephalus* under that name. That these names are absolute synonyms of *fuscus* (Scudder himself stated that his *oculatus* might not be distinct from *fasciatus* of Thomas, which is unquestionably synonymous with *fuscus*) we are convinced from study of the type of *oculatus,* the description of *hydrocephalus* and the series of undoubted *fuscus* before us.

Thomas' *fasciatus* we find, from the remaining specimens of his type series which are now before us, to be a synonym of *fuscus.*

Saussure and Pictet have described *comanchus* from specimens of the present species showing only minor differences in the spines of the caudal tibiæ.

The present insect is the only species of the genus found in the United States from the eastern edge of the great plain to the Sierras. Adults are normally large, though not averaging as large as *S. longispina.* As we have remarked on page —, material in the instars preceding maturity shows the genitalia in both sexes in no way different from the adult condition; such material is here recorded as "nearly adult." As we have already stated, some of these examples are remarkably small and appear to indicate considerable size variation in the species, others with genitalia in the unformed stages are sometimes quite large. At present the general heaviness and solidity of the limbs appears the only means of separating adults from some of the nearly adult examples.

In the present species megacephalism is often found in adults, particularly of the male sex. This is always accompanied by a proportionate broadening of the pronotum, which occurs principally in the cephalic portion. The unusually globose occiput, occasionally protruding bead-like eyes (normally very little protruding) and more than usually roughened exposed portion of the jaws, give individuals in which this condition has reached its maximum, a very singular appearance.

At high elevations in Texas, New Mexico, Arizona and apparently generally in southern California, the limbs are found to average somewhat stouter and shorter than in other portions of the insect's distribution. This feature is, however, decidedly variable. The limbs of *fuscus* average distinctly shorter and stouter than in *S. talpa* or *longispina*.

The caudal tibiæ have their dorsal surface very weakly convex to weakly concave, the spines vary from minute and delicate to stout and heavy, while the distal spurs also vary both in stoutness and in length. Normally the spines increase slightly in length distad, the fifth disto-internal spine being much smaller than the others only in the abnormal condition discussed in the next paragraph.

Some of the females before us from southern California show a striking abnormality in the greatly enlarged third spine of the dorso-internal margin of the caudal tibiæ, in extreme cases this spine being longer than any of the distal spurs. This feature is also shown by the series before us to exhibit great variability and though possibly indicating incipient racial development, has by no means reached a condition of sufficient stability to warrant nominal designation.

The spine count for the dorsal margins of the caudal tibiæ in the series before us is as follows:[1]

Number of spines, internal	2–5	3–5	4–4	4–5	5–5	5–6	
Number of specimens	1	2	8	19	89	5	
Number of spines, external	2–3	2–5	3–3	3–4	4–4	4–5	5–5
Number of specimens	5	1	74	28	14	1	1

[1] One specimen with a malformed limb has two instead of the normal three pair of distal spurs, the pair of much smaller disto-ventral spurs are represented by three minute spurs.

Measurements (in Millimeters.)[1]

	Width of Head.	Width Be- tween Eyes.	Length of Pro- notum.	Width of Pro- notum.	Length of Caudal Femur.	Length of Caudal Tibia.	Longest Tibial Spur.	Length Caudal Meta- tarsus.
Males:								
Jordan, Montana....	12	7.7	7.7	11.2	14.9	13.1	3.7	......
Uva, Wyoming......	11.8	7.9	7.7	10.3	13.7	12.7	4.1	4.4
Cedar, Colorado.....	.....	......	7.1	10.7	12.5	12.1	4	4.1
Claudell, New Mexico	12.5	7.8	8.3	12.2	13.8	12.5	4.3	4.6
Salt Lake City, Utah.	11.3	7.6	7.7	10.7	13.7	12.6	4.1	4.7
Soldiers Home, Cal...	13.4	7.9	9.6	12.6	16	13.8	4.2	4.8
*Prescott, Arizona ...	7	4.1	5.2	6.8	11.7	10.7	3.1	4.1
Females:								
Gebo, Montana	11	7	7.2	10.2	12.8	12	3.6	4.2
Worland, Wyoming..	10	6.6	6.8	9.7	12.2	11.4	3.3	4
Ogden, Utah	11.1	7.1	7.6	11.2	13.3	12.2	3.2	4
Juarez, Mexico	12.3	8	8.6	12.1	14.7	13.2	3.6	4.1
Reno, Nevada.......	10.2	6.7	7.4	9.4	12.8	11.8	3.1	4.1
Sierra Madre, Cal....	11.2	6.7	8.7	10.7	14.2	12.7	3.2	4.2
*Wyoming[2]	8.3	5.2	6	8	10.9	10	3	3.6
*Yakima, Washington	8.6	5.1	6.6	8.1	12	10.3	3.1	3.8
*Claremont, Cal.....	8.7	5.2	6.3	8	11.4	10	2.3	3.2

The specimens marked with an asterisk in the instars are preceding maturity.

Coloration.—Head, pronotum, underparts and limbs warm buff, in many individuals suffused with ochraceous to differing degrees; the head often showing a more brownish-yellow coloring, a few very narrow and widely separated darker lines rarely indicated on the occiput. Abdomen shining blackish brown above, the caudal margins of the segments narrowly of the general warm buff coloration. In immature individuals, particularly those of deeper coloration, these bands are greatly reduced and are indistinguishable in several specimens before us which have shrivelled much in drying; on such specimens the description of *fuscus* was based.

Distribution.—Known northern limits from Jordan, Montana, westward to Yakima, Washington, and Drain, Oregon. The known limits of eastern distribution are Boxbutte County, and southwestern Nebraska; Claudell, New Mexico; El Paso, Texas, and Juarez, Mexico. In the latter country the extent of the species distribution is yet conjectural, though probably covering at least the greater portion of the northern plateau.

[1] We omit the body length, as the softness of the abdomen in the present genus precludes the possibility of accurate measurement.

[2] This specimen is one of the types of *S. fasciatus* of Thomas.

Specimens Examined.—In addition to a number previously fully and correctly recorded: 114; 13 males, 16 females, 31 immature males and 54 immature females.

Jordan, Custer County, Montana, X, 19, 1905 (G. F. Beebe), 1 ♂ [U. S. N. M.]

Gebo, Carbon County, Mont., XI, 22, 1899 (J. Johnson) 1 ♀ [Hebard Cln.]

Worland, Wyoming, IV and VIII, 1911 (L. Bruner), 2 juv. ♀ [Hebard Cln.].

Owl Creek, Hot Springs County, Wyo., VIII, 31, 1896 (R. P. Currie), 1 juv. ♀ [U. S. N. M.].

Uva, Wyo., IX, 8, 1898 (E. Boothroyd), 1 ♂ [Hebard Cln.]

Wheatland, Wyo. (Niswander), 1 ♀ [Hebard Cln.]

Laramie, Wyo. (Niswander), 1 ♀, 1 juv. ♂ [Hebard Cln.].

Wyoming, 2 nearly adult ♀, TYPES of *S. fasciatus* Thomas [U. S. N. M.].

Boxbutte County, Nebraska (J. G. Smith), 1 juv. ♂ [Hebard Cln.].

Hat Creek, Sioux County, Nebr., 1 very small juv. ♂ [Hebard Cln.].

Squaw Cañon, Sioux County, Nebr., VII, 1892, 1 juv. ♂ [Hebard Cln.].

Cedar, Colorado, VIII, 1910 (J. W. Wescott), 1 ♂ [A. N. S. P.].

Colorado, 2 ♂, 2 ♀ [Colo. State Dept. Agr. Cln. and U. S. N. M.].

Claudell, Roosevelt County, New Mexico, IX, 1911 (Mrs. P. Perkins), 1 ♂ [Hebard Cln.].

Jemez Hot Springs, N. M., III, 14, 1912 (J. Woodgate), 1 nearly adult ♀ [Hebard Cln.].

Albuquerque, N. M. (C. F. Wickham), 3 juv. ♂, 4 juv. ♀, 1 very small juv. ♀ [Hebard Cln.].

Kelly, Socorro County, N. M. (F. G. Schaupp), 2 juv. ♂ [U. S. N. M.].

Dripping Spring, Organ Mountains, N. M., IX, 1899 (T. D. A. Cockerell), 1 juv. ♀, 1 very small juv. ♂ [U. S. N. M.].

Fort Wingate, N. M., III, 12 to VI, 26, 1910 (J. Woodgate), 5 juv. ♂, 3 juv. ♀, 1 very small juv. ♂ [Hebard Cln.]; X, 15, 1907 (J. Woodgate), 1 juv. ♀[1] [A. N. S. P.].

[1] Recorded by Rehn as the synonymous *S. oculatus*.

Black Range, Sierra County, N. M., VIII, 1915 (H. A. Pilsbry), 1 nearly adult? small ♂ [A. N. S. P.].

El Paso, Texas, 1908, 1 ♀ [U. S. N. M.].

Juarez, Chihuahua, Mexico, IX, 4, 1908 (D. E. Murray), 1 ♀ [Hebard Cln.].

Southern Idaho, 1 juv. ♀, TYPE of *S. fasciatus* Thomas [U. S. N. M.].

Snake River, Idaho, VIII, 21, 1883, 1 juv. ♀ [Hebard Cln.]; X, 1890, 1 ♀ [U. S. N. M.].

Springfield, Idaho, VIII, 23, 1906 (H. Skinner), 1 juv. ♀; 1 juv. ♀ [both A. N. S. P.].[2]

Pocatello, Idaho, 5,000 feet, VIII, 6, 1910 (Rehn and Hebard; dead on lowest mesa), 1 juv. ♂ [Hebard Cln.].

Yakima, Washington (C. V. Piper), 1 nearly adult ♀ [Hebard Cln.].

Umatilla, Oregon, VI, 24, 1882 (S. Henshaw), 1 juv. ♂ [Hebard Cln.].

Peterson, Utah, XII, 5, 1878 (L. Hirst), 1 ♀ [U. S. N. M.].

Odgen, Utah, X, 1909 (M. M. Childs), 1 ♀, 1 nearly adult ♀ [U. S. N. M.].

Salt Lake City, Utah, 1 ♂, 1 juv. ♂ [A. N. S. P.].

Reno, Nevada, 1 ♀ [Hebard Cln.].

Keani's District, Navajo Indian Reservation, Arizona, IV, 28, 1901 (A. W. Barber), 1 juv. ♀ [Hebard Cln.].

Grand Cañon, Ariz., VII, 12, 1892, 1 nearly adult ? small ♀ [Hebard Cln.].

Williams, Ariz., VII, 24 (Barber and Schwarz), 1 nearly adult ? small ♂ [U. S. N. M.].

Prescott, Ariz., VI, 14, 1904 (R. E. Kunze), 1 nearly adult ♂,[3] [Hebard Cln.].

Phoenix, Ariz., IX, 16, 1903 (R. E. Kunze), 1 juv. ♀[4] [Hebard Cln.].

Carr Cañon, Huachuca Mountains, Ariz., VIII, 1905 (H. Skinner), 1 juv. ♀[5] [A. N. S. P.].

[2] Recorded by Rehn as the synonymous *S. fasciatus*.

[3] Recorded as the synonymous *S. oculatus* by Rehn.

[4] Recorded by Rehn as the synonymous *S. oculatus*.

[5] Recorded by Rehn as the synonymous *S. oculatus*.

Madera Cañon, Santa Rita Mountains, Ariz., V and VI, 1898 (E. A. Schwarz), 2 juv. ♂ [U. S. N. M.].

Sycamore Cañon, Baboquivari Mountains, Ariz., X, 8, 1910 (Rehn and Hebard; in "tinajas"[6]), 1 juv. ♂ [Hebard Cln.].

Monument 200, Yuma Desert, Ariz., III, 1894 (E. A. Mearns), 1 juv. ♀ [U. S. N. M.].

Chilcoot, California, IV, 25, 1915 (E. O. Essig), 1 juv. ♂ [Hebard Cln.].

Russian River, Cal., 1 ♂, 1 nearly adult ♀ [A. N. S. P.].

Marin County, Cal., 2 nearly adult ♀ [Cal. Acad. Sci.].

Santa Clara Valley, Cal., 1 juv. ♀ [Hebard Cln.].

Natoma, Cal., VII, 2, 1885, 1 juv. ♀ [U. S. N. M.].

Lone Pine, Cal., VI, 14, 1891 (A. K. Fisher), 1 juv. ♀ [U. S. N. M.].

Ft. Tejon, Cal., 2 ♂ [U. S. N. M. and Hebard Cln.].

Tehachapi, Cal., 4,100 feet, XII, 12, 1906, 1 nearly adult ♀, 1 juv. ♀, 2 very small juv. ♀ [Cornell Univ. Cln.].

San Luis Obispo, Cal., VI, 27, 1906 (A. N. Caudell; under cow droppings), 1 juv. ♂, 2 juv. ♀[1] [U. S. N. M.].

Guadaloupe, Cal., VI, 24, 1909 (A. N. Caudell), 1 juv. ♂[2] [U. S. N. M.].

Santa Barbara, Cal., I and II, 1876 (Osten-Sacken), 1 ♀ [M. C. Z.].

South Santa Monica, Cal. (J. J. Rivers), 1 nearly adult ♀ [Hebard Cln.].

Soldiers Home, Los Angeles County, Cal., XII, 1909 (J. H. Demarest), 1 ♂ [U. S. N. M.].

Pasadena, Cal. (H. W. Rust), 1 ♀[3] [A. N. S. P.].

Sierra Madre, Cal., V, 30, 1906 (A. N. Caudell; dead in field), 1 ♀[4] [U. S. N. M.].

[6] These are the natural water tanks found in the usually dry mountain stream beds in the desert regions of the southwestern United States. Several specimens in various stages of decay were found at the time in these pools, as well as the remains of individuals of a number of other species of Orthoptera.

[1] Correctly recorded by Caudell.

[2] Correctly recorded by Caudell.

[3] Recorded by Rehn as *S. californicus*.

[4] Correctly recorded by Caudell.

Claremont, Cal. (C. F. Baker), 2 nearly adult ♀, 1 very small juv. ♂[5] [Hebard and Cln. and U. S. N. M.].

Los Angeles County (D. W. Coquillett), 1 ♂, 1 juv. ♀ [U. S. N. M.].

San Bernardino, Cal. (G. W. Dunn), 3 nearly adult ♀, 1 juv. ♀ [Hebard Cln.].

Beaumont, Cal., 2,700 feet, IX, 28, 1910 (Rehn and Hebard; dead on adobe plain), 1 nearly adult ♀ [Hebard Cln.].

Mojave Desert, Cal., VII, 5, 1893 (Loew), 1 juv. ♀ [U. S. N. M.].

San Diego, Cal. (J. L. Lippincott), 2 ♀, 1 nearly adult ♀, 1 juv. ♀ [A. N. S. P.]; 2 nearly adult ♀, 2 juv. ♀, 1 very small juv. ♂ [Hebard Cln.]; VIII, 1900 (Marlatt), 1 juv. ♀ [Hebard Cln.].

Scudder's records of *fasciatus* and *oculatus* all apply to *fuscus*, of which species these names are synonyms. His records of *longispina* from San Diego, California, and of *irregularis* from Fort Tejon, California, are incorrect, being properly referable to *fuscus*.

Stenopelmatus longispina Brunner. (Plate I, Figs. 6 to 9.)

XXXVIII, p. 260. [♂, Vancouver, British Columbia.]

1888. *Stenopelmatus californicus* Brunner, Verh. zoöl.-bot. Gesellsch. Wien, XXXVIII, p. 261. [♀, Vancouver, British Columbia.]

1888. *Stenopelmatus irregularis* Brunner, Verh. zoöl.-bot. Gesellsch. Wien, XXXVIII, p. 261. [♀, Mazatlan, Mexico; Arizona; California.]

1902. *Stenopelmatus terrenus* Rehn, Ent. News, XIII, p. 240. [[Juv.] ♀ (incorrectly), Texas.]

Typical material of the differently appearing sexes of the present species were described by Brunner, the male as *longispina*, the female as *irregularis*. Furthermore, it is evident that *californicus* is based upon a female in which the third and fourth internal spines of the caudal tibiæ are not more widely separated than the others. This is simply a minor variant which occurs in a few specimens of several series before us. Rehn's name, *terrenus*, is based upon a typical immature female which has, however, been dried after immersion in alcohol, with pronotum more decidedly constricted caudad than usual as a result. The specimen probably came from California, having been obtained from the Cope collection of reptiles, where it had been doubtless incorrectly labelled. Another immature male specimen of

[5] Recorded, with a question, by Rehn as *S. californicus*.

1888. *Stenopelmatus longispina* Brunner, Verh. zoöl.-bot. Gesellsch. Wien, the same size and from the same lot, correctly recorded by Rehn as *longispina,* bears the same labelling. From the series now at hand it is evident that the range of *longispina* does not extend far inland from the Pacific coast. Brunner's record of the synonymous *irregularis* from Arizona, will probably be found to apply to *S. fuscus.*

The present species is decidedly the largest known of the genus. In specimens of maximum size, the head is extremely large but no indication of an abnormally bulbous occiput or protruding eyes is shown, a condition frequent in *fuscus.* In the immature stages the head is not as large proportionately as in the adult and the pronotum in consequence does not expand as much cephalad. As discussed under *fuscus,* the later instars preceding maturity might easily be mistaken for the adult condition.

The caudal tibiæ have their dorsal surface very weakly concave, this varying slightly in different individuals. The spines and spurs, though varying somewhat both in length and position individually, are more constant than in *fuscus.* The normal form and armament of the caudal femora is best understood by reference to the figures (plate VII, figs. 8 and 9). The most frequent variation is, in the males, the fifth internal spine equal to or longer than the fourth and the presence often of small supplementary external spines; in the females, absence of the fifth internal spine and presence of small supplementary external spines. The length of the limbs and of their spurs shows considerable variation, the longest spur (dorso-internal) of the caudal tibiæ is, however, very rarely much shorter than the caudal metatarsus.

The spine count for the dorsal margins of the caudal tibiæ in the series before us is as follows:

Number of spines, internal	2–5	3–4	4–4	4–5	5–5	5–6	5–7
Number of specimens	1	1	25	6	51	6	1
Number of spines, external	1–2	2–2	2–3	3–3	3–4	4–4	4–5
Number of specimens	2	48	21	8	3	8	2

The specimens marked with an asterisk are probably in the instar preceding maturity.

Coloration.—Head, pronotum and limbs, antimony yellow. In dark individuals (apparently more often encountered in the female sex) the head and pronotum are mummy brown, the limbs strongly

MEASUREMENTS (IN MILLIMETERS).

	Width of Head.	Width Between Eyes.	Length of Pronotum.	Width of Pronotum.	Length of Caudal Femur.	Length of Caudal Tibia.	Longest Tibial Spur.	Length Caudal Metatarsua.
Males:								
Berkeley, California..	11.4	7.3	9.8	10.8	19.2	18.9	6.9	5.7
*Drain, Oregon......	7	4.8	6.2	7.2	13.8	13.2	4.3	4.7
*Marin County, Cal..	8.8	5.6	7.8	8.3	17.3	16.5	5.7	4.9
Females:								
Berkeley, California..	12.8	7.8	9.9	11.7	18.3	16.8	5.3	5
Berkeley, Cal........	14.1	8.7	11	14	19.7	19	5.7	5
Menlo Park, Cal.....	12.2	7.2	10	12.1	17.9	17.2	4.7	5
Alameda County, Cal.	12.2	7.5	10.1	12.1	18.7	17.6	4.8	5.1
*San Francisco, Cal...	11.1	7	8.7	10.9	14.9	14.2	4.4	4.7

suffused with the same color. A paired transverse marking of tawny or russet is usually well indicated on the pronotum (plate VII, fig. 7). Abdomen shining blackish brown above, the caudal margins of the segments narrowly of the general coloration. The underparts are generally of the paler color. In dried immature examples, as in *fuscus,* the pale dorsal abdominal bands are often less apparent.

Distribution.—The present insect is known on the Pacific coast from Vancouver, British Columbia to the Mexican boundary. It has not been found but a very short distance inland, except at Drain and Roseburg, Oregon, and Sacramento, Lake Tahoe and San Bernardino, California. In Mexico, the species has been recorded from Mazatlan alone.

Specimens Examined.—In addition to a number previously fully and correctly recorded: 73; 1 male, 4 females, 25 immature males, and 43 immature females.

Baird's Ranch, Redwood Creek, Humboldt County, California, VI, 9, 1903 (H. S. Barber), 1 juv. ♂, 1 juv. ♀ [U. S. N. M.].

Samoa Beach, Humboldt County, Cal., VI, 18, 1907 (J. C. Bradley; in sand dunes), 1 juv. ♀ [Hebard Cln.].

Ukiah, Cal., IV, 1885 (J. H. Burke), 2 very small juv ♂ [Hebard Cln.].

Sacramento, Cal. (E. O. Essig), 1 juv. ♀ [Hebard Cln.].

Lake Tahoe, Cal., IX, 7, 1 juv. ♂, 1 juv. ♀ [Hebard Cln.].

Eldridge, Cal. (J. A. Kusche), 1 large juv. ♂, 2 large juv. ♀, 2 juv. ♂, 1 juv. ♀, 4 small juv. ♂, 1 small juv. ♀, 2 very small juv. ♂, 2 very small juv. ♀ [Hebard Cln.].

Manzanito, Marin County, Cal., X, 27, 1906 (J. C. Bradley), 2 juv. ♀, 1 very small juv. ♂, 1 very small juv. ♀ [Cornell Univ. Cln.].

Marin County, Cal., 1 nearly adult ♂, 2 juv. ♂, 1 juv. ♀, 3 very small ♂ [Cal. Acad. Sci. and Hebard Cln.].

Martinez, Cal., I, 6, 1883 (H. W. Turner), 1 nearly adult ♀ [Hebard Cln.].

Berkeley, Cal. (J. Rivers), 2 ♀; III, 1906, 1 very small juv. ♀, X, 3, 1906, 1 ♂ (both J. C. Bradley) [all Hebard and Cornell Univ. Clns.].

Haywards, Cal., VI, 16, 1906 (F. E. Beal; in stump), 1 nearly adult ♀ [U. S. N. M.].

Alameda County, Cal., II, 1888 (G. W. Dunn), 1 ♀, 2 nearly adult ♀, 2 juv. ♀ [Hebard Cln.].

San Francisco, Cal. (E. Ehrhorn), 1 nearly adult ♀, 1 small juv. ♀ [Hebard Cln.]; (H. Edwards), 1 nearly adult ♀ [Cornell Univ. Cln.].

Menlo Park, Cal., 1905 (F. Hornung), 1 ♀, 4 juv. ♀, 1 small juv. ♀ [U. S. N. M. and Hebard Cln.].

Palo Alto, Cal., III, 1892, 2 juv. ♀, 1 small ♂, 2 small juv. ♀, 1 very small juv. ♀ [Cornell Univ. Cln.].

San José, Cal., 1 nearly adult ♀ [M. C. Z.].

Felton, Santa Cruz Mountains, Cal., V, 1907 (J. C. Bradley), 1 juv. ♂, 2 juv. ♀, 5 small juv. ♀ [Cornell Univ. Cln.].

San Bernardino, Cal. (G. W. Dunn), 1 nearly adult ♂ [Hebard Cln.].

San Diego, Cal. (J. Rivers; Blaisdell), 2 juv. ♂, 1 juv. ♀ [Hebard Cln.].

Scudder's records of *longispina, irregularis, californicus* and *histrio,* all apply properly to the present species, of which *irregularis* and *californicus* are synonyms, with the exception of the specimens mentioned at the end of the treatment of *S. fuscus* in the present paper.

Specimens of the present species, in the Academy of Natural Sciences of Philadelphia, have been recorded by Rehn as follows: as *histrio,* San Francisco, California, 1 small juv. ♂, 1 small juv. ♀; as *irregularis,* Santa Clara County, California, 1 very large juv. ♀, San Francisco, California, 1 very large juv. ♀; as *pictus,* San Francisco, California, 1 juv. ♂. The material in this series from San Francisco is all from the same lot collected by L. E. Ricksecker.

Stenopelmatus pictus Scudder. (Plate VII, Figs. 10 to 13.)
1899. *Stenopelmatus pictus* Scudder, Can. Ent., XXXI, p. 116. [1♂, ♀: California; San Francisco, California.]

We here select a single type the largest female from San Francisco, California.

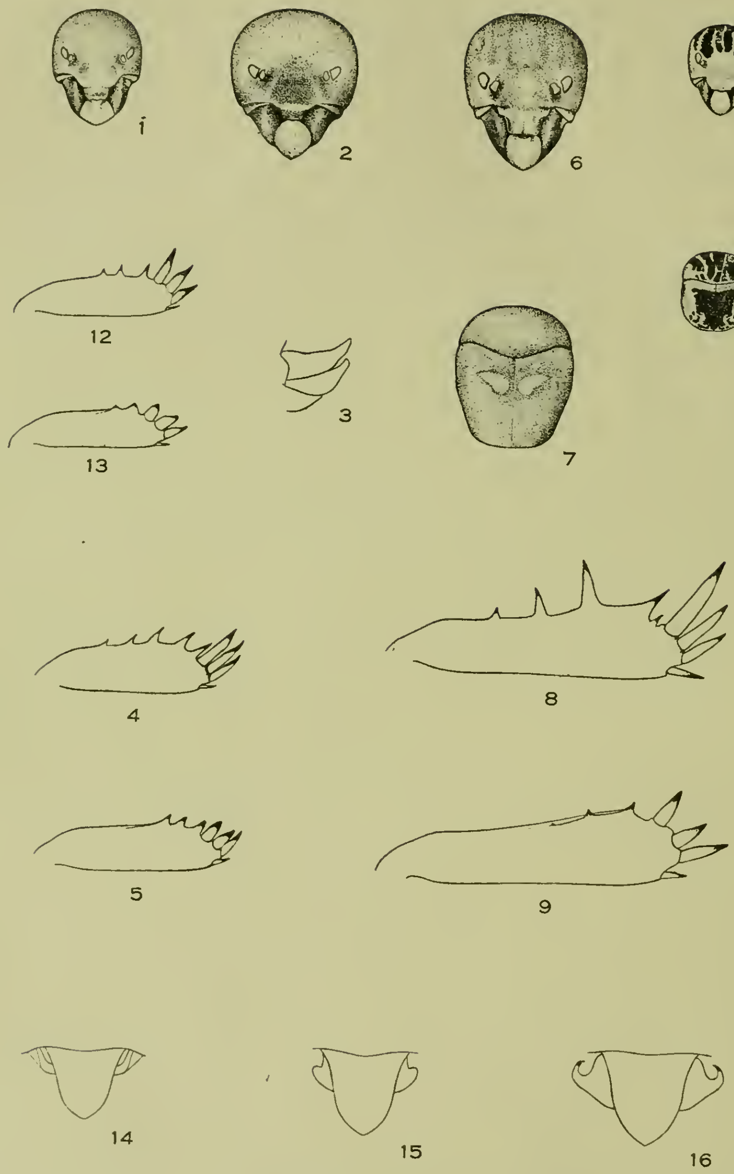
This species is closely related to *S. longispina*, though of very decidedly different general appearance from the normal condition found in that species. The most striking features are: the very small size; distinctly and heavily marked occiput and pronotum, and reduced armament of the less strongly developed caudal femora, both in size of distal spurs in proportion to the metatarsus and average fewer number of spines on the dorsal margins. Certain series of *longispina*, in the later instars preceding maturity, and in consequence with genitalia as in the adult condition, closely resemble material of the present species. These agree in size and the more quadrate pronotum, but differ in the more slender form, usually more decided tawny pronotal marking (plate VII, fig. 7) slightly more elongate limbs and the other features which distinguish *longispina*, as discussed above.

The caudal tibiæ have the dorsal surface weakly concave distad in the females, deplanate in the males. The males have the limbs distinctly longer than the females, this most pronounced in the caudal femora.

In the twelve known specimens of the present species, all now before us, the spine count for the dorsal margins of the caudal femora is the same: internal, 3 and 3; external, 2 and 2. The species is known from so few specimens that little can be ascertained as to its variability. Though variation doubtless occurs, if, as is indicated by the collections of Orthoptera made up to the present time, the present insect is decidedly limited in distribution, probably much less variation will be encountered than in the other widely distributed forms.

The measurements given above are all from material which shows genitalia of mature form. As such occurs, however, in individuals of the genus in the later instars preceding maturity, in the absence of larger series of the present species we are unable to state positively that these specimens are fully mature.

Coloration.—Head, pronotum, limbs and underparts, ochraceous buff. Dorsum of pronotum and occiput heavily marked with shining



Stenopelmates.

MEASUREMENTS (IN MILLIMETERS).

	Width of Head.	Width Between Eyes.	Length of pronotum.	Width of pronotum.	Length of Caudal Femur.	Length of Caudal Tibia.	Longest Tibial Spur.	Length Caudal Metatarsus.
Males:								
California. *Paratype*	6	3.9	4.8	6	9.1	9	2.9	3
Palo Alto, Cal.	6.9	4.1	5.7	6.8	10.2	10.1	2.4	3.4
Palo Alto, Cal.	6.7	4	5.2	6.4	10	9.7	2.7	3.4
Females:								
San Francisco, Cal. *Type*	7.8	4.9	5.9	7.6	10.1	8.7	2.3	2.7
San Francisco, Cal. *Paratype*	6.3	3.8	4.8	5.9	7.8	7	1.7	2.3
San Francisco, Cal. *Paratype*	7.4	4.7	5.8	7.2	9	8.1	2	2.6
San Francisco, Cal.	6	3.7	4.3	5.6	6.8	5.9	1.7	2.3
Palo Alto, Cal.	6.8	3.9	4.8	6.7	8.1	6.9	1.9	2.6

blackish brown (plate VII, figs. 10 and 11). Dorsal surface of abdomen blackish brown, the caudal margins of the segments narrowly ochraceous buff.

Distribution.—The species is known only from the localities here given.

Specimens Examined.—In addition to the type and three paratypes, we have examined the following series of 8 specimens; 2 males, 4 females and 1 immature individual.

San Francisco, California (W. Holden; H. Edwards), 3 ♀ [M. C. Z. and A. N. S. P.].

Palo Alto, Cal., III, 1892, 2 ♂, 1 ♀; 1 ♀, 1 juv. ♀ [Cornell Univ. and Hebard Cln.].

EXPLANATION OF PLATE VII.

Stenopelmatus fuscus Haldeman.

Fig. 1. Head, cephalic aspect. Megacephalism weakly indicated. (Natural size.) ♀. Gebo, Montana.

Fig. 2. Head, cephalic aspect. Megacephalism strongly indicated. (Natural size.) ♂. Ft. Cajon, Cal.

Fig. 3. Lateral outline of ovipositor. (× 2.) ♀. Gebo, Montana.

Fig. 4. Lateral outline of caudal tibia, internal. (× 2.) ♀. Gebo, Montana.

Fig. 5. Lateral outline of caudal tibia, external. (× 2.) ♀. Gebo, Montana.

Stenopelmatus longispina Brunner.

Fig. 6. Head, cephalic aspect. (Natural size.) ♀. Berkeley, California.

Fig. 7. Dorsal view of head and pronotum. (Natural size.) ♀. Berkeley, California.

Fig. 8. Lateral outline of caudal tibia, internal. (× 2.) ♀. Berkeley, California.

Fig. 9. Lateral outline of caudal tibia, external. (× 2.) ♀. Berkeley, California.

Stenopelmatus pictus Scudder.

Fig. 10. Head, cephalic aspect. (Natural size.) Type, ♀. San Francisco, California.

Fig. 11. Dorsal view of head and pronotum. (Natural size.) Type, ♀. San Francisco, California.

Fig. 12. Lateral outline of caudal tibia, internal. (× 2.) Type, ♀. San Francisco, California.

Fig. 13. Lateral outline of caudal tibia, external. (× 2.) Type, ♀. San Francisco, California.

Figs. 14 to 16. Dorsal outlines of male supra-anal plate in the genus *Stenopelmatus* to show development of the genital hooks. (Much enlarged.)

Fig. 14. Early instars in which lateral ridges alone are indicated.

Fig. 15. Later instar in which lateral blunt swellings are developed.

Fig. 16. Late instars and adult condition in which fully developed lateral hooks are found.

XANTHŒCIA BUFFALOENSIS GRT., ITS LARVAL HABIT AND OCCURRENCE WITHIN OUR FIFTY-MILE FAUNAL ZONE.

By Henry Bird,

Rye, N. Y.

The keen powers of discernment possessed by the late A. R. Grote have been generally impressed on subsequent students of the Noctuidæ, whenever his species are involved. Though he described a unique example of *Xanthœcia* (*Ochria*) *buffaloensis* many years before (1877), his recollection of details remained clear to him, and after his departure from America to Hildesheim, our correspondence frequently referred to this species for he was fond of this and allied genera. He was wont to remark that once having studied a species, its features were always distinct in his memory, which was born out by his recollection of this moth though he had not seen his type for a decade. His specimen came from Buffalo, N. Y., as indicated by the name. Twenty-two years later one from Chicago, as then only a second example apparently, was re-described by Strecker as *Hydrœcia latia,* the small tubercle on the frons being overlooked by him.

This feature of "*latia*" escaped notice up to 1911[1] when but four specimens were known to us in collections. Last year an occurrence at Elizabeth, N. J. (Mr. O. Buchholz), makes it evident the species is a denizen of our fifty-mile faunal zone. A proper acquaintance however must rest in a knowledge of the larval habit when a sufficiency of material will be available, but our search to this end for many years had been without result. It easily qualified as one of the most elusive Noctuids of our state, so that one exposing the larval habit and foodplant would score an important discovery.

Last season this honor fell to Mr. F. M. Jones at Wilmington, Del., when it transpired the nearly full larval history was observed and a number of moths reared. Very generously this material has been placed at our disposal, and later, at the time of larval maturity, an investigation of the foodplant near Elizabeth, N. J., disclosed the species working there. The young, second stage, boring larva was first met by Mr. Jones and enough difference existed with the Papaipemæ to at once warrant the assumption the new disclosure must be *buffaloensis*. The apprehension of such astute larvæ is due usually to a patient perusal of suspected or assumed suitable, foodplants, and when in the process of elimination *Saururus cernuus* L. was given over to investigation, after several seasons success prevails. The choice of such a water-loving plant, growing as it usually does in standing water, must surely work disaster to the larva at times. This coupled with a severe parasitism which begins at a very early stage, earlier than any of the allies suffer, and with fungi working havoc at maturity and with the pupa, makes us realize very forcibly why the imago is a rare moth. As if to meet an extra hazardous experience this larva is remarkable in several ways. In the point of activity, in changing from one plant to another when the food seems to have no bearing, and in the matter of appetite it is a record-breaking gourmand consuming as it does about twice its bulk daily of the root-stock. When it is recalled some of the *Papaipema* species like *pterisii* and *humuli* eat scarcely more than this amount during the whole larval period of two months, the contrast in this case is pronounced. There is further the power of expelling frass to some distance so that the operations of this larva are not to be confused with any other. How the eggs are placed is unknown, but hibernation

[1] JOUR. N. Y. ENT. SOC., XIX, p. 88.

surely occurs at this period. On June 19 when the larvæ were first encountered, they were well on in the second stage and tunnelling near the top, sometimes entering where the petiole sheath encircled the stem at the second leaf downward. Their presence at this tender portion causes the part above to die and furnishes a ready clue to their position. The borings finally get down to the base though so many changes from one plant to another occur that in no instance under observation did this happen with an individual plant. During the penultimate and last stage every two or three days sees a change. It requires but a few moments for a larva to leave a plant and bore its way in out of sight into another, as they move and operate with a nervous haste quite out of the ordinary with such borers. Entry is a little above the ground level and they work both upward and down into the root, though rather avoiding the latter until quite mature. *Saururus* has a horizontal rootstock which extends a long way for so small a plant and affords a good chance for extended mining. Occasionally a larva will mine 50 cm. in these roots and yet make the long journey back to the ventilating orifice in the stem once in ten to fifteen minutes, for disposing the frass outside. Except for the first work at the top, the plant shows no wilting or browning of the foliage.

Pupation seems normally to occur in the gallery at the root crown or in the root according to Mr. Jones, there being no further enlargement of the orifice. Our experience had to do with diseased larvæ only and these left the plant but imperfectly transformed under a covering of moss. Parasitism in the early stages (two and three), from a small *Ichneumon* as yet undetermined, was very severe. The orifice then made is too small for this wasp to enter and it may pierce the stem with the ovipositor to reach the gallery or host, since a similar species has been observed puncturing the enfolding leaf-roll which sheltered a Pyralid larva, in order to reach its host. Apparently the parasitic larva attains growth in a few days when it spins a white cocoon nearby, and in fifteen days gives up the imago. The host is exceedingly small at this time to support this species and the larval period must needs be brief.

A close relationship to *Papaipema* larva is shown in the species under consideration, even the darkened girdle appearing, though it is not so pronounced. There is little change up to maturity.

Stage III.—Head brown, no side line, ocelli prominent; constricted above the mouth-parts which seem produced; cervical shield darker, shaded at sides; tubercles prominent, blackish, I and II on twelve but slightly larger than the preceding ones; anal and leg plates blackish; body color pale brownish, livid, with a purplish-gray luster; the narrow dorsal and sub-dorsal lines pure white, continuous, or nearly so, the latter being broken into a series of dashes as it crosses joints four, five and six; a broader subspiracular line on two and three, then broken at the girdle, then continued vaguely on the abdominal segments.

Stages IV, V.—Similar.

Penultimate Stage.—Little change, paler; head now more rounded, clypeal suture prominent; tubercles generally larger than the spiracles, on the abdominal segments V is an elongated oval plate larger than the others, VI also being notably defined; on ten IV*a* has not appeared.

Maturity.—Very cylindrical, color and markings lost in a whitish translucence; tubercle now more prominent by contrast, on joint ten IV*a* develops with the examples under observation, the most individual feature being the elongate character of V which is about four times the size of the spiracle, on eleven III and III*a* are separate, whereas they were formerly confluent; anal plates blackish; length 48 mm. Much disparity exists with individuals attaining maturity, early examples finishing the latter days of July, while tardy larvæ may be feeding all through August.

The pupa is very cylindrical, light brown, a protuberance at clypeus projecting at a right angle as aligned with the ventral surface and the frons; the cremaster is a slight thickening of the chitin, flattened ventrally, supporting two small spines, set well apart and somewhat convergent; above these another smaller spine in the same dorsal alignment; length, 22 mm. The pupal period seems about four weeks.

That an unspotted variation of the moth existed with this species, a parallel to what frequently happens with *Papaipema*, was previously known and breeding developments indicate this is quite as prevalent as the type form. In this instance there is less indication of generic position, so well suggested by the white spots, nor is there the prominent anterior crest which is a character for placing the unspotted allies. Superficially this form might easily lead one astray, indeed Dr. J. B. Smith would never admit it and *buffaloensis* were one and the same species. So it seems wisest to call attention to the facts at this time and to designate the departure with a varietal name.

Xanthœcia buffaloensis simplicissima new variety.

The tubercle on the clypeus and the general color same as type form.

The median area of primaries warm brown with reddish irrorations, the basal and terminal areas washed with purplish; the ante- and postmedial lines are the most prominent marking, double, the inner brown, the outer purplish black as bounding the median field; the median shade line is vague, the subterminal very dentate and sprinkled with a scattering row of reddish golden atoms; the round orbicular and the kidney-shaped reniform but indistinctly outlined in a shade of the darker ground; claviform wanting. Secondaries much paler, of the lighter purple brown and now almost a shade of fawn. Expanse 33–37 mm.

Type locality, Wilmington, Del., F. M. Jones collector; four specimens Aug. 21 to Sept. 30, 1915. A paratype is with Mr. Jones, a male type with the author.

The genitalia are very distinct from the general type in *Papaipema* and possess good individual characteristics, agreeing of course with the type form whose difference only rests in the white spots of the primaries. It has been suggested that Strecker's term "*latia*" be retained for this unspotted form, but such procedure would conflict with the rules, since his type is, and the description personifies that form in which the stigmata are white marked, that which had already been characterized by Grote.

MISCELLANEOUS NOTES.

A Migratory Flight of Dragonflies.—On the afternoon of October 13, 1915, a rather compact swarm of dragonflies was observed in migration at New London, Conn. The swarm came from the north into the Connecticut College grounds and went on southward toward the city. They passed along a hillside overlooking the Thames River and nearly a half mile from the river.

This is not the first time this species has been observed in large swarms, but the mass movements of animals are always interesting. It is particularly so in this case, since Mr. H. J. Shannon (Harper's Magazine, September, 1915) has suggested and has amassed considerable evidence to show that this, as well as some other strong-flying dragonflies migrate southward before cold weather sets in and that there is a northward trend in the spring.

Unfortunately the writer was absent from home when this flight occurred and the following notes are based upon observations made by my wife. The specimens she captured proved to be all *Anax junius* (Drury), the sexes being of equal numbers.

Mrs. Osburn was standing by the window looking out into the back yard—the house is on the college grounds clear at the city limits and with open country beyond—when, as she looked, the air seemed suddenly to become filled with large dragonflies all coming along the hillside from the north. Realizing that something unusual was taking place, she seized an insect net and cyanide bottle and ran out among them. Six specimens were taken about as fast as they could be bottled. As they all seemed to be of one species she took no more of them, but stood watching them for about fifteen minutes.

They flew back and forth across the open lot and fields as far as she could see them, apparently feeding as they went, while the swarm as a whole moved leisurely southward in a body as above stated. The breadth of the swarm could not be judged, nor could the number be estimated, but there seemed to be thousands of them in sight at a time.

One thing which occasioned Mrs. Osburn much surprise was the fact that, contrary to the usual behavior of the larger dragonflies, these seemed not at all shy, but flew so close to her that they would almost brush against her before turning out of their course. Those taken were captured without the least difficulty and any number might have been taken with ease. There was no variation in their behavior during the time they were watched. While there is no explanation for this loss of fear in migrating animals, it has been observed frequently, especially among those moving in large numbers.

After Mrs. Osburn was compelled to return to the house she kept watch occasionally from the window. The body of the swarm had entirely passed by the end of an hour and after that time, three o'clock, only occasional stragglers were seen during the remainder of the afternoon. These, like the ones that preceded them, were headed in a southward direction.—Raymond C. Osburn.

Florida Carabidæ.—Mr. H. P. Loding has called attention to the failure to mention in my "Carabidæ of Florida" the occurrence in Alabama of the following Floridian species, viz: *Pasimachus subsulcatus, Ardistomis puncticollis, Cymindis elegans, Tachys columbiensis, T. ventricosus, Loxandrus celeris* and *Olisthopus parmatus.* He also mentions *Bradycellus neglectus* as an Alabama species and therefore somewhat liable to occur in Florida. Since southern Alabama and northern Florida are practically a continuous region these omissions should be corrected by those using the list.—C. W. Leng.

Florida Beetles.—I found about thirty specimens of *Dicaelus quadratus,* noted as rare in Leng's "List of the Carabidæ of Florida," at Detroit, the last station this side of Key West, from the 16th to the 21st of May,. 1915. I had never taken it before, though I have done considerable collecting in Florida. *Euphoria limbalis* Fall was also rather plentiful at Detroit. At Enterprise in 1910 I took a single specimen of *Chlænius maxillosus* on May 10, as well as quite a number of two other species, *floridanus* and *circumcinctus,* but this year the Chlæniini were quite scarce.—D. M. Castle.

Snout Beetles on Holly Bloom.—While visiting recently with Mr. H. W. Wenzel in Philadelphia, he gave me among other rarities two small snout beetles, *Xanthus pygmæus* and *Anthonomus latiusculus,* taken late in May on the flowers of Holly at Anglesea. This oft-quoted locality is rapidly becoming too civilized for good collecting; but those of our readers who have holly trees near them, may secure these species by examining the trees when in bloom.—C. W. Leng.

Additional records of the Deer Bot-fly Cephenomyia abdominalis.—This species was described by Prof. Aldrich in the June, 1915, number of this journal from three males collected on White Face Mountain in the Adirondacks, New York, July 6 and 10, 1914. In looking over my Diptera I have found two additional specimens, kindly presented to me by their collector, Mr. Frank E. Watson. One is labeled "Summit of Mt. Marcey, N. Y., 5,344 ft., July 3, 1913," and the other, simply "North Elba, N. Y., July, 1913." This last, however, may have been collected on one of the mountains ascended by Mr. Watson. These five specimens are so far the only ones reported of this rather large and conspicuous fly, which, however, cannot be rare in the higher mountains of the Adirondacks.—Wm. T. Davis.

Limenitis ursula var. albofasciata.—A specimen of this rare form was found on Staten Island, August 22, by Oscar Fulda.—G. C. Hall.

Eucactophagus graphipterus Champion (Coleop.) in New Jersey.—Since my note in the Canadian Entomologist for January, 1915, under "Field Notes and Questions" recording the finding of this rare member of the family Calandridæ in a New Jersey greenhouse, other specimens have been found in the same place, evidently introduced in orchids from the U. S. of Colombia. If left to develop unchecked in an orchid house, it is likely to become a serious pest as larvæ have been found infesting *Lycaste, Odontoglossum* and various other species having large, soft bulbs. The larva excavates a large cavity in the bulb, destroying much of the interior and paving the way for decay, which of course finally results in the death of the bulb. Pupation takes place inside the infested bulb and the adults feed on the leaves and other portions of the plant disfiguring them to a certain extent. An infested bulb can be detected before the adult emerges but only after considerable larval feeding has been done, by pressing it slightly with the thumb and fingers. If it contains a cavity, the tissue over it gives in and if such a bulb is cut open, the larva is readily found. A little practice soon enables one to become acquainted with how a healthy bulb and one containing a cavity should feel. Unfortunately, the opportunity for further study of this unusual pest was spoiled by the owners of the infested orchids being unusually active in destroying all of the infested bulbs they could find.—Harry B. Weiss.

Cicindela hirticollis var. rhodensis new var.—In the Ent. News, Oct., 1903, Mr. C. Abbott Davis described a new var. of *C. hirticollis* under the name of *nigrita*. As this name is preoccupied it seems advisable to re-name this form, and also at the same time to give such other information regarding this var. as is now available.

Cicindela hirticollis var. **rhodensis** nov. var.

Size and shape variable as in *hirticollis;* color brown to brownish-black; elytral markings indistinct and incomplete, often immaculate except a faint white spot at the tip of the wing case, sometimes considerably extended along the outer edge. Beneath as in *hirticollis,* but generally less hairy.

Occurs on sandy beaches along the Atlantic Coast from Point

Judith to Narragansett Pier, R. I., at Horseneck beach, Westport Harbor, Mass., at Orgunquit, Maine, at Gardiner Island and along the ocean side, Long Island, New York.—Edwin E. Calder.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY.

MEETING OF MAY 18, 1915.

A regular meeting of the New York Entomological Society was held May 18, 1915, at 8: 15 P. M., in the American Museum of Natural History, President Dr. Raymond C. Osburn in the chair, with sixteen members and three visitors present.

Mr. Barber spoke of "Hemiptera Collected in Northern Florida by Messrs. Mutchler and Watson," pointing out that whereas the material used in compiling his list of Florida Hemiptera had been collected by various Museum expeditions and by Mrs. Slosson and Messrs. Davis, Van Duzee and others, mainly on the east coast and in the southern part of the peninsula and had proved rich in West Indian forms, the present lot of material had been collected mainly in the northwestern port of the State, adjoining the mainland of Alabama and Georgia, and had proved poor in West Indian forms, and practically identical with the fauna of the Gulf Strip.

The extreme southern character of the fauna was shown not only by the species collected but by the poor representation of Capsidæ or Miridæ. Among the more notable captures were *Chilianella productilis, Largus davisi,* and *Matapodius confraternus.*

The paper was discussed by Messrs. Olsen, Davis and Schaeffer, bringing out the fact that the Miridæ, while deficient in southwestern states and West Indies, were comparatively plentiful through Mexico and Central America.

Mr. Engelhardt exhibited specimens of the Sesiid moth, *Memytrus palmi,* described from Florida from a specimen now in American Museum collection, and known from another Floridian specimen in Mr. Palm's collection and numerous examples from North Carolina and other localities northward to Long Island, commenting upon its preference for white and red oak and, to a less degree, scarlet oak, and its resemblance to yellow-jacket wasps. He said that its habit of breeding in the larger branches made it usually difficult to collect in numbers, but that it had been fortunate in finding a locality near east New York, where the cutting down of the trees had compelled it to breed in smaller and more accessible branches, so that upwards of fifty infested pieces had been cut off. One of these was exhibited to show the work of the larva, circling around the branch during its first season and entering the heart wood the same fall or second year, and the pupa in its burrow in the very center of the branch.

Mr. Comstock spoke of his experiences with Mr. Watson in 1914 and with

Mr. Woodruff this year in collecting Lycænidæ at Greenwood Lake, particularly in reference to *Incisalia henrici,* which at the same date and locality proved less abundant this year than in 1914, when on May 3 a few were found and on May 10 about twenty were taken on the top of a knoll (about 1,200 feet elevation) two hours' walk from Glen Station. *Anthocaris genutia* was very abundant both years and other Lycænidæ were found, *irus, augustus,* etc., but the absence of *henrici* this year was remarkable. Mr. Comstock closed with a discussion of food plants in which Messrs. Davis and Engelhardt joined.

Mr. Engelhardt remarked on the abundance of *Anthocaris genutia* on April 24 in Dutchess County, N. Y., near the Connecticut state line, where the *Arabis,* on which it feeds, was also abundant.

Mr. Wm. T. Davis stated that he had spent the 6th and 7th of May at Lakehurst, N. J., and at night had found many moths on the flowers of the beach plum, *Prunus maritima,* among them were *Graphiphora subterminata* Smith, *Graphiphora culea* Gro. and *Jodia rufago* Hüb. At sugar there were five species of *Phaeocyma* and the bug *Largus succinctus* Linn. Five individuals of this last-mentioned species were present and a pair were in copulation. This species also occurs at night on flowers. Adults have been found at Lakehurst in April, May and June; in July nymphs, and adults again in late August and in September. It has also been found in copulation on June 4.

Mr. Davis remarked also that on account of their different dates of blooming, one might use skunk cabbage, willow bloom and beach plum in succession for night collecting and thus prolong the season.

Mr. Leng exhibited small branches of dogwood infested by the scolytid beetle, *Phlœotribus frontalis,* showing the characteristic clusters of sawdust at the entrances to the numerous burrows, and said they had been collected by Mr. H. W. Wenzel on May 10 near Philadelphia.

Mr. Dow exhibited a cocoon from Panama and several other insects, living and dead.

Dr. Osburn spoke briefly of his new home at No. 358 Mahegan Ave., New London, Conn., and said he hoped to have visits there from members of the Society interested in the varied collecting of that locality, where fresh and tide water shores, hills and plains would, he felt sure, prove remunerative.

After refreshments the Society adjourned to the first Tuesday in October.

MEETING OF OCTOBER 5, 1915.

A regular meeting of the New York Entomological Society was held October 5, 1915, at 8:15 P. M., in the American Museum of Natural History, Vice-President H. G. Barber in the chair, and twenty members present, with three visitors, including Mr. H. H. Knight, of Cornell University.

Dr. Lutz exhibited two luminous larviform insects received from C. L. Holmes, Waterbury, Conn., similar to others collected by himself at North Mountain, Pa., and received from Tompkin's Cove, N. Y., and referred to an illustrated article by Riley in Am. Ent., 1880, apparently referring to the same insect, which in the dark looked like a miniature trolley car from the luminous spot on the sides of each segment. Mr. Schaeffer said he believed it was the female of *Phengodes laticollis*, but should be referred to H. S. Barber in Washington, who had specially studied the subject, and to whom he had sent similar specimens from Yaphank, L. I. The discussion that followed brought out the error in the suspicion of early authors that these luminous creatures were larvæ of *Melanactes, Asaphes* or other Elateridæ, the successful work of H. S. Barber having shown them to belong to Lampyridæ.

Mr. Mutchler exhibited in advance of a complete report on the expedition to Porto Rico: *Tetracha sobrina* taken at Ensenada, P. R., June 14; *Cicindela hebræa* taken at Anasco, P. R., September; *Cicindela boops* taken at Ensenada, P. R., June 14; *Cicindela trifasciata* taken at Ensenada, P. R., June 14, and a *Cicindela*, apparently new, taken by Mr. Watson in San Domingo.

Mr. Watson exhibited Sphingidæ donated to the Museum by Mr. B. Preston Clark, of Boston, with a collection of American Sphingidæ, containing 34 species, new to the collection, mostly subtropical, and including the new *Hemoroplanes acuta* R. & J., from Bolivia.

Mr. Shoemaker spoke briefly of his summer collecting at Washington, D. C., and at Slide Mt., in the Catskills, the latter resulting in the capture of about 1,800 beetles and 500 to 600 Lepidoptera. On the September visit to Washington he was accompanied by Mr. Nicolay and their joint efforts yielded twenty-two specimens of Cychrus.

Mr. Nicolay described their joint efforts in greater detail, regretting the comparative failure of bait bottles on account of cold nights, but extolling the merits of the Virginia shore of the Potomac River, opposite Plummer's Island, where their success under small and moderate-sized stones led to search beneath larger ones, until, as he expressed it, they were "moving the landscape a little." *Pterostichus purpuratus* was common and *P. approximatus* and other desirable Carabidæ were found, while Parnidæ were seen crawling like spiders on wood pulled out of the water into the sunshine, and *Cremastochilus* sp. was found under a stone with ants, which dragged it down under the soil when disturbed.

Mr. Davis said in his experience *Cremastochilus* buried itself, but Mr. Nicolay repeated that in this instance two ants pulled on the front legs while he pulled on the hind legs.

Mr. Nicolay also spoke of Cicindelidæ caught at Mt. Pocono, Pa., and promised to show them at the next meeting.

Mr. Dow mentioned the death on August 24 of J. Turner Brakeley, of Lahaway, and his friendship with Smith Grossbeck and the two Wenzels, and promised a paper on his personal characteristics and entomological activity for next meeting. He exhibited specimens caught at Lahaway this summer and at Allaben in the Catskills where he met Pearsall and Crosby commenting especially on the abundance of *Strategus antæus* and *Cicindela lepida* at Lahaway, where the burrows of the latter could be found only two or three feet apart in perfectly smooth grassless places of white sand. He donated *Arctia caia* from Allaben to the local collection and a number of other specimens to the members present.

Mr. Olsen, referring to a European Aphid previously reported by him as occurring in this country, added that he had learned from Gillette of its occurrence in other parts of the United States.

Mr. Sherman spoke of his visit to the White Mountains in September and especially of the increased facilities afforded for collecting by the permanent camps on the summit, at the Lake of the Clouds, which is in the heart of the alpine garden, and of the prospect of additional camps being built at Hermit Lake and in the Great Gulf. Many new trails have been added by the Appalachian Mountain Club. He met Sheriff, of Boston, while in the mountains who showed him a *Carabus chamissonis* found under a stone, still entirely white, though it darkened in a few hours.

Mr. Engelhardt spoke of his visits to Pleasant Valley, in the foothills of the Berkshires, where he had good collecting, particularly at night, and was pleased to find the postmaster a naturalist. He described particularly a bait bottle in which a mouse, accidentally caught, died and served to attract Silphidæ in such numbers that the bottle was entirely filled.

Mr. Sleight spoke of the material collected abroad by Mr. Holinan and sent to him.

Mr. Davis spoke briefly of his visit at the end of May to Rock City in the western part of the state and of several visits to Long Island, exhibiting dragon flies caught by shooting charges of fine shot at them with a sling shot. He also read a letter from Charles Dury, in reference to the latter's journey through Arizona, Nevada and California, and showed a copy of the recent work by Bentley B. Fulton, "The Free Crickets of New York: Life History and Bionomics," being Tech. Bull. No. 42 issued by N. Y. Agl. Exp. Sta., Geneva, N. Y., to which he gave the highest commendation as the first complete and accurate treatment of the subject, regretting only that a botanical error appeared on page 30, where the bur oak (*Q. macrocarpa*) should be the post oak (*Q. minor*), the bur oak not being found, so far as known, on Long Island. The error is repeated on page 27. Dr. Lutz called attention to the return of W. S. Genung, known some years ago by his collections in Georgia, Florida, Cape Breton and Newfoundland, to entomological activity in his seventy-second year, his present address being New Augustine, Fla.

Mr. Woodruff spoke of finding an unusual dragon fly again at Litchfield, Conn., from June 30 to July 15, the species being *Leucorhinia frigida,* and represented by males only.

Mr. Bird spoke of his continued search for boring lepidopterous larvæ and said he had now succeeded in finding another species within the fifty-mile limit.

Mr. Hall exhibited a Staten Island specimen of *Limenitis ursula* var. *albofasciata* taken by Oscar Fulda, August 22; and commented on other local records for this rare form.

Mr. J. W. Angell spoke of collecting at Twin Lakes, Conn., in favorable terms, and exhibited thirty-five exotic Neolamprima and a series (14 ♂♂, 4 ♀♀) of *Lucanus elaphus*.

Mr. Schaeffer spoke of expeditions to West Point with Colonel Robinson and of various new Long Islands records of which he will furnish details at a later meeting. Mr. Leng exhibited some Coleoptera taken on Staten Island by his son, which, as far as new to the local list, will be mentioned in short notes. These included also *Ochthebius foveicollis* and *Hydraena pennsylvanica* from Willow Brook, near Bull's Head, where the growth of *Anacharis* in the water and the protruding willow roots on the banks made excellent collecting for aquatic species, especially Parnidæ, which occur in great numbers.

Mr. Schaeffer mentioned, in connection with the West Indian List, the occurrence in Trinidad of two new species of Eucnemidæ.

Mr. Barber spoke of his experiences at Lakehurst in September, where the rains had caused an unusually verdant appearance and remarkably poor collecting.

Mr. Knight, commenting on *Malachius æneus,* said it was very common at Batavia, N. Y.

MEETING OF OCTOBER 19, 1915.

A regular meeting of the New York Entomological Society was held October 19, 1915, at 8:15 P. M., in the American Museum of Natural History, Vice-President Harry G. Barber in the chair, with fourteen members present.

On motion the following were elected to active membership in the Society, viz.: W. D. Funkhouser, 415 N. Tioga St., Ithaca, N. Y.; M. D. Leonard, Department of Entomology, Cornell University, Ithaca, N. Y.; Lawrence H. Dunn, Board of Health Laboratory, Ancon, Canal Zone.

On motion, Dr. F. E. Lutz was elected a delegate to the Second Pan-American Scientific Congress, with C. W. Leng as alternate.

Mr. Nicolay exhibited a collection of "Local Cicindelidæ" in reference to which he said in part that since 1910 he had collected personally or obtained by exchange twenty-five species and varieties. A series of *C. patruela* from Pocono, Pa., where this species is plentiful early in September at a place locally called the Knob, was illustrated by photographs of the locality; as was a series of *C. limbalis* from the wagon road approaching the summit of Storm King Mountain, near West Point, N. Y. Brownish forms of *C. purpurea* from Pocono and a green specimen collected by Mr. Pearsall in the Catskills Mountains were subjects of comment. In reference to *C. harrisi*, Mr. Nicolay said that no typical *C. sex-guttata* were found with it, and while it might be an altitudinous form of that species, it could scarcely be a senile form, since its peculiar color was developed only in the mountains. In regard to local races, Mr. Nicolay pointed out that *nigrita* was not apparently approached in the Chesapeake Bay race of *hirticollis,* as it was at Rockaway Beach, and Mr. Davis added that it was only on Long Island that immaculate forms of *modesta* were locally found, Aqueduct being the great center. At Lakehurst, though the species were found in numbers, such variations were so far unknown. Messrs. Shoemaker and Angell joined in the discussion.

Mr. Dow, under the title "A Pilgrimage to Lahaway," described the strong character of the late J. Turner Brakeley, dwelling upon the aid he had given John B. Smith and others, and the lovable nature that dominated his career in spite of his many eccentricities. As this paper will later be published in full, no extract is given.

Meeting of November 2, 1915.

A regular meeting of the New York Entomological Society was held November 2, 1915, in the American Museum of Natural History, at 8: 15 P. M., Vice-President Harry G. Barber in the chair, with eleven members and two visitors present.

Mr. Dickerson spoke on "Insects of Season of 1915," dwelling particularly on those of economic importance, and pointing out the opportunities for collecting on the masses of flowers in commercial nurseries and the liability of European insects being found there from the growing practice of importing shrubs with balls of earth about the roots.

The European Mole Cricket, *Gryllotalpa gryllotalpa* L., found in this way at Rutherford, N. J., by Weiss and determined by Rehn, was shown as an example; also *Exochomus 4-pustulatus,* Rutherford, July 10, and Riverton, March 29, from bay trees imported from Belgium in the nurseries; *Plagiodera versicolor,* found on willows in nurseries at Rutherford, and *Carabus nemoralis* as additional examples among Coleoptera. In some cases the origin of the insects was an interesting problem. The Tingid, *Leptobyrsa explanata,* for instance, is a native insect found on wild azalea, and is also found in nurseries on imported rhododendrons perhaps from confusion with a similar European insect, perhaps from prior introduction in Europe on rhododendron stock brought from America. *Leptophya mutica* Say is another species found on fringetree (*Chionanthus virginica*) in southern New Jersey. *Otiorhynchus sulcatus,* a beetle common to Europe and America, is also found in nurseries, the adults damaging the leaves of rhododendron, but possibly being introduced also in the earth about the roots. Its habits are mainly subterranean and it is easily trapped under boards.

Mr. Dickerson also spoke of the varying plenty of certain injurious insects in different years. An abundance of plant-lice in the early summer was noted combined with a scarcity of lady bugs. The injury to apple foliage was great, in which connection Mr. Dickerson spoke of the necessity of spraying just as leaf buds begin to swell, as emphasized in Bulletin 402, "Controlling Plant Lice in Apple Orchards," by R. J. Parrott, and of the effect of combinations of nicotine in the spraying mixture. The tanglefoot joint as a remedy for peach tree borers was also mentioned. The varying plenty of the catalpa sphinx, especially on *Catalpa brugei* in nurseries, was also alluded to. It was not abundant this year but may be next year, since its parasite was also scarce.

Mr. Dickerson exhibited also *Adalia humeralis* from Nutley, N. J., June 16, *Blethisa quadricollis* Hald, a specimen taken at Arlington, N. J., April 10, in a wet situation, thus confirming the single record in the New Jersey List;

a botfly, *Cuterebra buccata* Fab., determined by Mr. Davis, found on sidewalk in Irvington, N. J., a *Psychoda cinerea* Banks, found in the bathroom; and the European pine tip moth, *Evetria buoliana* (to which Bulletin 170, U. S. Dept. of Agriculture, is devoted), which fortunately has not spread rapidly here, but is so serious a pest in Europe that 150,000 larvæ have been gathered and destroyed in one locality. Mr. Busck has investigated its appearance on Long Island and the importation of pines has been stopped.

Mr. Dickerson spoke also of the attacks of a *Chactocnema*, similar to *C. confinis* (which is known to attack sweet potato and bindweed), on cultivated mallow in a nursery at Rutherford; and of the larvæ of Barini working in the lower stem of *Gaillardia* and other cultivated composites. He closed by urging greater attention to such nurseries by collectors.

His remarks were followed by a general discussion of the subjects introduced.

Mr. Leng stated that in addition to *Otiorhynchus sulcatus* the European species, *O. auricapillis*, was known to have been introduced with imported stock at Cromwell, Conn. (fide W. D. Pierce), and *O. singularis* was reported from several localities by New England collectors and by Mr. Shoemaker.

Mr. Davis said the catalpa sphinx always flew ahead of its parasite and was liable for two or three years to defoliate the trees, as at Lakehurst a few years ago, but the parasite soon followed, and thereafter held it in check.

Mr. Angell spoke of the various localities for *Carabus nemoralis* to which Mr. Davis added Staten Island.

Mr. Davis also added Staten Island to the localities for *Plagiodera versicolor* Laich. (*armoraciæ* Fab.), his earliest record being August 3, 1911, in the Clove Valley. This year on October 9 numbers were found under willow bark at Bull's Head, where it had also been taken in July on the willow leaves by C. W. Leng, Jr.

Mr. Davis spoke of its identification by Mr. Schwarz from specimens he had taken to Washington and Mr. Woodruff added that Mr. Schaeffer had sent him the same name. Mr. Dickerson added also that specimens from New Jersey had been sent him two or three years ago, so that this European enemy of willow and poplar might be considered fairly established near New York City.

Mr. Davis exhibited the description of the species under the name *armoraciæ* in Stephens' Manual of British Beetles, saying that it was not safe to leave a generic name out over night and perhaps scarcely a specific name. He commented also on the more natural appearance of specimens killed in cyanide; and exhibited specimens of *Micromalthus debilis* given him by Mr. Herbert S. Barber and the latter's interesting work on its varied method of reproduction.

Mr. Barber exhibited *Carthasus rufonotatus*, which he could now add to the New Jersey List. His remarks will be printed in Short Notes.

Mr. Davis exhibited his collection of Long Island Cicindelidæ, commenting especially on the ancient record for *C. unipunctata* and recent captures of *C. consentanea* by Mr. Schott at Wyandanch, L. I., April 24; by Mr. Harris at

Quogue and Westhampton in September and by Mr. Wood at Port Jefferson, on a gravelly bluff sloping down to the beach.

He also showed the varied forms of *C. rugifrons* and *C. modesta* taken in one day's collecting at Aqueduct and said while that locality was destroyed, a smaller dune further along the shore was still good.

Mr. Harris recalled the work of Mr. Johnson and Mr. Joutel at Aqueduct, and spoke of his own recent trip to Oak Island, across the Great South Bay, where Johnson lost his life, to obtain the *dorsalis, hirticollis* and *repanda* that the latter had collected there. He spoke also of *C. munifica,* a large form of *dorsalis,* with broad conspicuous bronze markings, which he had received from Professor Calder, of Providence, who had collected it at Narrangansett Pier, so far as known, the most northern locality for the species; and of the gradual disappearance in dried specimens of *rugifrons* of the brassy color sometimes noted in the field.

Mr. Davis said the same change in color might be noted in *C. 6-guttata,* specimens in old collections being often of a more violet shade.

Mr. Angell recorded finding *C. 6-guttata* on October 12. Mr. Dow exhibited plaster cast from Lahaway of a spider burrow and another of *Cicindela modesta* and spoke of the characteristic form of burrow made by each species.

Mr. Rich spoke of the presentation at Ithaca by Mr. Leach of the U. S. Bureau of Entomology of some of the economic matters mentioned by Mr. Dickerson, particularly regarding peach tree borers.

MEETING OF NOVEMBER 16, 1915

A regular meeting of the New York Entomological Society was held November 16, 1915, in Heim's Restaurant, at 8:15 P. M., with Vice-President H. G. Barber in the chair and eighteen members and five visitors, viz.: Mr. Henry Brown, a member of the Soc. Ent. of France; Mr. H. L. Viereck, of the Washington Biologists' Field Club; Mr. Harry B. Weiss, of the New Jersey Agl. Exp. Sta.; Mr. Herbert Lang and Mr. James C. Chapin, of the American Museum Congo Expedition, and Mr. Stephen G. Rich, present.

The curator reported a donation from Mr. Dickerson to the local collection; and resumption of the study of the Coleoptera thereof on Saturday, November 20, at 2 P. M., the subject being the family Cleridæ.

The secretary read letters from several members, including Messrs. Green, Bird, Love, Knapp, Groth, Wunder and Joutel, regretting their inability to attend the supper which preceded the meeting.

Mr. Laurence V. Coleman, 150 Maple St., Brooklyn, was elected to active membership.

Mr. Dow reported for the committee on Lahaway that Mr. J. W. Angell and he had again visited the Plantation.

Messrs. Davis and Leng spoke of their recent visit to Washington, of the friends with whom they had visited while there, and of their scientific results, which will be printed in the JOURNAL. Mr. Davis also exhibited photographs of persons and places and a printing press for locality labels obtained from

Herbert S. Barber, by which any number of labels may be quickly prepared. Mr. Leng showed the recent Report No. 107 by F. C. Craighead on "Larvæ of the Prioninæ."

Mr. Engelhardt read a paper on the "Mecoptera of N. E. United States," which will be printed elsewhere.

Upon invitation by the chairman, several of the visitors spoke briefly expressing their gratification.

Messrs. Lang and Chapin, referring to the entomological results of their Congo Expeditions, said that they were novices in entomology and that Mr. Davis was largely responsible for their exertions in that direction; Mr. Chapin disclaimed any strong affection for the skin beetles, termites and driver ants that in various ways hindered their work. He said that actually they depended more or less on native help, such as boys stationed along the road with nets or visiting other localities of which they know. One elderly ex-soldier, *Kaseesa* by name, but nicknamed "Peperua" (= butterfly in Medje language), because he was often employed to use the butterfly net, had been very serviceable, though once his hunger for fresh meat led him to assail with his net a native hunter carrying an antelope, and while his stratagem secured the desired delicacy, there was trouble next day when the scared hunter got over his fright.

Dr. Lutz, speaking of the entomological collections they had brought back, said that scarcely a third had been unpacked and that they were evidently very extensive and most important additions to the American Museum stock of insects. He only regretted that lack of competent workers in the country would necessarily retard their study and urged the specialists in the Society to aid the Museum in working up this valuable material.

Mr. Doll and Mr. Benedict spoke briefly of their pleasure in being able to attend the meeting.

Mr. J. W. Angell described the Lahaway Plantation, mentioning the accommodation obtainable at Prospertown, close by, the good condition of the buildings, the attractive features, including the many different environments for collecting, and the complete isolation of the great forest which had not been cut for forty years. He urged that it be acquired, since in years to come increasing cultivation would make such an opportunity unlikely to recur.

MEETING OF DECEMBER 7, 1915.

A regular meeting of the New York Entomological Society was held December 7, 1915, at 8:15 P. M., in the American Museum of Natural History, Vice-President Harry G. Barber in the chair, with twenty-one members and three visitors, including Mr. Harry B. Weiss and Mr. H. L. Viereck, present.

The curator reported gift of *Pterostichus purpuratus* from Mr. Shoemaker; also the completion of the local collection of Cleridæ, and announced a special meeting of Coleopterists on Saturday, December 18, at 2 P. M., for the study of the Malachiidæ.

The following were elected to active membership: Stephen G. Rich, Harry B. Weiss, Henry Brown.

Mr. Howard L. Clark, North Farm, Bristol, R. I., was proposed for active membership by Mr. Bird.

Mr. Bird presented a paper on "*Xanthœcia buffaloensis* Grt., its larval history and occurrence within our fifty-mile faunal zone," which will be printed in full in the JOURNAL. He exhibited specimens, dilating upon the clypeal tubercle and its possible use; and referring to the occurrence of the species within the city limits, said he had found the larvæ in New Jersey on their now known food plant, *Saururus cernuus* L., and they would probably be found also on Staten Island.

Mr. Bird also added *Nonagria laeta* to the local list and made known its food plant, *Sparganium,* which has not hitherto been recorded.

Mr. Leng exhibited a specimen of *Otiorhynchus sulcatus* in which one of the deciduous cusps was present, while the other was lacking, so that its scar on the mandible could be seen; and compared the use of the cusps in breaking through the pupal stage with the clypeal tubercle shown by Mr. Bird.

Dr. Lutz, commenting on Mr. Bird's remarks, said that special horns, spines, etc., could not always with safety be ascribed to special uses, since such were often the marks of old, specializing stock.

Mr. Dickerson exhibited pink and green specimens of *Amphiscepa bivittata* Say, collected at West Norwood, N. J., August 28, by sweeping, both sexes being represented, and referred to the fact that pink insects were usually found in the fall.

Mr. Davis mentioned Professor W. M. Wheeler's resumé of facts concerning pink insects.

Mr. J. W. Angell spoke of the combats between males of *Lucanus cervus* in which the mandibles were used as weapons and quoted Janson's experience with them, in which the elytra were found greatly damaged.

Mr. Dow exhibited a pine snake from Lahaway which had swallowed a partridge egg, and a number of curious nests made by wasps from the same locality, in which coat hooks, door hasps, etc., had been utilized by the insects.

Mr. Viereck later, commenting upon them, said that *Sceliphron solitarius* was the architect responsible for most of them.

Mr. Weiss exhibited *Eucactophagus graphipterus* Champ., a Calandrid weevil found at Summit, N. J., in greenhouses where orchids with soft bulbs, like *Odontoglossum,* were grown. A more complete account will be printed in Miscellaneous Notes.

Mr. Davis exhibited insects collected in Cuba by Mr. M. R. Harrington while engaged in archaeological work. Many came from a cave near Baracoa where the walls were in places covered with roaches; and others included *Pyrophorus, Elaphidion, Stenodontes* and other Coleoptera as well as Pentatomids and Cicadas.

Mr. Davis also read "Additional Records of the Deer Bot-fly," which will be printed in Miscellaneous Notes, and exhibited it and allied species of *Cuterebra.*

Mr. Leng exhibited the West Indian Lycidæ of the American Museum and

National Museum combined and commented on the distribution of genus *Thonalmus,* one section of which is apparently confined to Cuba and the Bahamas, while no species at all occur in Porto Rico.

Mr. Leng also read a letter from F. G. Schaupp, written in 1892, recounting his first experiences in America in 1866.

Mr. Barber exhibited two European species of Lygæidæ occurring in N. E. America, one, *Stygnocorus rusticus,* having been already reported by Horvath in 1910, the other, *S. pedestris,* having been lately found in Nova Scotia and brought to his attention by the Bussey Institution.

Mr. Nicolay spoke of his visit via Dyckman St. Ferry to Palisades Interstate Park and regretted that the natural scenery and conditions had been greatly damaged by ill-advised attempts to improve them. Mr. Davis fully endorsed his views, saying that greater destruction had been wrought by order of the commissioners than an irresponsible horde of picnickers could possibly accomplish if bidden to do their worst for an entire Sunday. He referred also to the formal protest filed by the Linnæan Society and furnished extracts from the proceedings of that Society.

Mr. Harris spoke of his visit to Washington and his studies with Mr. Schwarz of the U. S. National Museum collection of Cicindelidæ, remarking particularly on the liability of species supposed to be exclusively Central American to occur in Arizona, New Mexico or Sonora. A form of *C. argentata* found by Oslar in Sonora, and *C. segnis,* related to *C. debilis,* found in Arizona by Eugene Smythe being examples.

MEETING OF DECEMBER 18, 1915.

A regular meeting of the New York Entomological Society was held December 18, 1915, at 8: 15 P. M., in the American Museum of Natural History, Vice-President Harry G. Barber in the chair, with twenty members and one visitor, Mr. Howard Notman, present.

The curator reported that the local collection of Malachiidæ had been completed and that the subject for study on January 15 would be the family Cistelidæ.

Mr. Schaeffer for the Publication Committee reported progress with the Van Duzee List, which had been delayed by the printer and by corrections received from the author.

Mr. Dow, in seconding the nomination of Mr. Howard L. Clark, recalled that gentleman's forty-two years of entomological activity and moved that he be elected by affirmative ballot cast by the secretary.

Mr. Clark was thereupon elected an active member.

Mr. Dow nominated Mr. Howard Notman, of 136 Joralemon St., Brooklyn, for active membership.

Mr. Davis announced the death on December 15 of Ignaz Matausch, a member of the Society for many years.

On motion, Mr. Mutchler was appointed a committee to prepare an obituary notice for the JOURNAL; and the secretary was instructed to express by letter to the widow the regret of the members.

The chairman appointed Messrs. Dickerson, Dow and Sleight a committee to prepare nominations for officers for the ensuing year.

Mr. Nicolay exhibited his collection of "Local Gyrinidæ" and other families of aquatic beetles and described methods of capture and local environment. He also showed sheets prepared for the N. Y. State List and enlarged photographs of the scenes amid which he had collected.

Mr. Davis, adverting to his remarks on the sunbasking habit of Gyrinidæ, recalled his printed observations,[1] and especially his experience at Pine Island, N. Y., with Mr. Woodruff when *Dineutes discolor* and *Gyrinus dichrous* were seen in separate assemblages, though on the same submerged tree, basking in the sun, and dropping off, one by one, when disturbed, like turtles.

Mr. Schaeffer and Mr. Leng spoke of the taxonomic difficulties involved in some of these groups, and the latter referred also to the work in progress by Mr. H. H. Knight, of Ithaca, on the Parnidæ.

Dr. Lutz, in the absence of Mr. Viereck, exhibited and spoke briefly of the parasitic Hymenoptera of Porto Rico.

Mr. Davis exhibited photographs received from Mr. Clarence Shoemaker of Messrs. Nicolay and Shoemaker at work along the Potomac, and quoted the nickname "Energy Shoemaker" as applied in Washington to the latter.

Mr. Shoemaker exhibited and donated to the local collection specimens of *Semiophora gristra,* taken at Lakehurst in October and identified as a rare moth by Dr. Forbes; also *Catocala amatrix,* captured as it flew alarmed from the pine trees, and *Xylina pexata.* He remarked upon the benefit he had already derived from the local collection in its incomplete condition and urged upon all members the advantage of completing it as rapidly as possible.

Mr. Weiss exhibited and donated to the local collection specimens of *Antonina crawi,* the cottony bamboo scale, found at Riverton, N. J., in August, an introduction from Japan; *Rhopalosiphon ligustri* Kalt., the privet plant louse, found in Jersey City in July, probably European in origin and remarkable as being one of the few enemies of privet; *Corthylus punctatissimus,* long known as attacking the rootstock of huckleberry, but lately developing into a pest attacking the rhododendrons and azaleas; the specimens shown were found at Somerville, N. J., October 7, 1915, and sections showing their work near the ground were included; *Pinipestris zimmermanni* Grt., the pine shoot moth, from Eatontown, N. J., August 15; *Monarthropalpus buxi* Lab., the boxwood leaf miner, probably introduced from Holland.

Mr. Weiss exhibited also a Pierid, found alive in French nursery stock at Rutherford, N. J., December 1, which has been identified as *Gonepteryx rhamni* Linn., ♀, the brimstone butterfly, common in Europe, Asia and North Africa.

Mr. Leng exhibited a species of Staphylinid beetle of the tribe Omalini,

[1] JOUR. N. Y. ENT. SOC., VII, p. 22, 1899.

found at the edge of sphagnum swamp near Roselle Park, N. J., by Mr. H. G. Barber while sifting. The species appears to be new to the United States and allied to the European *Boreaphilus,* according to letters from Mr. E. A. Schwarz.

Mr. Leng also called attention to the articles by Paul Schulze in Verhandlung der Deutschen Zoologischen Gesellschaft, 1913, on the composition and reaction to alkaline fluids of the tuberculate elytra of beetles, especially Cicindelæ, which may explain some differences observed and hitherto supposed to be of taxonomic importance.

Mr. Rich spoke of the flight of beetles when deprived of one or both elytra, citing some of the literature on the subject, and stating that from his experiments the elytra appeared to have a function similar to that of the planes of a flying machine.

His remarks were discussed by Dr. Lutz, Messrs. Davis, Schaeffer and Leng, the latter describing the use of the abdominal apex by Staphylinidæ in folding the elytra after a flight.

Mr. Davis said this was already known and referred to J. G. Wood, "Insects at Home," p. 66 (1872), where the process is described.

Dr. Lutz said the earwigs also use their forceps for the same purpose.[1]

[1] Wood, p. 227, and "Flashlights of Nature," by Allen.

THE

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Organized June 29, 1892.—Incorporated June 7, 1893.

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Eighth Ave.

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NOTES ON SOME SLAVE-RAIDS OF THE WESTERN AMAZON ANT (POLYERGUS BREVICEPS EMERY).[1]

By William Morton Wheeler,

Forest Hills, Mass.

While camping during the summer of 1915 at Fallen Leaf Lake near Lake Tahoe, in the Sierras of California, I had an opportunity to observe several slave-raids of the western amazon ant (*Polyergus rufescens* Latr. subsp. *breviceps* Emery), a form not hitherto known to occur in California. In my book on the ants[2] I described a few forays of this ant in Colorado, but the Californian colonies exhibited some peculiarities of behavior not heretofore observed in any of our North American amazons. Only five colonies were seen during ten days devoted to the study of the ants of the Lake Tahoe region, so that in this locality *P. breviceps* is evidently much rarer than in certain localities (*e. g.*, Florissant) at the same or greater elevations in the Rocky Mountains of Colorado. The slave in all the colonies was an ill-defined variety of *Formica fusca,* less pubescent than var. *subsericea* Say or *argentea* Wheeler and larger and less shining than the typical form of the species.

The notes taken on the following dates refer to as many different colonies:

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 113.

[2] Ants, Their Structure, Development and Behavior. Columbia Univ. Press, 1910, p. 475–477.

July 22. At 4.30 P. M. a large army of *breviceps* workers was seen hastening along the rocky trail, at an altitude of about 6,000 ft., on the eastern slope of Mt. Tallac, about 50 feet above the surface of Fallen Leaf Lake. The ants were followed to a *fusca* nest which they had just reached. The *fusca* workers had retired into their galleries and could be seen hurriedly closing the small entrance from within with pellets of earth, evidently for the purpose of shutting the amazons out. The latter, however, at once tore out the barricade and poured into the nest. Soon they began to bring up the *fusca* pupæ and at once hurried back over the trail. I followed them to their own nest which was nearly 60 feet from the plundered colony, in the narrow crevices of some large rocks where it could not be examined. By 5.15 P. M. all the amazons had entered their nest. The supply of *fusca* brood secured on this raid was not considerable, since only about one in ten of the returning workers carried a pupa or larva in its jaws. Retracing my steps to the *fusca* nest, I found its inhabitants slowly and apparently with reluctance returning to it.

July 24. A small colony consisting of a wingless, ergatoid female and about a dozen small *breviceps* workers and nearly two dozen *fusca* workers was found under a log in a warm hollow at an altitude of nearly 7,000 ft. on the eastern slope of Angora Peak. This was evidently a young colony, with the ergatoid female functioning as its queen. This insect had the gaster considerably distended with eggs.

July 25. At 4.20 P. M. I encountered a small colony of *breviceps* returning from a raid on the Mt. Tallac trail near Fallen Leaf Lodge, not far from the spot where I observed the foray of July 22. I did not stop to locate the nest.

July 29. At 3.45 P. M. I came upon a large *breviceps* army returning to its nest laden with pupæ near Glen Alpine Springs at an altitude of about 7,000 ft. The nest was easily found under a large flat stone, which I lifted just before the returning army arrived. The nest-chembers were full of *fusca* workers and pupæ, but only two or three amazons had remained among them, and had not, therefore, taken part in the foray.

The notes taken on the following dates refer to a single *breviceps* colony which was observed on five consecutive days, not only by myself but also by many of my fellow campers and by Mr. Wm. W.

Price, the genial ornithologist and proprietor of Fallen Leaf Lodge:

July 26. At 4.10 P. M. I discovered the nest of a very large *breviceps* colony under a small flat stone near the mouth of the canyon through which the stream runs from Glen Alpine Springs to Fallen Leaf Lake. The army of several hundred workers was just emerging and congregating around the three nest orifices in preparation for a foray. The ants very soon hurried off in great excitement down the canyon to a *fusca* nest at least 70 feet distant. The trail was difficult, as the insects had to cross a very dusty road, climb over a pile of rough boulders, creep under a lot of low bushes and then traverse many feet of rocky soil. The first individuals, however, reached the *fusca* nest at 4.30 P. M. and at once entered it through several openings so small and so much obstructed with pellets of earth that I should not have found the nest without the guidance of the amazons. The *fusca* workers offered no resistance, but fled in all directions. A few managed to escape with larvæ in their jaws. The amazons poured into the nest entrances and soon emerged with the first pupæ, nearly all of which were naked (*i. e.*, not enclosed in cocoons) at 4.40 P. M. and at once started for home. The vanguard of the returning army, nearly every worker of which was carrying a pupa, reached the nest at 4.55 P. M. and the last stragglers had arrived by 5.10 P. M. The foray was therefore completed in an hour. It was accompanied by an unusual performance—a partial marriage flight. About 20 winged female amazons and a greater number of males left the nest with the army of workers and while some of the couples lingered behind and mated on the ground or low vegetation and several of the males flew away without mating with their sisters, several of the females accompanied the workers and even entered the *fusca* nest. None, however, was seen to return with the pupa-laden workers. A few, which had mated, tore off their wings and ran about over the ground. They probably returned to the nest after I had left the spot.

July 27. I visited the amazon nest at 3.35 P. M. and found that the army had just departed. It took a more northerly direction than on the preceding day, and after covering a distance of about 75 feet, stopped and began to hunt about among the stones and sparse vegetation. After several minutes devoted to this search, the greater portion of the army moved on but the remainder discovered a small *fusca* nest, plundered it without opposition and at once returned home with all the pupæ that could be secured. The main army hurried on over a very rough, stony trail. They stopped twice, searched about diligently but in vain, and each time changed the direction of their route. Several completely or partially deälated females accompanied the main army the whole distance and seemed to be quite as keenly interested in the proceedings as the workers. The army halted a third time at a spot 125 feet distant from the point where the first nest was plundered and succeeded in discovering a flourishing *fusca* colony consisting of large workers. These were very aggressive and fully prepared to defend their nest, which, like all the *fusca* nests in the vicinity of the amazon colony, was very carefully concealed under and between stones. The amazons reached this nest at 4.30 P. M. and exhibited great excitement. Some of them attacked the *fusca* fiercely, while others kept digging their way into the earth-barricaded entrances. *Fusca* workers could be seen defending their doorways from within, but they were mercilessly dragged out and massacred in the usual manner, by having their heads pierced with the sickle-shaped mandibles of the amazons. Finally, after a struggle of fully 30 minutes, at 5 P. M. the first *fusca* pupæ were brought out. Their bearers turned at once in the direction of their nest, nearly 200 feet away and hurried towards it over a path, *which, for fully 40 feet, was entirely different from the one over which they had come.* A stream of pupa-laden amazons issued from each of two nest orifices and at once united to form a single file. Even the young callow *fusca* workers were dragged out by the antennæ and then seized by the thorax and carried along. Several of the deälated females returned with the workers but none was seen to carry a pupa. The army reached the home nest at 5.30 P. M., so that this foray, during which two *fusca* colonies had been thoroughly plundered, and fully 400 feet of ground had been traversed by most of the individuals, was completed in two hours.

July 28. The amazon army left the nest at 4.15 P. M., plundered a large *fusca* colony after traversing nearly 80 feet of rough, stony soil to the southeastward, and returned with many pupæ by 5.30 P. M. The army was accompanied both to and from the *fusca* nest by several deälated females, but none of them carried pupæ.

July 29. I arrived late at the amazon nest, but found Mr. Price already there with several campers, all intently watching the ants. According to their statements, the army left the nest about 3 P. M. After going some 60 ft. it hesitated and part of it discovered a small *fusca* colony, plundered it and returned home at once with the booty, while about half of the army changed its direction and proceeded to a point about 80 feet from the home nest in a more northerly direction than any of the previous forays and along the bank of the stream. The ants soon succeeded in detecting a *fusca* colony, which, however, offered stubborn resistance. This was overcome and the robbers were all returning laden with pupæ when I reached the spot between 4.50 and 5 P. M. One of the observers saw a few winged amazon females in the outward-bound army, but none was seen returning to the nest.

July 30. The amazon nest was watched by Mr. Price, about twenty campers and myself from 2.30 to 4.30 P. M. but made no foray. This was very probably due to the weather, which was cloudy and much colder than on the preceding days. Nevertheless quite a number of males escaped from the nest, especially between 2.30 and 3.30 P. M. Some of them flew away, others almost immediately returned to the nest and several were violently dragged back into it by the *fusca* slaves. Only two deälated females left the nest. They ran about for some time and then returned into the entrances of their own accord. The slaves were very active at all three entrances and seemed to be constantly keeping the worker amazons from making a sortie. On lifting the stone covering the galleries several winged females were seen near one of the entrances, but none of them left the nest. The following morning I was compelled to leave Fallen Leaf Lodge and was therefore unable to continue my observations.

The following points are particularly interesting in these field observations in connection with those recorded in my ant book on the same subspecies in Colorado, *P. rufescens bicolor* in Illinois and *P. lucidus* in New York:

1. Although it is known that both the European and American amazons make their raids only during the afternoon, the sorties previously recorded for our American forms, though also observed during July, occurred at an earlier hour, as follows: *breviceps* at 1.55 P. M. *bicolor* before 2 P. M.; at 1.35 and 1.20 P. M.; *lucidus* at 2.20 P. M. One foray of *lucidus* observed by Burrill in Pennsylvania started be-

fore 2.30 P. M.[3] The four sorties of *breviceps* observed near Fallen Leaf Lake occurred at 4.10, 3.35, 4.15 and 3 P. M., and the three armies merely seen returning to the nest July 22, 25 and 29, could hardly have started out before 3 P. M. In this connection I may mention, also, that the two forays of the small shining *P. rufescens læviceps* Wheeler which I observed July 20, 1914, on the slopes of Mt. Tamalpais, near San Francisco, Calif., must have left their nests after 3 P. M. How are we to account for this difference in time of sortie between the Californian amazons and those of Colorado, Illinois, Pennsylvania and New York?

Before attempting to answer this question it will be advisable to glance at some of the published accounts of the typical European *P. rufescens.* The most comprehensive observations on this ant have been made by Forel in Switzerland.[4] During 33 days he saw a single *rufescens* colony make 44 expeditions and estimated that the ants secured from the various plundered colonies of *F. fusca* and *rufibarbis,* on these and other expeditions, which he did not observe, a total of fully 40,000 larvæ and pupæ. Concerning the time of sortie in general he writes (p. 289): "As Huber says, *P. rufescens* nearly always leaves its nest in the afternoon between 2 and 5 o'clock. Von Hagens saw a sortie at 6 P. M.; I have observed two at 1.30 P. M. These are, to my knowledge, the extreme cases. Expeditions have never been observed in the morning. Ebrard says that they depart very late on their first expedition (during June) and thereafter a little earlier each day. I have never observed anything of the kind. I have seen amazons from two different formicaries departing at 2.15 P. M. and at 4 P. M. respectively. On the other hand I have seen amazons of the same colony depart on several successive raids at the same hour. The hour of departure depends as a rule on the temperature; the warmer it is, the later do the amazons depart and *vice versa.* The amazons of the same formicary departed during one year as follows: July 1, 3.15 P. M.; July 23, 5 P. M.; Aug. 10, 3 P. M.; Aug. 12, 1.30 P. M.; Aug. 14, 4.45 P. M., etc. The departure of Aug. 10 and 12 coincided with a pronounced and sudden drop, that of Aug. 14 with a pronounced rise of temperature. According to the formicaries, the

[3] "A Slave-making Foray of the Shining Amazon (*Polyergus lucidus* Mayr)," JOURN. N. Y. ENT. SOC., 16, 1908, pp. 144–151.

[4] Fourmis da la Suisse, 1874.

expeditions begin from the middle of June to the beginning of July (possibly sooner in very warm localities) and end between the middle of August and beginning of the September." Emery,[5] who has succeeded in solving the interesting problem of the establishment of amazon colonies, gives the time of two forays of a colony in northern Italy during 1908 as July 24, 4.30 P. M. and July 25, 3 P. M. and of two forays of this same colony during 1907 as July 16, 4.30 to 5 P. M. and July 19, as 5 to 7 P. M.

Forel is probably correct in supposing that the time of sortie of the amazon army is determined by temperature. We may suppose that a certain optimum, probably near 70° to 75° F., is required by the ants. This is often attained during the sunny afternoon hours of July and August in temperate North America and Eurasia. It would certainly be below the usual maximum diurnal temperature and would bear a certain relation to it, so that it would be reached earlier in the afternoon on hot than on cool days. Thus we could account for the differences in the time of sortie between the Californian amazon colonies and those of the Rocky Mountains, Middle and Eastern States since the average midday temperatures of July at altitudes of 6,000 to 8,000 ft., on the southern and eastern slopes and in the canyons preferred by the ants, is certainly much lower in California than it is in the other localities mentioned. It is not improbable, however, that atmospheric humidity may also be a factor in determining the time of sortie. At any rate, all future descriptions of amazon expeditions, both in this country and abroad, should be accompanied by accurate temperature, barometric and humidity records, for in time such records might enable us to ascertain the precise external stimuli that call forth such periodic behavior as the slave-raids and nuptial flights of ants.

2. The second matter of interest in the observations made at Fallen Leaf Lake is the behavior of the males and females of *brevi-ceps*. Emery has been puzzled by the behavior of these forms in the European *rufescens*. Huber and Forel had witnessed marriage flights of this ant and Burrell[6] described a feeble marriage flight of

[5] Osservazioni ed Esperimenti sulla Formica Amazzone. Rend. Sess. R. Accad. Sci. Ist. Bologna, 1908, 16 pp.; Nuove Osservazioni ed Esperimenti sulla Formica Amazzone, *ibid.*, 1909, 8 pp.; Ulteriori Osservazioni ed Esperienze sulla Formica Amazzone, *ibid.*, 1911, 18 pp.

[6] *Loco citato*, p. 150.

lucidus July 22, 1903. Aug. 20, 1903, I saw a large and very typical flight of *lucidus* subsp. *montivagus* Wheeler near Colorado Springs. Emery observed a colony of *rufescens,* which, during 1907, had no marriage flight but from which winged and deälated females issued and accompanied the workers on their forays. In 1908 the same colony gave off a lot of males which flew away but no females accompanied the raids. The observations on the Californian *breviceps* show that the males and females may stay long in the maternal nest, that some of them may escape from time to time and mate outside the nest and that both winged and fecundated, deälated females may accompany the workers on their raids while a marriage-flight is taking place. A single colony may thus exhibit during the course of a few days combinations of the two extreme conditions noticed by Emery during two seasons. I called attention to the protracted retention in the nest of males and females of *lucidus* in 1908,[7] but before making the observations on the Californian *breviceps* I had never seen the females accompanying the workers on their raids, though both Emery and Forel had seen this repeatedly in the typical *rufescens.* These authors have also failed to notice any inclination on the part of the females to bring home pupæ. My observations leave me skeptical in regard to Emery's assumption that the female *Polyergus* mates inside the nest.

Emery's observations on colonies kept in artificial nests show conclusively that the fecundated and deälated female of *Polyergus* founds her colony by entering a *fusca* formicary, killing its queen by piercing her head with the mandibles and securing adoption in her place by the *fusca* workers. Does the female, while accompanying the foraging army, gain acquaintance with the situations and personnel of the various *fusca* nests in the area dominated by the *Polyergus* colony, so that she can at her leisure select and invade a propitious colony in which to secure adoption? Or does she actually secure adoption in a colony which has just been plundered and is therefore in a depressed and nonresistant state, as seems always to be the case with *fusca* colonies after they have had to submit to this sudden and severe calamity? The former method is suggested by the iso-

[7] "The Ants of Casco Bay, Maine, with Observations on Two Races of *Formica sanguinea* Latreille," Bull. Amer. Mus. Nat. Hist., 24, 1908, p. 640 *nota.*

lated deälated females sometimes found running about on the ground at a distance from the maternal nest, as if looking for a host-colony; the latter method would seem to have many advantages. Perhaps both methods are adopted by different females.

3. The finding on July 24 (p. 108) of a small and evidently incipient *breviceps* colony consisting of an ergatoid or wingless female with about a dozen workers and twice as many *fusca* slaves, is significant, because the female was functioning as the mother of the colony and must therefore have been fecundated. The ergatoid female of the European amazon has been known for more than a century. It was first recognized by Pierre Huber[8] and has been repeatedly taken by Forel, Emery and Wasmann. According to Forel (Fourmis de la Suisse, p. 137), "this singular creature, which is very constant in type, is rather rare. Nevertheless, during certain years some specimens of it are found in most of the formicaries. Its rôle, if it has one, is unknown. Perhaps it can replace the queens in their functions. Dissection has proved to me that its ovaries are identical with those of the queen, etc." Wasmann[9] describes one of these females which he kept in an artificial nest with amazon workers and slaves from April, 1885, to September, 1886. It was treated by the slaves as a true queen, licked, fed and, when disturbed, carried to a place of safety. Its eggs, however, produced only males, showing that it had not been fecundated. In 1908 I published a similar observation[10] on a large colony of *lucidus* which I had under observation for five years in a field near Bronxville, N. Y.: "During four years this colony produced numbers of males and females, both winged and ergatoid, and the winged females lingered for weeks in the nest without deälation. The first week of the past April [1908] I found the whole community with its larvæ and mother queen enjoying the spring warmth in the superficial galleries just under the large flat stones with which I had covered the nest in September, 1903. I captured the queen and part of the colony and transferred them to an artificial nest. Aug. 9 [1908] I again visited the nest, and to my surprise, found it teeming with several hundred mature males clinging to the

[8] Recherches sur les Moeurs des Fourmis Indigènes. 1810, p. 251.

[9] Die zusammengesetzten Nester und gemischten Kolonien der Ameisen, Münster s.W., 1891, p. 84.

[10] Ants of Casco Bay, etc., *loc. cit.*, p. 141, *nota*.

lower surface of the stone, but with no winged or deälated females. Besides the males I found only a single large ergatoid female, several dozen workers and slaves [*Formica incerta*] and half a dozen cocoons enclosing nearly mature male pupæ. Without doubt, the ergatoid had usurped the rôle of the mother queen, and being unfertilized, had produced only male offspring. The comparatively small number of slaves had been able to rear an enormous number of these little creatures although the absence of *incerta* pupæ in the nest indicated that the *Polyergus* workers had made no forays during the past summer." Emery[11] cites an unpublished observation of Wasmann concerning an ergatoid female of *rufescens* which produced workers and must therefore have been fecundated. This observation supports my interpretation of the origin of the *breviceps* colony taken on Angora Peak, Cal., July 24. Emery believes that the ergatoid females may be fecundated in the maternal nest, but this might occur quite as easily outside the nest and on the ground during a marriage flight of the males.

Considerable interest attaches to the ergatoid female of *Polyergus* because it is so much like the only females known to occur in certain tropical ant genera such as *Leptogenys, Onychomyrmex* and *Paranomopone.* It suggests that the ants of these genera once possessed, like *Polyergus,* two kinds of females, one winged and one wingless, and that the colonies for some reason no longer develop the former. In the singular parasitic *Hapagoxenus sublævis* the two forms still occur but in different geographical regions, the winged form in Saxony, as Viehmeyer has shown, and the wingless form in Sweden, as was first established by the classical observations of Adlerz.

POSTSCRIPT.

After the preceding pages were written I received a fourth interesting paper from Professor Emery on the amazon colony which he had under observation from 1908 to 1914.[12] In 1908 and 1909 he succeeded in establishing in artificial nests two amazon colonies with the aid of two fecundated queens that had secured adoption by *fusca* workers. In March 1910, he combined the two formicaries and the

[11] Osservazioni e Esperimenti, etc., 1908, *loc. cit.*, p. 7.

[12] Histoire d'une Société Expérimentale de *Polyergus rufescens*, Rev. Suisse Zool., 23, 1915, pp. 285–400, 2 figs.

single colony thus formed flourished and grew to considerable size by July 18, 1911, when he took it into his garden and observed the behavior of the amazons when he opened the nest and permitted them to make slave-raids on various colonies of *Formica fusca* var. *glebaria* and *F. rufibarbis*. Similar experiments were performed during the summer of 1912 and 1913. July 14, 1914, when he released the colony for the last time in a courtyard of his villa, the ants established themselves in the soil and soon afterwards moved to another more permanent nest. The amazons made several sorties till October 2, but secured no booty, as there were no nests of the slave-species in the courtyard. The observations were very suggestive in connction with the interesting problem as to how the amazon armies are guided to the nests they plunder. Like Forel and myself, Emery believes that exploring workers, which leave the nest singly, ascertain the position of the slave colonies in the environment and are thus able to determine at least the initial direction to be taken by the army when it leaves the nest. I shall not discuss this difficult question here, but will merely call attention in conclusion to the times of sortie of the army as recorded in Emery's paper. These are given as follows:

1911.	Aug.	22—4.30 P. M. and 5.15 P. M.
1912.	"	17—5.00 P. M. and 6.30 P. M.
	"	21—4.20 P. M.
	"	24—4.30 P. M.
	"	28—5.40 P. M.
1913.	July	5—4.50 P. M.
	"	30—5.15 P. M.
1914.	"	16—6.00 P. M.
	"	17—6.30 P. M.
	"	25—7.00 P. M.
	Aug.	8—5.30 P. M. and 6.15 P. M.
	Oct.	2—3.30 P. M.

It will be seen that all but one of the sorties were very late, between 4.20 and 7 P. M., the average time being about 5.30 P. M. This is much later than the average time of sortie of Swiss colonies of *rufescens* or of the Californian *breviceps*, and indicates that the temperature during July and August in northern Italy (presumably near Bologna), in such enclosed spaces as gardens and courtyards, may be higher in the late afternoon. On Aug. 22, 1911, Aug. 12, 1912, and Aug. 16, 1914, two sorties occurred on the same day. This has also been occasionally observed by Forel in the field. On Aug. 9, 1914, there were three sorties, but the time of their occurrence was not recorded.

NEW LIMNOPHILINE CRANE-FLIES FROM THE UNITED STATES AND CANADA (TIPULIDÆ, DIPTERA).

By Charles P. Alexander,

Ithaca, N. Y.

The tribe Limnophilini of the subfamily Limnobinæ, in the Nearctic fauna, includes a considerable number of species placed in a relatively small number of genera. During the past few years a number of interesting forms have accumulated in the collection of the author and these are described herewith; I am greatly indebted to Mr. C. W. Johnson, Mr. Frederick Knab and Mr. W. L. McAtee for the loan of this and other material sent me for study.

Limnophila marchandi, new species.

Allied to *L. alleni;* color of the thorax gray; ground color of the wings hyaline; basal abdominal tergites gray with prominent setigerous punctures.

Female.—Length, 30 mm.; wing, 20 mm.; Middle leg, femora, 10 mm.; tibiæ, 8.7 mm.; tarsi, 8.6 mm.

Rostrum short, dark brown, palpi dark brown. Antennæ with the two basal segments dark brown, the flagellum light brown; first scapal segment elongated; segments of the flagellum short, gradually narrowed to the seventh segment of the organ beyond which the segments are very slender and attenuated. Head dark brown, the margin of the vertex adjoining the inner margin of the eye, paler, more yellowish; head narrowed behind.

Pronotum light brownish gray, clearer gray on the sides, with a delicate impressed median line; scutum with numerous long hairs whose bases are surrounded by brown spots. Mesonotal præscutum clear light gray with three dark brown stripes; the middle stripe is broad, the median area is paler brown and narrowly bisected by a very delicate dark brown median line which runs the length of the sclerite; the middle stripe does not attain the transverse suture; lateral stripes short, crossing the transverse suture onto the scutum; the pale area between the lateral and middle stripes is lined with a paler shade of brown; sides of the sclerite bearing abundant long pale hairs many of which are encircled by a dark brown spot producing a dotted appearance which is especially noticeable before the pseudosutural foveæ; scutum clear, light gray with five brown lines, the outermost pair very broad, dark brown, continuations of the lateral præscutal vittæ; inside these stripes a pair of narrow lighter brown stripes; a delicate median brown vitta continued backward from the middle præscutal stripe; scutellum gray with numerous long pale hairs which are surrounded by indistinct brown spots; postnotum gray, the sides dark brown. Pleura clear light gray, indistinctly and delicately lined and dotted with pale brown. Halteres short, pale, the knob brownish just before the apex. Legs with the coxæ gray; trochanters dull yellow; femora dull yellow, their apices dark brownish black; tibiæ dull yellow, the apices narrowly black; tarsal segments one and two brown, narrowly tipped with black; remainder of the tarsi black; legs hairy. Wings hyaline or nearly so, the costal cell dark brown; a yellowish spot before the arculus and before the radial cross-vein; brown markings as follows: a large blotch beyond the arculus; at the origin of *Rs;* at the end of the sector continuing down to the cell 1st M_2; apex of the wings in cells 2d R_1 and R_2; grayish brown seams on the crossveins and deflections of veins; a grayish brown cloud in cell *Cu* continuing down into the tip of cell 1st *A;* pale gray clouds in the middles of the other cells of the wings. Venation as in plate 1, fig. 2; Sc_1 ending just beyond the base of cell R_2; crossvein *r* not far from the tip of R_1; R_{2+3} shorter than the deflection of R_{4+5}; cell 1st M_2 hexagonal; M_{1+2} beyond *m* about equal to the basal deflection of Cu_1; basal deflection of Cu_1 only a little longer than the prominent downward deflection of M_3.

Abdominal tergites with the first segment dark brown; remaining tergites light gray with a salmon caste; a broad dorso-median dark brown line; lateral margins indistinctly pale; a narrow sublateral brown line; the entire surface is densely spotted with prominent brown setigerous punctures; sternites pale grayish brown with an indistinct narrow dark brown median line and impressed lines on each segment forming an irregular quadrate figure; the surface with abundant brown setigerous punctures; caudal margins of the sclerites silvery.

Habitat.—Eastern United States.

Holotype, ♀, Framington, Connecticut; June 7, 1914; Dr. R. W. Marchand.

The type is in the collection of the Boston Society of Natural History.

This interesting crane-fly is closely allied to *L. alleni* Johnson, (see plate VIII, fig. 1) from which it may be separated by the appended key. It is curious that there should be two such striking Limnophilas found in the eastern states and overlooked by collectors until within the last few years. This fly was handed to me for description by Mr. Johnson, to whom I am indebted for many other kindnesses and at his suggestion I dedicate the species to the collector, Dr. R. W. Marchand. The tent-trap observations made at Ithaca, N. Y., in 1915 by Miss Ruby B. Hughes indicate that the larvæ of *Limnophila alleni* live in wet organic mud.

1. Larger (wing, ♀, 21.5 mm.); thoracic dorsum reddish brown with three velvety brown stripes, the middle one narrowly split by a line of the ground-color; wings yellowish and brown; basal abdominal tergites yellow without prominent setigerous punctures..........**L. alleni** Johnson.
   Smaller (wing, ♀, 20 mm.); thoracic dorsum gray with three narrow velvety-brown stripes, the middle one split by a broad pale line; ground-color of the wings hyaline; basal abdominal tergites gray with prominent setigerous punctures ....**L. marchandi,** n. sp.

Limnophila mundoides new species.

Black, the thoracic dorsum shiny; wings hyaline or nearly so; femora yellow, the anterior pair with the apical half black; hypopygium of the male enlarged, complex in structure.

Male.—Length, 5.6 mm.; wing, 6.2 mm.

Rostrum black, very short, palpi brownish black. Antennæ black, short, the first segment elongated, the flagellar segments elongate-oval. Head black.

Thorax shiny black. Halteres white. Legs slender, the coxæ dull yellow, the base of the fore coxa suffused with black on the outer face; trochanters dull yellow; femora not conspicuously hairy, fore femora with the basal half yellow, the apical half dark brown; middle femora with the basal two thirds yellow, the apical third dark brown; hind femora yellow, the tip narrowly browned; tibiæ brown; tarsi dark brownish black. Wings hyaline or nearly so, the stigma indistinct, the veins dark brown. Venation as in plate 1, fig. 3: Sc short, ending just before the tip of the sector; Sc_2 close to the tip of Sc_1; Rs long; R_{2+3} very short, subequal to the basal deflection of R_{4+5}; M_{1+2} beyond m about equal to cell M_1; basal deflection of Cu_1 almost underneath the middle of cell 1st M_2.

Abdomen black, the sternites somewhat paler. Male genitalia remarkably developed for this genus of flies, this condition approached by no Nearctic species hitherto described but suggesting in some respects the condition obtaining in *Phyllolabis* O. S. and *Oromyia* Alex. The ninth tergite arched, convex, produced caudally into a prominent median lobe which is slightly enlarged apically and truncated to slightly concave across the tip; sides of the tergite with numerous very long, prominent hairs; the ninth sternite is not distinct from the tergite, produced caudad on the mid-line beneath into a prominent bifid lobe which bears an abundance of very short pubescence and a few long hairs; ninth pleurite complete; pleural appendages two, a caudal-lying, very slender, slightly curved chitinized lobe that is directed caudad, the tip inward; the anterior lobe is densely hairy on the outer face, the apex chitinized. Just dorsad of the bifid sternal appendage, on either side, arises a prominent flattened lobe with exceedingly abundant long black hair and numerous punctulations; the ventral apical angle of this lobe is pale and produced into a short hook directed inward.

Habitat.—Eastern United States.

Holotype, ♂, Plummers Island, Maryland; June 3, 1914; R. C. Shannon.

Paratype, ♂, Beltsville, Maryland; June 9, 1915; W. L. McAtee.

The type is in the collection of the United States National Museum.

This interesting fly differs from *L. munda* Osten Sacken (see plate VIII, fig. 4), which it superficially resembles, in the hyaline wings, the legs are not conspicuously hairy, the increased amount of black on the fore and middle femora and the prominent genitalia of the male.

Limnophila terebrans new species.

Black, the thorax with a slight gray bloom; wings slightly suffused with brown: R_{2+3} very short, less than the deflection of R_{4+5}.

Male.—Length about 7.5 mm.; wing, 7.7 mm.

Female.—Length, 8 mm.; wing, 8.1 mm.

Rostrum very short, dark brown, the palpi similar in color, very short. Antennae rather short, the first segment elongated, dark brown, remaining segments of the organ submoniliform, the apical segments of the flagellum not conspicuously elongated, flagellum light brown, the segments with a dense pale pubescence. Head broad, the vertex broad and bearing a very low, obtuse tubercle. Head dark gray.

Thorax black with a yellowish gray bloom over the entire surface, the usual mesonotal interspaces with prominent long yellow hairs; postnotum more reddish. Halteres short, stout, dull yellow. Legs with the coxæ dark brown; trochanters brownish yellow; legs of the male longer and more slender than those of the female which are club-shaped and more conspicuously hairy; femora yellow tipped with dark brown, the fore femora with the apical half brown, the hind pair with only the apex darkened; tibiæ brown; tarsi dark brown. Wings with a slight brownish tinge, the stigma dark brown, cross veins and deflections of veins seamed with brown. Venation as in plate 1, fig. 5: *Rs* elongate, slightly arcuated at the origin; R_{2+3} short, a little less than the deflection of R_{4+5}; petiole of cell M_1 longer than this cell. The right wing of the allotype is abnormal, the cell R_2 nearly sessile; cell 1st M_2 very small to obliterated, the petiole of cell M_1 much longer than this cell.

Abdomen dark brown; valves of the ovipositor very long and slender, the tergal valves slightly upturned at the apex.

Habitat.—Eastern United States.

Holotype, ♂, Cabin John, Maryland; May 5, 1899.

Allotype, ♀, topotypic, in coitu with the type.

The types are in the collection of the United States National Museum.

The related species of this group may be separated by the key that is appended to the following species.

Limnophila barberi new species.

Black, the interspaces of the mesonotal præscutum with a gray bloom; fore femora brown except at the extreme base.

Male.—Length, 6.4 mm.; wing, 8.3 mm.

Female.—Length, 7.6 mm.; wing, 8.1 mm.

Rostrum very short as in this group of the genus, dark brownish black, the palpi dark brown. Antennæ short, dark brown, the apex of the first segment a little brighter. Head dark brown with a sparse grayish bloom.

Mesonotal præscutum black with a sparse gray bloom, the usual thoracic stripes devoid of bloom, very shiny and very broad; scutum similar, the median area broadly gray pruinose; scutellum and postnotum dull brown. Pleura dark brown with a light gray bloom, the dorsopleural membranes indistinctly dull yellow. Halteres pale, the knob very little darker. Legs with the coxæ dull yellow, a little brownish on the basal half of the outer face; legs slender, the femora yellow with the apices brown, on the fore legs including all except the extreme base of the segment, on the hind legs including a little more than the apical half; tibiæ and tarsi dark brown. Wings sub-hyaline, crossveins and deflections of veins narrowly seamed with brown, the costal cell light brown, the stigma indistinct, the veins dark brown. Venation (see plate 1, fig. 6), as in the *munda* group, the radial sector elongated, almost straight, R_{2+3} about equal to the deflection of R_{4+5}; basal deflection of Cu_1 just before the middle of cell 1st M_2.

Abdominal tergites dark brownish black, the sternites more reddish; male hypopygium more reddish; the valves of the ovipositor of the female chestnut.

Habitat.—Western United States.

Holotype, ♂, Eureka, California; May 24, 1903; H. S. Barber.

Allotype, ♀, topotypic, in coitu with the type.

The types are in the collection of the United States National Museum.

The species is dedicated to the collector, Mr. H. S. Barber, of Washington.

The species that are allied to, or resemble, *Limnophila munda* O. S. may be separated by the following key:

1. Mesonotal præscutum entirely shiny black 2
   Mesonotal præscutum with a gray bloom, at least on the sides of the sclerite 3

2. At least the basal half of all the femora yellow; legs stout, hairy; wings tinged with brown (fig. 4) .... **munda** O. S.
   Fore femora with the extreme base only, yellow; legs slender, not conspicuously hairy; wings almost hyaline (fig. 3) ...... **mundoides** n. sp.
3. Entire mesonotal præscutum with a gray bloom; fore femora with only the apices brown; venation in fig. 5 .... **terebrans** n. sp.
   Interspaces of the mesonotal præscutum with a gray bloom; fore femora brown except at the extreme base; venation as in fig. 6 ... **barberi** n. sp.

Limnophila terræ-novæ new species.

Belongs to the *adusta* group; head gray; thorax dark brown; wings infuscated with brown at the tip.

Female.—Length, 9.5–11.3 mm.; wing, 9.2–11.4 mm.

Rostrum and palpi dark brown. Antennæ with the first segment elongated, dark brown with a sparse grayish bloom; segments two to six yellowish brown; the terminal segments brown. Head gray.

Mesonotal præscutum dark brown, shiny, covered with a sparse yellowish brown bloom which becomes almost lacking on the median area; scutum, scutellum and postnotum similar to the præscutum. Pleura brown, sparsely grayish yellow pollinose, the dorso-pleural membranes yellow. Halteres yellow with the knob brown; legs with the cocxæ and trochanters shiny yellow; femora brown, slightly brightened basally; tibiæ and tarsi brownish yellow, the latter more brownish apically. Wings with a pale brown tinge, the costal cell brown, yellowish at the base of the wings; stigma elongated, dark brown; apex of the wings infuscated; brown seams along the cord, crossveins and deflections of veins; *Cu* and *Rs* narrowly seamed with brown. Venation (see plate VIII, fig. 7) as in the *adusta* group.

Abdomen dark brown, the ovipositor reddish.

Habitat.—Newfoundland.

Holotype, ♀, Sandy Lake, Newfoundland; July 28, 1906; Owen Bryant.

Paratypes, 2 ♀'s, topotypic, July 25–28, 1906.

The type is in the collection of Mr. Charles W. Johnson; paratypes in the collection of the author.

This fly comes closest to *L. similis* Alex. (Eastern U. S.), *L. fulvocostalis* Coq. (Bering Is.), and *L. insularis* Johnson (Bermuda); *L. similis* has the legs with the brown apices to the segments narrow, the costal cell yellow, etc.; *L. fulvocostalis* resembles *similis,* with the costal cell yellowish brown, the wing-apex not infuscated; *L. insularis* has the wings unmarked, the legs yellowish with the tarsi browned toward the tips.

Limnophila oslari new species.

Belongs to the *lenta* group; body-coloration gray; wings whitish with a distinct oval brown stigma.

Male.—Length, 6.2–6.8 mm.; wing 6.8–7.6 mm.

Rostrum and palpi dark brownish black, grayish pruinose. Antennæ moderately elongated, dark brownish black, the segments gray pruinose; segments of the flagellum oval. Head clear light gray, with numerous setigerous punctures on the sides.

Thorax and pleura clear light gray without stripes. Halteres light yellow. Legs with the coxæ and trochanters reddish yellow; femora dark brownish black, the base more yellowish; tibiæ and tarsi dark brownish black. Wings whitish subhyaline, the stigma oval, dark brown; veins dark brown. Venation as in plate 1, figs. 8, 9: the venation somewhat variable as in the related eastern species, *L. lenta* O. S.; *Sc* ending just before the tip of the sector; *Rs* shorter than or equal to R_{2+3}, usually strongly arcuated to angulated at the origin; crossvein *r* on R_{2+3}, at the fork or on R_2; crossvein *r–m* arcuated; basal deflection of Cu_1 at the fork of *M* to one third the length of cell 1st M_2.

Abdominal tergites dark gray, the hypopygium reddish yellow.

Habitat.—Colorado, New Mexico.

Holotype, ♂, Platte Canon, Colorado; July 30, 1914; E. J. Oslar.

Paratype, ♂, Colorado (ex collection C. V. Riley).

Paratype, ♂, White Mts., New Mexico, South Fork of Eagle Creek, alt. 8000 feet, August 18; C. H. T. Townsend.

This species differs from the related Eastern species, *L. lenta* O. S. in its gray coloration, that of *lenta* being yellow or yellowish.

Limnophila osborni Alexander.

1914 *Limnophila osborni* Alexander; Proc. Acad. Nat. Sci. Philad., 1914, p. 596, pl. 25, fig. 6.

This interesting late summer crane-fly seems to be northern in its distribution. A male and a female from Price Co., Wisconsin, August 29, 1897, as part of the W. M. Wheeler collection, is in the American Museum of Natural History. The female sex has never been characterized and the specimen is made the allotype:

Sex ♀, similar to the male but larger; the abdominal tergites brown, indistinctly trivittate with darker; ovipositor with the tergal valves upcurved, elongated, slender, subacute, the sternal valves split into hair points at the tips. Length, 9.2 mm.; wing, 9 mm.

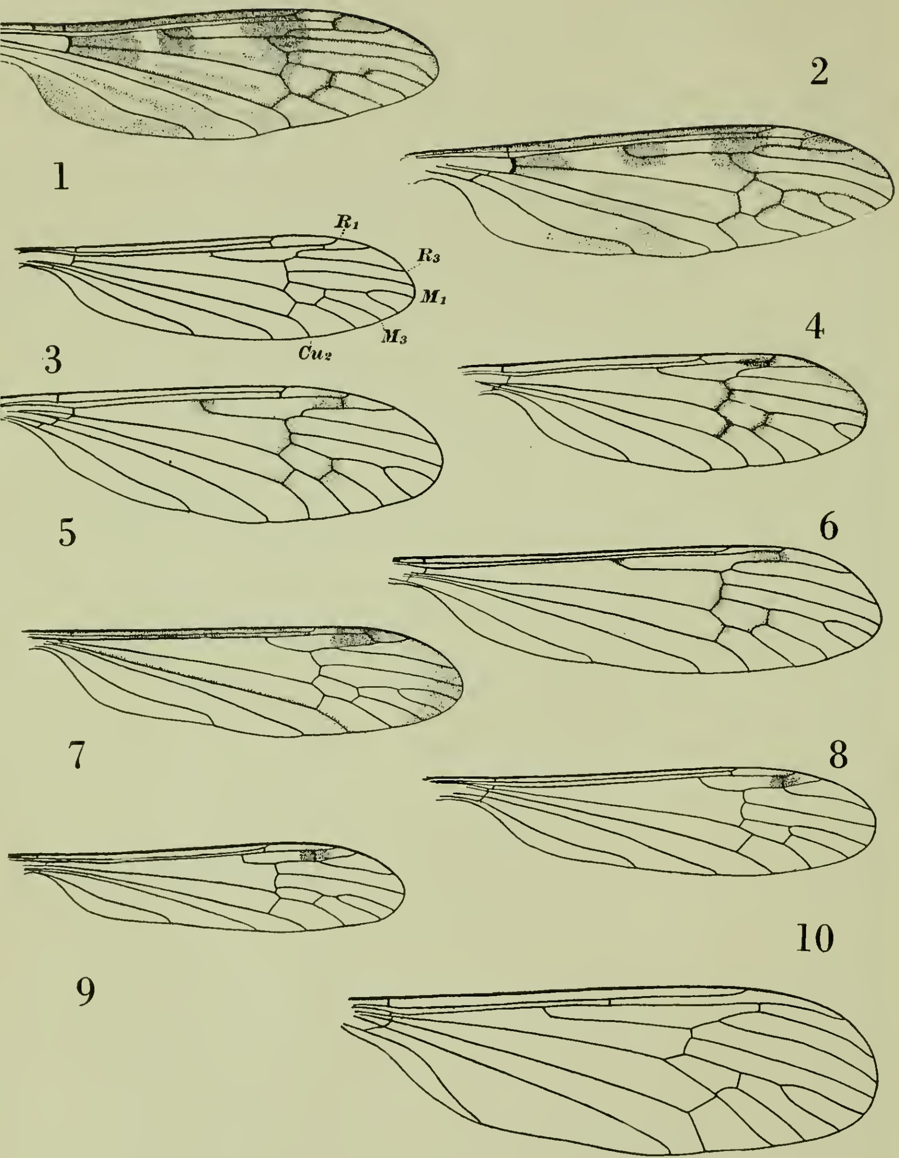
The allotype is in the collection of the American Museum of Natural History.

Trichocera (Diazosma) subsinuata new species.

Differs from the described species of the genus in the subsinuatæ course of the second anal vein; wing-veins long-hairy.

Male.—Length, 7.3 mm.; wing, 9.2–10 mm.

Female.—Length, 8–9 mm.; wing, 9–11.4 mm.



Tipulidæ.

Rostrum and palpi dark brown. Antennæ of the male not so elongated as in typical *Trichocera*, densely hairy, dark brown, the basal segments sometimes yellowish but more often uniform in color. Head small, depressed, light brown.

Pronotum prominent, the scutellum conspicuously light yellow, the scutum brown, with numerous long black hairs on either side of the median line. Mesonotum brown without stripes, scutellum and postnotum more yellowish, somewhat pollinose. Pleura brown, the dorsopleural and metapleural regions more yellowish. Halteres light brown. Legs with the coxæ and trochanters dull yellow; femora brown; tibiæ and tarsi dark brown. Wings very broad, infumed with dusky; veins dark brown, densely long-hairy. Venation (see plate 1, fig. 10) as in typical *Trichocera* but the second anal vein not recurved into the anal angle of the wing, subsinuate, in this respect differing from the described American forms.

Abdomen dark brown.

Habitat.—Northern United States and Canada.

Holotype, ♂, Hall Valley, near Platte Canon, Colorado; August 11, 1915; E. J. Oslar.

Allotype, ♀, topotypic.

Paratypes, 4 ♂♀, topotypic; ♀, Waubamick, Parry Sound, Ontario, June 13, 1915; H. S. Parish; ♂, Woodworths Lake, Fulton Co., New York, June 15, 1914; C. P. Alexander.

Types in the collection of the author, a paratype in the collection of Dr. W. G. Dietz.

This generalized form is very interesting in the course of the second anal vein of the wings. The range of the species is northern, presumably of the Canadian life-zone.

EXPLANATION OF PLATE VIII.

Fig. 1. Wing of *Limnophila alleni* Johnson.
Fig. 2. Wing of *Limnophila marchandi* n. sp.
Fig. 3. Wing of *Limnophila mundoides* n. sp.
Fig. 4. Wing of *Limnophila munda* Osten Sacken.
Fig. 5. Wing of *Limnophila terebrans* n. sp.
Fig. 6. Wing of *Limnophila barberi* n. sp.
Fig. 7. Wing of *Limnophila terræ-novæ* n. sp.
Figs. 8, 9. Wings of *Limnophila oslari* n. sp.
Fig. 10. Wing of *Trichocera (Diazosma) subsinuata,* n. sp.

DESCRIPTIONS AND RECORDS OF NORTH AMERICAN HIPPOBOSCIDÆ.

By MYRON H. SWENK,

LINCOLN, NEBR.

1. **Olfersia albipennis** Say.

1823. *Olfersia albipennis* Say, Journal of the Academy of Natural Sciences of Philadelphia, III, p. 102.

Length 5 mm., the head and thorax alone measuring 2.75 mm., and the distance from the front of the head to the tip of the wing measuring 7 mm., the thorax being 2 mm. wide at the widest part. Head and thorax blackish brown. Head elliptical, nearly one and one half times as wide as long, the face about twice as broad as the eyes and narrowing anteriad, the rather broad orbital margins and the semicircular, uniformly convex vertex smooth and polished, leaving a subtrapezoidal, opaque median area. Inner edges of the polished orbital margins more or less hairy. Clypeus seven tenths as long as the front, usually rather shiny, divided into two sections by a deep, median, transverse sulcation, the apical section rather broad and anteriorly broadly and shallowly emarginate, so that its visible basal width along the dividing sulcation is fully one half of the distance across the emargination between the lateral apices. Antennary processes brownish black and bearing long ferruginous and black hairs. Palpi blackish, subequal to the clypeus in length, copiously clothed with short, pale hairs. Eyes shining blackish. Humeral processes short and heavy, their tips obtuse, in color a yellowish testaceous distinctly paler than the coloration of the rest of the thorax above, bearing several short blackish hairs and one long black bristle. Mesonotum with a distinct, impressed, median longitudinal line and straight, deep, transverse, median sulci which are but slightly if at all interrupted medially, the whole having a distinct cruciate form. Mesonotum anteriorly with a very few, long, pale ferruginous hairs. Scutellum posteriorly broadly rounded, its apical margin finely rimmed and thinly provided with short, pale hairs, a deep median longitudinal sulcus giving it a sub-bilobed appearance. Pleura opaque and grayish because of a thin pollinosity over the dark brown integument. Under side of head brown, the labium whitish. Sternum flat, shining dark brown, the anterior angles prominent and extending as short, contrastingly black lobes between the anterior coxæ. Legs dark brown, below finely pale-haired, above sparsely black-haired, the claws black. Tergum light brown, darkening laterally, the base and apical portion together with a medio-apical stain, blackish, venter light brown, the whole abdomen thinly short-haired, these varying in color from pale at the base to blackish toward the tip of the abdomen, tergum with two latero-apical tufts of long, black hairs. Wings whitish, the costal veins and basal part of the longitudinal veins dark brown, the costa only moderately thickened beyond the end of the first vein which joins the costa a little before the first crossvein, the costal border of the marginal cell one and one third times as long as the costal border of the first submarginal cell, the first basal cell over twice as long as the second basal cell.

Say states that the numerous species described in the paper in which *Olfersia albipennis* and *Ornithomyia nebulosa, pallida* (=*anchineuria*) and *confluenta* were described (Journ. Acad. Nat. Sci. Phila., iii, pp. 9–54 and 73–104), were collected chiefly by himself while on the Major Long Expedition. Inasmuch as the party spent the period from September 9, 1819, to June 6, 1820, at Engineer Cantonment, near the present site of the town of Blair in eastern Nebraska, and since he notes "*Ardea herodias,*" "*Strix nebulosa*" and "*Sylvia sialis*" (respectively the three species of birds from which the first three above-mentioned flies were collected) as present at Engineer Cantonment during his stay, it seems highly probable that the types of these species were collected at that place. *O. confluenta,* taken from "*Ardea candidissima,*" was probably taken lower down on the Missouri river or further east. With *O. nebulosa* and *O. pallida,* their hosts become so uncommon outside the Missouri valley that it is almost certain they could not have been taken by Say at any point further west.

O. albipennis is here redescribed from three specimens all collected at Lincoln, Nebraska, two April 18, 1892, on a black-crowned night heron (*Nycticorax nycticorax naevius*) by L. Bruner, and the third April 13, 1900, on a green heron (*Butorides virescens virescens*) by J. S. Hunter. Say's specimen was from a great blue heron (*Ardea herodias* subsp.). The coincidence of locality and host, together with the perfect agreement of my specimens with Say's description, especially in such characters as the pale humeral tubercles, whitish wings, size, etc., make it as certain as one can reasonably be that the above-described species is truly *albipennis* Say. As Say's type is lost, I select the above-mentioned specimen from the green heron to stand as the neotype of the species.

A variety of *O. albipennis,* having the scutellum with the median longitudinal sulcus very weak, so that the scutellum is not at all subbilobed in appearance, and the vertex with a large, shallow anterior concavity (this is feebly marked in typical *albipennis*) is represented in a specimen collected on the laboratory window of the department of entomology at the University of Nebraska, May 11, 1901. This specimen was not infesting a heron, but either a mourning dove (*Zenaidura macroura marginella*) or one of six species of shore birds, fresh specimens of all of which were in the room at the time. These shore birds were the semipalmated plover (*Ægialitis semipalmata*), golden plover (*Charadrius dominicus dominicus*), Hudsonian godwit (*Limosa hæmastica*), white-rumped sandpiper (*Pisobia fuscicollis*), red-backed sandpiper (*Pelidna alpina sakhalina*) and semipalmated sandpiper (*Ereunetes pusillus*).

The European *O. ardeæ* Macquart has been recorded by Loew from "North America," and by J. B. Smith from New Jersey on the little blue heron (?black-crowned) night heron and bittern, and is the only other North American species recorded from a heron. The larger size (6 mm.), dusky wings and shining black coloration described for *ardeæ* indicates entire distinctness from *albipennis*.

2. **Olfersia botaurinorum** new species.

Very similar to *O. albipennis* Say, above redescribed, but distinctly larger, the length of the head and thorax measuring 3.25 mm., the width of the thorax at its widest part 2.5 mm., and the distance from the front of the head to the tip of the wing 8 mm. Color of head and thorax darker, more blackish, the color of the humeral processes not distinctly paler than that of the rest of the thorax above. Head less broad, one and one fourth times as wide as long, the apical section of the clypeus comparatively narrow at base and rather deeply emarginate at apex, so that the visible basal width along the dividing sulcation is not more than one third of the distance across the emargination between the lateral apices. Antennary processes black and bearing much black hair. Face without obvious hair along orbital margins and mesonotum likewise not hairy. Wings faintly clouded. First vein joining the costa considerably before the first crossvein. Otherwise agreeing with the preceding description of *O. albipennis*.

Type.—Omaha, Nebraska, May 26, 1907, on a least bittern (*Ixobrychus exilis*) by R. H. Wolcott.

Paratypes.—Type lot, 1 specimen; Lincoln, Nebraska, April 21, 1901, on a bittern (*Botaurus lentiginosus*) by J. C. Crawford.

It is possible that this form is conspecific with *A. ardeæ* Macquart, but after a careful comparison with the description I have decided to let it stand as distinct. Certainly the wings are not as dark as described for *ardeæ*. The specific name is from the subfamily to which the bitterns belong.

3. **Olfersia scutellaris** new species.

Resembling *O. albipennis* Say, but differing from that species, as above described, in the following characters: Somewhat larger, the length about 5 mm., the head and thorax alone measuring 3 mm., the thorax being nearly 2.5 mm. wide at the widest part, and the distance from the front of the head to the tip of the wing measuring 7.5 mm.; head less broad, subcircular, the width only one and one sixth times the length, the face very broad, fully two and one half times as broad as the eye; elevated orbital margins opaque or slightly shiny along extreme outer edges only, their inner edges distinctly hairy; clypeus four fifths as long as front, the apical section shaped as in *O. botaurinorum* but with the base slightly wider, so that it is slightly more than one third (three eighths) of the distance between the lateral apices; antennary processes blackish and bearing much black hair, the palpi slightly shorter than the clypeus; eyes dull plumbeous; each side of scutellum with a long black bristle; wings slightly darker, the first vein joining the costa considerably before the first crossvein; coloration of head and thorax brownish fuscous, the shiny vertex and basal portion of the median longitudinal line stained with reddish, the tips of the tubercles and the scutellum reddish yellow, the latter contrasting strongly with the much darker mesonotum.

Type.—Watkins' Station near Manchester, Michigan, on a least bittern (*Ixobrychus exilis*), May 30, 1894, by R. H. Wolcott (Coll. No. 190).

This species is even closer to *O. botaurinorum,* just described, than to *O. albipennis,* agreeing with the former in size, clypeal structure and venation, but easily separated by the more brownish general coloration, yellowish scutellum, hairy face and mesonotum, broader front, opaque orbital margins and dull-colored eyes.

4. **Olfersia intertropica** Walker.

1849. *Ornithomyia intertropica* Walker, List of Dipterous Insects in the British Museum, IV, p. 1144.

1903. *Olfersia intertropica* Austen, Annals and Magazine of Natural History, Series 7, XII, p. 264.

The type of this species came from the Galapagos Islands, and Austen records additional specimens from Bahia, Brazil, Orizaba, Mexico and Honolulu, Hawaii. The latter author regards *O. acerta* Speiser, described from the Hawaiian Islands, as a synonym of *intertropica* after comparison of paratypes of the former with the cotypes of the latter in the British Museum. A specimen from Orizaba, Mexico, collected in January, 1892, by Prof. Bruner is before me. *O. pallidilabris* Rondani, described from Mexico, is very close to *intertropica,* as pointed out by Speiser, but if, as that author indicates, *pallidilabris* has no fine pale hairs on the orbital margins, the specimen at hand can not belong to that species.

5. **Olfersia angustifrons** Van der Wulp.

1903. *Olfersia angustifrons* Van der Wulp, Biologia Centrali-Americana, Diptera, II, p. 430.

1903. *Olfersia angustifrons* Austen, Annals and Magazine of Natural History, Series 7, XII, p. 265.

This species has been recorded from Oaxaca (Oaxaca) and Teapa (Tobasco), Mexico, and from Rio Sucio, Costa Rica, one specimen from each locality, all in the British Museum. A fourth specimen may now be recorded from Motzoronga, in southern Vera Cruz, Mexico, taken from a species of trogon, February 18, 1892, by L. Bruner. The narrow front (equal to an eye in width) and the rather long palpi and proboscis (the former one and one fourth and the latter three times as long as the clypeus, which is two thirds as long as the front), are good characters of this species which are given in the original description. The Motzoronga specimen, however, has the auxiliary vein complete, though very weak.

6. **Olfersia americana** Leach.

1818. *Feronia americana* Leach, Memoirs of the Wernerian Natural History Society, Edinburgh, II, pl. XXVII, fig. 1–3.

1830. *Olfersia americana* Wiedemann, Aussereuropaische Zweiflügelige Inseckten, II, pp. 606–607.

1835. *Olfersia americana* Macquart, Histoire Naturelle des Diptères, II, p. 641.

1872. *Hippobosca bubonis* Packard, Guide to the Study of Insects, p. 417.

1878. *Olfersia americana* Osten Sacken, Catalogue of the Diptera of North America, p. 213.

1895. *Olfersia americana* Johnson, Proceedings of the Academy of Natural Sciences of Philadelphia, pp. 303–340.

1899. *Olfersia americana* Johnson, Twenty-seventh Annual Report New Jersey Board of Agriculture, p. 699.

1903. *Feronia americana* Austen, Annals and Magazine of Natural History, Series 7, XII, p. 264.

This species, the type of which is yet extant in the British Museum, was originally described by Leach from a specimen from Georgia, and has subsequently been recorded by Packard from Massachusetts on the great horned owl (*Bubo virginianus virginianus*), from Illinois and Texas by Osten Sacken, the latter record being from Dallas on the red-tailed hawk (*Buteo borealis*), from Florida by Johnson on the screech owl (*Otus asio asio*), and from Haddonfield, New Jersey, November 9, on the red-tailed hawk, also by Johnson. In Nebraska it has been taken at Brownville on the great horned owl (*Bubo virginianus virginianus*) on December 30 by the late Ex-Governor R. W. Furnas, and at West Point on the rough-legged hawk (*Archibuteo lagopus sancti-johannis*) in October, 1884, by L. Bruner, these two specimens being before me. A third specimen at hand is labeled simply "Louisville, Kentucky." Apparently the species is widely distributed in the eastern United States on our commoner birds of prey.

The published descriptions of *O. americana,* while sufficiently explicit that I believe I have correctly identified the species, are yet so brief and general that a redescription of the species would be proper at this time.

Length 6–7 mm., the head and thorax alone measuring 4.5 mm., and the distance from the front of the head to the tip of the wing measuring 10.5–11.5 mm., the thorax being 3 mm. wide at the widest part. Head and thorax brown. Head slightly elliptical, one and one third times as wide as long, the face strongly narrowing anteriad, its width across the middle of the front one and one third times as broad as the eyes at the same level, the elevated, rather narrow orbital margins and the elevated, plano-convex lenticular vertex polished, the depressed, subtrapezoidal median area opaque. A very few short scattered bristles on the inner edges of the polished orbital margins. Clypeus nearly five sixths as long as the front, dullish, the apical section rather broad basally and very broadly and shallowly emarginate anteriorly, this emargination being really arcuate in form, so that the visible basal width along the dividing sulcation is only a little over one third of the distance across the emargination between the lateral apices. Antennary processes black, conspicuously black-haired. Palpi long, fully one and one half times as long as the clypeus, yellowish to brownish in color, finely black-haired. Eyes satiny black. Humeral processes short, bluntly pointed, about concolorous with thorax above or the very tips somewhat paler. Mesonotum with both the longitudinal and the transverse lines rather deeply impressed, especially the latter which are scarcely interrupted medially. Mesonotum not distinctly hairy anywhere. Scutellum with the posterior margin weakly convex, laterally thinly hairy, and with a distinct subapical rim, medio-longitudinally rather broadly and shallowly depressed or impressed, giving the sclerite a slightly sub-bilobed appearance. Pleura above yellowish brown, below shading into a pale yellowish concolorous with the flat, shining sternum, the latter with the anterior angles feeble and concolorous with the rest of the sternum. Head beneath pale yellowish, the labium whitish. Legs light brownish above and light yellowish beneath, not suffused with dusky except on the tarsi, mostly sparsely black-haired but with a few pale hairs beneath toward the bases of the legs. Abdomen pale brown, becoming more or less blackish terminally, rather strongly and closely black-haired, the apical lateral tufts long, beneath yellowish white, thinly short black-haired. Wings iridescent white, the costal veins and basal part of the longitudinal veins brownish yellow, the costa considerably thickened beyond the end of the first vein which joins the costa much before the first crossvein, the costal border of the marginal cell from one and one fifth to two times as long as the costal border of the first submarginal cell, the first basal cell distinctly more than twice as long as the second basal cell. Auxiliary vein incomplete.

7. **Olfersia wolcotti** new species.

Of the same size and general appearance as *O. americana* Leach, above redescribed, but the front much narrower, not wider than the breadth of an eye, the orbital margins subparallel or but slightly narrowing anteriad; clypeus only about one half as long as the front, the apical section somewhat narrower basally but its apical emargination distinctly deeper and less broad, so that the visible width along the dividing sulcation is nearly one half of the distance between the lateral apices; palpi blackish, twice as long as the clypeus; general coloration of head and thorax darker, dark reddish brown rather than yellowish brown as in *americana*, the legs strongly suffused with blackish; wings faintly dusky, the costal veins and basal part of the longitudinal veins blackish.

Type.—Ann Arbor, Michigan, on a broad-winged hawk (*Buteo platypterus*) shot in the woods west of the town, April 20, 1894, by R. H. Wolcott (Coll. No. 129).

Named in honor of Dr. R. H. Wolcott, in recognition of his valuable work both in entomology and in ornithology. The size of the species precludes its confusion with any other except *O. americana*.

For convenience in separating the above seven species of *Olfersia* the following table is offered:

Size larger, the length to end of wings 10 mm. or more; palpi longer than clypeus.
- Front narrowing anteriad, distinctly broader than an eye; coloration yellowish .... **americana.**
- Front subparallel, not broader than an eye; coloration dark brownish. **wolcotti.**

Size smaller, the length to end of wings not over 8 mm.
- Front subparallel, not broader than an eye; palpi longer than clypeus. **angustifrons.**
- Front distinctly broader than an eye; palpi subequal to or shorter than clypeus.

Clypeus basally one half as broad as the distance across emargination; length to end of wings 7 mm.

Front distinctly less than twice as broad as an eye; scutellum with a copious, long, apical fringe ....**intertropica.**

Front about twice as broad as an eye; scutellum with a very thin, short, apical fringe ....**albipennis.**

Clypeus basally about one third as broad as the distance across emargination; length to end of wings 7.5–8 mm.

Mesonotum and scutellum blackish-brown; orbital margins shining, glabrous ....**botaurinorum.**

Mesonotum dark brown, scutellum yellowish; orbital margins opaque, hairy ....**scutellaris.**

8. **Ornithomyia buteonis** new species.

Length 7–7.5 mm. Head yellowish-brown, the broadly crescentic orbital margins and the vertex polished, the median area opaque. Clypeus convex, slightly emarginate and rather weakly pitted anteriorly and bearing a small, round pit on the posterior margin. Antennary processes distinctly less than twice as long as broad, clothed with bright pale ferruginous hair, broadly lanceolate owing to both margins being evenly convex, the tips narrowly rounded. Eyes light brown. Thorax above fuscous brown, paling to testaceous on the humeral angles, the inner margins of the dentiform processes and the adjacent spiracle whitish. Mesoscutum with a feeble median impressed line and deep, sinuate, lateral median transverse impressed lines. Scutellum fuscous brown, strongly tinged with reddish on the anterior margin, discally shallowly depressed, and bearing a row of about a half dozen short black hairs near each margin. Under side of head and thorax pale testaceous, the labium whitish at tip. Legs above reddish-brown, below pale testaceous, the tibiæ with the edges fuscous, the tarsi fuscous, the claws black. Abdomen yellowish, copiously but not densely clothed with short, black hairs. Wings clear, the costal veins and bases of the longitudinal veins dark brown, the first longitudinal vein ending in the costa at a point nearly above the first crossvein, the costal border of the marginal cell about one fourth longer than the costal border of the first submarginal cell and the first basal cell more than the length of the second crossvein longer than the second basal cell.

Type.—Neligh, Nebraska, April 26, 1900, on a broad-winged hawk (*Buteo platypterus*) by Merritt Cary.

Paratype.—Guàpiles, Costa Rica, March 1, 1903, by J. C. Crawford.

Belongs to the *O. erythrocephala* group. Agrees with *O. erythrocephala* Leach, of Brazil to Mexico and the West Indies, in size and venation, but differs in the reddish-brown rather than ferruginous head, the concolorous clypeus, the darker legs and the reddish anterior border of the scutellum. *O. nebulosa* Say, from the western United States, is of the same size, but differs in the clypeus being pale (concolorous with the rest of the head in *butconis*), and the reddish-brown mesonotum with three yellowish lines (fuscous brown without markings in *butconis*). From *O. fusciventris* Wiedemann, described from Kentucky, *butconis* differs in larger size (*fusciventris* is only 5 mm. long) somewhat less deeply emarginate anterior border of clypeus (deeply and angularly emarginate in *fusciventris*), flattish scutellum (basally inflated in *fusciventris*) and in the coloration of the thorax being much darker than the head (concolorous in *fusciventris*). *O. pilosula* Van der Wulp, from Costa Rica, is smaller (5.5 mm.) and has the head and thorax rufous. *O. haitiensis* Rondani, from Haiti, is distinct in its dark-haired antennæ and different venation, the first longitudinal vein ending in the costa before the first crossvein. This latter venational character will also separate *O. avicularia* Linnaeus, the common European species, and *O. varipes* Walker, of Mexico to Colombia and Peru, the latter further differing in the shape of the antennary process. *O. anchineuria* Speiser (= *O. pallida* Say) may be distinguished at once by the interstitial first and second cross veins, making the second basal cell nearly as long as the first basal cell (much shorter in *butconis*). The coloration is entirely different from *O. butalis* Coquillett, described from Bering Island.

9. **Ornithomyia costaricensis** new species.

Length 7 mm. Front and vertex wholly glossy bright ferruginous, the posteriorly broadening orbital margins and the vertex triangle perfectly smooth and polished, the median area microscopically tesselated, giving it a satiny luster, and of subuniform width. Clypeus concolorous with front and vertex, anteriorly medially emarginate because of a deep rectangular pit, posteriorly also with a large, deep, oval pit. Antennary processes twice as long as broad, their sides convex and their tips narrowly rounded, of a darker ferruginous color than the clypeus and front and provided with long, ferruginous hairs. Eyes glossy black. Humeral prominences pale, heavily black-haired. Mesonotum shining blackish, slightly suffused with reddish along the anterior sutures, bearing a faintly impressed median line and deep, slightly curved, transverso-median depressions on each side of it. Scutellum rounded posteriorly, medially much depressed transversely and this depression bearing several long-black hairs, shining black like the mesonotum but with the anterior margin reddish testaceous, interrupted medially by a blackish stain. Sternum and under side of head greenish testaceous. Legs beneath greenish testaceous, above fusco-testaceous, becoming dusky on the tibiæ, fuscous on the tarsi and with the claws black. Abdominal tegument dark brown, but so heavily clothed with black hairs as to appear blackish. Wings slightly clouded.

the costal veins and bases of the longitudinal veins blackish, the first longitudinal vein ending in the costa slightly before the first crossvein, the costal border of the marginal cell fully twice as long as the costal border of the first submarginal cell, and the first basal cell twice the length of the second crossvein longer than the second basal cell.

Type.—Juan Viñas, Costa Rica, March, 1902, by L. Bruner.

The shiny blackish mesonotum seems to distinguish this species from all of the described North American congeners except *O. butalis* Coquillet, which is much smaller (4 mm.), has the front black spotted on the orbits and vertex with yellow, and is otherwise very different. The species is really close to *O. erythrocephala,* but apparently differs in the deep anterior pit on the clypeus, the red anterior border on the scutellum, and, compared with Van der Wulp's description of *O. robusta* which Austen places as a synonym of *erythrocephala* after a comparison of the types of both in the British Museum, it should also differ in darker legs and abdomen, although these color differences are not clear from a comparison with Leach's original description of *erythrocephala.* From *O. haitiensis* it differs at once in the ferruginous hairs on the antennary process, the dark legs and the different venation (the first longitudinal vein ends considerably before the first crossvein and the costal border of the marginal cell is less than twice as long as the costal border of the first submarginal cell in *haitiensis*). The venational characters are much like those of *O. buteonis,* just described, and separate the species from several of its congeners.

10. **Ornithomyia pirangæ** new species.

Length 4.5 mm. Head and thorax above shining brownish testaceous, clearing to yellowish testaceous on the lower orbital margins, vertex, anterior margin and median line of mesonotum and base of scutellum. Orbital margins, broadening posteriorly, and vertex, polished, the median area conspicuously duller and of subuniform width throughout. Clypeus anteriorly medially emarginate and bearing a small, shallowly rounded pit, most of its dorsal surface involved in a large, oval, deep pit. Antennary processes a little less than twice as long as broad, the outer margins strongly convex and the inner margins nearly straight, causing the pointed tips to appear divergent, in color fusco-testaceous and clothed with dark hairs. Eyes brown. Mesonotum with a slight median longitudinal depression and somewhat stronger transverse, slightly sinuate, median lateral depressions. Scutellum slightly convex and with a slight transverse depressed line near apex which bears four strong black bristles. Under side of head and thorax shining pale testaceous, the long spines on anterior coxæ and the labium whitish. Legs greenish testaceous, paler beneath, the tarsi infuscated and the claws black. Abdomen yellowish, copiously but not densely clothed with short, black hairs. Wings clear, the costal veins and bases of the longitudinal veins black, the first longitudinal vein ending in the costa above the second crossvein and considerably before the first crossvein, the costal border of the marginal cell a little less than twice as long as the costal border of the first submarginal cell and the first basal cell as much longer than the second basal cell as the length of the second crossvein.

Type.—Juan Viñas, Costa Rica, March 15, 1902, on a summer tanager (*Piranga rubra*) by L. Bruner.

This species is apparently closest to *O. haitiensis* Bigot, with which it agrees in the dark hair on the antennary processes and the first longitudinal vein ending in the costa before the first crossvein, but differs in its smaller size (*haitiensis* is 7 mm. long), in the form of the clypeus (*haitiensis* has a small dorsal pit but a large and deep angular anterior pit) and in the coloration (*haitiensis* has a large, well-defined, cordiform mesonotal area, a black ocellar spot, etc.) It differs at once from *O. erythrocephala* Leach and *O. bellardiana* Rondani in the dark instead of ferruginous hairs on the antennal processes. Its small size separates it at once from the described North American forms except *O. butalis* (which has a very different coloration), *O. anchineuria* (which has the basal cells of subequal length) and *O. fusciventris* (which has the head and mesonotum uniformly colored).

The three species of *Ornithomyia* above described may be separated as follows:

Hair on antennary processes ferruginous.
  Head yellowish brown, the mesonotum fuscous brown .... **buteonis.**
  Head bright ferruginous, the mesonotum blackish .... **costaricensis.**
Hair on antennary processes dark .... **pirangæ.**

ON CERTAIN CATERPILLAR HOMOLOGIES.

By WM. T. M. FORBES,
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A recent paper by Stanley B. Fracker[1] raises some interesting questions as to the interpretation of the caterpillar setæ. He takes the prothorax as a typical segment, having the largest number of setæ of any simple segment, names its setæ, and then, assuming the setæ of the following segments are strictly homologous, so far as they go, applies to them the same names. My belief is that the correspondence is partial, and so far as the prothorax is concerned confined to a couple of the mid-ventral, and possibly the mid-dorsal setæ. In the following discussion the thoracic setæ will be referred to by the Greek letters applied to them by Fracker, the abdominals, by the numerical system now in use, derived, so far as the principal setæ are concerned, from Wilhelm Müller.

The abdominal setæ consist of i, ii, iii and iii *a*, which lie above the spiracle, iv and v, between the spiracle and the subventral fold; vi between this fold and fold *psi*, appearing only after the first moult, vii on the outer side of the leg-base, typically of three setæ, and viii on the inner side, near the mid-ventral line; besides these ix, subventrally, and x subdorsally are minute setæ, lying close to the incisure and touching the posterior curve of the preceding segment; presumably, like our own tendon-organs, they serve to report to the caterpillar its own position.

In the Hepialidæ there is a slight modification, the three setæ nearest the spiracle, behind and below, are in an oblique row, and placed high up;[2] I have assumed that these are iv, v and vi, moved up and back, as they have in Incurvaria.[3] Fracker assumes that the two lower are iv and v (kappa and eta), that the upper is a new subprimary (theta), and that the usual subprimary vi (mu) is absent. In the first stage, as figured by Dyar, there are only two setæ very slightly higher than the two lower of the row in the last stage. The

[1] The Classification of Lepidopterous Larvæ; Illinois Biological Monographs: **II**, 1; 1915, Urbana, Ill.

[2] Ann. Ent. Soc. Am., III, pl. 12, fig. 33.

[3] *L. c.*, fig. 34.

approximate correspondence in position of the two primaries of the first stage (which we agree to be iv and v) with the two lower of the later stages, leads Fracker to believe them the same; from the same data however I concluded that iv and v, which are very high even in the first stage, had moved considerably farther, and that vi had appeared as usual below them. The problem could only be settled by a full study of the muscular system, and determination if the organs of that part of the body have moved up, or by definitely locating the subventral fold, which runs in the Frenatæ between v and vi. The first is impossible in the complete lack of material, but a specimen before me shows most of the dorso-ventral muscles in the last stage (see figure). The two folds (the subventral and *psi*) are both formed by intermediate insertions of the retractor muscles of the proleg, etc.; we find in *Hepialus* the most dorsal of these insertions, defining the subventral fold, are immediately below the spiracle; and far above, not below, the seta which I interpret as vi. A second insertion appears below vi, which I interpret as marking the fold *psi*. I then rest in my former opinion that the three setæ are iv, v and vi, not a new subprimary, iv and v.

Next in order is the homology of the meso- and meta-thorax with the abdomen. I think we are agreed that i is alpha, ii is beta, x is gamma (four setæ on the thorax,[4] both in Jugatæ and Frenatæ); vii *a* and *b* are nu and pi, vii *c* is tau, viii is sigma and ix is omega. The difference then is in Dr. Fracker's assumption that the numbering used was intended to imply homotypy, which was the case only with the ventrals and small primaries; and in the lateral region, comprising iii, iii *a*, iv, v and vi on the abdomen, and epsilon, rho, kappa, theta and eta (delta, rho, kappa, theta, and epsilon in the Jugatæ) of

[4] It has been a puzzle to me for some time why the mesothorax has three setæ in group X, while the metathorax has four. Y. H. Tsou, in the Trans. Amer. Micr. Soc., XXXIII, 223, has recently given a satisfactory explanation, namely that one of the normal four setæ has moved across the incisure to the prothorax, where it has been generally overlooked or treated as a secondary prothoracic seta. In other points I am inclined to disagree with Mr. Tsou for the same reasons as with Mr. Fracker. And why should two papers from the same laboratory on the same subject worked out at the same time use entirely different nomenclatures for the same structures! One paper must be translated before it can be compared with the other, and then we find that in other features they are often in agreement.

the thorax. Again I believe, though this time mainly without evidence on either side, that the setæ of Jugatæ and Frenatæ are homologous, but differ a little in position. So I take the anterior lateral, epsilon, of the Jugatæ, to be eta of the Frenatæ, and delta of the Jugatæ to be epsilon of the Frenatæ.

As to homologies with the abdomen so far as number of setæ goes the comparison is close, only that there are two subprimaries on the thorax. Unfortunately the presence and location of the wing and spiracular rudiments makes the homology impossible. Above the spiracle, on the abdomen we have only iii and iii*a*, while above the wing-rudiment, which must be well above the spiracular level, we have all except eta of the Frenatæ on the thorax, and that is far above the actual thoracic spiracular rudiment, which lies on the level of vi (pi). Eta is anterior, and free from the wing, but there can hardly have been extensive migration of kappa and theta as they are closely associated (above) with the wing-base, especially the primary kappa. We have then epsilon, rho, kappa, theta and possibly eta (if it is epsilon of the Jugatæ) to compare with the two setæ iii and iii *a* of the abdomen. Under the conditions any comparison is a guess, and Fracker's one that iii *a* is epsilon, and iii is rho, is as likely as any. Below the spiracle, we have nothing to represent iv, v and vi, as

SUMMARY.

Meso-, and Meta-thorax.			Abdomen.		
Forbes (after Dyar).	Fracker Jugatæ.	Fracker Frenatæ.	Forbes (after Dyar).	Fracker Jugatæ.	Fracker Frenatæ.
i *a*	alpha	alpha	i	alpha	alpha
i *b*	beta	beta	ii	beta	beta
x *a*, x *b*, x *c*, x *d*	gamma	gamma	x	gamma	gamma
Level of dorso-ventral muscles					
ii *a*	delta	epsilon ?	iii *a*	epsilon	epsilon
ii *b*	rho	rho ?	iii	rho	rho
iii	theta	theta	absent		
iv	kappa	kappa	absent		
v	(epsilon ?)	eta	absent		
Level of wings and spiracles					
absent			iv	theta	kappa
absent			v	kappa	eta
absent			vi	eta	mu
vii (vi Dyar)	nu, pi	nu, pi	vii *a*, vii *b*	nu, pi	nu, pi
setæ on coxa			vii *c*	tau	tau
viii	sigma	sigma	viii	sigma	sigma
ix	tau	omega	ix	Tau group	omega

eta is so far forward as to be nearly out of the question; in fact if the position of the spiracular rudiment means anything, the subventral region is practically undeveloped in the caterpillar meso- and meta-thorax.

Coming to the prothorax I can only say that I agree with Fracker as to the ventral part, and again can see no proof of homologies in the lateral and dorsal part. The muscles imply here as large an over-development of the lateral region, as it was under-developed in the rest of the thorax, but hardly prove it. The spiracle has risen again to its abdominal level.

It seems probable that these differentiations of seta-pattern on thorax, prothorax, and abdomen, are much older than the seta-plan of either one, itself. For instance in the Trichoptera the seta-plan has not fully taken the Lepidopterous pattern, especially on the thorax, but the three types of arrangement already exist.

A few other points may be noted at this point in connection with Fracker's paper.

The bisetose prespiracular wart on prothorax in the Pyralidina, combined with the typical micro-seta-pattern on the abdomen and prolegs, is diagnostic, and fills a serious need in the definition of the group. I do not think the character has been noted before.

Many of the Cosmopterygid-Œcophorid series are not leaf-feeders, as stated by Fracker in his family table; they may bore in seeds, stems, and even thorns, several are scavengers, and one carnivorous. This leaves the Cossidæ uncomfortably close to the Gelechiidæ; of course our species are much larger when full grown: iii of the abdomen is duplicated in Cossus, but the character may not be general.

The uniordinal crochets of the Dioptidæ are a surprise to me. The trifid venation of the imago, and according to Packard the pupal characters, associate this family with the Geometridæ; they are however also close to the Pericopidæ and Hyssidæ in the rest of their venation, almost intergrading with the South American Pericopidæ, and may be more closely related to them than we have supposed. The structures at the base of the abdomen ought to be investigated, as they are characteristic, and of one type in the Pericopidæ, Lymantriidæ, Arctiidæ, some Noctuidæ, etc., while in the Bombycid series a wholly different structure appears, and in the Geometridæ, as noted by Prout, a third. The Thyatiridæ seem to cling still to the Geometridæ.

Apatelodes, and other Eupterotidæ, has well marked, though small warts, as also I believe have a few primitive exotic Lasiocampidæ; they differ so far as I know from practically all the following families by their abundant and conspicuous secondary hair. They really come very close to the Bombycidæ, which also have warts dominated by secondary hair, and widespread prolegs, with regular biordinal hooks, but in the familiar *B. mori* at least the hair is much more reduced.

Sthenopis shows the characters of the Hepialidæ as given by Fracker.

I believe that the true Heliodinidæ (*e. g., Lithariapteryx*) are re-

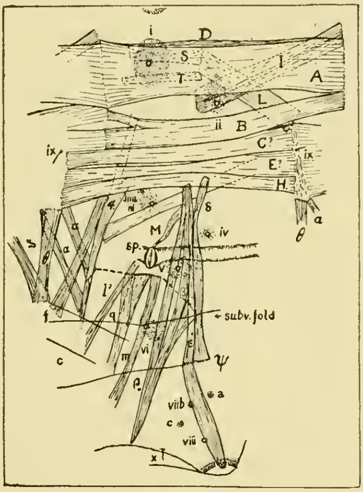

Fig. 1. Lateral and dorsal muscles of larva of *Hepialus humuli.* The drawing is from a prepared skin and to be trusted only for what it shows. The muscles are labelled according to Lyonet's system, the tubercles according to what I believe to be their homologies. The drawing is mainly from the fourth abdominal segment. Note presence of *S* and *T,* migration forward, rather than back, of lower dorsal longitudinal fibers, and position of upper ends of *m* and *q,* intermediate insertion of beta, and lower end of uppermost fiber of alpha. *subv. f.* Subventral fold—marked by the broken line. *sp.* Spiracle. viii is seen by transparency.

lated more or less closely to the Yponomeutidæ, while the Heliozelidæ (*Antispila* and *Coptodisca*) are much more primitive forms on another line, connecting perhaps with the Elachistidæ. Their larval characters bear this out, and I suppose "Heliodinidæ" on page 49 will change to Heliozelidæ.

In the Pieridæ (at least in *Pieris rapæ, brassicæ,* and *daplidice*) certain of the most conspicuous setæ are undoubtedly the three upper primaries, as I have proved by breeding the first stages.[1] The crowd of secondary setæ which confuse the picture in the full-grown larva are much fewer in the second stage, appearing gradually stage by stage, and the history of setæ i, ii and iii is continuous; as to iv and v I feel much less certain, but suspect they are the two largest in the subventral region, as they have the same relative position, essentially, in stage one. When so traced the primaries of *Pieris rapæ* may be recognized by their light color, and i and ii by their glandular character.

Dr. Fracker's paper has a bibliography citing most of the articles mentioned above. The typical arrangement of muscles and skinfolds is given in Ann. Ent. Soc. Am., VII, 109, 1914.

NOTES ON ALLECULIDÆ (COLEOPTERA).

By Charles W. Leng,
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The name of this family was changed by Dr. G. Seidlitz in Erichson's Insekten Deutschlands because the former name was derived from *Cistela,* which was originally used by Geoffroy for an insect of a different family. Following Seidlitz the family Cistelidæ of our Check List becomes the family Alleculidæ of Junk's Catalogus Coleopterorum, constituting part 3, by F. Borchmann.

It is to be regretted that some errors may be detected in this author's work. *Myctochara horni* Dury, Journ. Cin. Soc. Nat. Hist., XX, 1902, is omitted, *Tedinus angustus* Casey is cited as *angustatus, Prostenus californicus* Horn is cited as from California notwithstanding the remarks of Champion, Casey and Fall, which make it plain that its occurrence in California must have been accidental and its real home is Central America. The treatment of the genus

[1] Psyche, 1909, 69.

Lobopoda, by which two of the species are transferred to *Allecula,* is unwarranted, and they should be restored to *Lobopoda.*

The citation by Borchmann of "*Mycetochara rufipes* Lec. Bost. Journ., I, 1866, p. 170" is however the most interesting of the errors in that its investigation has led to the discovery of others. This species was actually described by the elder Leconte in Ann. Lyc. Nat. Hist. N. Y., I. 1824, p. 170, and was redescribed by the younger Leconte in New Spec. Col., 1866, p. 136, as a Hymenorus. According to Casey, who saw the type, it is however a Mycetochara. Gemminger & Harold cite "Bost. Jour., I, p. 170; New Spec. Col., 1866, p. 136," thus starting an error, which Casey inadvertently followed in Col. Not., III, in substituting "Bost. Journ." for "Ann. Lyc. N. Y." Borchmann apparently combined the Gemminger & Harold references to produce his citation "Bost. Journ., I, 1866, p. 170," in which nothing is correct but the page. Henshaw's Bibliography is correct; but his Check List is in error in citing both *Mycetochara rufipes* (7612) and *Hymenorus rufipes* (7596); the latter should be erased. Seidlitz is also in error (Erichson's Insekten Deutschlands) in citing a *rufipes* in each genus. I am indebted to Col. Casey for aid in unraveling this tangle, which makes it appear as if two species were involved, instead of one described in 1824.

All authors appear to agree in treating Ziegler's *Pseudocistela erythroptera* as a synonym of *brevis,* notwithstanding the striking difference in appearance caused by the reddish color of its elytra. While its description at this time might not be justifiable, I think it would be more in accordance with the facts to retain Ziegler's name, since it already stands in the literature, as a varietal name than to sink it in synonymy, and thereby possibly provoke a redescription at some future time of an insect that will always be noticeable in our collections.

THE INSECT FAUNA OF NEW JERSEY GREEN-HOUSES EXCLUSIVE OF THE COCCIDÆ.

By Harry B. Weiss,

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While greenhouse insects are not strictly a part of the New Jersey fauna, many of them are to all purposes firmly established in their glass homes and constitute a force to be reckoned with by the grower of indoor plants. The number of square feet under glass in New Jersey is conservatively estimated at several millions and in this somewhat tropical atmosphere, certain species breed more or less continually. The following list while dealing only with New Jersey insects is representative of conditions in most greenhouses in north-eastern United States. Forty-nine species are listed exclusively of the Coccidæ which have been treated in a separate paper. This family numbers thirty-two species all of which belong strictly to the greenhouse fauna, being unable to maintain themselves out of doors in New Jersey throughout the year. The list while aiming to be as complete as possible does not include accidental visitors remaining only for short periods of time or such insects as white grubs and wire-worms accidently introduced in the soil and troublesome until they have been worked out.

NEW JERSEY GREENHOUSE INSECTS.

Order THYSANURA.

Sub-order Collembola.

Achoreutes armatum Nicolet.

Found in greenhouses where mushrooms are grown.

Isotoma quadri-oculata Tullb.

A greenhouse species imported from Europe.

Order THYSANOPTERA.

Family THRIPIDÆ.

Parthenothrips dracænæ Heeger.

On *Drachæna*, *Ficus*, sp., palms.

Thrips tabaci Lind.

The onion thrips. On cucumbers under glass.

Heliothrips hæmorrhoidalis Bouche.

The common greenhouse thrips. Feeds on ferns, croton, dahlias, azaleas and others.

Order HOMOPTERA.

Family APHIDIDÆ.

Aphis gossypii Glover.

The melon aphis. On cucumbers under glass.

Aphis hederæ Kalt.

On English ivy under glass. Not common.

Aphis nerii Fonsc.

On oleander. Not common.

Aphis rufomaculata Wils.

Green aphis of chrysanthemum. Also occurs outside.

Rhopalosiphum violæ Pergande.

On violets in greenhouses.

Macrosiphum lactucæ Kalt.

The lettuce plant louse. On lettuce under glass.

Macrosiphum rosæ Linn.

The rose aphis, common. Also occurs outside.

Macrosiphum sanborni Gill.

The black aphis of chrysanthemum. Also occurs outside.

Myzus rosarum Kalt.

On roses. Common. Also occurs outside.

Myzus persicæ Sulz.

Attacks carnations, asparagus fern, *Primula* under glass. Occurs outside on peach, etc.

Family ALEYRODIDÆ.

Aleyrodes vaporarium West.

The "greenhouse white fly," found on tomato, melon, cucumber, fuchsia, heliotrope and many others under glass.

Order HEMIPTERA.

Family MIRIDÆ.

Halticus citri Ashm.

An outside feeder, but has been found in greenhouses on chrysanthemum and smilax.

Order DERMAPTERA.

Family **FORFICULIDÆ.**

Forficula auricularia Linn.

The common European "ear-wig." Found occasionally on imported plants in greenhouses.

Order ORTHOPTERA.

Family **BLATTIDÆ.**

Periplaneta americana Linn.

Occasionally found in greenhouses.

Periplaneta australasiæ Fabr.

In greenhouses. Common.

Pycnoscelus surinamensis Linn.

In greenhouses.

Order COLEOPTERA.

Family **COCCINELLIDÆ.**

Adalia bipuncta Linn.

Occasionally found in greenhouses.

Exochomus 4-pustulata Linn.

Has been taken in greenhouses on bay tree. An importation from Europe.

Family **OTIORHYNCIHIDÆ.**

Aramigus fulleri Horn.

"Fuller's rose beetle." Feeds on roses and gardenia. Larvae feed on roots of these plants. Not common.

Family **CALANDRIDÆ.**

Eucactophagus graphipterus Champ.

Larvæ live in bulbs of *Lycaste, Odontoglossum* and other species of orchids having large soft bulbs. Not absolutely common. Introduced from Central America.

Order LEPIDOPTERA.

Family **ARCTIIDÆ.**

Hyphantria cunea Dru.

Larvæ occasionally occur in greenhouses on various plants during the fall.

Diacrisia virginica Fab.

Larvæ occasionally found during fall in greenhouses feeding on various plants.

Isia isabella S. & A.

Larvæ found under same conditions as above two species.

Family NOCTUIDÆ.

Peridroma margaritosa Haw.

Larva is known as the variegated cut worm. Attacks carnation buds, sweet peas, chrysanthemum, smilax and other plants. Occurs outside on various plants and is one of the injurious cut-worms.

Callopistria floridensis Guen.

Larva is known as the "Florida fern caterpillar." Feeds on various ferns under glass. Quite a serious pest.

Family PYRALIDÆ.

Hymenia perspectalis Hubn.

Larva known as the Alternanthera worm. Feeds on alternanthera varieties. Probably occurs outside.

Phlyctaenia ferrugalis Hubn.

The common greenhouse leaf-tier. Larva injures chrysanthemum, ageratum, geranium, carnation, violet, rose and others. Common out of doors.

Nymphula obliteralis Wlk.

In greenhouses, larva living in case on leaf of water lily and other aquatic plants.

Family TORTRICIDÆ.

Archips rosaceana Harr.

The rose leaf roller. Larva feeds on flower buds of rose, also on carnations. Common on orchard trees and small fruits outside.

Family YPONOMEUTIDÆ.

Plutella maculipennis Curt.

The diamond back moth. Larva feeds on sweet alyssum and garden stocks. Common outside on cabbage, etc.

Family TINEIDÆ.

Gracilaria zachrysa Meyrick.

Larvæ feed on azalea leaves. Introduced from Europe. Up to present has not been found on hardy azaleas.

Order HYMENOPTERA.

Family ENCYRTIDÆ.

Encyrtus flavus Howard.

Bred from *Coccus hesperidum* (soft scale).

Family CHALCIDIDÆ.

Isosoma orchidearum West.

"The Cattleya fly." Infests *Cattleya* orchids, larvæ living in the bulbs. Quite a pest.

Family FORMICIDÆ.

Pheidole anastasii Emery.

Common in greenhouses.

Tetramorium caespitum Linn.

The lawn-ant. An importation from Europe. Has been found in greenhouses.

Tetramorium guineense Fabr.

Common in greenhouses.

Prenolepis fulva Mayr. subsp. **pubens** Forel.

Common in greenhouses.

Order DIPTERA.

Family MYCETOPHILIDÆ.

Sciara multiseta Felt.

Occurs in greenhouses where mushrooms are raised.

Sciara inconstans Fitch.

The fickle midge. Occurs in greenhouses where mushrooms are grown.

Family CECIDOMYIIDÆ.

Neocerata rhodophaga Coq.

The rose midge. Maggots occur in leaf and flower buds of roses in greenhouses.

Phytophaga violicola Coq.

The violet gall midge. Maggots curl leaves of greenhouse violets. Not common.

Family PHORIDÆ.

Aphiochæta albidihalteris Felt.

Occurs in greenhouses where mushrooms are grown. One of the mushroom flies.

Family SYRPHIDÆ.

Eristalis tenax Linn.

The common drone or chrysanthemum fly. Occasionally found in greenhouses during fall.

Family AGROMYZIDÆ.

Phytomyza chrysanthemi Kowarz.

The chrysanthemum leaf-miner or Marguerite fly. Larvæ mine leaves and do considerable damage. Has not been found breeding freely outside.

Summarizing the above list, the orders are represented as follows:

	Strictly Greenhouse Species.	Species Which Occur In and Out Doors.	Total.
Thysanura	1	1	2
Thysanoptera	2	1	3
Homoptera	4	7	11
Hemiptera	0	1	1
Dermoptera	1	0	1
Orthoptera	2	1	3
Coleoptera	2	2	4
Lepidoptera	3	8	11
Hymenoptera	5	1	6
Diptera	3	4	7
Totals	23	26	49

Including the 32 species of Coccidæ, the Homoptera is by far the best represented order, most of the members belonging to the families Aphididæ and Coccidæ. This is no doubt due to the close relationship which exists between the members of these families and their host plants and also the comparative ease and safety with which they can be transported. The Lepidoptera is the next best represented group followed by the Diptera and Hymenoptera, the remaining orders being poorly represented. The Diptera and Hymenoptera can undoubtedly be added to by breeding out the parasites of the species listed. It was thought unwise however to list the known parasites before they had actually been found in New Jersey under glass. The Coleoptera can also be increased by the identification of two species recently found feeding on orchids.

Of the total of 49 species listed, 23 are unable to maintain themselves out of doors, the remaining 26 being equally at home either under glass or in the open. Most of the strictly greenhouse species are of tropical or sub-tropical origin, having been introduced at various times from such localities and afterwards flourishing in an atmosphere approaching that of their natural homes and containing their native food plants. This is especially true of such species as *Pheidole anastasii* Emery, *Tetramorium guineense* Fabr., *Prenolepis fulva* Mayr. subsp. *pubens* Forel and *Isosoma orchidearum* Wst. in the Hymenoptera, of *Phytophaga violicola* Coq., in the Diptera, of *Callopistria floridensis* Guen., in the Lepidoptera, of *Eucactophagus graphipterus* Champ., in the Coleoptera and of the greenhouse roaches in the Orthoptera.

The 26 species which occur both in and out of greenhouses, are practically all inhabitants of the upper austral zone which have at different times made their way into the greenhouses where different conditions of temperature and moisture prevail and have become acclimated for short and long periods of time. In other words, each species has simply followed its one or more food plants into the new climate.

The inability of the strictly greenhouse or tropical species to maintain themselves out of doors is undoubtedly due more to the absence of proper food than anything else, this lack of food being as effective a check upon the spread of insects as climate, the food of course also depending upon climate and soil.

Thus, the insect fauna of a greenhouse really depends upon the kinds of plants growing there. If the flora is tropical, most of the insects will be also. If the plants are local growing as well outside of as in the greenhouse, then the insects feeding upon them will be local species. Out of a total of 81 species (including the Coccidæ) found in New Jersey under glass, two-thirds are strictly greenhouse insects because most greenhouses are devoted to the growing of exotic plants.

It is a noteworthy fact that the majority of greenhouse insects have not received the attention that they should from economic entomologists and as a result most of the work done in combating these pests is ineffective and worthless. Thus there is open to the economic man, an almost virgin field, in which the factors of temperature and moisture will play an important and vital part in successful control.

Membracidæ.

NOTES ON A PECULIAR NYMPH-VARIATION OF ENCHENOPA BINOTATA SAY.

By IGNAZ MATAUSCH,

NEW YORK.

Probably none of the native species of the Membracidæ varies to such an extent in its nymphal colors as *Enchenopa binotata.* In this paper I have given an account of observations made during 1912 of one of the most striking nymph forms of that species.

On June 5, at Roselle, N. J., my son Herbert found an insect which at first I did not recognize as a Membracid, but on closer examination I found to my surprise it was a nymph of that family in the fourth stage, but with the porous covering very heavy, fuzzy in appearance, silvery white in color and conspicuously marked with deep velvety black.

The specimen was found on a low Viburnum bush two to three feet in height, near the place where my observations of the previous year were made, and I tried to find more in the same locality, but at first did not succeed. Later, however, my son found two more on the same bush, and one near by on another Viburnum. Two of these were in the fourth nymphal stage, and one in the fifth and were all identical with that first collected. Pl. IX, fig. *a* shows the fourth stage; figs. *b* and *c* the fifth, highly magnified. Subsequently six more were found, the last on June 29, and I observed that they always occurred singly, and on the young shoot near, or on the petiole of the leaf. Two of this lot however varied from those formerly taken, in having light green markings in place of the black, except that the sternum, mouth parts and upper portions of the legs ranged through various shades of light brown.

The temporary color occurring during the moulting period between the fourth and the fifth stages were observed by me in two of the insects on June 23 and 24 respectively. These also differed greatly from all these I have hitherto noticed in this species. Instead of appearing in the characteristic yellow color with lateral red mark-

[1] Observations on the Life History of *Enchenopa binotata* Say in the JOURN. N. Y. ENTOM. SOC., Vol. XX, No. 1. March, 1912.

ings, as described in a former article[1] they appeared at first blue-green with yellow markings gradually fading to a white and black color instead of brown, except that the base of the prothorax just above the head, continued a bright emerald green for some time before turning to white. Where, however, the black markings occur in the completed insect at first a grayish color became visible, and gradually deepened into black. The entire change was completed within twenty-four hours.

The insects were very restless in captivity, and 6 of the 10 collected died, only 4 becoming adult, *i. e.*, two of the black and white insects and the two green and white ones above mentioned. In moulting from the fifth to the adult stage all four of these passed through the same color phase (*i. e.*, green with yellow markings) as between the fourth and fifth stages.

In all cases the change began early in the morning and was completed by night of the same day; the first insect on July 1, two more on July 2, and the last beginning at 4.30 A.M., on July 8. The adult color assumed in each instance was dark purplish brown, characteristic of the darker color-variation occasionally seen in *E. binotata*. No insect of this adult color was found by me in collecting at this same color but exclusively on walnut.

Mr. G. J. Keller, of Newark, N. J., has kindly sent me four specimens, one male and three females of *E. binotata* which he collected on walnut June 9, at Elizabeth, N. J. These were of a similar lighter color than I have found on that plant (Newark, N. J., 1909).

Mr. Halsey J. Bagg sent me, July 19, a number of Membracidæ nymphs found by him on Butternut at the old Bagg Homestead at Stillville, N. Y. All but one of these matured. It is remarkable that these nymphs were *E. binotata* with the same color variations as above mentioned, *i. e.*, some were black and white, while the rest were green and white. All however were of the same purplish brown color when full grown. The last two of these died July 27.

MISCELLANEOUS NOTES.

The Occurrence of Archips infumatana Zell. in the Eastern United States.—It seems strange that a moth of such comparatively large size and conspicuous richness and beauty of coloring, and one so long known to science as the Tortricid in question, should so rarely have been referred to in print. Yet so far as I have been able to discover the literature contains but three or four citations of this species, and those are quite meager. *Archips infumatana* was described by Zeller in 1875 in Verh. k. k. Zool. Bot. Ges. Wien, XXV, p. 216, from two pair taken in Missouri. In Fernald's Catalogue of the Tortricidæ of North America north of Mexico its habitat is given as Missouri and Wisconsin, and the same localities are cited in Dyar's List. But hitherto there has been no record of the species from east of the Mississippi Valley. Such a record I am now able to supply. On the 28th of July, 1915, at Litchfield, Conn., this purple-and-brown-shaded *Archips* was found in considerable numbers clinging to the leaves of a lusty young hickory, evidently just emerged from web-nests spun on its branches. An examination of the material in the American Museum of Natural History brings to light two female specimens labelled N. Y., and in Mr. Kearfott's collection is a male taken by Mr. Chas. R. Ely, July 14, 1909, at East River, Conn. In view of the above it becomes highly probable that the moth has a general wide distribution coterminous with the range of its food-plant, hickory.—Lewis B. Woodruff.

Notes on Malachidæ.—While going over our collections in this family of beetles with Messrs. Leng and Mutchler the writers of this note found that certain interesting additions could be made to the local records.

Collops vittatus Say. Staten Island, N. Y., June 25, and Cedarhurst, Long Island, N. Y., June 29, 1904. This species is not mentioned in the last New Jersey list, which included Staten Island records.

Collops sublimbatus Schaeffer. This species was described from Clayton, Rabun Co., Ga., from specimens collected near the top of Black Rock Mt. It is said to closely resemble *C. georgianus* Fall. (see Can. Entomologist, June, 1912, p. 187). Specimens with "the head polished, the disk of prothorax shining and scarcely punctate, have been taken at Great Falls, Va., June 16 and 19, 1910, and on Plummer's Island, Md., June 15, 1911, bringing the known distribution of the species much further north. Prof. Fall regards *sublimbatus* as a probable variety of *tricolor*" (This JOURNAL, Vol. XX, pp. 257–258, Dec., 1912).

Anthocomus erichsoni Lec. Lakehurst, N. J., July 9, and Bronxville, N. Y., July 4, 1911, and June 1, 1912. This is an addition to the New Jersey list of 1910.

Pseudebæus bicolor Lec. Yaphank, L. I., N. Y., May, 1911, male. In the 1910 New Jersey list this species is reported from Anglesea only.

Attalus melanopterus Er. Lakehurst, N. J., June 17. This is an addition to the New Jersey list of 1910.

Melyrodes cribrata Lec. Ft. Lee, N. J., May 23, one specimen from black-berry blossoms. This species was described from South Carolina and Pennsylvania by Le Conte, but is not mentioned in the New Jersey list and is therefore an addition. Charles Dury reports it under the name of *Melyris cribratus* in the 1902 list of the Coleoptera observed near Cincinnati, Ohio, and in the List of the Beetles of the District of Columbia Ulke states that *Alymeris cribrata* is "chiefly found on chestnut blossoms."—Lewis B. Woodruff and Wm. T. Davis.

Notes on Tiger Beetles from North Carolina.—Mr. Franklin Sherman recently presented the writer with some interesting Cicindelas collected in North Carolina. He and Mr. C. S. Brimley have made several visits to Sunburst in Haywood County, where in May and June they have taken *Cicindela ancocisconensis* Harris. This species has been reported from New Hampshire, New York, West Virginia and Illinois by Mr. Edward D. Harris, and from Vermont, New Hampshire, New York, Pennsylvania, Illinois and Virginia by Mr. Charles W. Leng. A series from Sunburst shows the insect to be brightly marked, but not more so than many specimens from some of the localities above mentioned. On the whole the species appears to be quite constantly marked over its known ranges.

Other Cicindelas taken at Sunburst at about 3,000 feet elevation are *purpurea, splendida, tranquebanca* and *repanda.*

Mr. Sherman also has *Cicindela tortuosa* taken at Boardman, Columbus Co., N. C., 21 September, 1915, by Mr. R. W. Leiby.

The most interesting species, however, is *Cicindela blanda* Dej. from White Lake, Bladen Co., N. C., June 5–15, 1914, and early June, 1915, collected by Mr. Sherman. In Revision of the Cicindelidae of Boreal America (1891), Leng states that *blanda* has been found in Ga. and North Carolina; that it is "very rare in collections" and "not recently found." In North American Cicindelidæ in the Harris Collection (1911), it is recorded from several localities in Alabama. The finding of the insect at White Lake gives for this rare species a definite locality in North Carolina.—Wm. T. Davis.

Local Records of Lepidoptera.—*Herse cingulata* Fab. One male specimen in fresh condition from East Quogue, L. I., Sept. 28, 1915, was collected by W. F. Downs.

Atrytone zabulon Boisd. & Lec. Although generally common at Washington Hights, New York, this species was unusually so last August. Most of the specimens were taken Aug. 21.—F. E. Watson.

IGNAZ MATAUSCH.

Mr. Ignaz Matausch, a member of the New York Entomological Society, and well-known as artist and modeler on the staff of the American Museum of Natural History, died December 14, 1915, of bronchial pneumonia after an illness of seventeen days.

Mr. Matausch was born September 1, 1859, in Budweis, Austria. Of a naturally artistic temperament he was trained from boyhood as a modeler and acquired such skill in his profession that at one time he supplied the private museum of Duke Schwarzenburg with models. He came to the United States in 1892, and resided in Cleveland, Ohio, till the year 1904 when he came to the American Museum of Natural History and was assigned to the modeling staff.

As he had a natural inclination toward entomological studies he joined the N. Y. Entomological Society in 1906 and has continued a member till the time of his death. As an entomologist his efforts were largely devoted to investigations in the life-history of the Membracidæ. Minute observation was one of his strongest characteristics and was clearly evidenced in his entomological work, in which his artistic talents also stood him in good stead. His fellow members will long remember the enthusiasm with which he displayed his well-drawn color-sketches of typical and unusual species of Membracidæ, and the excellent series of models constructed by him to exemplify the range of form in this group. Especially interesting are the models illustrating the life-history of *Enchenopa binotata* Say.

Mr. Matausch was best known, however, for the remarkable series of giant insect models which he constructed for the American Museum and which are displayed in the Hall of Public Health, to illustrate the insect carriers of disease. These are without doubt the most accurate models of the kind ever constructed, and are valuable not merely in connection with the purpose above mentioned, but also as unusual demonstrations of external insect anatomy. Every part was modeled with minute care from living as well as dead specimens, hundreds of which were examined in the course of the preliminary studies. The series includes magnified representations of eggs' larva, pupa and adult of the common house fly (*Musca domestica* Linné), eggs of the rat flea (*Ceratophyllus fasciatus* Bosc.), carrier of the bubonic plague, and the adult of the common louse (*Pediculus corporis* de Geer). Many other invertebrate models constructed by Mr. Matausch are exhibited in the Darwin Hall of the Museum, the most noteworthy of which are those demonstrating the anatomy of the spider (*Lycosa carolinensis* Walck.), and of the common squid (*Loligo pealii* Lesueur).

The dissections for the former were made by Mr. Matausch with the collaboration of Dr. Alexander Petrunkevitch, while the latter was constructed under the supervision of Dr. L. W. Williams.

The writer was most closely associated with Mr. Matausch in connection with the construction of the Invertebrate Window Groups in the Darwin Hall. In this work Mr. Matausch formed one of a quartet of skilled museum artists, and the contributions of his hand are seen blended with those of others in a series of complex invertebrate ecological exhibits which have attracted wide attention both here and abroad. The success of these groups is largely due to the exceptional techniqe of Mr. Matausch and his fellow artists.

In Mr. Matausch the N. Y. Entomological Society has lost a faithful worker and the American Museum of Natural History an artist gifted with an unusual and possibly unique combination of faculties.

Mr. Matausch's entomological publications are as follows:

Gynandromorphic Membracidæ. JOURN. N. Y. ENT. SOC., Vol. XVII, 1909, p. 165.

Observations on Membracidæ in the Vicinity of Elizabeth and Newark, N. J. JOURN. N. Y. ENT. SOC., Vol. XVIII, 1910, pp. 164–171.

Similia Camelus Fabricius and Some of Its Variations. JOURN. N. Y. ENT. SOC., Vol. XVIII, 1910, pp. 171–172.

Entylia Germar and Its Different Forms. JOURN. N. Y. ENT. SOC., Vol. XVIII, 1910, pp. 260-263.

The Effects of Castration in Membracidæ. JOURN. N. Y. ENT. SOC., Vol. XIX, 1911, pp. 194–196.

Observations on the Life-History of Enchenopa binotata Say. JOURN. N. Y. ENT. SOC., Vol. XX, pp. 58–67.

Observations on Some North American Membracidæ in Their Last Nymphal Stages. Bull. Amer. Mus. Nat. Hist., Vol. XXXI, 1912, Art. XXVI, pp. 331–336.

Notes on a Peculiar Nymph Variation of Enchnopa Binotata Say. Journ. N. Y. Ent. Soc. Vol. XXIII, p. —.

ROY W. MINER.

JULIUS MEITZEN

Mr. Julius Meitzen, a former member of the New York Entomological Society died of pneumonia on May 1, at the age of 80.

Mr. Meitzen was interested in Coleoptera of the world of which he had brought together a fair collection.

PORCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY.

MEETING OF JANUARY 4, 1916.

The annual meeting of the New York Entomological Society was held January 4, 1916, at 8:15 P. M., in the American Museum of Natural History, Vice-President Harry G. Barber in the chair, with 23 members and six visitors present.

Mr. Dickerson, as chairman of the Nominating Committee, submitted the following nominations for officers for 1916: For President, Harry G. Barber;

for Vice-President, Lewis B. Woodruff; for Secretary, Chas. W. Leng; for Treasurer, William T. Davis; for Librarian, Frank E. Watson; for Curator, Andrew J. Mutchler; for Executive Committee, R. C. Osburn, C. E. Sleight, R. P. Dow, E. Shoemaker, G. P. Engelhardt; for Publication Committee, Charles Schaeffer, F. E. Lutz, W. P. Comstock, E. L. Dickerson; for Delegate to New York Academy of Science, Wm. T. Davis. On motions duly made, seconded and carried, the nominations were closed and the officers above named were elected by affirmative ballot cast by the Secretary.

The president appointed the Auditing Committee, C. F. Groth, G. W. J. Angell, John D. Sherman, Jr., and the Field Committee, Chas. Wunder and Alan Sloan Nicolay.

Mr. Sherman spoke of the Roberts collection of water beetles and the effort being made to secure it for the American Museum; also of a new Check List of Coleoptera which, in conjunction with Mr. Leng, he hoped to publish.

Mr. Ottolengui spoke of his pleasure in being able to attend the meeting after thirteen years' absence, and his sorrow at hearing of Mr. Roberts's illness.

Mr. Davis spoke of "Some Insects from Western New York," using as exhibits a map showing the 800-mile route covered by automobile with Profs. Bradley and Crosby, of Cornell University, Mr. Hook, and Dr. Forbes as companions, several large boxes of insects and many photographs of the region, besides specimens of plants, rocks and oil peculiarly indicative of its character. He said in part that the southwestern corner of the State, near Olean, was selected a year ago, because it was on the watershed of the Allegheny River, and that at Rock City an excellent base was located where the care necessary to preserve the oil derricks from fire kept the woodland in the best condition for entomologists, while the elevation of 2,300 ft. and the connection with the West through the Allegheny River (evidenced by the presence of the cucumber tree) caused the occurrence of many interesting species. The preliminary visits to McLean, near Ithaca, remarkable for its cold highland swamp, where Labrador tea, the small cranberry and trillium grow, and to various glens near Ithaca, and subsequent visits to Watkins Glen, Lake Erie, Potter's Swamp and Letchworth Park, were also interesting.

Among the insects shown, *Phyciodes batesii*, which was taken in considerable numbers, was styled the prize catch, though a mountain form of *Papilio turnus*, *Melitæa harrisi* and *Pieris oleraceæ* were also conspicuous among the butterflies. *Tachopteryx thoreyi*, collected at Portage, *Gomphus descriptus* from West Danby and Ithaca, and *Tetragoneuria canis* from West Danby, were among the fourteen species of dragonflies shown.

Henicocephalus biceps Say (*culicis* auct) was observed gathering in swarms over piles of sawdust like flies, as described by O. A. Johannsen, in Psyche, XVI, 1909, and was another interesting capture.

Exceptionally large galls made by the fly, *Eurosta solidaginis*, on golden rod, as described by Chi Ping in Pomona Journal Ent. & Zool., VII, 1915, formed another exhibit. A large number of *Anthonomus sp.* found on *Kalmia latifolia*, and of *Malthodes sp.* were among the many interesting coleoptera shown, though the larger *Cychrus, Centrodera* and *Anthophilax* were more showy. An interesting series of *Donacia rufa* found on *Caltha palustris* and on buttercup and of *Galerucella rufosanguinea* found in such numbers on wild cherry that the trees were in places defoliated, were also included.

In orthoptera a large box was required to show the captures which included sixteen species all collected before the middle of June.

Mr. Davis's remarkably successful photography showed well the gigantic rocks, sometimes grasped by the great exposed roots of the yellow birches, that give Rock City its name, and in one plate the shooting of a completed oil well, with the column of oil rising high above it, and added much to the interest of his remarks, which were discussed by Messrs. Schaeffer, Dickerson and others at their conclusion.

Mr. H. B. Weiss read a paper on "Insect Fauna of New Jersey Greenhouses excluding Coccidæ"—which will be printed elsewhere.

In reply to a question, Mr. Weiss said that *Aramigus fulleri*, the larva of which feeds on roots of greenhouse roses was rare in New Jersey, being actually known from only three or four places.

The secretary read a communication from Dr. Osburn on a dragonfly migration, observed by Mrs. Osburn, which will be printed in Miscellaneous Notes.

Mr. Engelhardt described a similar occurrence observed near the shore of Long Island on Columbus Day, October 12, when thousands of *Anax junius* were seen zigzagging about and settling in the grass.

Mr. Dickerson recorded with regret the death of F. M. Webster.

Mr. Dow exhibited and donated specimens of wood from Lahaway, N. J., showing the work of woodpeckers in search of larvæ of *Prionoxystus robiniæ*, remarking on the length of tongue obviously required to reach them, and the number of years elapsed betwen the commission of the crime and its detection by the splitting of the wood; the annual rings serving both to conceal the evidence and count the years. He also donated specimens of the work of *Trypoxylon* and other wasps.

A member contributed anonymously the following lines composed by an ancestor, who had ben unjustly reproached by a female afflicted with *Pediculus capitis*:

"A lady once told me and in her own house
That I was not worth three skips of a louse,
Forgive the dear creature, the words that she said,
For ladies will talk of what runs in their head."

MEETING OF JANUARY 18, 1916.

A regular meeting of the New York Entomological Society was held on January 18, 1916, in the American Museum of Natural History, President Harry G. Barber in the chair, with 12 members and two visitors present.

In the absence of the secretary, the president requested Mr. Sherman to act as secretary.

Miss C. Sidney Spencer, of 437 W. 59th St., College P. & S., proposed for membership at the last meeting, was duly elected.

Dr. Lutz, delegate to the Pan-American Congress, reported that he had attended its meetings.

Mr. Davis, delegate to the New York Academy of Sciences, reported the contemplated centennial celebration early in 1917, of the anniversary of the founding of the New York Lyceum of Natural History, in 1817.

Mr. Davis presented some notes by Mr. Woodruff and himself on local Malachiidæ, found on Staten Island and Long Island.

Prof. Brues spoke of his trip to the West Coast of South America in 1912 with the Strong Expedition from the Harvard Medical School, and especially of the studies by this party of the relations between insects and some of the diseases prevalent in the regions visited. On the west coast of South America yellow fever is confined to parts of the Colombian coast and the lowlands of Ecuador, where there is a dense forest growth, with heavy rainfall and hot climate, Guayaquil being a great hot-bed of disease, especially prevalent during the rainy season. Among the natives the disease occurs almost entirely with young persons, but visitors, even natives from the nearby mountains, are susceptible at any age. Owing to the many changes in the government of Ecuador, little has been done to stamp out the disease, although it has been entirely eliminated at the Isthmus. The boats anchor at Guayaquil, 400 meters from shore, and after the four days' journey to Panama, are quarantined two days, and this period of six days covers the period of incubation, thus preventing disease from spreading north. The mosquito carrying yellow fever in this territory is *Stegomyia pallipes*.

At Buena Ventura, on the west coast of Colombia, the common mosquito, *Culex fatigans* (*quinquefasciata?*) is a carrier of the elephantiasis and phaleriasis prevalent there, and also at Panama.

In the deep canyons, including the Lima River, near Lima, the two diseases known as verruga (meaning await) and arroya fever, are quite common, occurring simultaneously in many cases and the latter having a very high death rate (about 80 per cent.).

Townsend believed the two diseases identical and found *Phlebotomys* to be the carrier.

The bacteriological investigations of the Strong Expedition, however, lead to the belief that the two things are separate diseases,—verruga, caused by an ultra-microscopic, presumably protozoan organism, and probably carried by a species of tick (like the somewhat similar Texas-fever and Rocky mountain fever diseases) and arroya-fever, caused by a small bacterian and carried by *Phlebotomys*.

These diseases are always contracted at night and at an altitude above 3,000 feet.

Prof. Brues spoke also of great abundance of insects near Guayaquil at electric lights, including a huge *Belostoma*, large water-beetles and Katydids.

In canyons further south in arid regions, along the rivers where only there is vegetation, occurred many interesting insects, especially a group of parasitic Tachinid flies, having many bristles, the species of which, while resembling each other superficially very closely, are separated by great structural differences in the antennal and mouth parts.

Very large carpenter bees, of the size of humming birds, visible at great distance, were also common.

Mr. Watson exhibited five paratypes of *Protoparce rustica* Fabr. var. *cubana* Wood, lately described in Ent. News (December, 1915), from the Museum collection.

Dr. Lutz mentioned his being present at the annual meeting of the Washington Entomological Society, when Pres. Caudell made his address on various superstitions associated with the orthoptera, and at which also the new office of honorary president was created, and Dr. Schwarz elected to same.

Mr. Dow exhibited photographs of the late Mr. Brakeley and of his house at Lahaway.

Mr. J. W. Angell exhibited some Lucanid monstrosities, including a *Lucanus* with seven legs; also his collection of Lucanids of the exotic genus *Chiasognathus*.

Mr. Davis called attention to the article by C. W. Beebe in Bull. of Zoölogical Society for January, 1916 (Vol. 19, No. 1), describing the many insects, shells, etc., sifted from the leaves, sticks, moss, earth and mold of a Brazilian jungle, taken from roots of a tree, about which *Heliconia* grew in abundance.

MEETING OF FEBRUARY 1, 1916.

A regular meeting of the New York Entomological Society was held February 1, 1916, at 8:15 P.M., in the American Museum of Natural History, President Harry G. Barber in the chair, with twenty members and several visitors present.

The curator reported the rearrangement of the Cistelidæ or Alleculidæ of the local collection, following the Saturday afternoon meeting of January 22, and announced as subject for the Saturday afternoon meeting of February 19, the families Lagriidæ and Melandryidæ.

Mr. Schaeffer for the Publication Committee reported the receipt of the first sheets of galley proof of the Van Duzee List.

Mr. Davis exhibited Occasional Papers of the Boston Society of Natural History, VII, 1915, being a review of New England Mollusks by Chas. W. Johnson.

Mr. Leng read "Notes on Cistelidæ" which will be published in the JOURNAL.

Mr. Schaeffer commenting thereon said he suspected the humeral red spot in some species of *Mycetochara* might be evanescent and the only difference betwen them and some of the totally black species might thus disappear.

Dr. Lutz and Mr. Davis gave a "Résumé of Explorations in Florida and the West Indies" illustrated with photographs. Dr. Lutz speaking first said that shortly after he became a member of the Society a fairly definite plan was formed in the Museum to devote exploration, in conjunction as far as possible with the affiliated societies, to the study of geographical distribution and routes of dispersal between North and South America. The effect of isolation as exemplified in the mountainous West Indian islands isolated by oceanic waters and in the mountains of Arizona, also isolated but by desert regions, and both equally in the path between the two continents, necessarily became a part of the problem. The steps thus far taken have included collections in our local region, in the mountains of North Carolina, in Florida, in the West Indies and in the northern part of South America. The local region was covered by the wagon journey, in which many of our members took a more or less active part, and the work on the local collection, still in progress, became a part of the general plan. The mountains of North Carolina were repeatedly visited by Beutenmuller and a large amount of material was accumulated. On account of the peculiar interest it possesses, Florida has been studied closely, in 1911 by Dr. Lutz with Davis and Leng, in 1912 by Davis and Grossbeck, in 1913 by Davis and Sleight, in 1914 by Mutchler and Watson; a different part of the State being visited on each occasion. The West Indies have been even more frequently visited, the first journey being a reconnaissance of the Lesser Antilles and northern South America by Prof. Crampton and Dr. Lutz, followed by the Jamaica trip of Grossbeck and Dow in 1912, the Cuban trip of Dr. Lutz and Mr. Leng in 1913, Porto Rican trips of Dr. Lutz, Barber, Mutchler and Watson in 1914 and 1915, and of Watson to San Domingo in 1915. Coöperation with the New York Academy of Sciences and the Porto Rican Government and the financial aid of friends of the Museum has materially enlarged the possibilities of West Indian exploration.

The number of specimens accumulated by these journeys is far in excess of 100,000 and the publication of the results has necessarily been slow, from the great number requiring identification. However, the Florida material has already served as a basis for the Diptera of Florida by Johnson, the Hemiptera of Florida by Barber and of the Coleoptera and the Carabidæ of Florida by Leng, as well as the description of new species of Orthoptera by Davis. A paper on the Lepidoptera left unfinished by Grossbeck's untimely death, will be finished by Watson. The West Indian material has served in the same way for the basis of the List of Greater Antillean Spiders by Dr. Lutz, following identifications by Banks, and for the Prel. List of Coleoptera by Leng and Mutchler.

Dr. Lutz added that a continuation of these explorations by Watson in Jamaica and by himself in Arizona was planned for 1916, and a continuation of the publication of the results was in prospect.

Mr. Davis, taking the floor, spoke particularly of the variety of environments found in Florida, using a quotation from Dr. Small's "Florida Trees" of 1913 as his text and illustrating his remarks by numerous excellent photographs of Floridian scenes. He said that Dr. Small's statements that Florida possessed a larger tree flora than any other equal area in the United States, and nearly half the species of trees in the United States are found in Florida, were remarkable in view of the sameness of the pine forests, as seen from the railroad car; and in view of the intimate relation between insects and their food plants, serve also as an indication of the variety of species of insects found in Florida. His own journeys in Florida with different companions had covered the central part of the state in 1911, the west coast in 1912 and the east coast in 1913, and his photographs showed the vegetation of many very different parts of the state from Jacksonville to Key West and from Key Marco and Chokoloskee on the gulf coast to Big Pine Key on the Atlantic coast. The human interest was never far distant in the remarks that accompanied the exhibition, and the members were entertained by bits of family history of the Seminole Indians Mr. Davis met, the dangers of navigation among the Ten Thousand Islands, the fact that he was out of sight of land on Lake Okeechobee, the wild cat that spit at Sleight at LaGrange, the wading through cypress swamps required to reach Deep Lake, as well as by the beauty of his pictures of the trees and scenery amid which his Florida insects were collected.

Dr. Lutz then exhibited his collection of West Indian photographs, arranged in series and accompanied by maps, marked to show where the photographs were taken. Time did not permit of his thoroughly explaining these pictures, aggregating over 600 subjects or dwelling upon the collections of Lepidoptera arranged by Mr. Watson and of Coleoptera arranged by Mr. Mutchler, to accompany them; but Porto Rico was especially selected to show the thorough manner in which the exploration, after five journeys, had been carried on at about twenty-five stations in different parts of the island.

During the informal examination of the photographs and specimens which closed the evening, Mr. Dow exhibited the mummied hand of an Egyptian wearing a ring in which a beetle was mounted, and Mr. Schaeffer exhibited the species of Coleoptera described and referred to in the December number of the JOURNAL, calling particular attention also to *Elatrinus bicolor*, found by Manee at Southern Pines, N. C., as the first species of the genus found in the East; and to *Calosoma sycophanta* found by Mr. Schott in Prospect Park, Brooklyn.

MEETING OF FEBRUARY 15, 1916.

A regular meeting of the New York Entomological Society was held February 15, 1916, at 8:15 P.M., in the American Museum of Natural History. President Harry G. Barber in the chair, with eighteen members and three visitors present.

Mr. Frank Morton Jones, 2000 Riverview Ave., Wilmington, Del., was elected an active member.

The secretary read an obituary notice of Ignaz Matausch, prepared by Mr. Miner, and two communications from Mr. Brehme.

Dr. Lutz read a paper on "Centers of Dispersal and their bearing on the present Distribution of Animals," in which some recent literature was discussed, and the idea that results of studies in palæontology might profitably be used in the study of insect dispersal was advanced.

Mr. Shoemaker exhibited "Some Insects taken near Slide Mountain, N. Y., in 1915," stating that he spent eight or nine days at a place between Big Indian and the base of the mountain, from June 26 to July 5, and, although more than half the days were disturbed by thunderstorms, that he had been able to obtain many insects by beating and sugaring. Ten specimens of *Cychrus canadensis,* one of *Anthophilax malachiticus,* and a great many Elateridæ and Cerambycidæ were among the beetles shown.

Mr. Davis read a paper by Stephen G. Rich on "Some Respiratory Structures of Dragon Fly Larvæ," illustrated by the author's drawings, figures from Packard, and specimens supplied by Mr. Davis.

Mr. G. W. J. Angell presented several volumes of the Annals of the Belgian Entomological Society to the library and exhibited a carabid beetle from Lake Tanganyika, Africa, apparently representing a new species and genus.

Mr. Woodruff exhibited specimens of the Tortricid moth *Archips infumatana,* taken at Litchfield, Conn., on hickory, and read a memorandum respecting same, which will be printed in Miscellaneous Notes.

Several members commented on the insects seen on the very warm days at the end of January. Mr. J. W. Angell caught a freshly emerged *Cicindela 6-guttata* in Bronx Park under a log; Mr. Olsen caught a water-beetle flying; Mr. Dickerson a noctuid moth flying in the window and Mr. Davis was told that the mourning cloak butterfly was flying on Staten Island.

Mr. Davis exhibited *Cicada canalicularis* from Portage La Prairie, Manitoba, and gave also other northern records known to him in Nova Scotia, Quebec and Ontario.

MEETING OF MARCH 7, 1916.

A regular meeting of the New York Entomological Society was held March 7, 1916, at 8:15 P.M., in the American Museum of Natural History; President Harry G. Barber in the chair, with fourteen members and six visitors present.

The curator reported donations to local collection from Messrs. Davis, Shoemaker and Leng and announced a meeting of coleopterologists on Saturday, March 18, to study Mordellidæ.

Mr. Carlos C. Hoffman, 2A San Augustin 56, Mexico D. F., was nominated for active membership, and the by-laws being suspended for the purpose, he was immediately elected.

Mr. J. W. Angell announced the death of Julius Meitzen, of pneumonia.

Letters from Henry Brown and Frank Morton Jones were read.

Mr. Watson exhibited "Recent additions to the Museum Collection of Sphingidæ"; speaking particularly of gifts from Mr. B. Preston Clark, of Boston, and of the following species:

Protoparce occulta Rothschild and Jordan. First specimen from Jalapa, Mexico, collected by Mr. Schaus. Second specimen from Jalapa, Mexico, collection of Hy. Edwards.

Xylophanes damocrita Druce, from Brazil, collector unknown.

Perigonia lusca f. *ilus* Boisduval, no locality on specimen, collector unknown. Rothschild and Jordan give the habitat as Mexico to Matto Grosso. Gift of Mr. B. Preston Clark.

Leucorhampa ornatus Rothschild, from Rio, Brazil, collector unknown. Gift of Mr. B. Preston Clark.

Euryglottis albostigmata basalis Rothschild. Inca Mines, Peru, collector, H. H. Keys. The typical form is from Colombia.

Mr. Watson also spoke of the genus *Calisto,* saying in part that this small but interesting genus, consisting of six species and two varieties, is found only in the Antilles. It seems to illustrate very well the effect of isolation on a species, as each of the Greater Antilles has its own peculiar forms, not found in any of the other islands, as far as is now known.

All of the forms are in the Museum Collection with the exception of *C. archebates* Menetries.

C. Zangis Fabricius is common in Jamaica.

C. nubila Lathy from Porto Rico, is a very common butterfly there.

C. archebates Menetries is from San Domingo (Haiti). The only specimens in existence, according to Seitz, are in the collection of Godman and Salvin and the St. Petersburg Museum.

C. pulchella Lathy is from San Domingo, where it seems to be locally common.

C. pulchella ♀-f. *tenebrossa* Lathy from San Domingo.

C. herophila Hübner from Cuba.

C. hysius Godart is from San Domingo, where it is very common. It is close to *C. herophila* Hübner, but is distinct.

C. hysius f. *confusa* Lathy, also from San Domingo. *C. hysius* Godart has also been reported from Jamaica.

Mr. Olsen made an "Exhibition of Membracidæ from Trinidad and British Guiana," including paratypes of a species recently described by W. D. Funkhouser.

Dr. Lutz referred to the complete deception in nature by which one of the species shown mimics an aphid attended by ants.

Mr. Dickerson gave a list of Nitidulidæ found on flowers in New Jersey nurseries, referring particularly to *Carpophilus antiquus* having been found on cornsilk.

Mr. J. W. Angell exhibited a number of Silphidæ and Scarabaidæ, referring particularly to a minute specimen.

Mr. Davis exhibited a paper sign, taken from a tree in Letchworth Park, that had been eaten by *Vespa maculata,* a case as he expressed it of "stealing paper to make more paper."

He also exhibited the species of *Galerucella* allied to *cavicollis,* pointing out the depth of the pronotal fovea and shining surface of the species he had found so abundant at Rock City, N. Y., as to completely defoliate *Prunus pennsylvanica* and *serotina.* He stated that this species appeared to be *cavicollis,* and to differ from our local species which is comparatively dull, without so deep a fovea, and certainly unknown to devastate the foliage so completely.

Mr. Davis also exhibited Coleoptera collected by Alanson Skinner in Manitoba, Wisconsin and Oklahoma, commenting particularly on the forms of *tranquebarica* var. *kirbyi*, from the northwest, and those of *sexguttata* var. *levettei* from Oklahoma.

Mr. Dickerson exhibited *Cactopinus hubbardi* Schwarz, identified by Charles Dury, calling attention to the remarkable horn.

Dr. McDunnough, at the invitation of the president, spoke of the Barnes collection of lepidoptera and the exquisite care taken to compare the specimens with the types in this country and abroad; praising especially Aug. Grote, Herman Strecker and A. S. Packard for the pains they had taken to so mark their types that such comparisons were facilitated, and closing by extending a cordial invitation to our members to visit Decatur to see the results.

Mr. Hoffman spoke briefly of his pleasure at being able to attend the meeting.

MEETING OF MARCH 21, 1916.

A regular meeting of the New York Entomological Society was held March 21, 1916, at 8:15 P.M., in the American Museum of Natural History, President Harry G. Barber in the chair, with 18 members present.

The curator reported donations to the local collection from Messrs. Dickerson, Dow, Shoemaker and Leng; and continuance of study on the Mordellidæ on Saturday afternoon, April 1.

Mr. Nutman exhibited 79 species of "Cerambycidæ from the Adirondack Mountains" collected by himself during the past nine years, principally between May and August and at elevations of about 1,000 feet. Mr. Nutman said the habits of the adults varied considerably, some like Leptura being found on flowers, others like Callidiini and Lamiini on logs or sides of houses in the sunlight, while a few of the *Callidium, Phymatodes, Asemum* and *Xylotrechus* seemed partial to the screen doors. Golden rod, wild cherry, spiræa and sumach were the most attractive flowers, the white daisy yielding only *Acmæops pratensis* and *Leptura chrysocoma*. Saperdas and Obereas were found on poplar, *Psenocerus supernotatus* on various vines about the house. The different species varied in date, *Asemum* being one of the earliest, dozens at a time coming from a norway pine stump about the beginning of May; *Leptura canadensis* on the contrary being found in July and August. The collecting was most productive at the edges of cultivated land but a few species were found in the woods, particularly *Anthophilax malachiticus*, a fine specimen of which excited admiration and envy. The species varied in abundance in different seasons, *Leptura vagans* for instance being common in 1909 and 1910, while *Leptura vibex* was not noticed until 1910, since when it has been common on blackberry.

Mr. Davis, commenting on the specimens shown, pointed out the narrow stripes of *Saperda candida*, which he had previously noticed in Adirondack specimens.

Mr. Dow read a paper on "Aristotle as an Entomologist," briefly sketching his history and citing many passages to show how often the first mention of the scientific names we use is found in his writings, even to the word Entomos itself; and how the first rudiments of our present classification can be traced in his differentiations.

Mr. Weeks after urging the claims of Solomon to be considered also as an entomologist, spoke feelingly against a bill to be introduced in the State Senate, looking to local control of mosquito extermination and solicited the support of the society in opposing it.

The president ruled that such matters were not within the scope of the society's activities.

Mr. Schaeffer presented the following additions and corrections to Smith's List of New Jersey Insects, and spoke also of the doubtful validity of the record of *Corymbites rotundicollis.*

Microrhagus audax Horn. Three specimens labelled New York, New Jersey and Fort Lee, N. J., July 26.

Microrhagus imperfectus Lec. One specimen, Fort Lee, N. J.

Phlegon pectorosus Lec. One specimen of this species taken at Bellport, Long Island, by A. Nicolay. This species is known from Indiana, Maryland and Pennsylvania and is likely to occur in New Jersey also.

Cardiophorus erythropus Er. One specimen of this species from Atlantic Highlands, N. J.

Elater carbonicolor Esch. Reported by Green from Clementon. It is an Alaskan species and has to be striken from the list. Mr. Green writes that it is a wrong identification and the species in question is *E. rubricus* Say.

Elater nigrinus Papk. A strictly northern species. Reported by Davis from Staten Island.

Elater luctuosus Lec. Reported by Beutenmuller from Fort Lee, and by Leng from Staten Island. Mr. Davis, who has the Staten Island specimen, showed it to me and it proved to be *E. pedalis*, a species not given in the New Jersey list, though I have also a specimen from New Jersey.

Melanotus opacicollis Lec. One specimen from Lakehurst, taken in August, new to the list.

Corymbites atropurpureus Melsch. One specimen of this species was collected by Jacob Doll in Paterson, May 3.

Corymbites copei Horn. Several specimens of this species from Pine Island, N. Y., collected by F. M. Schott and from Lakehurst, N. J.

Mr. Mutchler announced the acquisition by the museum, with the aid of several members of the society, of the Roberts collection of water beetles, including 19,000 specimens, practically all the described North American species, and many types. He exhibited a portion of the collection to show the admirable mounting and unusually long series of specimens.

Mr. Olsen exhibited a wax model he had made of *Acanthia lectularia,* in connection with which the secretary read a newspaper comment on Mr. Dow's title "There were bugs before ours, classic bugs; and we like to hear about them for they cannot bite us now."

Mr. Angell exhibited a rare species of *Strategus*.

Mr. Weiss showed a map giving the distribution, mostly in greenhouses, of comparatively new insect pests and spoke also of the *Cattleya* midge, of European earwigs becoming established at Newport, R. I., and of a hymenopterous leaf-miner.

MEETING OF APRIL 4, 1916.

A regular meeting of the New York Entomological Society was held April 4, 1916, at 8:15 P.M., in Heim's Restaurant, President Harry G. Barber in the chair, with twenty-one members present.

The librarian reported the binding of a set of the JOURNAL in Holliston Library Buckram No. 50.

Mr. Howard J. Shannon, 73 Union Ave., Jamaica, L. I., was elected an active member.

Mr. Davis spoke of a number of species of *Cicada*, illustrating his remarks by maps showing the distribution and by boxes of specimens in which were pinned drawings made by Mr. Olsen, of the diagnostic structures. In the course of his remarks he dwelt upon the necessity of specimens from type locality for accurate comparison with the original descriptions and recounted the difficulties he had surmounted in obtaining such for some of the early described species, which were thereby in some cases rescued from undeserved synonymy. In respect of distribution, he said that Leconte's districts, divided by meridional lines, and illustrated by the map in his Coleoptera of Kansas and Eastern New Mexico, 1859, were, for *Cicada*, more satisfactory than Merriam's zones, though the species with wishbone-shaped uncas were perhaps somewhat southern in distribution except that they extended northward through the Mississippi Valley.

Mr. Leng read a paper on "*Omophron* and its Distribution" in which he attempted to show that while the preglacial dispersal of the genus was from a northern centre towards the south, where Madagascar and Cape of Good Hope in the old world, and Hispaniola and Mexico in the new world have been reached, the postglacial dispersal has been in the contrary direction, viz.: from south to north, as evidenced by the spread of Gulf Strip species like *labiatum* and *nitidum* northward, the one along the Atlantic coastal plain, the other through the Mississippi Valley; and by the occurrence of numerous species now within the areas covered by ice during the glacial period. His remarks were illustrated by specimens of the American species and a few of those found in Mexico, Europe and Africa.

Dr. Lutz and Mr. Davis, in discussing the subject, pointed out that the idea of the north as the ancestral home of the larger groups was old and well supported by geological evidence in mammals and in trees.

Dr. Lehmann, upon invitation by the president, spoke of his interest in certain groups of lepidoptera during the last seven years and his journeys, completed and in prospect, devoted mainly to hunting *Argynnis* and *Melitæa*. Utah, Colorado and California are planned for 1916, and he said he would gladly give the lepidoptera caught outside his special desiderata to institutions or individuals desiring them.

Mr. Mutchler exhibited *Chauliognathus marginatus*, taken at Ramsey, N. J., April 1, by Dr. Lutz.

Mr. Dow, in a speech entirely beyond the ability of the secretary to reproduce, once more presented in glowing terms the attractiveness of Lahaway, and urged the members to join him in an inspection of the place on Sunday, April 16, when the arbutus will be in bloom.

MEETING OF APRIL 18, 1916.

A regular meeting of the New York Entomological Society was held April 18, 1916, at 8:15 P.M., in the American Museum of Natural History; Vice-President Lewis B. Woodruff in the chair, with fourteen members present.

The curator reported donations to the local collection from Messrs. Davis and Leng.

The librarian reported donation from Mr. J. W. Angell.

Dr. Lutz read a paper on "The Distribution of *Bombus* with Notes on certain species of Boreal America," illustrated by boxes of specimens and diagrams showing the phylogeny and range of certain species. The paper will be published in full.

Mr. Dow spoke of collecting at Lahaway on April 16 with Mr. Bequaert, exhibiting a number of the insects found and donating the more desirable to the local collection and to his fellow members. *Tricrania sanguinipennis* Say, an addition to Smith's New Jersey List, was found crawling on dune-like banks in a situation similar to that in which it was found last year at Central Park, Long Island, and Mr. Dow remarked that *Tettyx* was also abundant at both localities. Other interesting captures were *Euphoria areata*, a *Dineutes* resembling *robertsi*, etc.

Mr. Dickerson exhibited a number of hymenoptera, diptera, neuroptera and hemiptera found on willow bloom at Chester, N. J., and commented on the absence of beetles.

THE

NEW YORK ENTOMOLOGICAL SOCIETY.

Organized June 29, 1892.—Incorporated June 7, 1893.

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Eighth Ave.

Annual dues for Active Members, $3.00.

Members of the Society will please remit their annual dues, payable in January, to the treasurer.

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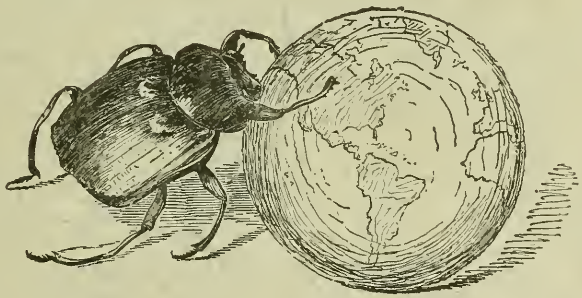

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Edited by CHARLES SCHAEFFER

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SAR ,PHAGIDÆ OF NEW ENGLAND: GENUS SARCOPHAGA.[1]

By R. R. Parker,

Bozeman, Mont.

Sarcophaga pachyprocta, new species.

1881. *Sarcophaga pachyprocta* Hagen, Can. Ent., vol. 13, pp. 148–149. Occurrence.

Type: Massachusetts Agricultural College, male and female.

Paratypes: United States National Museum, one male, one female (no. 19168); Boston Society of Natural History, one male, three females; Gypsy Moth Parasite Laboratory at Melrose Highlands, Mass., one male, one female; collection of C. W. Johnson, one male, two females; collection of author, two males, one female.

Male.—Breadth of front at its narrowest part from five-sevenths to five-sixths eye width; arista shortly plumose on basal half; vestiture of back of head black except for a narrow hand of yellow hair just above foramen and similarly colored hairs on a small portion of the metacephalon just beneath; cheeks clothed with black bristles and bristle-like hairs; lateral verticals present; greater ocellars nearly as strong or sometimes stronger than uppermost pair of frontals; first and third veins prominently bristly; costal spine short but distinct; section III of costa practically equal to section V; vestiture of legs short except for scattered, long hairs on ventral surfaces of middle and hind femora; middle femur without posterior ventral row of bristles;

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

bristles of thorax stout and prominent, hinder two pairs of anterior dorsocentrals almost as strong as postsuturals; acrostichals present; three pairs posterior dorsocentrals of about equal size; scutellar apicals present; lower sternopleura with bristles only; abdomen short, stout, its outline more elliptical than oval; nota clothed dorsally and ventrally with short, reclinate bristles; vestiture of third plate erect; second segment usually with two stouter marginals at center; genital segments completely filling cavity of fourth notum (see figure); second segment discoidal, rounded, dull orange, first much larger and completely pollinose or its posterior part dull orange.

Female.—Vestiture of back of head black except for a narrow band of yellow hair just above foramen and similarly colored hairs on a small portion of the metacephalon just beneath; cheeks clothed with black bristles and bristle like hairs; greater ocellars nearly as strong or sometimes stronger than uppermost pair of frontals; hairs covering anterior spiracles mostly grayish; first and third veins prominently bristly; costal spine short but distinct; section III of costa practically equal to section V; bristles of thorax stout and prominent; hinder two pairs of anterior dorsocentrals almost as strong as postsuturals; acrostichals present; three pairs posterior dorsocentrals of about equal size; bristles of lower sternopleura in three distinct rows; distinctly larger and more erect bristles mixed with vestiture of lateral and ventral surfaces of fourth notum; second segment usually with two stouter marginals at center; genital segments dull orange, sixth notum not divided into lateral lips, seventh similar in shape and visible just beneath it, but much smaller (almost vestigial).

Length: 5 to 11 mm., average 8 to 10 mm.

Male, Head.—Viewed from side parafrontals and genæ with dark reflections. Breadth of front at its narrowest part varies from five-sevenths to five-sixths eye width; cheek height one third or slightly greater than one third that of eye. Front prominent, sides of frontal vitta parallel anteriorly but its margins effaced below ocellar triangle. Second antennal segment dark, sometimes brownish especially at tip; third about twice length of second; arista shortly plumose on basal half. Back of head somewhat convex, its vestiture black except for a narrow band of yellow hair just above foramen and similarly colored hairs on a small portion of the metacephalon just beneath. Cheeks clothed with black bristles and bristle-like hairs. Gena with a row of minutes hairs near lower eye orbit and a few others that are scattered. Palpi dark.

Chætotaxy.—Lateral verticals present; vibrissæ inserted just above line of oral margin; greater ocellars nearly as strong, sometimes stronger than uppermost pair of frontals.

Thorax.—Metanotum clothed with short scattered reclinate bristles. Hairs covering anterior spiracle dark basally, lighter toward tips; those of anterior margin of posterior spiracle dark brown; those of spiracular cover only brownish basally, mostly yellowish. Epaulets dark.

Wings.—Bend of fourth vein varies from an acute to a right angle; anterior cross-vein slightly more basal than end of first longitudinal; first and third veins prominently bristly; costal spine distinct; section III of costa practically equal to section V; alulæ fringed with hair; calypters whitish, their margins fringed with white hair.

Legs.—Dark; tarsi without ventral bands of reflecting hairs; vestiture short except for a few scattered, long hairs on ventral surfaces of middle and hind femora. Posterior trochanter without "brush"; femur spindle shaped; anterior face with three rows of bristles, those of intermediate row shortest and not developed distally, those of lower row well separated and present on distal two thirds or thereabout; posterior face with ventral row of long, slender hair like bristles; tibia straight or slightly curved; tarsus not shorter than tibia; fourth segment at least one half fifth. Middle coxa with a single row of bristles, but there may be a few others anterior to it dorsally; femur with a complete anterior ventral row of bristles, posterior ventral row lacking or represented by long, well separated hairs; submesotibial bristle very strong. Ventral face of anterior coxa with an irregular row of bristles at each side only.

Chætotaxy.—Bristles stout and prominent. The hinder two pairs of anterior dorsocentrals almost as strong as postsuturals; two pairs of acrostichals, presutural pair absent; inner presuturals absent or very weak; three pairs posterior dorsocentrals of about equal size; prescutellar acrostichals present but weak as compared to other bristles; scutellar apicals absent; three sternopleurals; lower sternopleura with bristles only.

Abdomen.—Rather short; depth almost equal to width so that it appears somewhat cylindrical, outline more elliptical than oval; nota clothed dorsally and ventrally with short reclinate bristles. Ventral plates as a whole with their sides converging posteriorly, sides of second and third distinctly rounded; vestiture hairy, that of first and second long, that of third shorter but erect.

Chætotaxy.—Second segment usually with a row of weak, slender, decumbent marignals, sometimes two at center may be stronger and more erect; third with a complete marginal row dorsally and laterally or dorsally with only two marginals at center; fourth with a complete row ending ventrally at third notum.

Genital Segments.—Prominent; large, abruptly terminating the abdomen and occupying to its fullest extent cavity of fourth notum (see figure). First (g. $s._1$), pollinose to varying extent, sometimes entirely so with reflecting colors of abdomen but usually posterior portion dull orange, posteriorly its vestiture longer than that of second segment, viewed from behind it presents a very large, slightly convex surface abruptly rounded forward dorsally (the segments being in their normal position), marginal bristles absent. Second (g. $s._2$) segment (examined in similar position) appears like a slightly raised dull orange disk, anal area small. Forceps short, base without upward flap-like extensions, its vestiture not longer than that of second segment; beyond base prongs become abruptly slender and very small, thence attenuated to tips, both together looking like the end of a large blunt needle, their outline in profile sinuate, the anterior edges hairy. The dull orange lamellæ of fourth ventral plate may show beyond edges of fourth notum.

Genitalia.—Penis and claspers peculiarly modified, head of penis prominently spiny anteriorly as seen in profile. Accessory plates short but as segments are pulled out they show from behind as two erect plates parallel to but much shorter than forceps.

Female.—They differ from the males in the following important characters.

Head.—Breadth of front at its narrowest part practically equal to eye width, inner eye orbits diverging downward. Vestiture of genæ may be longer and more scattered.

Thorax.—Hairs covering anterior spiracle more distinctly grayish, entirely so or dark only basally.

Legs.—Lower row of bristles on anterior face of third femur more nearly complete than in male; ventral row of posterior face consisting of long, well separated bristles (usually four or five) on proximal half or slightly more. Anterior and posterior rows of bristles of middle femur complete, very weak on distal half, "comb" absent.

Chætotaxy.—Bristles of lower sternopleura arranged in three distinct rows.

Abdomen.—Depth much less than width, outline oval. Vestiture of short, reclinate bristles except that bristles become longer and more erect laterally on second and third nota and laterally and ventrally on fourth notum. Ventral plates concealed in part; first and second plates, sometimes also third and fourth, with one or more pairs of surface bristles besides those of posterior margin.

Genital Segments.—Dull orange, grayish or yellowish pollinose. Sixth notum not divided into lateral lips, narrow, visible only from behind, margin fringed with bristles; spiracles below eenter, often concealed by edge of fourth notum; seventh notum much smaller than sixth, but similar and visible just beneath it.

Described from seven male and nine female specimens; several others examined.

Range: New England—Mass., Provincetown, Truro, Horseneck Beach, Nantucket, Cambridge, Saxonville, Lunenburg.

United States: N. Y., N. J., Pa., O.

Foreign: Canada (Manitoba?), Cuba (?), Hayti (?).

This species is peculiarly distinct from all others described. The character of the genital segments is distinctive in both sexes. The parafrontals and genæ are silvery gray, and particularly striking in the male because of the unusually wide front for that sex. There has been considerable doubt in my mind into which niche in the family this species could be sidetracked. Both its genital and external characters differ decidedly from those found in the genus *Sarcophaga*. Some time ago I submitted a specimen to Dr. Böttcher for his opinion. He replied in part that it "represents a type which I do not know from Europe or palearctic countries, but it has much the same features characteristic for several South American species," and also states that he had thought of making a new subgenus on the characters involved. This seems inadvisable for me to attempt on the basis of the single species represented among my material, so, for the present, it seems best to accept the genus *Sarcophaga* as a useful dumping ground. The more important characters which harmonize least with *Sarcophaga* are the vestiture of the back of the head, the broad front in the male, the stout nature of the chætotaxy throughout, the shape and vestiture of the abdomen in the male, and the genital segments and genitalia. There are other characters which would assume importance if they were duplicated in related forms.

NEW WESTERN GALL MIDGES.

By E. P. Felt,

Albany, N. Y.

The following accounts of species are based largely on material collected and reared by Mr. P. H. Timberlake, of the U. S. Bureau of Entomology, while in Colorado and California, the observations on habits and life history notes being made by him. It will be noted that his work has disclosed the presence of a number of gall midges upon various composites, indicating the prevalence of somewhat the same conditions as are to be found upon related plants in the eastern states. The rearing of several species of *Diarthronomyia* is particularly interesting in connection with the recent discovery of the chrysanthemum midge, *D. hypogæa* H. Lw. in this country. There are included in this lot of descriptions two accounts of species of Lasioptera infesting the leaf sheaths or the lower portion of the stem of two grasses, new records due to the investigations of Mr. C. N. Ainslie, also of the U. S. Bureau of Entomology.

ONODIPLOSIS new genus

This form, on account of the greatly reduced palpi, the somewhat produced mesonotum and the modified ovipositor, is allied to the series referable to Hormomyia and its near associates, and particularly to *Monarthropalpus* Rubs. The type is *O. sarcobati* n. sp.

Onodiplosis sarcobati new species.

This remarkable midge was reared May 24, 1914, by Mr. P. H. Timberlake from a bud gall on *Sarcobatus vermiculatus,* collected on the west shore of Utah Lake. Only two females were reared.

Gall. An irregular, oval bud deformation, fleshy, becoming hard and apparently composed of appressed, thickened bud scales, length 10 mm., diameter 6 mm.

Female.—Length 3.5 mm., sparsely haired, brownish yellow; 14 segments, the fifth with a stem one-third the length of the subcylindrical basal enlargement, the latter distinctly constricted near the middle and with a length two and one-half times its diameter; subapically and basally there are sparse whorls of short, stout setæ and apically and near the middle, low, rather broad circumfili; terminal segment reduced, irregularly suboval, with a length from one and one-fourth to nearly twice its diameter. Palpus consisting of an irregular, tapering, sparsely setose segment having a length about twice its diameter. Mesonotum shining dark brown or black. Scutellum a little darker, postscutellum reddish brown. Abdominal sclerites dark brown or black, the pleuræ dark red, the ovipositor reddish, with a tuft of long, silky, yellowish white hairs on the distal segment. Wings hyaline, subcosta uniting with the margin near the middle, the third vein well beyond the apex, the fifth vein indistinct distally, joining the posterior margin at the distal fourth, its branch near the basal half; halteres pale yellowish, fuscous apically. Coxæ black, the legs a nearly uniform reddish; claws long, slender, simple, the pulvilli as long as the claws. Ovipositor short, stout, with a length about one-half that of the abdomen, the basal segment much stouter, with a length about twice its diameter, the distal segment a little longer, much more slender, tapering to an obtusely rounded apex and thickly clothed with long, silky, yellowish white hairs, the latter having a length approximately one-half that of the segment.

Exuvium.—Length 3 mm., stout, the thoracic horns moderately stout, bidentate. Mesonotum, wing cases and base of antennal cases variably infuscate, the antennal cases hardly reaching the base of the abdomen, the wing cases extending to the third abdominal segment, and the leg cases to the fifth abdominal segment, the dorsum of the abdominal segments with numerous uniformly distributed, minute, triangular, chitinous points; posterior extremity broadly rounded. Type Cecid. 1642.

Hormomyia caudata new species.

The midges described below were reared April 29, 1915, by Mr. George G. Ainslie, of the U. S. Bureau of Entomology, from what were evidently modified buds or shoots of a sedge, probably *Cyperus* species collected April 15 at Clarksville, Tenn. The galls were found at the very base of the plant and at the time contained both larvæ and pupæ. The species is easily distinguished from other known females by the greatly produced fifth antennal segment in connection with its moderate size.

Gall.—Somewhat cylindrical, fleshy-walled, monothalamous, length 4 to 5 mm., diameter approximately half the length. The walls become thin upon maturity and rupture at the upper end, thus affording an opening for the escape of the pupa.

Pupa.—Length 3 to 4 mm., moderately stout, whitish, the older ones yellowish orange with brown eyes, wings and legs; thoracic horns rather long, nearly straight, light brown. Antennæ extending to the third abdominal segment, the wings to the fourth and the legs to the sixth and seventh. The dorsum of the abdominal segments thickly spotted with chitinous points and near the middle a broad, transverse band of relatively long, stout, chitinous points.

Female.—Length 4 mm. Antennæ extending to the third abdominal segment, sparsely haired, light brown; 14 segments, the fifth with a short stem about one-fifth the length of the cylindrical basal enlargement, which latter has a length about four times its diameter and moderately long circumfili at the basal fourth, the distal third and subapically; terminal segment somewhat produced, the basal enlargement with a length four times its diameter and apically a moderately long, stout, knob-like process. Palpi; first segment subquadrate, the second narrowly oval, the third greatly produced, with a length five times its diameter. Mesonotum reddish brown. Scutellum and postscutellum probably lighter. Abdomen yellowish orange. Wings hyaline; halteres yellowish basally, reddish fuscous apically. Coxæ and legs mostly pale straw, the claws strongly curved, simple, the pulvilli plainly longer than the claws. Ovipositor about one-half the length of the abdomen, the terminal lobes almost linear, tapering slightly distally and with a length over four times the width. Color characters largely conjectural. Type Cecid. a2718.

Asphondylia adenostoma new species.

The small gall midge described below was reared June 4, 1912, by Mr. P. H. Timberlake from apparently unmodified seeds of *Adenostoma fasciculatum* collected in Laurel Canyon near Hollywood, Cal., May 30, 1912. The seeds or achenes were unmodified externally, the midge issuing through a hole in the side, the pupal exuviæ being left in a partly protruding position.

Female.—Length 2 mm. Antennæ extending to the second abdominal segment, rather thickly haired, black; 14 segments, the fifth with a length about four times its diameter and with unusually heavy, somewhat flattened circumfili apically and at the basal third. On some of the basal segments there are irregular anastomosings of the circumfili, suggesting the condition obtaining in certain species of *Cincticornia*. The twelfth antennal segment with a length one-fourth greater than its diameter, the thirteenth with a length equal to its diameter, and the fourteenth a flattened spheroid. Palpi; the first segment subquadrate, the second with a length over twice its width, the third slender, indistinctly segmented near the middle, somewhat expanded distally and with a length over twice that of the third. Mesonotum dark brown or black. Scutellum fuscous orange, postscutellum fuscous yellowish brown. Abdomen brownish black, the pleuræ reddish. Halteres pale yellowish, fuscous subapically. Legs brownish black; claws stout, strongly curved, the pulvilli as long as the claws. Ovipositor nearly as long as the body and presenting the usual characteristics of the genus.

Exuvium.—Length 2 mm. The anterior portion variably infuscate, the thoracic horns long, stout, triangular in outline, the external margin finely serrate, and the surface minutely and irregularly striate. Wing cases extending to the third abdominal segment and the leg cases to the fifth. The anterior portion of the dorsum of the abdominal segments with a broad, transverse, nearly uniform band of stout, triangular, chitinous processes; posterior extremity broadly rounded. Type Cecid. 1632.

Asphondylia chrysothamni new species.

The gall described below was reared by Mr. P. H. Timberlake May 12–14, 1914, from bud galls on the rayless goldenrod, *Bigelowia graveolens,* collected near Murray, Utah. This species is apparently related to *A. eupatorii* Felt from which it may be easily separated by the markedly shorter twelfth antennal segment and also by palpal and colorational characters.

Gall.—Swollen or enlarged leaf buds with a length of 5 to 6 mm. and a diameter of 3 mm., the walls being composed of short, ovate, aborted, glume-like leaflets without any specialized central cell.

Exuvium.—Length 3.75 mm., light brown, the heavier, chitinized portions at the anterior extremity somewhat darker; antennal horns somewhat curved, triangular, smooth, acute apically, the antennal cases extending to the base of the abdomen, the wing cases to the base of the second abdominal segment, and the leg cases to the base of the fourth abdominal segment; posterior extremity rounded; the dorsum of the abdominal segments with a transverse row of stout, tooth-like spines near the posterior third and irregular, scattering spines representing two or three rudimentary, transverse rows on the basal half of each segment.

Female.—Length 3.5 mm. Antennæ nearly as long as the body, sparsely haired, blackish, the third antennal segment with a length seven times its diameter, the twelfth with a length a little greater than its diameter, the thirteenth a little shorter than the twelfth, the fourteenth globose. Palpi; first segment irregularly subquadrate, with a length over twice its diameter, the second moderately long, stout, with a length less than twice that of the first.

The face, the occipital margin on the top and sides of the head, a triangular spot on the propleura, a small spot below the insertion of the wings, and a narrow sclerite between the middle and hind coxæ, creamy white; the neck yellowish with a narrow, longitudinal, blackish sclerite on each side. Mesonotum, scutellum and postscutellum slate-colored. Abdomen sparsely clothed with light brown or reddish hairs, black; pleura brownish yellow. Wings hyaline, the legs blackish, except that the posterior tibiae and tarsi are brownish; claws stout, evenly curved, the pulvilli as long as the claws. Ovipositor about as long as the abdomen.

Male.—Length 3.5 mm. Antennæ nearly as long as the body, sparsely haired, blackish; 14 segments, the third with a length five times its diameter, and the fourteenth with a length over three times its diameter. Palpi; first segment irregularly quadrate, curved, with a length over twice its diameter, the second segment slender, tapering and more than twice the length of the first. Color very similar to that of the female but the abdomen is more slate-colored like the thorax, the pleuræ being reddish, the hind tibiæ and the first tarsal segment blackish, the four distal tarsal segments being paler. Basal clasp segment short, very stout; terminal clasp segment short, greatly swollen, bidentate, the teeth very asymmetrical; dorsal plate moderately long, divided, the lobes tapering roundly to a narrowly rounded, thickly setose apex. Color characters after Timberlake. Type Cecid. 1613.

Asteromyia gutierreziæ new species.

The midges described below were reared by Mr. P. H. Timberlake in May and June, 1914, from a black, blister-like gall on the slender flower stems of *Gutierrezia sarothrae*, collected near Salt Lake City, Utah. The species produces a gall very similar to that of *Asteromyia carbonifera* Felt and the adult presents many characters in common with this widespread eastern species, from which it is most readily separated by the third vein uniting with costa near the distal third and the moderately stout, obtuse harpes with a conspicuous, eccentric, quadrate, chitinous tooth. In the eastern *C. carbonifera* the third vein unites with costa near the basal half, while the harpes taper to a decidedly slendex apex bearing a conspicuous, quadrate tooth. The insect hibernates in the gall and Mr. Timberlake is of the opinion that there may be two generations annually, since he has reared the insect in numbers during May and June and in September observed galls on new growth showing pupal exuviæ, these latter being indications of a second brood.

Gall.—Irregular, dull black thickenings of the slender flower stems, ranging in length from 6 to 8 mm. and approximately doubling the thickness of stems, with a diameter of .5 mm. Except for its location the deformation is very similar to that of *C. carbonifera.*

Larva.—Length 2 mm., bright orange yellow, the breastbone reddish brown, enlarged apically, tridentate, the teeth blunt and the middle one slightly the longer.

Male.—Length 2 mm. Antennæ brownish black; 15 segments, the fifth with a length three-fourths its diameter, the terminal segment slightly produced and obtusely rounded. Palpi; first segment irregularly oval, moderately stout, the second nearly as long and as stout as the first. Occiput densely covered with black scales, the eyes margined with white scales and the face with a few rather short, white hairs near the middle. Mesonotum probably dark brown or black, the margins with groups of moderately long white hairs. Abdomen black, the segments margined posteriorly with white scales; the venter suffused with white scales; genitalia black. Coxæ black, with a spot of white scales at the base; femora mostly white scaled, black beneath, the hind pair almost entirely white; tibiæ black above, white beneath; tarsi black, the segments annulate with white basally; claws stout, strongly curved. Genitalia; basal clasp segment moderately stout; terminal clasp segment long, swollen basally; dorsal plate moderately long, triangularly incised, the lobes broadly rounded; ventral plate long, broadly rounded. Harpes broad, tapering sightly to a truncate apex bearing a stout, quadrate, chitinous tooth.

Female.—Length 2 mm. Antennæ with 16 segments, the fifth with a length three-fourths its diameter; terminal segment apparently compound, composed of two closely fused. Palpi; first segment irregularly quadrate, curved, the second a little longer, broadly fusiform. Ovipositor with a length about half the abdomen, the terminal lobes broadly orbicular and sparsely setose. Type Cecid. 1623.

Asteromyia grindeliæ Felt.

1912. Felt, E. P. N. Y. Ent. Soc. Jour. 20: 149.

This species was first reared July 27, 1911, by Mr. P. H. Timberlake from blister leaf galls on *Grindelia robusta* collected near Santa Barbara, Cal., and again October 20, 1915, from a greenish or blackish, oval, blister gall on *G. cuneifolia* collected in a salt marsh at Milebrae, Cal.

Gall.—The gall on *G. cuneifolia* is a typical greenish or oval, blister leaf gall with a diameter of 3 or 4 mm.

Male.—The specimen reared in 1915 differs somewhat from that obtained in 1911, in that there are 15 antennal segments, the fifth with a length about three-fourths its diameter, the terminal segment somewhat produced, compound and with a length about one-half greater than its diameter; the abdomen with the first four segments black and submedian whitish spots, those on the first segment quadrate and on the others subtriangular and separated by a moderately broad, black line; the distal segments vary from yellowish to reddish brown.

Female (previously unknown).—Length 2.25 mm. Antennæ probably with

18 segments, the fifth with a length about three-fourths its diameter; dorsum of the abdomen black, with white markings as follows; the basal segment with the distal third white, laterally, the white extending to the basal half of the segment and interrupted mesially by a moderately broad, black, median line, the second to the fifth abdominal segments with lunate, submedian white markings and conspicuous triangular ones laterally; the sixth with the submedian markings extending and confluent with the lateral ones, and the seventh white, except for an oval, median, black spot. Ovipositor about one-half the length of the abdomen, the terminal lobes broadly oval. Otherwisê nearly as in the male. Colors after Timberlake. Cecid. 1639.

It is possible that the species infesting *G. cuneifolia* is distinct, though the probabilities are against this, and for the present we have tentatively referred it to the above named form. It is desirable to rear a goodly series of midges from both host plants in order that more careful comparisons can be made.

Lasioptera echinochloa new species.

The midges described below were reared in August and September, 1915, by Mr. C. N. Ainslie from injured or infested stems of crippled plants, *Echinochloa crusgalli* collected at Elk Point, S. D. The larvæ are usually found in numbers in fibrous, somewhat decayed stubbs in the crown and were also taken from lower normal portions of the stem. The species is allied to *L. lactucæ* Felt, from which it may be easily distinguished by the almost total lack of scales upon the mesonotum. Mr. Ainslie reared a species of *Polymecus* from this midge.

Larva.—Length 2.5 mm., moderately stout, pale salmon, the head moderately large, tapering to a narrowly rounded apex; antennæ biarticulate; breastbone tridentate, the median tooth slightly shorter, the posterior extremity broadly rounded; skin coarsely shagreened.

Puparium.—Length 3 mm., a pale brownish straw, somewhat fusiform, both extremities rounded.

Exuvium.—Length 2.5 mm., whitish transparent; antennal cases hardly extending to the base of the abdomen, the wing cases to the base of the third abdominal segment, and the leg cases of the first, second and third pair of legs to the fourth, sixth and seventh abdominal segments, respectively; the basal two-thirds of the dorsum of each abdominal segment thickly set with minute, chitinous points.

Female. Length 1.5 mm. Antennæ extending to the base of the abdomen, sparsely haired, dark brown; 20 segments, the fifth with a length about equal to its diameter; terminal segment reduced, narrowly oval. Palpi; first segment irregular, subquadrate, the second narrowly oval, the third one-half longer, more slender, the fourth a little longer and more slender than the third. Mesonotum shining black. Scutellum yellowish brown, postscutellum a little darker. Abdomen black, with rather inconspicuous silvery white, submedian, lunate spots, the seventh segment mostly whitish; venter suffused with dull silvery scales. Wings with subcosta uniting with the margin at the basal half, the discal spot obscure. Halteres, coxæ and femora basally, yellowish, the distal portion of femora, tibiæ and tarsi mostly dark brown; claws slender, strongly curved, the pulvilli as long as the claws. Ovipositor about two-thirds the length of the abdomen, the terminal lobes slender, lanceolate, with a length about four times the width and rather thickly setose.

Male.—Length 1.5 mm. Antennæ hardly extending to the base of the abdomen; 16 segments, the fifth with a length one-fourth greater than its diameter; terminal segment broadly oval. Palpi; first segment subquadrate, irregular, the second narrowly oval, the third a little longer, more slender, the fourth one-half longer and more slender than the third. Genitalia; basal clasp segment rather long, slender; terminal clasp segment long, swollen basally; dorsal plate broad, broadly and triangularly emarginate, the lobes tapering to a broadly rounded apex; ventral plate moderately long, broad and tapering to a narrowly rounded apex. Halteres moderately broad, tapering slightly to an irregular, tuberculate apex. Colors probably much as in the female. Type Cecid. a2719, Webster 11,876.

Lasioptera inustorum new species.

This midge was reared in May, 1915, by Mr. C. N. Ainslie from blackened leaf sheaths of *Panicum virgatum* collected at Elk Point, S. D. This species runs in our key to *L. impatientifolia* Felt, a species which also produces a carbonaceous discoloration in vegetable tissues. A most striking difference between the two is in the much produced lobes of the ovipositor of this western midge.

The leaf sheath of the infested plants shows an irregular, somewhat diffuse blackening near its base. The blackened area may have a length of 3 cm. and extend more than half way around the stem, the latter being unaffected. Within the blackened tissues there may be found larval cells, the larvæ occurring in tubular, silk-lined cavities some 5 to 6 mm. long.

Larva.—Length 2.5 mm., rather long, slender, reddish orange, the head rather small, the antennæ long, biarticulate; breastbone long, slender, bidentate, with a minute, median tooth; skin coarsely shagreened, the posterior extremity broadly rounded.

Exuvium.—Length 2 mm., whitish transparent, the antennal cases hardly extending to the base of the abdomen, the wing cases to the third abdominal segment, and the first, second and third pairs of legs to the fourth, fifth and sixth abdominal segments, respectively. There are numerous minute, chitinous points on the distal three-fourths of the dorsum of the abdominal segments.

Male.—Length 1.5 mm. Antennæ hardly reaching to the base of the abdomen, sparsely haired, black; 16 segments, the fifth with a length a little greater than its diameter; terminal segment reduced, narrowly oval. Palpi; first segment short, subquadrate, the second narrowly oval, the third a little longer, more slender, the fourth one-half longer and more slender than the third. Mesonotum, scutellum and postscutellum probably black. Abdomen dark brown, the segments posteriorly sparsely margined with dull silvery scales. Genitalia yellowish. Wings hyaline, the third vein uniting with the dark brown costa at the basal third, the discal spot obsolete. Halteres and legs mostly pale yellowish straw, the distal portion of femora and the basal portion of tibiæ and the distal tarsal segments yellowish white; claws slender, strongly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment rather long, slender; terminal clasp segment rather short, swollen basally; dorsal plate moderately long, broad, deeply and roundly emarginate, the lobes narrowly rounded; ventral plate moderately long, broad, roundly truncate. Harpes broad at base, tapering to a slender, prolonged, chitinous internal tooth.

Female.—Length 2 mm. Antennæ reaching nearly to the base of the abdomen, sparsely haired, black; 20 segments, the fifth with a length three-fourths its diameter; terminal segment broadly oval. Palpi; first segment subquadrate, the second narrowly oval, the third a little longer and more slender, the fourth one-half longer than the third. Ovipositor about one-half the length of the abdomen, the terminal lobes slender, with a length five times the width, sparsely setose and narrowly rounded apically. Color characters presumably nearly as in the male. Type Cecid. a2715, Webster 11,881.

Rhopalomyia enceliæ new species.

A series of midges were reared April 18 and 20, 1913, by Mr. P. H. Timberlake from a greenish or dark gray, conical, globose, thick-walled gall sometimes confluent and distorting the stem. This species is easily distinguished from all other American Rhopalomyias described as having but fourteen antennal segments.

Gall.—Conical, thick-walled, lateral bud gall, length 6 mm., diameter 3 mm., frequently confluent basally, sometimes twisting the stem and producing a marked deformation of the plant. The apex of individual galls may be evenly rounded or flattened with flaring lips, which latter are sometimes produced as small, leafy expansions. There is a more or less distinct orifice as in the case of galls produced by *Phytophaga rigidæ* O. S.

Female.—Length 2.5 mm. Antennæ extending to the second abdominal segment, sparsely haired, brown, the basal segments black; 14 subsessile segments, the fifth with a stem about one-fifth the length of the subcylindric basal enlargement, which latter has a length two and one-half times its diameter; terminal segment somewhat produced, evidently composed of two closely fused and with a length about three and one-half times its diameter. Palp consisting of one small, narrowly oval segment bearing one or more long, stout setæ. Mesonotum and abdomen black, shining; halteres yellowish basally, reddish apically. Legs a pale straw; claws moderately slender, strongly curved, the pulvilli as long as the claws. Ovipositor nearly as long as the abdomen, the terminal lobes narrowly oval. Type Cecid. 1627.

Rhopalomyia salviæ new species.

The midges characterized below were reared by Mr. P. H. Timberlake in May, 1912, from several collections of leaf galls on *Salvia* (*Ramona*) *californica* and *S. nivea,* collected in the Puente Hills near Whittier, Cal. This gall was also collected by Professor E. P. Van Duzee January 10, 1914, at Alpine, Cal. This species runs in our key to near *R. antennariæ* Whlr. or *R. gutierreziæ* Felt, from both of which it appears to be quite distinct.

Gall.—Leaflets of *S. californica* and presumably adjacent leaflets are dwarfed by the formation of a conspicuous conical, minutely pubescent, grayish brown, thick-walled gall having a length of 1 cm. and a diameter of .6 cm. The structure appears to be a greatly thickened, hypertrophied leaf, only rudiments remaining, the walls being spongy and the interior containing an oval larval cell with a length of about 3 mm. The midge evidently escapes through an apical opening somewhat resembling that in the gall of *Phytophaga rigidæ* O. S. A very different leaf gall, apparently produced by the same midge, occurs on the margins of moderately well developed leaves. It is a typical thin-walled, tubular gall with a length of about 6 mm., a diameter of 1.5 mm. The interior is occupied by an elongate larval chamber. Basally the gall is concolorous with the leaf, the distal third being purplish, the slightly curved apex a little lighter. A modification of the first type of gall is seen on the aborted leaflets of *S. nivea* (or *leucophylla*). These galls are irregularly obconical, with a length of about 7 mm., a diameter of 3 mm. and are more or less confluent, otherwise nearly as described above.

Exuvium.—Length 2.25 mm., mostly whitish transparent, the anterior thickened portions of the head and thoracic structures brownish. Antennal horns short, stout, indistinctly bidentate, the lateral process decidedly longer; antennal cases extending to the base of the abdomen, wing cases to the third abdominal segment, and leg cases to the fifth abdominal segment; the posterior extremity rather broadly rounded, the dorsal surface of the abdominal segments thickly spotted with minute, chitinous points.

Male.—Length 2.5 mm. Antennæ extending to the third abdominal segment, sparsely haired, the two basal segments black, the others dark brown; 14 to 16 segments, the fifth with a stem three-fourths the length of the cylindric basal enlargement, which latter has a length one and one-half times its diameter; terminal segment reduced, narrowly oval. Palpi; first segment irregular, with a length about twice its diameter, the second reduced, narrowly oval. Mesonotum and scutellum black, naked. Abdomen mostly black, the distal two segments brownish and the basal portion of the genitalia gray. Coxæ black, legs brownish, the claws moderately stout, strongly curved, the pulvilli nearly as long as the claws. Genitalia; basal clasp segment stout, moderately broad, the basal third with scattered, subconical tuberosities; terminal clasp segment moderately stout, tapering, strongly curved; dorsal plate deeply and triangularly incised, the lobes broadly rounded; ventral plate indistinct; harpes long, broad, the distal margin narrowly rounded and subapically a chitinous ridge with three or four quadrate teeth; style long, narrowly rounded apically.

Female.—Length 2.25 mm. Antennæ extending to the base of the abdomen, sparsely haired; 15 sessile segments, the fifth with a length two and one-half times its diameter; terminal segment somewhat produced, with a length about three times its diameter, the apex narrowly rounded. Palpi; first segment irregular, quadrate, the second broadly and irregularly oval, Ovipositor probably nearly as long as the abdomen, the terminal lobes narrowly oval and finely pubescent. Coloration nearly as in the male. Color characters after Timberlake. Type Cecid. 1624, C. 1626.

Rhopalomyia ampullaria new species.

A few midges were reared July 6, 1913, by Mr. P. H. Timberlake from a flask-shaped leaf gall on sage bush, *Artemisia tridentata*, taken near Salt Lake City, Utah. This species may be distinguished from related forms by the uniarticulate palpi and the small number of antennal segments.

Gall.—A somewhat flask-shaped or subconical, solitary or confluent white pubescent leaf gall, diameter at base 2 mm., height 3 mm. A section shows the basal portion of the gall to be thick-walled, with an oval cell having a length of about 1.5 mm. and a distal tubular, thin-walled portion separated from the larval cell only by a thin, matted layer of filaments, the top being lightly filled with a curled, woolly mass.

Exuvium.—Length 2 mm., moderately stout, the thicker, chitinous portions slightly colored, the other parts semi-transparent; antennal horns rudimentary, represented by rounded processes; antennal cases extending to the second abdominal segment, the wing cases to the third, and the leg cases to the fifth; posterior extremity broadly rounded.

Female.—Length 2.5 mm. Antennæ extending to the base of the abdomen, sparsely haired; 15 sessile segments, the fifth with a length two and one-half times its diameter; terminal segment somewhat reduced, tapering to a narrowly rounded apex. Palp consisting of one moderately long, stout, fusiform segment with a few stout setæ apically. Mesonotum reddish brown. Scutellum yellowish, postscutellum a little darker. Abdomen yellowish orange, the ovipositor yellowish. Halteres pale yellowish. Legs pale straw; claws moderately stout, strongly curved, the pulvilli as long as the claws. Ovipositor about one-half the length of the abdomen, the terminal lobes narrowly oval, with a length about twice the width and rather thickly setose. Type Cecid. 1618.

Rhopalomyia grindeliæ new species.

This species was reared by Mr. P. H. Timberlake in October, 1915, from apparently unmodified flower heads of tar weed, *Grindelia cuneifolia,* collected on a salt marsh near Millbrae, Cal.

Gall.—The flower heads from which this species was reared presented no external modifications. The larvæ apparently inhabit individual florets, rendering them hollow and infertile.

Male.—Length 2.5 mm. Antennæ extending to the third abdominal segment, sparsely haired, yellowish brown; 16 segments, the fifth with a stem as long as the cylindric basal enlargement, the latter with a length about one-half greater than its diameter; terminal segment with the basal portion somewhat reduced, with the apical stem represented by a long, somewhat enlarged, fusiform, setose appendage. Palpi probably biarticulate, the distal segment long, somewhat expanded distally and with a length four times its diameter. Mesonotum shining dark brown, the scutellum and postscutellum a little lighter. Abdomen dark brown. Genitalia fuscous yellowish. Halteres yellowish basally, fuscous apically. Coxæ yellowish, legs pale straw; claws long, slender, evenly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment short, broad; terminal clasp segment rather short, swollen near the middle; dorsal plate broad, broadly and triangularly emarginate; ventral plate broad, very broadly and roundly emarginate. Harpes stout, divergent, tapering to irregular, strongly tuberculate appendages.

Female.—Length 3.5 mm. Antennæ extending to the base of the abdomen, sparsely haired, yellowish brown; 17 cylindrical, sessile segments, the fifth with a length about twice its diameter; terminal segment produced, with a length three times its diameter, tapering to an obtuse apex. Palpi; the first segment short, subquadrate, the second with a length four times its diameter and tapering slightly to a broadly rounded apex. Mesonotum shining dark brown. Scutellum yellowish brown, postscutellum dark brown. Abdomen dark red, the ovipositor and apical segments pale brown; thorax and abdomen sparsely clothed with long, black pubescence. Halteres and legs yellowish brown. Ovipositor as long as the abdomen, the terminal lobes narrowly lanceolate, with a length four times the width and sparsely setose. Type Cecid. 1638.

Rhopalomyia utahensis new species.

A number of midges were reared by Mr. P. H. Timberlake in May, 1913, from an ovoid bud gall on rabbit brush, *Chrysothamnus graveolens,* collected in the vicinity of Murray, Utah. The gall, as described by Mr. Timberlake, presents characters very similar to those of *Cecidomyia strobiloides* Towns. (Psyche, 7: 176, 1894), and it is possible that the galls are produced by the same species. This insect runs in our key to *R. crassulina* Ckll., from which it may be easily separated by its distinctly larger size and also by well marked structural differences.

Gall.—Ovoid, hypertrophied leaf buds, length 10 to 11 mm., diameter 7 to 8 mm., two or three frequently being confluent, monothalamous, green or somewhat purplish and externally with short, recurved, aborted leaflets covered with a rather thick, gray arachnose pubescence. Apparently the same species was reared from a similar more globose leaf bud gall at once distinguishable by the absence of pubescence.

Male.—Length 3 mm. Antennæ extending to the fourth abdominal segment, sparsely haired, grayish yellow, the first two segments black; 18 segments, the fifth with a stem three-fourths the length of the cylindric basal enlargement, which latter has a length nearly twice its diameter; terminal segment with a length three times its diameter and tapering slightly to an irregularly rounded apex. Palpi presumably biarticulate. Mesonotum shining black. Scutellum and postscutellum probably dark reddish brown. Abdomen probably dark brown, the pleuræ fuscous yellowish. Halteres whitish basally, fuscous apically. Legs pale yellowish or grayish, sparsely black-haired; claws moderately slender, evenly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment stout, broad; terminal clasp segment rather stout, long; dorsal plate broad, deeply and triangularly emarginate, the lobes broadly rounded laterally; ventral plate broad, broadly and roundly truncate. Harpes moderatey long, slightly divergent and irregularly rounded apically; style short, stout.

Female.—Length 3 mm. Antennæ extending to the third abdominal segment, sparsely haired, dark grayish, the first two segments black; 18 subsessile segments, the fifth with a length two and one-half times its diameter; terminal segment slightly produced and narrowly oval. Palpi; first segment somewhat produced, subquadrate, the second irregular, tapering distally to an acute apex and with a length about three times its diameter. Mesonotum and dorsal sclerites of abdomen shining black. Scutellum and postscutellum probably dark brown; pleuræ yellowish gray with a slight reddish tinge. Ovipositor short, with a length probably less than half that of the abdomen, the terminal lobes broadly oval and sparsely setose. Other characters practically as in the male. Colors mostly after Timberlake. Type Cecid. 1608.

Rhopalomyia chrysothamni new species.

This midge was reared in May, 1913, by Mr. P. H. Timberlake from a pubescent, variable, conical, stem gall on rabbit brush, *Chrysothamnus graveolens,* collected in the vicinity of Murray, Utah. The species approaches closely *R. utahensis,* from which it may be most easily separated by its decidedly smaller size, the fewer antennal segments and particularly by the peculiar type of gall.

Gall.—A variable, conical outgrowth of the stem with a height of about 4 mm. and a basal diameter of 2 to 3 mm. The gall contains basally, an oval, thin-walled cell with a length of 2.75 mm. and a diameter of 1.75 mm., the hollow, distal portion being filled with a slender, thread-like growth of delicate cells placed end to end and forming a rounded or, in some cases, nearly truncate plug.

Exuvium.—Length 1.5 mm., moderately stout, the anterior thicker poritons brownish, the thinner parts semi-transparent; antennal horns short, stout, feebly and unequally bidentate, the antennal cases extending to the base of the abdomen, the wing cases to the third abdominal segment, and the leg cases to the fourth and fifth abdominal segments; posterior extremity broadly rounded; the dorsum of the abdominal segments with numerous minute, chitinous points.

Male.—Length 2.5 mm. Antennæ nearly as long as the body, sparsely haired, the basal antennal segments black, the others yellowish; 17 segments, the fifth with a stem three-fourths the length of the cylindric basal enlargement, which latter has a length about one and one-fourth times its diameter; terminal segment somewhat reduced, tapering to a narrowly rounded apex. Palp consisting of one moderately long, stout segment. Head, thorax and the abdomen basally black, the distal segments of the abdomen mostly yellowish. Legs yellowish white or grayish, the tibiæ and tarsi paler, the coxæ and femora darker; claws slender, strongly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment moderately long, stout; terminal clasp segment long, stout; dorsal plate broad, deeply and triangularly emarginate; ventral plate moderately long, broad, deeply and roundly emarginate, the lobes rather broad and broadly rounded.

Female.—Length 1.5 mm. Antennæ extending to the fourth abdominal segment, sparsely haired, yellowish gray; 16 segments, the fifth with a length about two and one-half times its diameter; terminal segment somewhat produced and frequently fused with the preceding. Mesonotum black. Abdomen cherry red, the distal segments and the ovipositor yellowish gray. Halteres yellowish with a white pubescence. Claws strongly curved, the pulvilli longer than the claws. Ovipositor short, with a length about one-fourth that of the abdomen, the terminal lobes orbicular, sparsely setose. Otherwise nearly as in the male. Color characters after Timberlake. Type Cecid. 1614.

Rhopalomyia glutinosa new species.

The midges described below were reared May 10, 1913, from a shining, glabrous, cortical swelling on the stem of rabbit brush, *Chrysothamnus graveolens.* The female presents many characters in common with that of *R. chrysothamni,* from which it may be most easily separated by the more reduced terminal antennal segments, the longer ovipositor and the narrowly oval, more setose terminal lobes.

Gall.—These are green, glabrous, cortical stem swellings which, as they age, become brown and present a very close resemblance to a group of Lecaniums. The gall has a height of about 2 mm. and a diameter of 3.5 mm., the midge escaping through a circular apical orifice.

Exuvium.—Very similar to that of *R. chrysothamni.*

Female.—Length 2.25 mm. Antennæ extending to the fourth abdominal segment, sparsely haired, brown, the two basal segments blackish; 16 segments, the fifth with a length two and one-half times its diameter, the distal segment reduced, with a length about twice its diameter. Palp consisting of a moderately short, broad segment having a length about twice its diameter. Mesonotum grayish black, with the lateral margins and median line black; abdomen dull red with the sclerites, the last two segments and the base of the ovipositor grayish black. Halteres pale yellowish. Anterior and mid legs fuscous, the hind legs, except the coxæ, pale yellowish gray; claws strongly curved, the pulvilli decidedly longer than the claws. Ovipositor with a length about one-half that of the abdomen, the terminal lobes narrowly oval and rather thickly setose. Type Cecid. 1615.

Rhopalomyia erigerontis new species.

The one male described below was reared by Mr. P. H. Timberlake in April, 1913, from a gall found on a plant provisionally identified as *Erigeron fragilis* and collected at Whittier, Cal.

Gall.—This is an oval apical bud deformation with a length of 10 mm. and a diameter of 7 mm., the modified leaflets being thickly clothed with a short white pubescence.

Exuvium.—Length 2.75 mm., mostly whitish transparent, the denser portions of the head and thorax brownish. Antennal horns short, stout, tapering to a broadly excavated apex; antennal cases hardly extending to the base of the abdomen, the wing cases to the third abdominal segment and the leg cases to the sixth abdominal segment; posterior extremity broadly rounded the dorsum of the abdominal segments dotted with very minute, chitinous points.

Male.—Length 2.25 mm. Antennæ extending to the third abdominal segment, sparsely haired, pale yellowish brown; 18 segments, the fifth with a stem as long as the cylindrical basal enlargement, which latter has a length about one-fourth greater than its diameter; terminal segment irregular, oval or subcylindrical and tapering to an irregularly rounded apex. Palp consisting of one segment composed of a narrow, oval basal portion and a slender, finger-like apical part. Mesonotum reddish brown. Scutellum and postscutellum a little lighter. Abdomen fuscous yellowish. Genitalia darker. Halteres yellowish transparent. Coxæ yellowish brown, the legs a nearly uniform pale straw; claws slender, evenly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment long, stout; terminal clasp segment very irregular, excavated internally and slightly recurved at the slender apex; both dorsal and ventral plates long, broad, broadly and roundly emarginate, the former broader. Harpes stout, tapering to a narrowly rounded apex; style short, stout. Type Cecid. 1629.

Rhopalomyia ericameriæ new species.

This species was reared by Mr. P. H. Timberlake April 21, 1913, from a small, rosette gall on *Ericameria* (*Chrysoma*) *palmeri,* collected in the Puente Hills near Whittier, Cal. The adults, aside from food preferences and general structures, may be most easily separated from related forms by the strongly marked characters of the male genitalia and the unusually short ovipositor of the female.

Gall.—This is a deformed or aborted, usually lateral branchlet forming a small rosette, frequently with the tip more or less recurved, length 1.5 cm., diameter 1 cm.

Exuvium.—Length 2.5 mm., moderately stout, whitish, except for the thicker portions of the chitin anteriorly. Antennal horns rudimentary, the antennal cases not reaching to the base of the abdomen, the wing cases to the second abdominal segment and the leg cases to the fourth and fifth abdominal segments; the dorsum of the abdominal segments with very minute, chitinous points; posterior extremity broadly rounded.

Male.—Length 3.25 mm. Antennæ extending to the third abdominal segment, thickly haired, probably yellowish brown; 18 segments, the fifth with a stem three-fourths the length of the cylindric basal enlargement, which latter has a length about two and one-half times its diameter; terminal segment somewhat reduced, with a length over twice its diameter and tapering to a narrowly rounded apex. Palp consisting of one long, somewhat capitate segment with a length about three times its greatest diameter. Mesonotum dark reddish brown. Scutellum reddish brown, postscutellum a little lighter. Abdomen brownish red, the genitalia yellowish. Halteres yellowish basally, fuscous apically. Legs mostly a pale straw. Genitalia; basal clasp segment long, stout; terminal clasp segment moderately long, slightly swollen near the middle; dorsal plate long, broad, triangularly emarginate, the lobes somewhat divergent and broadly rounded; ventral plate long, broad, broadly and roundly emarginate. Harpes broad, obliquely truncate apically, the distal margin somewhat recurved; style rather short, stout.

Female.—Length 2.25 mm. Antennæ missing. Palp consisting of one moderately stout segment with a length nearly four times its diameter, the distal fourth tapering. Mesonotum probably darker and the abdomen presumably redder than in the male. Ovipositor with a length about one-half that of the abdomen, the terminal lobes broadly oval and sparsely setose. Color characters largely conjectural. Type Cecid. 1637.

Phytophaga wellsi new species.

The midges were reared by Mr. B. W. Wells March 20, 1916, from a somewhat top-shaped leaf gall on hackberry, *Celtis occidentalis,* collected presumably in the vicinity of Columbus, O.

Gall.—Monothalamous, somewhat top-shaped, the walls moderately thick and the surface sparsely clothed with a whitish, appressed pubescence, the greatest diameter ranging from 3 to 4 mm.

Larva.—Whitish, stout, the posterior extremity rounded, the breastbone rather broad, short, with two long, widely separated teeth, the excavation broadly rounded; skin coarsely shagreened.

Male.—Length 2 mm. Antennæ nearly as long as the body, rather sparsely long-haired, yellowish brown; 16 segments, the fifth with a stem one-half the length of the cylindric basal enlargement, which latter has a length about twice its diameter; terminal segment somewhat reduced, tapering slightly to a subconical, smooth apex. Palpi; first segment subquadrate, the second narrowly oval, nearly twice the length of the first, the third nearly twice the length of the second, more slender, the fourth one-half longer than the third, more slender. Mesonotum shining dull reddish brown, the margin sparsely brown-haired. Scutellum brownish, postscutellum yellowish orange. Abdomen coarsely white-haired, mostly dark brown, the incisures yellowish white. Wings hyaline; halteres yellowish transparent. Coxæ fuscous yellowish, the legs mostly pale straw, the pulvilli nearly as long as the claws. Genitalia; basal clasp segment long, stout; terminal clasp segment short, curved, swollen near the middle; dorsal plate long, broadly dilated apically, the rather slender lobes with a narrowly rounded, setose apex and diverging strongly; ventral plate moderately short, deeply and narrowly incised, the lobes long, rather broad and tapering slightly to a narrowly rounded, sparsely setose apex. Harpes stout, obscurely denticulate distally; style short.

Female.—Length 2.25 mm. Antennæ extending to the third abdominal segment, sparsely haired, dark yellowish; 18 sessile segments, the fifth with a length one-half greater than its diameter, the terminal segment reduced, roundly and broadly conical. Palpi; the first segment irregularly subquadrate, the second about as long as the first, the third one-half longer than the second, more slender, and the fourth more slender than the third and about twice as long. Mesonotum shining dark brown. Scutellum yellowish brown, postscutellum fuscous yellowish. Abdomen sparsely dark-haired, dark reddish orange, the ovipositor yellowish orange and with a length nearly as long as the abdomen. Halteres yellowish transparent basally, fuscous subapically, whitish apically. Coxæ dark brown; legs mostly dark brown. The lobes of the ovipositor short, roundly triangular and sparsely setose. Type Cecid. a2713.

Phytophaga timberlakei new species.

The midges described below were reared by Mr. P. H. Timberlake in March, 1915, from branches and limbs of willow, *Salix fendleriana,* collected by J. P. O'Gara near Salt Lake City, Utah, the preceding November. This species resembles *P. perocculta* Ckll., from which it may be separated by the decidedly shorter antennal stems in the male and the presumably shorter palpi. There are minor differences in the male genitalia. The larvæ, according to Mr. Timberlake, may be found in tubular cells beneath the bark and cause hardly any external swelling.

Exuvium.—Length 4 mm. Whitish transparent, the antennal cases hardly extending to the base of the abdomen, the wing cases to the third abdominal segment, and the leg cases of presumably the fore, middle and posterior legs extending to the fourth, fifth and seventh segments, respectively. The dorsum of the abdominal segments with transverse rows of minute spines.

Male.—Length 3 mm. Antennæ extending to the third abdominal segment, sparsely haired, yellowish brown; 19 segments, the fifth with a stem one-half the length of the cylindric basal enlargement, which latter has a length one-half greater than its diameter; terminal segment produced, tapering slightly to a narrowly rounded apex and with a length two and one-half times its diameter. Palpi obscure in the preparation. Mesonotum reddish brown. Scutellum and postscutellum lighter. Abdomen yellowish orange. Legs pale straw; claws moderately stout, evenly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment stout; terminal clasp segment moderately long tapering strongly distally; dorsal plate broad, broadly and triangularly emarginate, the lobes broadly expanded, broadly oval and sparsely setose; ventral plate moderately long, broad, deeply and roundly emarginate, the lobes moderately short, broad and tapering to a broadly rounded apex. Harpes short, broad, obliquely truncate and at the internal angle a stout, quadrate, chitinous tooth; style short, stout.

Female.—Length 3.5 mm. Antennæ extending to the first abdominal segment, sparsely haired, yellowish brown; 20 sessile segments, the fifth with a length one-fourth greater than its diameter, the terminal segment slightly produced, narrowly oval, with a length over twice its diameter. Palpi; first segment short, quadrate, the second a little longer, broader, the third a little longer and more slender than the second, the fourth about twice the length of the third, moderately stout. Ovipositor about three-fourths the length of the abdomen, terminal lobes short, broadly oval and sparsely setose. Color characters in both sexes largely conjectural. Type Cecid. 1646.

KEY TO THE SPECIES OF DIARTHRONOMYIA.

a. 17 or 18 antennal segments, the fifth in the male with a stem three-fourths, and that of the female with a stem one-third the length of the basal enlargement, respectively.

b. Mesonotum dark reddish brown, the abdomen reddish brown; terminal antennal segment of the male greatly produced; length, male 2 mm., female, 3 mm. Reared from a variable monothalamous or polythalamous, globose leaf bud or rosette gall or a bladdery leaf gall on *Artemisia tridentata* ....artemisiæ Felt.

bb. Mesonotum dark brown, the abdomen pale orange; terminal antennal segment of the male usually reduced. Reared from an irregular. oval, concolorous swelling with a length about 2 mm., usually at a distinct angle to the surface of the plant tissues, and frequently causing large, confluent swellings of the stem, leaf or flower head of *Chrysanthemum* ....hypogæa H. Lw.

aa. 15 or 16 antennal segments.

b. Antennal segments of the female subsessile, the fifth with a stem one-fifth the length of the cylindrical basal enlargement, the fifth of the male with a stem three-fourths the length of the basal enlargement. Reared from an oval, thin-walled, pubescent cell with a length about 1 mm. and attached at an oblique angle to the under side of the leaf or from flower buds of *Artemisia heterophylla* or a vertical, oval leaf gall on *A. tridentata* ....**occidentalis** n. sp.

aaa. 14 antennal segments.

b. Antennal segments of the female sessile, the fifth with a length twice its diameter, the fifth antennal segment of the male with a stem three-fourths the length of the basal enlargement; circumfili not greatly produced. Reared from a brownish or reddish subconical, thin-walled cell with a length of 1.5 mm., a diameter of .5 mm. and protruding at an oblique angle from the tissues of *Artemisia californica* ....**californica** Felt.

bb. Antennal segments of the female sessile, the fifth with a length four times its diameter, the circumfili greatly produced and frequently extending to or beyond the base of the next segment. Reared from irregular, lobulate, woolly masses, apparently lateral bud galls which are frequently confluent; individual galls with a diameter of 4 mm., on *Artemisia californica* ....**floccosa** n. sp.

Diarthronomyia artemisiæ Felt.

A series of midges were reared by Mr. P. H. Timberlake in May and June, 1915, from variable, globose, leaf bud and rosette galls on *Artemisia tridentata,* and also from a bladdery leaf gall found upon the same plant and collected near Salt Lake City, Utah. The leaf bud galls presented a marked variation in pubescence, the smaller ones being naturally more pubescent, while the larger ones, presumably because of the greater expansion of the normal surface of the plant, are decidedly less pubescent. The larger ones, according to Mr. Timberlake, are polythalamous, the others monothalamous. The bladdery leaf galls are notably softer than the others and less pubescent, as in the case of the larger leaf bud galls. The interior of these deformities is filled with loose, spongy matter composed of finely crinkled filaments surrounding one or more larval cells.

Exuvium.—Length 2 mm. Stout, the head, mesonotum, antennal and wing cases a variable reddish brown, the anterior horns small, the antennal cases hardly extending to the base of the abdomen, the wing cases to the third abdominal segment, the leg cases to the fifth abominal segment; dorsum of the abdomen nearly smooth, the posterior extremity broadly rounded.

Diarthronomyia occidentalis new species.

Numerous small midges were reared by Mr. P. H. Timberlake in September, 1912, from small, oval, thin-celled galls on the leaves of *Artemisia heterophylla,* collected at the Sweet Water Dam, San Diego County, Cal., and also from flower buds taken in the Puente Hills near Whittier. It was also reared from a similar, nearly vertical solitary or clustered grayish or almost black oval gall on the under side of leaves of *Artemisia tridentata* collected at Salt Lake City, Utah, in May, 1915. The species is a small one, the gall resembling very closely that produced by the European chrysanthemum midge, *D. hypogæa* H. Lw., and the adults have a close affinity with this species, though they may be easily distinguished therefrom by the somewhat smaller size and the smaller number of antennal segments.

Gall.—An oval, thin-walled, pubescent cell, length about 1 mm., attached to the under side of the leaf and at an oblique or nearly vertical angle to the supporting surface. Gall grayish on *A. heterophylla* or grayish or nearly black on *A. tridentata.* The galls in the flower buds are recorded by Timberlake as apparently the same though rather thinner walled.

Female.—Length 1.25 mm. Antennæ extending to the base of the abdomen, sparsely haired, pale flesh-colored; 14 to 15 subsessile segments, the fifth with a stem about one-fifth the length of the cylindric basal enlargement, which latter has a length two and one-half times its diameter; terminal segment slightly reduced, narrowly rounded apically. Palpi; first segment small, globose, second smaller, subglobose. Eyes black; face yellowish. Mesonotum yellowish brown. Scutellum and postscutellum pale yellowish; abdomen pale reddish, fuscous yellowish distally. Legs pale yellowish, the claws slender, evenly curved, unidentate, the pulvilli a little shorter than the claws. Ovipositor about half the length of the abdomen, the terminal lobes rather long, roundly tapering to a narrowly rounded apex, sparsely setose.

Male.—Length 1.25 mm. Antennæ extending to the third abdominal segment, sparsely haired, pale yellowish; 15 or 16 segments, the fifth with a stem three-fourths the length of the cylindric basal enlargement, which latter has a length two and one-fourth times its diameter; terminal segment produced, with a length about three times its diameter. Palpi; first segment short, subquadrate, second smaller, subquadrate. Coloration similar to the female, except that the abdomen is pale yellowish and the genitalia fuscous and the legs paler than in the female. Genitalia; basal clasp segment short, stout, broadly triangular; terminal clasp segment short, stout, with a conspicuous tooth apically; dorsal plate moderately long, triangularly emarginate, the lobes broad, subtruncate apically; ventral plate long, broad, broadly and roundly emarginate. Harpes moderately stout, triangular, with a short, rounded, chitinous lobe at the internal distal angle; style short, stout. Type Cecid. 1633.

Diarthronomyia floccosa new species.

The midges characterized below were reared by Mr. P. H. Timberlake, November 20 and 28, 1912, from large, woolly galls on *Artemisia californica* collected on the ridge between Mill Valley and the Muir Woods in Marin County Cal. Apparently the same gall was also found at Santa Barbara, Cal. This species approaches *D. californica* Felt, from which it may be easily separated by the relatively much longer antennal segments and the greatly produced circumfili. The gall is also very different.

Gall.—Irregular, lobulate, woolly masses apparently arising from lateral buds, frequently confluent, individual galls having a diameter of about 4 mm.

Female.—Length 1.25 mm. Antennæ extending to the third abdominal segment, sparsely haired, pale yellowish; 14 subsessile, cylindrical segments, the fifth with a length four times its diameter, the distal circumfilum high and produced, frequently extending to or beyond the base of the next segment; terminal segment reduced, narrowly conical, with a length nearly three times its diameter and tapering to a narrowly rounded apex. Palpi probably biarticulate. Head black. Thorax mostly pale yellowish brown. Scutellum and postscutellum lighter. Abdomen crimson red, shading posteriorly to a fuscous yellowish brown. Wings hyaline, narrow, with a length fully twice the width; halteres pale yellowish brown. Legs pale yellowish; claws strongly curved, unidentate, the pulvilli nearly as long as the claws. Ovipositor nearly as long as the abdomen, apically slender, the terminal lobes relatively short, broad, tapering roundly to a narrowly rounded apex and sparsely setose. Color characters from Timberlake. Type Cecid. 1628.

Monardia foliata new species.

The male described below was taken on a window and received under date of March 21, 1916, from Professor T. D. A. Cockerell, Boulder, Colo. It is quite different from the entire series with fourteen antennal segments, because of the distinctly longer stem of the fifth antennal segment. The genitalia are also peculiar.

Male.—Length 2 mm. Antennæ nearly as long as the body, sparsely haired; 14 segments, the fifth with a stem one-fourth longer than the basal enlargement, which latter has a length one-fourth greater than its diameter; terminal segment slightly produced, broadly conical. Palpi; first segment subquadrate, the second and third each a little longer and more slender, the fourth nearly one-half longer than the third. Mesonotum shining black. Scutellum and postscutellum dark reddish brown. Abdomen sparsely white-haired, dull black;

halteres yellowish transparent basally, yellowish brown apically. Legs mostly yellowish gray and sparsely clothed with moderately long, whitish hairs; distal tarsal segments somewhat darker; claws moderately stout, evenly curved, finely denticulate and with a minute tooth subapically, the pulvilli a little shorter than the claws. Genitalia; basal clasp segment very short, broad; terminal clasp segment moderately long, narrowly oval; harpes extended, foliate, the basal angles produced laterally as chitinous, tooth-like processes, obliquely truncate; distal angles with the margin strongly chitinized and bearing three or four short, stout teeth. Type Cecid. 1649.

THE CARPENTER-BEES OF THE UNITED STATES OF THE GENUS XYLOCOPA.[1]

By Arthur J. Ackerman,

Amherst, Massachusetts.

Introduction.

This paper forms the major part of a thesis for the degree of master of science at the Massachusetts Agricultural College, and it has been prepared under the supervision of Dr. H. T. Fernald. It is an endeavor to make more easy the identification of the bees of this genus.

The collections upon which the work in this paper is based are those of the American Entomological Society in Philadelphia, the United States National Museum, the Museum of Comparative Zoölogy of Harvard University, the Brooklyn Museum, the Children's Museum of Brooklyn, the collection of the Massachusetts Agricultural College, the private collection of Dr. G. C. Crampton, and other smaller collections. The few types existing in this country have been examined and descriptions made from them, added to by the examination of a large series of specimens; redescriptions of all the species and a key for their separation are also included.

Earlier works and literature found to be of great value in the preparation of this paper are: Illiger, Magaz. f. Insectenk., 1806; Lepeletier, Hist. Nat. Insect. Hymen., II, 1841; Smith, Cat. Hymen. Brit. Mus., II, 1854; Cresson's descriptions in the Trans. Amer. Ent.

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

Soc. and the Proc. Ent. Soc. of Philadelphia; Smith, Monograph of the Genus Xylocopa, Trans. Ent. Soc. London, 1874; Taschenberg, Zeitschrift für den Gesammten Naturwissenschaften, 1879; Peréz, Contribution a L'Etude Des Xylocopes, Act. Soc. Bordeaux, LVI, 1901; and Maidl, Die Xylocopen des Wiener Hofmuseums, 1912, Annalen Naturhistorischen Hofmuseums.

For the loan of material through Dr. H. T. Fernald, for the privilege of study at the several museums named, and for counsel and suggestions given at various times, the writer wishes to express his gratitude and appreciation to Dr. H. Skinner and E. T. Cresson, Jr., of the American Entomological Society at Philadelphia, to Mr. J. C. Crawford, of the U. S. National Museum, to Mr. Samuel Henshaw, of the Museum of Comparative Zoölogy at Harvard University, to Mr. Charles Schaeffer, of the Brooklyn Museum, to Mr. George P. Engelhardt, of the Children's Museum of Brooklyn, and to Dr. Henry Franklin, of Amherst, Massachusetts.

At this point I desire to express my sincere thanks to Dr. H. T. Fernald for his friendly guidance and encouragement and for his many helpful suggestions in this work. To Dr. G. C. Crampton I also wish to acknowledge my appreciation of his willing aid at all times.

HISTORY.

The earlier writers included species of *Xylocopa* under various genera. Linné, Fabricius and others described many species which belong to *Xylocopa* under the genus *Apis*. Fabricius, Illiger and Lepeletier placed some species under *Bombus;* Jurine under *Bremis* and *Trachusa;* Westwood under *Centris;* Lepeletier under *Lestis;* and Klug under *Megilla*.

The genus *Xylocopa* was established by Latreille in 1802 and he included under it three species, *Apis violacea* Fabr.; *morio* Fabr.; and *brasilianorum* Fabr. Which one of these three species was the type of the genus he failed to designate.

In 1838 Westwood proposed as a connecting link between *Anthophora* and *Xylocopa* a new genus, *Mesotrichia,* which resembled *Xylocopa* because of its habitat and *Anthophora* because of its extraordinary formation of the intermediate legs, and describes one species, *M. torrida*. Again in 1840 Westwood split *Xylocopa,* forming the new genus *Platinopoda,* characterized by the anterior tarsi being dilated.

In 1841 Lepeletier proposed two subgenera of *Xylocopa, Andinctia* and *Schönherria,* his *Andinctia* corresponding to *Platinopoda* of Westwood. *Schönherria* was called a subgenus because the scutellum of the females was inclined and not elevated on its hind margin. Smith, in his Monograph of the genus *Xylocopa,* did not recognize the subgenera of Lepeletier but divided the genus into geographical regions. In 1894 Gribodo tried to form a new subgenus, called *Koptorthosoma,* because of a truncate scutellum. Peréz and Maidl, in 1901 and 1912 respectively, divided the genus geographically as Smith had earlier done.

Too many species have been recorded as occurring in the United States. Of the fifteen species collected or reported from this country I feel certain that only nine are distinct, while the remainder are synonyms or subspecies.

HABITS.

Since the writer has had no opportunity of studying the habits of these insects, such information will be taken from the best articles on the subject available at the present writing.

Ashmead in Psyche, Vol. VII, pp. 23–25, gives the following on the habits of *Xylocopa:*

"The genus *Xylocopa* comprises some of the largest bees known, many of which closely resemble the bumble-bees. From their method of boring in posts and rafters, in which they construct their nests, they are known as carpenter-bees. The most common species in the United States is *Xylocopa virginica* Linné. I have frequently found their nests made in the railings of a porch, in posts, rafters, doors, palings of fences, door frames, window sills, etc.

"The species bores a cylindrical hole, about one half inch in diameter, until the depth of ten, twelve or more inches is attained. At the bottom of this long tunnel or gallery, the female now deposits a ball of pollen-paste in which she lays a single egg. This is then carefully covered over with a thin partition formed of sawdust and a glutinous substance or secretion, and this constitutes the first cell. Upon this another ball of pollen-paste and an egg is laid and again enclosed by a partition, and so on until a series of cells, one above another, is formed and the tunnel is filled. The imagos hatch out in July and August and hibernate in the middle states during the winter months."

Westwood, in his Classification of Insects, Vol. II, p. 278, says that the bees form about a dozen cells, one above another, in one tunnel. When the larvæ in these cells are full grown they assume the pupa state, head downward, so as to allow the lowermost and oldest to make its way out of the bottom of the burrow as soon as it becomes winged, and which consequently takes place earlier than in those which occupy the upper cells.

Davidson in Entomological News, 1893, p. 151, gives an article on observations of *Xylocopa orpifex* in southern California. In opposition to Westwood's statement he notes that the bees, after hatching, all make their exit through the original opening; thus the bees in the top cells come out first, while those in the lower cells, which are the older, make their exit last. He suggests, as the reason for this, that the bees in the upper cells are all males, while those in the lower cells are all females.

L. O. Howard, in Proc. of Ent. Soc. of Washington, Vol. II, p. 331, gives an article on hibernation of the carpenter-bees. He states therein that the male as well as the female does hibernate. Previously it had been thought that the male does not winter over.

EXTERNAL ANATOMY.

Head.—The head, which is hypognathous, is relatively large as compared with the thorax. It is broad and usually rather thick, and viewed from the front its form is subcircular in outline. Its size varies somewhat but as a rule is wider and thicker in the female. The face is usually slightly convex in profile and here the punctation is most dense, while that on the vertex and cheeks is rather sparse. The face generally bears but few short hairs, while the pilosity on the cheeks, especially the lower half, is long and dense.

The vertex is bounded posteriorly by the occiput and anteriorly by an imaginary transverse line between the antennal pits. The vertex in the males is narrowed toward the occiput and is likewise narrowed on the front surface because of the marked approximation of the eyes. In the lower portion of the vertex there is a pit which surrounds the middle ocellus and is continuous with a median groove on its lower margin. This median groove passes downward to the frontal carina, which is located between the antennal pits or just a little above them. The frontal carina is a protuberance of varying form, bluntly ridged in some species, sharply ridged in others, and even entirely absent in some cases.

The frons extends from the vertex to the upper margin of the clypeus and with a triangular prolongation on each side extending downward between the clypeus and the eye to the base of the mandible. The area between the bases of the antennæ and the central part of the dorsal margin of the clypeus is called the frontal shield. The logitudinal grooves extending downward on each side from the base of the antennæ and ending in a pit halfway down the sides of the clypeus are termed frontal grooves in this paper, and the pits are termed lateral foveolæ.

The clypeus is a trapezoidal, more or less flattened plate occupying the lower front portion of the head. It is marked off from the frons by strong sutures, or sometimes by elevated ridges along its upper margin. Along its lower margin it bears the labrum. This margin is quite straight and transverse, its outer fourth, however, turning rather sharply upward and outward toward the eye. The sides of the clypeus curve downward toward the base of the eye. In the male it is more regularly trapezoidal in form, while in the female its inferior half is usually much wider. The smooth impunctate area between the base of the mandible and the lower part of the eye is probably formed by a posterior extension of the frons and an anterior extension of the gena. This area may be called the malar space.

The labrum is attached to the lower margin of the clypeus but slightly behind the outer surface of this margin, and varies in form in different species as well as in the sexes of the same species, sometimes appearing one-lobed, sometimes two-lobed, sometimes three-lobed. The general form of the labrum is triangular or trapeziform and it extends downward in approximately the same plane as the clypeus.

The genæ or cheeks are the sides of the head behind the eyes. There is no line of demarcation between the genæ and the occiput, or between the genæ and the vertex. They are widest along the upper half, gradually narrowing toward the mandibles.

The antennæ are situated on the frons opposite the middle of the eyes. The distance between their insertions is equal to that between the insertions and the margin of the eyes, in the females; in males, however, the distance between the insertions is greater than that to the eyes. The bulb is quite different in appearance from the remainder of the scape. The scape or first antennal segment is by far the longest segment of the antenna and is slightly widened at both ends. The next joint to the scape is the pedicel, which is the shortest segment of the antenna. The flagellum or whip of the antenna is made up of ten segments in the female and eleven in the male. The first joint of the flagellum is always the longest and is narrowed toward its base. The form of the antenna is cylindrical and it is often finely pubescent.

The mandibles of the female are large and powerful; they are widest at the base and gradually narrow toward the apex. In some specimens there is a distinct emargination on the upper side; also there is some variation in the number of teeth. In all females they are bidentate at the apex but some have one and some two additional blunt teeth on the upper margin. The mandibles are more uniform in the male, always being two-toothed at the apex and without teeth on the upper margin. The front tooth is the smaller and not as pointed as the hind one. The mandibles of the male are smaller and considerably less powerful than those of the female. In both sexes the mandibles bear but few punctures; there is often a depressed area at the base. They are marked by a prominent longitudinal groove extending along the upper margin and a faint one along the lower margin with a ridge between them.

The compound eyes are large and oval in form with well rounded ends and protrude considerably from the head. In the males they are as a rule larger than in the females and often occupy two-thirds of the frontal area. They are also approximated on the summit of the head, so that the distance between them is less above than below. The color of the eyes is lighter than the general color of the body, except in fulvous males where it is darker.

The ocelli, three in number, form a triangle on the vertex. In some species the hind ocelli are a very short distance behind the median one. The posterior ocelli in many species are carinated in front, thus causing them to appear sunken behind; this condition occurs more often in the females than in the opposite sex. There is also a pit or indentation behind each of the posterior ocelli in many species, these indentations being called ocellar pits. In males of those species in which the compound eyes converge above, the hind ocelli touch the inner margin of the eyes. The color of the ocelli is darker than that of the eyes; it is sometimes black but more often brown.

Thorax.

The thorax, as in most Hymenoptera, in addition to the three thoracic segments of other insects, includes the propodeum or first abdominal segment.

Prothorax.—The pronotum is firmly attached to the anterior margin of the mesonotum. Laterally it is prolonged in the form of a lobe, the pronotal lobe, which extends backward nearly to the mesothoracic epimeron. There is an oblique groove extending from the front of the notum to the base of the pronotal lobe, which divides the former into an upper and two lower plates, one on either side of the body. Between these two plates lies a pair of sclerites on the ventral surface approximated along the median ventral line and usually called the prosterum, though really constituting the propleuron. In this paper the usual name, though morphologically inaccurate, is retained for convenience.

The lower lateral plate of the pronotum, which is usually termed the propleuron, extends downward on each side from the base of the pronotum and pronotal lobe and becomes greatly narrowed ventrally. The pronotum is slightly concave on each side. The sternum of this segment has become reduced almost to nothing, only a trace of it remaining close to the fore coxæ.

Mesothorax.—The mesonotum consists of two plates, the scutum and the scutellum. The scutum is the very large anterior plate which extends from the posterior margin of the pronotum back to a point over the middle of the hind wing. It is quite convex, especially in front, where its antero-lateral angles extend downward to the pronotal lobes. Running backward from the anterior margin of the scutum is a faint median suture which becomes obliterated at about halfway to the posterior margin. A short distance from this line and extending parallel to it are two short sutures, one on either side, the parapsidal furrows. On the middle of the plate is a large, shining, impunctate area without pilosity, which in some species extends back even to the middle of the scutellum. This is known as the disk or glabellum of some authors. The mesonotum is slightly wider anteriorly and its surface, except on the disk, is usually densely and finely punctate with varying amounts of pilosity. The front margin is slightly convex. The lateral margin is emarginate to a point behind the tegula, then turns outward and downward slightly. Here a sharp angle separates the dorsal surface of this plate from a nearly vertical portion which extends backward to the anterior margin of the side of the scutellum and largely concealed by the fore wing. The posterior margin usually is quite straight.

The scutellum, situated directly behind the scutum, is separated from it by a distinct suture. Its surface is somewhat variable, being either well rounded or flattened above and turning downward sharply behind. Its front margin above is transverse but at the sides extends forward, while the hind margin is curved backward more or less. Along the lateral forward extensions is a small, somewhat fused plate on each side, which occupies the anterior half and terminates at the front wing process. The scutellum is densely punctured except on the anterior median surface and its pilosity corresponds to the number of punctures.

The mesopleuron is made up of the epimeron and the episternum. The former is composed of two plates, the anterior, smaller one being situated a little above the posterior, and lying just above and behind the pronotal lobe at the base of and partly concealed by the tegula. Along the lower margin of the posterior plate is a well marked suture which separates it from the episternum and which terminates just above the middle of the anterior margin of the pleural plate of the metanotum. The episternum is the very large lower plate of the mesopleuron. It is convex, densely punctured and pilose. Below, it is fused with the mesosternum with no suture between to show the limits of each. The mesosternal portion is concave with a slight longitudinal suture extending along the median line.

The post-scutellum, as shown by Snodgrass in his excellent work on the thorax of Hymenoptera (Proc. of U. S. Nat. Mus., Vol. 39, p. 53, 1910) is entirely concealed within the body between the mesothorax and the metathorax. However, since systematists generally apply post-scutellum to the true metanotum, I shall use this practice in the present paper so as to prevent confusion.

Metathorax.—This segment is very small and compressed, lying between the mesothorax and the propodeum or first abdominal segment. The true metanotum (here called the post-scutellum) is a very narrow transverse plate, slightly wider in the middle than at each side where there is a wide lateral plate extending forward to the hind wing. The metanotum is rather well punctured and pilose. The metapleuron consists of two plates, the upper larger one extending from the base of the hind wing to the mesocoxa, being situated somewhat anterior to the lower one which is small and bears the hind leg. The upper plate is elongate and oblong, the upper portion being wider than the lower one. In front it articulates with the lower plate of the epimeron and below this with the posterior margin of the episternum. Its hinder margin articulates with the propodeum. The lower plate is very small and is triangular in form. The anterior extension of the triangle passes between the propodeum and the middle coxa to the lower end of the upper metapleural plate; the lower one passes between the middle and hind coxa and fuses with the metasternum; the third passes backward for a short distance between the hind coxa and the propodeum. The metasternum is a small trapezoidal plate whose anterior portion is convex and posterior portion concave.

The propodeum is the true first abdominal segment and it bears a spiracle on each side. The spiracles are elongate and curved anteriorly. The propodeum consists of a notal plate which has become firmly joined to the metathorax while its ventral plate has been entirely lost. It is divided into a median area and two lateral ones by two fine, curved ridges which meet on the lower margin. The median area has a median longitudinal ridge extending from its upper to its lower margin. The lateral areas are large and a little depressed about the spiracles. There are few punctures on the median area though there may be considerable pilosity on the sides.

Abdomen.

The number of segments of the abdomen is six in the female and seven above in the male (not counting the propodeum as an abdominal segment). The abdomen is well punctured and pilose, especially along the sides.

The dorsal sclerite of the so-called first segment is much the largest. Its large triangular anterior face extends downward and overlaps the small ventral sclerite on each side. The anterior face presents a large, median, concave area, the excavation being widest at its lower end. The punctation of the dorsal surface of this segment is finer and denser than on any of those that follow, while the pilosity is rather thick and often is present as a tuft on either side.

On the dorsal surface of segments two to five inclusive the punctation is quite well marked and dense, especially along the sides. The dorsal surface, however, is naked and shining in many species though in others there may be a little pubescence present, which is most noticeable along the hind margin of the segments. Each segment consists of a dorsal and a ventral sclerite, the former overlapping the latter on each side. The last segment of the female is more pointed than that of the male and the sides of the dorsal sclerite overlap the ventral sclerite as in the preceding segments. On the dorsal surface of the female are two rows of short spines which converge toward the apex. These are called the epipygium in this paper.

In the male the last dorsal sclerite (the seventh) overlaps the sixth sternal plate, since in this sex there are only six sternal sclerites while there are seven dorsal ones. A pair of styli or cercus-like pieces, known as penicilli, occur at the tip of the last visible dorsal plate among males of two species, *orpifex* and *tabaniformis*. The pilosity of the last segment is caused by long and dense hairs, a fact frequently made use of in classification. A slight median longitudinal carina often occurs in the dorsal and ventral plates of the entire abdomen.

Sting.—This organ is situated in a cavity at the end of the abdomen and is a tapering shaft which is directed backward. It consists of three plates, a dorsal one and two ventral ones. The dorsal plate is called the sheath and forms the upper and side areas of the sting; its greatly swollen basal portion is termed the bulb. Ventrally at the base of the bulb are two lateral arms which curve inward and upward to form the ventral plates of the shaft. These arms are called the lancets or darts which slide along tracklike grooves found on the ventral edges of the dorsal plate.

Between the lancets two poison glands empty into the bulb. Within the bulb and running the length of the shaft is the sting canal which receives the poisonous secretions. The distal ends of the lancets are barbed on either side. Surrounding the base of the shaft are paired plates which are connected with the base of the lancets by a triangular plate. These paired plates overlap the bulb and at the distal ends of the inner pair are borne the elongate palpus-like appendages which enclose the sting. Minute branched hairs are found on the posterior ends of these palpi which are probably tactile.

Male Genitalia.—The male genitalia are attached to the abdomen by the cardo. This sclerite forms the basal portion and is connected with the stipes on each side dorso-laterally. The stipe is a large lateral plate, the two being usually called the claspers; at the end are two lobes, the outer one usually bearing hairs, known as the lacinia and squama. These are usually fused together in this genus. The stipes extend backward dorsally, laterally and ventrally to form the greater bulk of the genitalia. Included within the extremities of the stipes are a pair of organs called the sagittæ. Their distal portions form the greatly recurved head, while the long basal part forms the shaft. Between the sagittæ is a foliaceous sclerite called the spatha.

Wings.—The wings of the carpenter-bee are large and powerful. They vary from hyaline to fuliginous with dark shades of blue, violet and green. A large arched plate, the tegula, slopes over the base of the front wing. Cresson's terminology for the venation is adopted in the present paper.

Front Wings.—The vein situated at the anterior margin is the costa. About half way along this margin is a weakly pigmented area known as the stigma. The vein just behind the costa and ending in the stigma is the subcosta. The cell included between the costa and subcosta, and terminating at the stigma, is the costal cell. The radial or marginal cell extends from the stigma and is rather sharply pointed at its outer end. The lower margin of this cell is bounded by the radius. Behind the costal cell is the median cell whose lower margin is the median and whose outer margin is the basal vein.

There are three closed and one open cell just behind the radius extending from the stigma to the outer margin. These are the first, second and third submarginal or cubital cells counting outward from the stigma. Their hinder margins are formed by the cubitus, while their outer margins are formed by the first, second and third transverso-cubital veins. The third submarginal cell is about equal in size to one and two together. Behind the submarginal cells one and two is the large first discoidal cell. The hinder margin of this cell is formed by the discoidal vein, while its outer margin is formed by the first recurrent nervure.

At the base of the wing just behind the median cell is the submedian cell whose hinder margin is the anal vein and whose outer margin is the transverso-medial vein. Beyond this cell and just behind the first discoidal is the second discoidal cell, the outer margin of which is the second recurrent nervure, and the hinder margin the subdiscoidal vein. The large, elongated lower basal cell is the anal cell. Behind the open fourth submarginal cell are two large open cells partially separated by veins and known as the first and second apical cells. On the hinder margin of the fore wing at the end of the anal cell is a broad notch known as the sinus.

Hind Wings.—In the hind wings there are only three closed cells; all are basal in position and elongate in form. The anterior one, called the costal cell, is very narrow. It is bordered in front by the costa and behind by the subcosta. The median cell is bordered in front by the subcostal vein, the stigma and the radial; behind by the media, part of the discoidal and the cubital; and distally by the first transverso-cubital vein. It is the largest cell, being very elongate and tapering at both ends.

The submedian cell is bordered distally by the transverso-medial vein and behind by the anal vein. The radial cell is open and is separated from the median cell by the radius. The first submarginal, the first and second discoidal, and the anal cells are all open. On the anterior margin of the hind wing, just beyond the stigma, is a row of frenal hooks or spinulæ which hook into the frenal fold in the posterior region of the fore wing, thus holding the two together. A slight sinus is present on the hind margin.

Legs.—The legs are long and moderately stout, the posterior pair being slightly longer than the others. The tibiæ are the only segments of the legs which bear spines; these are located on the distal portion of the inner surfaces. There is one spine present on each tibia of the male, while in the female there is one on each fore and middle and two on each hind tibia. The spines on the fore tibiæ which fit into a semi-circular indentation on the first segment of each fore tarsus form the antennal comb or cleaner. On the outer surface about half way down on the posterior tibia of the female is an excrescence which is called the tibial scale in this paper. It is a surface whose irregular surrounding edge is well raised above the plane of the segment and bears two teeth at its lower extremity. The tibial scale is also present in the male but is very small and barely perceptible. The coxæ are large, subcylindrical and closely articulated with the body. The trochanters are small at their base but increase in size at their distal ends; they arise dorso-apically from the coxæ. All the femora are large and are stoutest at the base, tapering toward the outer end. The tibiæ are shorter than the femora and are rather uniform in size throughout; their inner surfaces are flattened or even concave. The tarsi are composed of five segments, the first being much longer than the other four together. The last segment bears a pair of curved bi-cleft claws between which is a pulvillus.

All the segments of the legs bear more or less hair, though it is longest and densest on the femur, tibia and first joint of the tarsus. The hind tibiæ and tarsi of the females are especially well adapted for collecting pollen because of their very long, dense hairs.

Secondary Sexual Distinctions.

There are several sexual distinctions, besides the copulatory armature in the males and the sting in the females, as follows:

1. The antennæ of the female have twelve segments, while the antennæ of the male have thirteen.

2. The posterior tibia in the female has two spines, while in the male there is only one present.

3. The female has six exposed abdominal segments, while the male has seven above.

4. There is a triangular row of spines on the dorsal side of the last abdominal segment in the female, not present in the male.

5. The mandibles of the male are always two-toothed and more narrowed than in the female.

6. The frons of the male of many species is yellow while that of the female is always dark.

7. The males of some species are entirely yellow while the females are dark.

8. The tibial scale is very large and prominent in the female while it is barely perceptible in the male.

DESCRIPTIONS.

The lists of references for this genus by Dalla Torre in his Catalogue Hymenopterorum, Vol. X, are so full in most cases that it has seemed unnecessary to give complete lists. However, all references of literature known to me since Dalla Torre will be given, thereby making the list as complete as possible.

SYNONYMY.

Synonyms.	Correct Names.
amblardi Peréz	*californica* Cress.
purpurea Cresson	*micans* Lep.
binotata Peréz?	*barbata* Fab.
binotata Maidl	*micans* Lep.
varipuncta Patt.	*mordax* Smith.
morio Cress.?	*mordax* Smith.
transitoria Peréz	*brasilianorum* Linné.
ordinaria Smith	*brasilianorum* Linné.
virescens Smith	*brasilianorum* Linné.
cubæcola Lucas	*brasilianorum* Linné.
mordax Smith	*brasilianorum* Linné.
æneipennis DeGeer	*brasilianorum* Linné.
varipuncta Patt.	*brasilianorum* Linné.

TABLE OF SPECIES.

Twelve antennal segments, six dorsal abdominal segments; females......1
Thirteen antennal segments, seven dorsal abdominal segments; males...12
1. Hairs of the abdomen entirely black 2
Hairs of the abdomen not entirely black 8
2. Wings fuliginous or fusco-hyaline......................................3
Wings sub-hyaline ....**orpifex** Smith
3. Mandibles with two teeth at the apex and one on middle of inner margin, integument black 4
Mandibles with two teeth at the apex and none on inner margin, integument deep blue ....**arizonensis** Cress.
4. Posterior ocelli with a large carina in front..............**fimbriata** Fabr.
Posterior ocelli without a carina in front.................................5
5. Wings fuliginous, scutellum rounded behind 6
Wings semi-hyaline, scutellum truncate behind 7
6. Wings with violet color predominant, tints of blue and purple apparent **brasilianorum brasilianorum** Linné.
Wings brass and copper colored with a strong violet tinge. **brasilianorum varipuncta** (Patt.)

7. Wings with faint violet and blue mixed throughout, scutellum sharply truncate behind .... **brasilianorum cubæcola** (Lucas)
   Wings with a faint tint of violet at the apical margin, scutellum almost truncate behind .... **brasilianorum æneipennis** (De Geer)
8. Hairs of abdomen yellowish white or pale ochraceous on first segment only 9
   Hairs of abdomen yellowish white or pale ochraceous elsewhere besides on first segment 10
9. Labrum triangular and consisting of one lobe .... **virginica** Linné
   Labrum oblong, emarginate in the middle, and apparently consisting of two lobes .... **californica** Cress.
10. Frontal carina very large and blunt .... **texana** Cress.
    Frontal carina very small and pointed 11
11. A short furrow midway between the posterior ocelli and ending in the median ocellar groove; body-color bluish purple .... **micans** Lep.
    No such furrow present; body-color black .... **tabaniformis** Smith
12. Mandibles with a large yellow spot at the base 13
    Mandibles without a yellow spot at the base or with but a very small one 17
13. Integument entirely fulvous 14
    Integument entirely black 16
14. Upper side of flagellum with white pubescence, frontal carina obsolete, form robust .... **fimbriata** Fabr.
    Upper side of flagellum without white pubescence, frontal carina small, form not robust 15
15. A dark brown area on middle of the clypeus, a black ring surrounding each ocellus .... **brasilianorum æneipennis** (De Geer)
    No such markings on clypeus or surrounding the ocelli. **brasilianorum brasilianorum** Linné.
16. Abdominal hairs entirely black .... **orpifex** Smith.
    Abdominal hairs white on the hind margin laterally of all but the last segment .... **tabaniformis** Smith
17. Front of head entirely dark colored 18
    Front of head with yellow on labrum, clypeus, and frontal shield....... 19
18. Wings fuliginous, integument brilliant blue, white abdominal hairs on first segment only .... **arizonensis** Cress.
    Wings fusco-hyaline, integument green, white abdominal hairs on segments one and four and a few on the sides .... **californica** Cress.
19. Antennæ entirely dark colored 20
    Antennæ with a yellow line on the lower side of the first segment. **micans** Lep.
20. Head with yellowish white hairs on cheeks, vertex, and a patch between antennæ .... **texana** Cress.
    Head with black hairs on cheeks, vertex, and between insertions of antennæ .... **virginica** Linné.

Xylocopa orpifex Smith.

Xylocopa orpifex Smith, Trans. Ent. Soc. London, p. 298, n. 118, ♀, ♂, 1874.
Xylocopa orpifex Davidson, Ent. News, p. 151, 1893.
Xylocopa orpifex Ashmead, Psyche, Vol. VII, p. 24, 1894.
Xylocopa orpifex Fowler, Rept. Cal. Exp. Sta., p. 318, 1898–1901.
Xylocopa orpifex Peréz, Act. Soc. Bordeaux, LVI, p. 122, 1901.
Xylocopa orpifex Cockerell, South Cal. Acad. Nat. Sc., No. 6, p. 87, June, 1904.
Xylocopa orpifex Maidl, Ann. Nat. Hist. Hof.–Mus. Wien, p. 309, 1912.

A small black insect; length of female, 17–20 mm.; of male, 15–18 mm.

Female.—Head and its hairs entirely black; broad, almost as wide as thorax, and thick; the mandibles dark, with three teeth, being bidentate at the apex and with a small tooth on the inner margin along which extends a deep longitudinal groove; the few hairs present on the mandibles are reddish brown, as is the case among most of the species; labrum small and black, consisting of one lobe somewhat triangular shaped with the upper margin elongate and a small lobe on either side hidden beneath; clypeus flat, with a smooth, shining, unpunctured space along the lower margin, the rest with small, close punctures, longitudinal carina not present; lateral foveolæ not very deep; frontal shield on same plane as clypeus, well punctured; frontal carina small and pointed, having a pit on the upper surface half way to the median ocellus, where it forms a heart-shaped groove reaching and surrounding the median ocellus; prominent ocellar pits present, situated dorso-laterally behind the posterior ocelli; eyes not large, far apart; antennæ piceous on under side of flagellum; vertex and cheeks with fewer punctures than on face, hairs black.

Thorax black, hairs black; disk black, shining, smooth and without hairs; scutellum well rounded, with few punctures, especially in its anterior half; post-scutellum very narrow and rather impunctate.

Color of integument and pile of abdomen everywhere black; punctation not close except on last segment where it is very fine and abundant; abdomen very short and robust; epipygium not wide at base, its spines very strong.

Wings subhyaline with a very slight violet tint, and a little darkened at their apices. Tegulæ black.

Legs black, their pile black except on inner tarsi where it is mixed with reddish brown. Anterior tooth of tibial scale very pointed, posterior tooth greatly rounded.

Male.—Differs from the female as follows: Head with yellow color at the base of the mandibles, on labrum, clypeus, frontal shield, and more or less of the areas between the clypeus and eyes; yellowish-white hairs on cheeks, vertex, and some on the face; head not as wide as in female and face much narrower; mandibles narrowed with only two teeth present; labrum much larger; clypeus a little convex, with longitudinal carina perceptible and impunctate; ocellar pits much smaller and rather inconspicuous; eyes much larger, vertex flatter. Thorax with a great abundance of dense yellowish-white hair, mixed with black, on the back and sides. Sides of abdominal segments more closely punctuated. Tibial scale much smaller and of only one lobe. A pair of cercus-like pieces (penicilli) are present on the tip of the seventh dorsal segment.

Type.—Probably in the British Museum.

Distribution.—California, Arizona, Oregon, Nevada.

This species can easily be distinguished from other species of the United States. Dr. L. O. Howard, in The Insect Book, figures *Xylocopa orpifex* on plate II, fig. 26.

Xylocopa micans Lep.

?*Apis nasuta* Christ, Naturg. d. Insect, p. 130, T. 8, F. 5, 1791.
Xylocopa micans Lepeletier, Hist. Nat. Insect. Hymén., II, p. 208, n. 58, ♂, 1841.
Xylocopa vidua Lepeletier, Hist. Nat. Insect. Hymén., II, p. 210, n. 61, ♀, 1841.
Xylocopa purpurea Cresson, Trans. Am. Ent. Soc., IV, p. 284, ♀, 1872.
?*Xylocopa purpurea* Smith, Trans. Ent. Soc. London, p. 299, n. 121, ♀, 1874.
Xylocopa micans Patton, Can. Ent., XI, p. 60, 1879.
Xylocopa micans Maidl, Ann. Nat. Hist. Hof.–Mus. Wien, p. 309, 1912.
Xylocopa binotata Maidl, Ann. Nat. Hist. Hof.–Mus. Wien, p. 310 (nec. Peréz), 1912.

Length of female, 15–18 mm.; of male, 20–22 mm.

Female.—Head almost as wide as thorax, black with deep blue and purple reflections, especially on the vertex and cheeks; punctures of face small, fine and close; grayish white hairs intermingled with some black occur on clypeus, lateral areas of frons between the clypeus and eyes, between the bases of antennæ, and on the cheeks; mandibles with four teeth, two large ones at the apex and two small ones on the upper margin, which are often worn off; color of mandibles black with a green spot at the base in many; labrum small and black, consisting of one triangular lobe whose upper margin is very elongate, and a small one on each side but hidden below; clypeus flat, greenish blue, well punctured, with a black, shining, impunctate space along the lower margin; longitudinal carina not present; frontal shield on same plane as clypeus, sides sloping, of a greenish blue color; frontal carina small and pointed, upper margin flat for a distance, then changing into a furrow which is concurrent with the groove surrounding the median ocellus; posterior ocelli slightly carinated in front, causing them to appear a little sunken behind, and midway between them is a short furrow extending from the median ocellar groove; small circular ocellar pits occur behind the posterior ocelli; under side of flagellum of antennæ piceous, otherwise black; eyes rather small and far apart; vertex somewhat raised on top just behind the ocelli and sparsely punctured; cheeks also sparsely punctured.

Thorax black on disk, otherwise blue and purple, well punctured; hairs black, with some pale ochraceous ones on the scutellum and post-scutellum and a small patch on each side just below the tegulæ; scutellum rounded and well punctured; post-scutellum very narrow.

Abdomen brilliant bluish purple; punctures small, fine and close, especially on the first and second segments; a patch of white hairs on the sides of segments one, five and six, and a few white ones on sides of the intervening segments; otherwise black; epipygium very narrow at the base, spines rugged.

Wings fusco-hyaline with a violet tint, darker at the apical margins; tegulæ blue.

Legs bluish purple, pilosity black except some brown on the inner surface of the fore tarsi. Tibial scale small, the anterior tooth being long and pointed, the posterior one very short and rounded.

Male.—Differs as follows: Head with yellow color on labrum, clypeus, frontal shield and lateral areas of frons between the clypeus and eyes as high as the insertion of the antennæ, and on the lower side of the first segment of the antennæ; whitish-yellow hairs on the face, vertex and cheeks; head not as wide as in female, face much narrower, especially in its upper half; mandibles narrower, convex along the middle, only two teeth present, the lower one being much the larger, dark brown with a slight yellow spot appearing at the base in some specimens; labrum larger; clypeus somewhat convex; an unpunctured longitudinal carina evident; a shallow furrow behind each posterior ocellus extending backward for a short distance and ending abruptly on the vertex; eyes much larger and converging strongly above, producing a very narrow vertex.

Thorax everywhere covered with dense whitish-yellow hair; integument with some green color, otherwise as in female. Abdomen green on first two segments, then changing to a blue color, and to a brilliant purple on the apical segments; ventral segments bluish purple mixed with more or less orange toward the middle; pilosity whitish-yellow on whole of first segment, a little on sides of all segments but the last, and a fringe on the hind margin of all the ventral segments except the apical segment; apical segment with a very thick brush of long, black hair. Wings a little lighter than in female; tegulæ brown.

Hair of legs not entirely black as in female, but with some whitish-yellow on fore tibiæ and tarsi, on middle and hind coxæ, trochanters, femora, tibiæ, and on the outer upper half of the first segment of tarsi; tibial scale much smaller and consisting of but one lobe.

Type.—Probably lost.

Distribution.—Florida, Georgia, North Carolina, Texas, California, Guatemala.

I have examined Cresson's type of *Xylocopa purpurea* at the American Entomological Society at Philadelphia and am convinced that it is *micans* Lep. Cresson's description was made from specimens from Texas, there being a series of four female specimens present, three from Texas and one from California, of which one from Texas is labeled lecto-type, and another from Texas is labeled para-type. Lepeletier's description was made from specimens collected in Carolina.

According to Cresson's description of *purpurea* there might be a distinction between it and *micans.* He described a tuft of white pubescence on each side of the apex of the abdomen only, while *micans* has a tuft of white on each side of the first segment in addition. Upon examining the type *purpurea,* however, I found the tuft of white hair on each side of the first segment and therefore know of no reason why *purpurea* is not a synonym of *micans.*

Male specimens of *micans* collected in Texas also agree in every way with the description of *micans* made by Lepeletier of the male from Carolina.

Micans has also been confused somewhat with *texana* Cr., but these two species are very different and should be easily distinguished.

In The Insect Book, plate III, fig. 24, Dr. L. O. Howard figures a female of this species.

Peréz probably had reference to some small Central American form according to his description of *binotata.* Maidl lists three females of *binotata* Peréz from Georgia and one male from Texas, but his short description of *binotata* does not agree very well with that of Peréz. I think that the insects which Maidl calls *binotata* are probably synonymous with *micans* Lep.

Xylocopa virginica Linné.

——————Drury, Ill. Nat. Hist., I, p. 96, ♂; Pl. 43, f. 1, 1770.
Apis virginica Linné, Mantissa Plantarum, II, p. 540, 1771.
Apis virginica Drury, Ill. Nat. Hist., II. App. 1773.
Xylocopa virginica Illiger, Mag. f. Insectenk, V, p. 151, n. 19, 1806.
Xylocopa virginica Peréz, Act. Soc. Bordeaux, LVI, p. 112, ♂, ♀; 1901.
Xylocopa virginica Maidl, Annals Nat. Hist. Hof.–Mus., Wien, p. 309, 1912.

Length of female, 22 mm.; of male, 22–24 mm.

Female.—Head almost as wide as thorax, black, though a tinge of blue or green occurs in some; punctures very fine on the face, hairs black everywhere; mandibles having two teeth at their apices and none on the inner margin, large with a good-sized punctured depression at their bases; labrum with one blunt, fairly large triangular lobe; clypeus rather flat, well punctured, an unpunctured concaved area along the lower margin, the upper margin slightly incurved in the middle, logitudinal carina barely perceptible; lateral foveolæ and frontal grooves not very deep; frontal shield on same plane as clypeus but with sides sloping; frontal carina rounded and very prominent; posterior ocelli slightly carinated in front with a small circular pit behind each; antennæ black, eyes not large and widely separated; vertex and cheeks having bluish purple tints, punctures larger and fewer than on face.

Thorax black on disk, changing to blue, green and purple on sides and below; pilosity very dense, whitish yellow on top except the disk and on sides, black below; scutellum olive green; post-scutellum sparsely punctured.

Abdomen black, showing green on the first segment; punctures small and few except on first segment which is well punctured; whitish yellow hairs occur only on the first segment, elsewhere they are black; epipygium very large, spines small.

Wings fusco-hyaline with a violet tint, darker at the apex, tegulæ brown or black.

Legs black, blue and purple; hairs black, brown on inner side of fore tarsi. Tibial scale with edges well raised so that interior appears hollowed out; anterior tooth very sharp, posterior one more rounded or even blunt and not as long as anterior one; form longer than wide.

Male.—Differs from the female as follows: Head, labrum, clypeus, frontal shield and lateral areas of frons between clypeus and eyes as high as the insertion of the antennæ, yellow; yellow hair present only on yellow colored areas of head, otherwise black; head not as wide as in female, face more narrowed, especially above; mandibles smaller than in female; labrum larger; clypeus slightly convex, lower marginal area not concaved; frontal carina smaller; eyes much larger and converging above, thus forming a much narrower vertex; ocellar pits imperceptible. Punctures of abdomen more abundant throughout, much finer and closer. Yellowish brown hair present on fore and middle tibiæ; tibial scale greatly reduced.

Type.—Location unknown to the writer.

Distribution.—This species is distributed generally throughout the United States and is also recorded from Cuba. It is the most common species of *Xylocopa* found in this country.

Variation.—A male specimen collected at Chapel Hill, Texas, differs from the typical male described above as follows: Face entirely black except a yellow area along the longitudinal carina of the clypeus, and yellow present on the labrum.

Drury described and figured this species (Ill. Nat. Hist., I, p. 96, Pl. 43, f. 1, male, 1770) without a name in 1770. During the following year (Mant. Plant. II) Linnæus gave the name *Apis virginica* to this insect. Drury (Ill. Nat. Hist., II, 1773) furnished an appendix of names covering his descriptions in volumes I and II. In 1806 Illiger placed this species in the genus *Xylocopa* for the first time, calling it *Xylocopa virginica.*

Xylocopa texana Cresson.

Xylocopa texana Cresson, Trans. Am. Ent. Soc., IV, p. 283, ♀, ♂, 1872.

Length of male and female, 22–24 mm.

Female.—Head about as wide as thorax, black, showing bluish purple in different lights; punctures abundant and fine especially on the face; hairs black; a large punctured depression at the base of the mandibles, whose teeth are two in number, located at the apex; labrum consisting of one blunt lobe, rather large and triangular in shape; clypeus well punctured, a little convex in its superior half, a deeply concaved, shining, impunctate area along its lower margin, which is dark red in many specimens, the longitudinal carina barely evident; lateral foveolæ and frontal grooves very deep and prominent; frontal shield iridescent, very convex; its sides sloping greatly; frontal carina very large and blunt (more prominent than in *virginica*), so that the median ocellus appears sunken, posterior ocelli carinated in front, a small circular pit behind each; antennæ black, eyes not large, widely separated; vertex and cheeks with a strong, bluish purple color, punctures larger and fewer on face, hairs entirely dark.

Thorax black on disk, changing to blue, green and purple on sides and beneath; pilosity very dense, yellowish white on top, except the disk and on sides, black below; scutellum blue to green, well punctured; post-scutellum small and little punctate.

Abdomen elongate, olive green with blue reflections; punctation fine and close on first segment, otherwise sparse; yellowish white hairs on first segment, a patch of them on sides of segments five and six, and a few scattered ones on sides of intervening segments, hairs elsewhere black; epipygium very large, spines small.

Wings fusco-hyaline with a violet tint, darker at the apex, tegulæ brownish black.

Legs blue, purple, sometimes a little greenish, hairs black, brown on inner side of fore tarsi. Tibial scale with anterior tooth narrow and very pointed, posterior one wider and pointed, the two teeth of equal length; form not as elongate as in *virginica,* being almost as wide as it is long.

Male.—Differs as follows: Head yellow on labrum, clypeus, frontal shield; in some specimens a little on the lateral areas of the frons between the clypeus and eyes as high as the insertion of the antennæ and a small spot at the base of the mandibles; color otherwise black with bluish purple on the vertex and cheeks; head not as wide as in the other sex, face more narrowed; hairs of head yellowish white on cheeks and vertex, some scattered patches on frontal shield, between insertion of antennæ and between the posterior ocelli; mandibles smaller, depression at base not so deep; labrum a little wider;

clypeus somewhat convex, area along lower margin not concaved; frontal carina much smaller; eyes much larger and approximated more or less above, producing a narrow vertex. Thorax with more yellowish white hairs than in the other sex, especially on the ventral surface where it is mixed with the black. Punctation of abdomen much finer and closer throughout; yellowish white hairs on the hind margin dorsally of segments four and five mixed with some black, otherwise pilosity as in female. Wings a little lighter than in other sex. Tibial scale very reduced; a variable amount of yellowish hair present on legs.

Types.—Cresson's typical specimen labeled "Lecto-type 2620" "Tex" is in the Acad. Nat. Sc., Philadelphia, along with a male labeled "Allo-type 2620" "Tex" and a male and female paratype. In the collection of the Museum of Comparative Zoölogy at Harvard is a male and female labeled "Type 556" "Dallas, Tex., Boll." In the U. S. N. M. are two specimens, a male and a female, labeled "Type No. 1792, U. S. N. M.," "Collection Belfrage."

Distribution.—I have examined specimens taken at Dallas, Round Mt. and Kerrville, Texas.

This species seems to occur throughout the northern and central part of Texas but I find no record of it in any other state. It is very closely allied to *Xylocopa virginica,* which is also found in some parts of Texas, though I find no record of it (*virginica*) occurring in the same localities with *texana.* The females of *texana* and *virginica* resemble each other very much. Generally speaking, however, the predominant color of *virginica* is black, while that of *texana* is green, with some blue present. This is a rather variable character, though, for many specimens of the one species will approach those of the other very closely in color. The frontal carina of *texana* is larger and more prominent than that of any other species found in the United States. The frontal carina of *virginica* is of medium size in the specimens collected from the eastern states, but it seems to increase in size on specimens taken from Texas, although it does not attain the size and prominence that it does in *texana.* The white pile present on the sides of segments five and six, and the few scattered ones along the sides of the other segments found in *texana* do not occur in *virginica;* this seems to be a rather constant character for separating the species.

The males of *texana* and *virginica* resemble each almost as closely as do the females. The following differences, however, serve to separate the two species. The predominant color of *texana* is green, while that of *virginica* is black; *texana* has but little or no yellow coloring on the lateral downward projections of the frons between the clypeus and eyes, while in *virginica* these areas are entirely yellow; the pilosity in *texana* is yellowish white on the cheeks, vertex, face, and on the hind margins of the fourth and fifth abdominal segments, while the corresponding pilosity of *virginica* is black. I have studied the genitalia of *texana* and *virginica* and there is no doubt in my mind that they are different species.

In his Insect Book Dr. L. O. Howard gives a photograph of *texana*, male, on plate II, fig. 27. This was taken of a specimen present in the collection of the U. S. N. M., which is labeled "Type No. 1792," "From Dept. Agri."

Xylocopa tabaniformis Smith.

Xylocopa tabaniformis Smith, Cat. Hymen. Brit. Mus., II, p. 362, n. 95 ♀, 1854.
Xylocopa tabaniformis var. *chiriquiensis*, Peréz, Act. Soc. Bordeaux, LVI, p. 120, ♀, ♂, n. v., 1901.
Xylocopa tabaniformis Maidl, Ann. Nat. Hist. Hof.–Mus. Wien, p. 317, ♀, ♂, 1912.

Length of female and male 17–18 mm.

Female.—Head black, hairs black, mixed with grayish-white on cheeks, hind part of vertex and face; punctation rather close and fine; mandibles with three teeth, two large ones at the apex, and one rounded small tooth on the upper margin, no depression at the base, upper longitudinal groove deep; labrum apparently of one small subtriangular lobe, but in addition one small lobe on either side hidden beneath; clypeus flat, punctures close and circular, longitudinal carina or ridge obsolete, impunctate area along lower margin not concave, upper margin straight; lateral foveolæ and frontal grooves deep and prominent; frontal shield flat in the middle, sides sloping gently; frontal carina small and pointed, the upper margin interrupted in the middle by a small pit; ocelli triangularly placed, the posterior ones with a circular pit behind each and not carinated in front; antennæ black; eyes small and rather far apart; vertex and cheeks well punctured, the whitish hairs short.

Thorax black, disk shining; hairs everywhere black, mixed with grayish-white on the back and sides, producing a sooty aspect; scutellum wide, with few punctures, especially in its anterior half, post-scutellum very narrow.

Abdomen black and not elongate, well punctured except along the middle of the segments, finely so on the sides; pilosity dense and white on the first segment and on the hind margin of segments two, three, four and five, except in the middle, black everywhere else; epipygium narrow at the base, spines large.

Wings subhyaline, of a brassy tint, tegulæ brownish black.

Legs black; hairs yellowish white on the intermediate and posterior tibiæ and tarsi exteriorly, brown on the inner side of the fore tarsi, otherwise black; tibial scale small, anterior tooth very pointed and long, posterior tooth very rounded and short.

Male.—This sex differs from the female as follows: Head yellow on labrum, clypeus, frontal shield, a large spot at the base of the mandibles, and some mixed with the black on the lateral downward projections of the frons between the clypeus and the eyes; head and face narrower; mandibles smaller, with only two teeth present (at the apex); labrum with only one tooth or lobe; clypeus with fewer punctures; ocellar pits very small or even obsolete; vertex more narrowed and flattened. Thorax as in the female. Abdomen differs in having a patch of long, white hairs on the sides of segment six. A pair of cercus-like pieces (penicilli) present on the top of the seventh dorsal segment. Tibial scale not much smaller than that of the female, but with only one lobe.

Type.—Probably in the British Museum.

Distribution.—Mexico; Brownsville, Texas; Utah.

Variations.—A male from Washington Co., Utah, differs from the typical male described above by having the hairs of the head and thorax entirely white and much denser, while the white hairs of the abdomen occur only along the sides.

Xylocopa azteca Cresson is a form very similar to *tabaniformis,* and there seems to be no reliable structural character upon which the two forms can be separated. *Azteca* female differs from the female of *tabaniformis* by the presence of white pilosity on segments one, two and three of the abdomen only, but this variation between the two forms seems to be constant. The males of these two forms show even less variation; they differ as follows: the white hairs of the abdomen in *tabaniformis* are tawny and less interrupted medially by the black hairs in *azteca*. *Azteca* could therefore be reduced to a subspecies of *tabaniformis,* but since there is no record of this form occurring in the United States I shall not include it in this paper.

Tabaniformis is primarily a neotropical species, but it also occurs in the southwestern United States. It is closely related to *orpifex,* these two species being the only Xylocopas of the United States which have penicilli present on the last dorsal abdominal segment. *Tabaniformis,* however, is easily distinguished from *orpifex* by the white pilosity of the abdomen present in the former.

Xylocopa fimbriata Fabr.

Xylocopa finbriata Fabr., Sys. Piez., p. 340, n. 7, ♀, 1804.
Xylocopa finbriata Fowler, Rept. Cal. Exp. Sta., part II, p. 318, 1898–1901.
Xylocopa finbriata Peréz, Act. Soc. Bordeaux, LVI, p. 81, 111, ♀, ♂, 1901.
Xylocopa finbriata Cockerell, Southern Cal. Acad. Nat. Sciences, No. 6, p. 87, June, 1904.
Xylocopa finbriata Maidl, Ann. Nat. Hist. Hof.-Mus. Wien, p. 311, ♀, ♂, 1912.

Length of female, 30–32 mm.; of male, 28–30 mm.

Female.—Head black, very large, as wide as thorax, face concaved in the middle, hairs everywhere black, long on the cheeks and face; mandibles with two large teeth at the apex, and one small, rounded tooth on the middle of the inner margin, no depression at the base and very few punctures present, the upper longitudinal groove very deep; labrum with three lobes; clypeus with large but few punctures, the lower marginal area irregular, having a small convex area in the middle with a large pit on each side of it, the upper margin with a well rounded elevation curved upward like a bow, the shining impunctate sides more sharply ridged and the lower extremities very prominently raised; longitudinal carina obsolete; frontal shield from the clypeus to the insertion of the antennæ flat, the superior half concaved, there being no frontal carina present; the lateral areas of the frons between the clypeus and eyes irregularly concaved and situated on a lower plane than the clypeus, so that the presence of lateral foveolæ and frontal grooves are merely marked by a suture on each side; median ocellus set in a very concaved, impunctate surface, with a short groove extending back for a little distance midway between the hind ocelli; the sides of the median ocellar area well ridged; a small concaved area behind the median ocellus and between the posterior ones which appear sunken behind the large, prominent carinæ; these carinæ start in front of the posterior ocelli and extend transversely toward the eyes, becoming gradually elevated and ending in the form of a pair of horns; ocellar grooves situated dorso-laterally to the posterior-ocelli; above, the vertex is sparsely punctured and narrow; cheeks well punctured.

Thorax black, disk very large, shining and hairy; hairs black, short and sparse on the back and sides, longer beneath; scutellum large and little rounded, the greater part impunctate, without pile, forming the hind part of the disk, only the posterior margin pilose; post-scutellum with hair everywhere.

Abdomen black, rather long but robust, punctation sparse except on the apical segments, hairs black, a faint carina along the middle extending the length of the tergum, and a very sharp and prominent one on the venter; epipygium not wide at the base, spines very large.

Wing opaque, the dominant color blue with tints of violet and a slightly greenish luster at the apex; tegulæ black.

Legs black, the hairs black; tibial scale well elevated, the two teeth at the apex of equal size, rather short, the anterior one a little more pointed, the posterior one striated on its posterior aspect.

Male.—Differs from the female in that it is entirely fulvous and also in the following points: Head narrow, punctation very fine; mandibles brown with a yellow spot at their base, black toward the apex, smaller, greatly constricted along the middle, no tooth on the upper margin; labrum with only one lobe, triangular in form; clypeus flatter, the upper margin and sides not elevated; frontal shield somewhat convex, the frontal carina replaced by a short groove concurrent with the median ocellar groove; ocelli not sunken, the median one situated but little lower than the posterior ones, a very shallow circular pit behind each posterior ocellus which has no carina in front of it; antennæ fulvous on the under side throughout, reddish-brown on the upper surface which has a fine white pubescence on its flagellum; vertex and cheeks with long dense fulvous hairs.

Thorax fulvous, the scutellum much flatter, the post-scutellum very wide and more densely pilose.

Abdomen with more brown color than on the other parts of the body, the hair yellow except at the apex, where it is long and reddish. Wings semihyaline, tegulæ fulvous, covered with hairs except on the middle.

The four intermediate legs and posterior coxæ, trochanters and femora, and the two anterior coxæ, trochanters and the external surfaces of the femora are reddish black; legs otherwise yellow; the anterior and intermediate tibiæ deeply hollowed; hairs fulvous; tibial scale small and black.

Type.—Location unknown.

Distribution.—Mexico, Central America, Brazil, Peru and reported from Yosemite Valley, California.

Fimbriata is a neotropical species and the report of its occurrence in California does not seem to be authentic. It has been collected in Mexico and may possibly occur in some of the semitropical regions of the southwestern United States, and therefore I include it in this paper.

This species is one of the largest forms of *Xylocopa.* The sexes differ greatly in color. The male is entirely fulvous while the female is entirely black. This wide contrast in color of the sexes seems to be characteristic of many other neotropical species of *Xylocopa,* especially among the larger forms. The female of *fimbriata* can be easily distinguished from its closest ally *frontalis* (Ol.) by the form of the carinæ in front of the posterior ocelli. The males of these two species, however, resemble each other very closely and are not so easily separated. *Fimbriata* has been confused with *varipuncta* (Patt.) from California (which I reduce to a variety of *brasilianorum* Fabr.), but can easily be distinguished from it.

Xylocopa Brasilianorum Brasilianorum Linné.

Apis brasilianorum Linné, Sys. Nat., Ed. 12a 1, 2, p. 961, n. 449, ♂, 1767.

Apis æneipennis De Greer, Mem. hist. Insect., III, p. 573, n. 5, ♀; pl. 28, f. 8. 1773.

Xylocopa cubæcola Lucas, Sagra., Hist. fis. Cuba, VII, p. 776, ♀, pl. 19, f. 8, 1850.

Xylocopa mordax Smith, Trans. Ent. Soc. London, p. 294, n. 111, ♀, 1874.

Xylocopa varipunctata Patton, Can. Ent., XI, p. 60, ♀,1879.

Xylocopa varipuncta Cockerell, Ent. News, 13, p. 318, 1902.

Xylocopa varipuncta Fowler, Rept. Cal. Exp. Sta., p. 318, 1890–1901.

Xylocopa varipuncta Cockerell, South. Cal. Acad. Sc., No. 6, p. 87, June, 1904.

Xylocopa brasilianorum Peréz, Act. Soc. Bordeaux LVI, p. 88, 100, ♀, ♂, 1901.

Xylocopa brasilianorum Maidl, Ann. Nat. Hist. Hof.–Mus. Wien, p. 312, ♀, ♂, 1912.

Xylocopa brasilianorum brasilianorum Linné.

Length of male, 22–24 mm.; of female, 24–26 mm.

Female.—Head black, almost as wide as thorax, well punctured, hairs black; mandibles with two large teeth at the apex and a small, rounded one on the middle of the upper margin, no depressed area at the base and with but few punctures, the upper longitudinal groove very deep with a depressed spot in the middle; labrum with three lobes, the lateral ones blunter and a little hidden beneath the hairs; clypeus flat, punctures large but few, longitudinal carina not present, the upper and lateral margins shining, impunctate, the upper margin a little elevated, the lateral ones more raised and more sharply ridged toward their lower extremities; frontal shield on a slightly higher plane than the clypeus; the frontal grooves marked by a shallow suture, the lateral foveolæ very small; frontal carina rather prominent, not sharply pointed, the upper side verging into a furrow concurrent with the heart-shaped groove of the median ocellus; ocelli small, the posterior ones not carinated in front but with large circular pits behind, a short, fine furrow midway between; eyes rather small and widely separated; vertex well punctured, the cheeks finely and sparsely so.

Thorax black, hairs black, short and not very dense on back; disk very large, including the anterior half of the scutellum, without hair or punctures and shining; scutellum behind the flat, unpunctured area rounded and sloping downward, and pilose; post-scutellum with few punctures, small and hairy.

Abdomen entirely black, hairs black, rather elongate, punctures close and fine on the anterior half, coarser on the posterior half; a longitudinal carina along the middle of the tergum, and a corresponding carina along the venter but much sharper and more prominent; epipygium not wide at the base.

Wings fuliginous, violet color predominating with tints of blue and purple; tegulæ black; length of wings 20 mm.

Legs black, hairs black; tibial scale with the anterior tooth longer, narrower and more pointed than the posterior one.

Male.—The male, besides being entirely fulvous, differs as follows: Head narrower, punctation fine; mandibles brownish black, with a yellow spot at base, constricted along the middle, smaller and no tooth present on the inner margin; labrum with only one lobe;

clypeus more convex, the upper margin and sides not elevated, longitudinal carina rounded; frontal carina very small and pointed, the upper margin faintly grooved with a pit in its middle; ocelli not sunken, close together, ocellar pits minute or obsolete, a shallow groove midway between the posterior ocelli; eyes not large and wide apart; lower side of antenna yellowish on first segment, otherwise yellowish brown, its upper side brownish black throughout and with no pubescence; vertex and cheeks with long, dense yellow hair and very fine punctures.

Thorax yellow with more or less brown, especially on the post-scutellum, propodeum and sides; hairs yellow; scutellum flat, shining, with but little hair and few punctures; post-scutellum also rather flat.

Abdomen yellow, with a brown band along the hinder margin of each segment, but this is variable as the color may become tawny in old specimens; pilosity yellow, rufous and long at the apex; finely and densely punctured throughout. Wings semihyaline; tegulæ fulvous.

The fore legs from their bases to and including the basal part of the femora, and the intermediate and hind legs as far as the tibiæ brownish black, otherwise yellow or fulvous; hairs everywhere yellow with a slight red tinge on the tibiæ and tarsi; tibial scale very small and black.

Type.—Location unknown.

Distribution.—Texas, Arizona, Southern California, Mexico, Central and South America, West Indies.

Xylocopa brasilianorum æneipennis (DeGeer).

This form differs from the typical *brasilianorum* as follows: Female—scutellum more truncate behind; abdomen with the ventral longitudinal carina even sharper and more prominent; wings semihyaline, with a brassy luster and a violet tint on the apical margin of the anterior wings; length 22–24 mm. Male—with a dark brownish area on the middle of the clypeus; a black ring surrounding each ocellus; bands along the hind margin of the abdominal segments wider and darker colored.

Habitat.—Arizona.

Xylocopa brasilianorum cubæcola (Lucas).

This form differs from *æneipennis* as follows: Female with the scutellum sharply truncate behind; ventral abdominal carina the same; wings a little darker, a faint violet and blue color occurring throughout both anterior and posterior wings, the violet predominating. Male unknown. Length 20–22 mm.

Habitat.—California.

Xylocopa brasilianorum varipuncta (Patt.).

This subspecies is more closely related to the typical *brasilianorum* than to either of the other two described above. It differs from the other three forms as follows: Female with scutellum not truncate but rounded as in the typical *brasilianorum;* ventral abdominal carina not exceedingly prominent but as in *brasilianorum;* wings fuliginous, not as dark as in *brasilianorum,* brassy and copper colored with violet reflections. Male not known. Length 26–28 mm.

Distribution.—Arizona, Southern California.

Xylocopa brasilianorum is a species of very wide range extending from South America north into the southern United States. It is also a very variable species, as Maidl first noted in his work on the *Xylocopa* collection of the museum of Vienna in 1912. I agree with Maidl in all his conclusions in regard to variation within this species. There is no doubt that many forms have been described as new species which are merely varieties or even synonyms of *brasilianorum.* The variable characters of these forms upon which various authors have established different species are color of wings mainly, formation of the scutellum, and size. The above variable characters occur in the female, while in the male there seems to be but little variation, if any. I have studied the genitalia of a large series of insects which have been described as different species and, like Maidl, have found very little difference among them.

In this paper I include only those forms which are found in or reported from the United States; that is, the subspecies *brasilianorum, varipuncta, æneipennis,* and *cubæcola. Varipuncta* (Patt.) is without a doubt the same as *mordax* (Smith). In the U. S. Nat. Mus. at Washington is one of the two original female specimens of *varipuncta* with Riley's labels on it. One of the two specimens was sent to Patton and he described it as a new species, *Xylocopa varipuncta.* It is likely that Patton did not see the specimen in the U. S. Nat. Mus., and it is probable that the one from which he made his description is lost.

A representative form of the species *brasilianorum* may be found in The Insect Book, where Howard figures *æneipennis* on plate II, fig. 25.

Among other described forms occurring within the range of *brasilianorum* which will without a doubt ultimately be recognized as subspecies of this species are *ordinaria* Smith, *morio* Cresson, *virescens* Smith, *transitoria* Peréz, and *mordax* Smith.

Xylocopa californica Cresson.

Xylocopa californica Cresson, Proc. Ent. Soc. Philadelphia, III, p. 40, n. 3, ♀, 1864.

Xylocopa californica Fowler, Rept. Cal. Exp. Sta., p. 318, ♀, ♂, 1898–1901.

Xylocopa amblardi Peréz, Act. Soc. Bordeaux, LVI, p. 115, ♂, 1901.

Xylocopa californica Cockerell, South. Cal. Acad. Sc., No. 6, p. 87, June, 1904.

Xylocopa californica Cockerell, Ent. News, p. 395, var. a. ♂, 1907.

Xylocopa californica Maidl, Ann. Nat. Hist. Hof.–Mus., Wien, p. 309, ♂, 1912.

Length of female, 22–24 mm.; of male, 20–22 mm.

Female.—Head thick, almost as wide as thorax, black with blue, green and purple tints, the green color predominating; hairs black, well punctured, especially on the face; mandibles black with two teeth at the apex, base flat and having very few punctures, inner longitudinal groove not very deep, outer one very faint; labrum semi-oblong in form, emarginate in the middle, giving the appearance of two lobes, small and black; clypeus flat, very closely punctured, iridescent, longitudinal carina small and faint; lateral foveolæ of median depth, frontal groove shallow; frontal shield flat, a little concaved above, closely punctured, iridescent; frontal carina short, blunt, upper side convex; median ocellus very sunken, posterior ones well carinated in front, no ocellar pits present; eyes small, very far apart, so that the face is extremely wide; antennæ of the usual female form; vertex just behind the posterior ocelli prominently raised, green and blue colored, punctation large, coarse and abundant; cheeks blue, purple and green mixed, large but sparse punctures.

Thorax with disk large and black, color otherwise blue and green, also on sides and below; pilosity short and sparse above, black with gray mixed, entirely black and longer on sides and beneath; scutellum green, well punctured, post-scutellum narrow and well punctured.

Abdomen above olive green with some blue at the apex, venter blue with tints of green; punctation fine and sparse above, very abundant below; a patch of grayish white hairs at the sides of segment one, everywhere else black; epipygium large, wide at the base, spines stout.

Wings fusco-hyaline with a strong violet tint, darkened at the apex; tegulæ bluish green. Legs greenish blue, hairs black; tibial scale very prominent, both lower teeth sharp, the anterior one more narrowed, irregular above.

Male.—Differs from the female as follows: Head smaller, not thick, face narrower, entirely dark with more green and purple; mandibles smaller, upper longitudinal groove deep, lower one more pronounced than in female, lower tooth at apex much the larger of the two; labrum with one triangular lobe, sometimes apparently trapezoidal; clypeus convex, longitudinal carina more prominent; frontal carina smaller and more pointed, upper margin flat; median ocellus less sunken, posterior ones less carinated in front; eyes much larger and converging slightly above; vertex behind posterior ocelli flat, cheeks not so thick. Thorax with the gray hairs more evident above, and present on each side below the wings, being entirely black below, only. Abdomen shorter and more robust, punctation above much finer and closer on the first four segments, coarse but abundant on the remaining segments; pilosity grayish-white on the whole of first segment, and laterally on the hind margin of the fourth and sometimes on the third segments, otherwise black; wings a little lighter, tegulæ brown, legs with tibial scale reduced to a point, inner surface of posterior tibiæ with short brown hair.

Type.—In the Acad. of Nat. Sc. at Philadelphia a female labeled "Lecto-type, No. 2619" "Cala."

Distribution.—California, Nevada, Colorado and South Dakota.

This species is of a distinct olive green color in both sexes; wings fusco-fuliginous with a violet tint. It is very similar to *arizonensis* (Cress.). Cresson described only the female of this species, while the first record that I find of a description to fit the male is by Peréz in 1901, who names his specimens *amblardi*. Peréz says that *amblardi* is very similar to *virginica* but, according to his description, there is no doubt that his species is the male of *californica* (Cresson). In 1912 Maidl recognized and described it under its right name.

Xylocopa arizonensis Cresson.

Xylocopa arizonensis Cresson, Trans. Am. Ent. Soc., VII, p. 212, ♀, ♂, 1879.

Xylocopa californica arizonensis Cockerell, South. Cal. Acad. Sc., No. 6, p. 87, June, 1904.
Xylocopa arizonensis Maidl, Ann. Nat. Hist. Hof.-Mus. Wien, p. 310, 1912.

Length of female, 25–27 mm.; of male, 22–24 mm.

Female.—Head thick, almost as wide as thorax, black, blue and purple mixed; well punctured, especially on the face; hairs entirely black; mandibles black, very wide, with two teeth, base not depressed and with few punctures, inner longitudinal groove not very deep, outer one faint; labrum semioblong, emarginate in the middle so as to form two lobes, small and black; clypeus flat, closely punctured, black and blue, longitudinal carina very faint; lateral foveolæ and frontal grooves of median depth; frontal shield iridescent, wide, flat in its lower half, deeply concaved above just beneath the point of the frontal carina, which is short, blunt, with the upper margin convex; ocelli large, median one deeply sunken, posterior ones very carinated in front, no ocellar pits present; eyes small and wide apart; antennæ of usual female type; vertex prominently raised behind the posterior ocelli, brilliantly blue colored, large and close punctures; cheeks well punctured, deep purple.

Thorax black, blue and purple, disk large and unpunctured; hair black everywhere, short and sparse above; scutellum well punctate except on anterior margin, blue colored and wide, post-scutellum narrow and well punctured.

Abdomen brilliant blue with purple reflections, punctation fine and sparse above, very abundant below, hairs everywhere black; epipygium large, wide at the base, spines stout.

Wings fuliginous, violaceous blue with purple tints, tegulæ blue. Legs bluish purple with black hairs; tibial scale large and prominent, both lower teeth sharp, the anterior one more narrowed throughout, irregularly notched above.

Male.—Differs from the other sex as follows: Head smaller, not so thick, face narrower, blue and purple; mandibles much smaller, lower tooth at apex much larger; labrum of one triangular lobe, appearing trapezoidal in some specimens; clypeus convex, more sparsely punctate, longitudinal carina more prominent; frontal shield convex and not concaved above, lateral foveolæ and frontal grooves deeper; frontal carina pointed, upper margin flat; median ocellus not deeply sunken, less carinated in front; eyes much larger, slightly converging above, so that the face is quite reduced; vertex above flat, punctures smaller, cheeks less thickened.

Thorax having pale ochraceous hairs mixed with the black above and on the sides, black hairs below. Abdomen somewhat shorter, pale ochraceous hairs on the whole of the first segment, otherwise black; punctation above much finer and closer on the first four segments, coarse but abundant on the remaining segments. Wings about as in female; legs with tibial scale reduced.

Variations.—I have a male from Alamogordo, N. M., which has been described by Cockerell as a variety (*arizonensis*) of the species *californica*. I include this individual as a variation of the species *arizonensis* (Cress.). It differs from the typical male *arizonensis* described above, only as follows: Clypeus yellow except along the lower margin where it is black; two brown longitudinal bands on the yellow area.

Types.—A female lecto-type No. 2621, from Tucson, Arizona, and a male allo-type from Prescott, Arizona, in the Acad. Nat. Sc. at Philadelphia.

Distribution.—Arizona, New Mexico, Lower California, Texas and Mexico.

This species can be recognized by its brilliant blue color and by the fuliginous, almost opaque wings. It resembles *californica* very closely and has even been called a subspecies of it. The wings of *arizonensis* are much darker and more deeply colored than those of *californica* and the color of the integument of the two species also is specifically different. Having studied the types of *arizonensis* and *californica* as well as having found a difference in the genitalia, there is no doubt in my mind that they are distinct species. The female of *arizonensis* has the hairs of the abdomen black everywhere, while the *californica* female has pale ochraceous hairs on the first abdominal segment. The male of *arizonensis* has pale ochraceous pilosity on the sides of the first abdominal segment only, while *californica* has these pale hairs on the whole first segment as well as on the hind margin laterally of segments three and four and a few along the sides of the intervening segments. From the above I see no reason why these two species should be regarded as one, even though both have many structural characters in common.

On plate III, fig. 27, of The Insect Book Howard figures *Xylocopa arizonensis.*

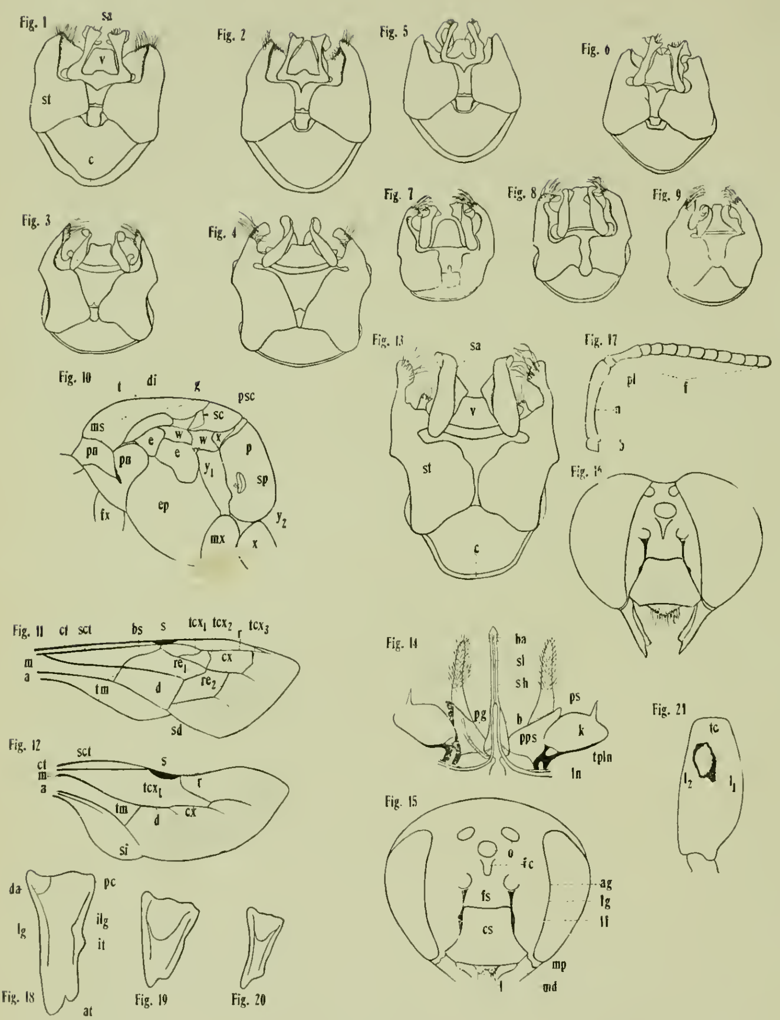
Fig. 1
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Fig. 14
Fig. 15
Fig. 16
Fig. 17
Fig. 18
Fig. 19
Fig. 20
Fig. 21

Xylocopa.

EXPLANATION OF PLATE 10.

Fig. 1. Dorsal view of genitalia of *Xylocopa arizonensis.*
Fig. 2. Genitalia of *Xylocopa californica.*
Fig. 3. Genitalia of *Xylocopa brasilianorum æneipennis.*
Fig. 4. Genitalia of *Xylocopa brasilianorum brasilianorum.*
Fig. 5. Genitalia of *Xylocopa texana.*
Fig. 6. Genitalia of *Xylocopa virginica.*
Fig. 7. Genitalia of *Xylocopa tabaniformis.*
Fig. 8. Genitalia of *Xylocopa orpifex.*
Fig. 9. Genitalia of *Xylocopa micans.*
Fig. 10. Side view of thorax of *Xylocopa virginica.*
Fig. 11. Anterior wing of female of *Xylocopa virginica.*
Fig. 12. Hind wing of female of *Xylocopa virginica.*
Fig. 13. Genitalia of *Xylocopa fimbriata.*
Fig. 14. Ventral view of sting of *Xylocopa virginica.*
Fig. 15. Front view of head of female *Xylocopa arizonensis.*
Fig. 16. Front view of head of male *Xylocopa virginica.*
Fig. 17. Antenna of male *Xylocopa californica.*
Fig. 18. Mandible of female of *Xylocopa finbriata.*
Fig. 19. Mandible of female of *Xylocopa virginica.*
Fig. 20. Mandible of male of *Xylocopa virginica.*
Fig. 21. Tibia of female of *Xylocopa virginica,* with tibial scale.

INDEX TO LETTERING OF PLATE 10.

a anal vein.
ag antennal grooves.
at apical teeth.
b bulb.
ba barbs.
bs basal vein.
c cardo.
cs clypeus.
ct costal vein.
cx cubital vein.
d discoidal vein.
da depressed area.
di disk.
e epimeron.
ep episternum.
f flagellum.
fo frontal carina.
fg frontal grooves
fs frontal shield.
fx front coxa.
g fused plate of scutellum.
o ocelli.
olg outer longitudinal groove.
p propodeum.
pc punctures.
pg poison gland.
pl pedicel.
pn pronotum.
pnl pronotal lobe.
ps palpi of sting.
pps palpi-plates of sting.
psc postscutellum.
r radial vein.
re_1 first recurrent vein.
re_2 second recurrent vein.
s stigma.
sa sagitta.
sc scutellum.
sct subcostal vein.
sd sub-discoidal vein.
sh sheath.
si sinus.

hx	hind coxa.	*sl*	sting canal.
ilg	inner longitudinal groove.	*sp*	spiracle.
it	inner tooth.	*st*	stipes.
k	quadrate plate.	*t*	tegula.
l	labrum.	*tc*	tibial scale.
lf	lateral foveolae.	tcx_1	first transverso cubital vein.
ln	lancet.	tcx_2	second transverso cubital vein.
l_1	anterior lobe.	tcx_3	third transverso cubital vein.
l_2	posterior lobe.	*tm*	transverso medial vein.
m	median vein.	*tpln*	triangular plate of lancet.
md	mandible.	*v*	spatha.
mp	malar space.	*w*	wing process.
ms	mesoscutum.	*x*	plate of metanotum.
mx	median coxa.	*y*	pleural plate of metanotum.
n	scape.	y_2	pleural plate of metanotum.

A REMARKABLE NEW GENUS OF ENCYRTIDÆ FROM THE WEST INDIES, BEARING TWO RING-JOINTS.

By A. A. Girault,

Washington, D. C.

The following Aphelinine-like genus is unique (save for *Meromyzobia* Ashmead) in bearing two large, distinct ring-joints in the antennæ. It differs from *Meromyzobia* in form, the funicle is but 3-jointed and the club is not long and solid but also 3-jointed.

AMEROMYZOBIA new genus.

Female.—Shaped like *Aphelinus* but the ovipositor distinctly extruded. In my table to the earth's encyrtine genera runs to *Coccobius*, a genus based on composite specimens (an *Aphelinus* and an *Arrhenophagus*). Head nearly round, thin, the face inflexed, the frons not prominent, of moderate width, the cheeks distinct but not so long as the eyes. Mandibles with three subequal, subacute teeth. Antennæ 10-jointed, with two distinct ring-joints (as in most Pteromalidæ), excluding the latter, as in *Coccophagus*. Fore wing broader than with *Aphelinus*, the hairless line present, the marginal vein nearly twice longer than wide, the stigmal somewhat over twice its length, long, the postmarginal obsolete or nearly. Marginal fringes of fore wings a little longer than normal (that is, not extremely short). Fore wing densely ciliate. Ovipositor extruded for a length equal to three fourths that of the ovate abdomen. Axillæ united acutely. Propodeum cross-linear mesad, much longer laterad.

Ameromyzobia aphelinoides new species. Genotype.

Female.—Length 0.90 mm., excluding the ovipositor.

Golden yellow, the wings slightly infuscated throughout, the distal half of the abdomen, the funicle, the propodeum except mesad and the extruded valves of the ovipositor, dusky or black. Scutum and scutellum with sparse, rather long, black setæ. Funicles one to two subequal, each not quite twice longer than wide, a little shorter than the pedicel, three a little shorter than two. Club definite, slightly wider than the funicle and nearly as long. Second ring-joint a little larger than the first, both wider than long.

The male appears to be similar but no perfect specimen at hand.

From one pair in the U. S. National Museum from St. Vincent, West Indies (H. H. Smith).

Type.—Catalogue No. 20294, U. S. National Museum, the female on a slide.

TWO NEW CICADAS BELONGING TO THE GENUS OKANAGANA.

BY WM. T. DAVIS,

NEW BRIGHTON, STATEN ISLAND, N. Y.

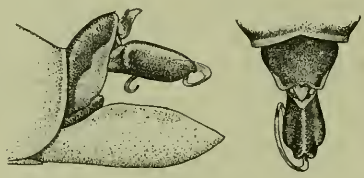
Through the courtesy of Mr. Edward P. Van Duzee I am enabled to describe a new species of *Okanagana* from Oregon. The fifteen specimens examined came originally from the Oregon Agricultural College and Experiment Station, Corvallis, Oregon.

Okanagana oregona new species.

Type male, Mary's Peak, Oregon, July 18, 1903. Davis collection.

Allotype female, Corvallis, Oregon, June 4. Collection Edw. P. Van Duzee.

Head as broad as the front margin of the pronotum; front not much produced. Median sulcus of the front deep and well defined. Pronotum with the humeral angles rounded and the anterior angles rather prominent. Opercula oblique with the extremities not as rounded as in some species of the genus. Last ventral segment with the base about as long as the sides which gradually converge to the rounded extremity. Uncus when viewed in profile sinuated but not hooked at the end; when viewed from above broadened out



and then constricted before the extremity which is notched. Basal areole of the fore wings clear or very little clouded, oblong, square at apex. Costa of the fore wings yellowish to beyond the middle, then fuscous; flaps at base of wings bright red; the dark clouded spot at base of cubital cell, common to many species, is not present, there is, however, the usual black spot at the extreme base of the wing. Hind wings entirely bright red at base, the red edged outwardly with irregular clouded spots. The dorsum partly covered with short golden hairs, especially on the abdomen, while the underside is clothed with rather long silky hairs. Head black with the supra-antennal plates, a band, expanded at the extremities extending transversely before the front ocellus, and the median groove leading from the ocellus to the hind margin, yellowish. Beneath, the head is black in the region of the transverse rugæ, margined with yellowish. Pronotum black, margined all around, but very narrowly in front, with yellowish. Metanotum black, posteriorly margined with yellowish. Dorsum of the abdomen black, the segments edged posteriorly with reddish. Uncus black. Beneath, pale, including the valve, with black spots and stripes about the legs. There are some conspicuous black markings at the base of the abdomen, and more than the terminal half of the rostrum is shining black.

MEASUREMENTS (IN MILLIMETERS).

	Male type.	Female allotype
Length of body	20	19
Width of head across eyes	6	6
Expanse of fore wings	48	50
Greatest width of fore wing	8	8.5
Greatest width of operculum	2.5	
Length of valve	4	

In addition to the type which is figured and allotype, the following specimens have been examined: Corvallis, Oregon, June 29, 1896, female; June, 1906, male (Buchanan); May 27, female (Currin); July 9, male; August, female. Mary's Peak, Oregon, July 18, 1903, three males (Gellatly). Eugene, Oregon, June 10, 1905, male (Foster). Crooked River, Oregon, June 23, 1906, male and female in copulation; also female marked 1906. Philomath, Oregon, September 14, 1906, male.

Accompanying these specimens there is a pupa 20 mm. in length and 6 mm. across the eyes. It is an *Okanagana* pupa and probably belongs to this species. The long series of specimens shows this to be a distinct species. It is not the *Cicada occidentalis* described by Francis Walker in The Naturalist in Vancouver Island and British Columbia by John Keast Lord, London, 1866, which is a much larger insect with different markings.

From the collection of the University of Kansas I have received for study through the kindness of Prof. S. J. Hunter and Mr. R. H. Beamer, a female *Okanagana* that differs considerably from other members of the genus known to me.

Okanagana rotundifrons new species.

Type, female, Congress Junction, Yavapai Co., Arizona, July (F. H. Snow).

A shining black and yellowish species with a conspicuously blunt and rounded front.

Head as broad as the front margin of the prothorax; the front blunt and rounded; the median sulcus broad and shallow. Pronotum with the humeral angles rounded, and the anterior angles both rounded and deflexed. The last ventral segment is broadly and deeply notched. Fore wings with the basal areole oblong, square at apex, and very clear; venation, including the costal and subcostal veins, shining black, except along the inner margins of the costal and subcostal veins and at the base of the wings, which is straw colored. Flaps of the fore wings pinkish in color; of the hind wings also pinkish but including a fuscous dash. Head above shining black, the supra-antennal plates yellowish except close to the eyes and the transverse groove above the front also yellowish. The front is shining black except a well defined line bordering the sides at the edge of the transverse rugæ. Pronotum shining black, the hind margin and median sulcus yellowish, the remainder of the surface intricately mottled with yellowish and black. Mesonotum shining black, with the hind margin narrowly yellowish, also a yellowish spot near the base of each fore wing. The W-mark is nearly obliterated, only the outer lines showing faintly. Metanotum black with the posterior margin yellowish. Dorsum of the abdomen shining black with the hind margins of all the segments edged with yellowish. Beneath, the legs are black, touched, particularly at the joints and narrowly along the sides, with yellowish; each abdominal segment is shining black at the base and yellowish on the posterior margin. The yellowish areas, both above and below, are also shining.

MEASUREMENTS (IN MILLIMETERS).

	Female type.
Length of body	25
Width of head across eyes	8
Expanse of fore wings	71
Greatest width of fore wing	11.5

While the type is so far the only known specimen, this species may be easily separated from all the other described members of the genus by the peculiarly blunt and rounded front and shining black and yellowish surface.

Explanation of Plate ii.

Fig. 1. *Okanagana oregona* Davis. Type.
Fig. 2. *Okanagana rotundifrons* Davis. Type.
Fig. 3. *Okanagana rotundifrons* greatly enlarged to show rounded front.

LOUIS H. JOUTEL.

Entomologists will learn with regret of the death of Mr. Joutel at his home in New York City on September 6, 1916. He was well known as a natural history artist whose work was remarkable for its accuracy, and as a careful student of insects. He faithfully served the New York Entomological Society in many ways and for some years was its treasurer, until failing health prevented further activities. A more extended account of his work will be published in a future number of the Journal.

CHRISTOPHER H. ROBERTS.

As we go to press we learn of the death, on September 29, at Pawling, N. Y., of Christopher H. Roberts, a former president of the New York Entomological Society, and one of our best known members. A more detailed notice will appear in a later issue.

Cicadidæ.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY.

MEETING OF MAY 2, 1916.

A regular meeting of the New York Entomological Society was held on May 2, 1916, at 8:15 P.M., in the American Museum of Natural History, President Harry G. Barber in the chair, with seventeen members and three visitors present.

The Curator reported gift of insects from Natal from Mr. S. G. Rich.

Mr. Wunder for the Outing Committee, brought up a Decoration Day meeting at Lahaway for discussion. The Secretary was instructed to put a notice in the Bulletin and further action was deferred to the next meeting.

Mr. Schaeffer for the Publication Committee, reported progress and interest shown in the Van Duzee List.

Dr. J. Bequaert read "Remarks on North American Nycteribiids," illustrated by specimens of these bat parasites and the related Streblidæ of similar habits, pointing out the comparative scarcity of Nycteribiidæ in the new world, three species only being known out of fifty-four described in the family. The taxonomy of the family was discussed and will be published later.

The paper was discussed by the President and Dr. Lutz.

Mr. Watson exhibited *Atrytone zabulon,* contributing a note in reference thereto, which will be printed in Miscellaneous Notes; also a small collection of Lepidoptera from the River Amazon, between Para and Manaos, collected by Dr. J. P. Thornley, on board a steamer during February; and several boxes of Florida Rhopalocera, collected by the Museum Expedition of 1914, covering northern Florida, from Jacksonville to Pensacola, September 25 to October 21. Mr. Watson said that the total number of species and varieties was 73, of which 60 were found at Gainesville. The best single day's collection was on September 28 at Gainesville, when 35 species and varieties were taken; but at Pensacola four males of *Thanaos funeralis* Scudder & Burgess, a species not heretofore recorded from Florida, were found. The complete record will be included in a forthcoming List of Florida Lepidoptera.

Mr. Davis, after commenting on the skilful preparation of Mr. Watson's butterflies, spoke of the abundance of the dogshead butterfly at Wilmington and Southern Pines, N. C., he had noted during the past fortnight and of the excellent wild country near Southport, N. C., where he and Mr. Barber had also collected and where he had been able to personally experience the effects of rattlesnake bite without serious results.

The snake, a small ground rattler, about nine or ten inches long was found disappearing in a pile of bricks, and its identity being unsuspected from the usual rattles being replaced by a small button, was seized by the middle, permitting it to turn and inflict a wound on one finger, followed by great swelling and, by the next morning, some giddiness and much discoloration of the affected parts. The specimen, fortunately young, was shown by Mr. Davis and the inconvenient but interesting experience served to corroborate Cope's mention of its occurrence in North Carolina, for Mr. Brimley's List, without interfering with his insect collecting.

Mr. Barber added some further details of the interest locally excited by Mr. Davis's experience and spoke of the case with which Southport is reached by Atlantic Coast Line in about eighteen hours, and the excellent prospects for collecting there later in the season. There was no sweeping to speak of in the latter part of April and little sweeping, the collecting being mainly in beating pine and cedar.

Mr. Davis spoke again of some of the friends he had visited, particularly of Mr. and Mrs. Manee, the latter being an able assistant to her husband, obtaining interesting results from trowel investigations of suspicious holes in the ground, and of Mr. Schwarz and H. S. Barber, with his filial devotion to his senior.

Mr. Dow exhibited beetles from Lahaway, offering any desirable specimens to his fellow members, and of the photograph of Mr. Shoemaker, taken to commemorate his fiftieth birthday.

THE

NEW YORK ENTOMOLOGICAL SOCIETY.

Organized June 29, 1892.—Incorporated June 7, 1893.

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Eighth Ave.

Annual dues for Active Members, $3.00.

Members of the Society will please remit their annual dues, payable in January, to the treasurer.

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OF THE

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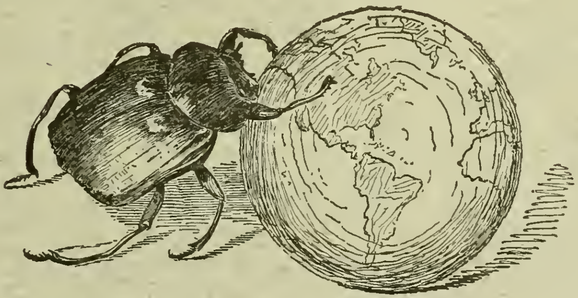

DECEMBER, 1916.

Edited by CHARLES SCHAEFFER

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JOURNAL

OF THE

New York Entomological Society.

VOL. XXIV. DECEMBER, 1916. No. 4.

LOUIS H. JOUTEL.

BY WM. T. DAVIS,

NEW BRIGHTON, STATEN ISLAND, N. Y.

More than half a century ago a number of families from France settled a short distance north of the Delaware River, in Delaware County, New York, at what was subsequently called French Woods, and there, on August 19, 1858, Louis Hippolyte Joutel was born. A little later his family removed to New York City, where he attended public school; then the art school in Cooper Union, and being an exceptionally good observer he picked up considerable knowledge about a number of subjects. For about thirty-five years he lived in the house at 164 East 117th St. In early days the surroundings were much more rural, but the great city gradually became densely built over and the population about his home more and more crowded. The garden, however, in which he and his sister took such a keen interest, remained the same, or there were only those small changes brought about by the planting of more trees, the foliage of which was to serve as food for many broods of caterpillars. This garden was small, for the house stood on but a city lot, yet it contained a greenhouse, where cacti in particular were grown, also beds of flowers and about twenty small forest trees that with characteristic ingenuity had been strapped to the fence and were from time to time skillfully pruned to keep them within bounds. Here in this garden he and his sister carried on many experiments; numerous species of moths were reared and even crossed, some of the hybrids being remarkable for their intermediate characters. In summer there were a number of aquaria in the garden and no pains were spared to rear gold fish of fantastic forms, and as many other species as would survive in so confined an area as a big glass jar or a tank.

From this interesting home many excursions were made to Bronx Park, Fort Lee and other nearby places in New Jersey, to Staten Island and to Long Island, in search of specimens. Sometimes it was for insects, but often for plants and fish for the aquaria, in fact for anything in nature that appeared interesting and unusual.

Many excursions were made to collect material in aid of his work, for Mr. Joutel was one of the most skillful natural history artists in America, and his knowledge of insects and their habits was a great asset in connection with his artistic work. His illustrations are well known. They will be found in some of Dr. Alpheus S. Packard's works, such as his Monograph of the Bombycine Moths of North America, in the reports of Dr. Ephraim P. Felt, state entomologist of New York; in some of the reports of the New Jersey state entomologist, in the Bulletins of the American Museum of Natural History and in many other publications devoted to entomology. Mr. Joutel was an illustrator for Harper and Brothers for a number of years, but when able, relinquished his work as a general illustrator and devoted himself to natural history subjects. This gave him a chance to investigate; to go afield in connection with his work, and before ill health prevented, he was active in rearing many kinds of insects, as well as fish, frogs, etc. He even raised some land or box turtles in his little garden. Facts of interest in connection with his entomological investigations were often presented at the meetings of the New York Entomological Society up to the year 1910. At the meeting of April 20, 1897, he exhibited about fifty species of beetles, mostly Longicorns that had been bred by him, and throughout the early published proceedings of the Society there is much information contributed by Mr. Joutel.

In the summer of 1903 Mr. Joutel was ill and later had pneumonia. Though he seemed at the time to recover from this attack, his illness gradually developed into consumption, but at his age the progress of the disease was not very rapid. No one was a better judge of his condition than he, not even the several doctors that examined him, and his shrewd observations on the matter, as indeed on many other things, was what often made a call on Mr. Joutel so interesting. He would point out some nice little differences in the insects he had lately examined, show you a cactus that had been skillfully grafted, or make some comical comments about himself. He certainly was most ingenious and had the ability to look at things, himself included, from several points of view. As to his skill in mechanical accomplishment, it may be stated that he decided to change the heating plant in his home, so he bought the materials and installed a hot water system, doing all the work himself. He said it was good exercise, for part of the day he would be sitting all too quietly drawing insects for Prof. Packard or Dr. Felt.

It is to be regretted that Mr. Joutel did not publish more of his observations, especially on white ants, of which he gave several interesting accounts to the New York Entomological Society. In July, 1903, he wrote in a letter: "I had a sad accident happen to my white ants. The cats had a fight among the jars and the whole thing was destroyed. I spent the morning looking over the debris for a few pairs and found two, so I will have to start fresh. I cut up the logs I brought home and was fortunate to find an old queen in one and she is now laying lots of eggs. She is about so long —————, and does not seem able to walk alone, but with the help of the workers she moves about from one place to another."

It has often been said that the Monograph of the Genus Saperda by Dr. Felt and Mr. Joutel was a model of its kind and in the preface to that work it is stated that "the junior author has undertaken the illustrations and systematic study of the species." His part in this work was probably his chief contribution to entomology, but his many fine plates drawn for Dr. Packard's monographs must not be forgotten in this connection.

Mr. Joutel was recording secretary of the New York Entomological Society from 1894 to 1897; treasurer from 1898 to 1903, and also served on many of the standing committees. The Society never had a better member; one who was more willing to do his best for its welfare. He passed away September 6, 1916, and is buried in Greenwood Cemetery, Brooklyn, New York.

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1906. Observations on Cicada tibicen L. and Allied Forms. (In conjunction with Wm. T. Davis.) < Entomological News, 17: 237–239.

1907. Philosamia Cynthia and Callosamia Promethea Crosses. < JOURNAL N. Y. ENTO. SOC., XV: 101–103.

1911. Phymatodes lengi, Joutel. < JOURNAL N. Y. ENTO. SOC., XIX: 198.

In the published Proceedings of the New York Entomological Society are to be found many contributions by Mr. Joutel, the most important of which are as follows:

Exhibition of *Leptura emarginata* found ovipositing in the branch of a white oak; meeting, October 1, 1895.

Notes on the life history of species of *Saperda* and *Goes;* meeting, Nov. 19, 1895.

Exhibition of *Cyllene pictus* and its borings in hickory; meeting, March 3, 1896.

Exhibition of the cruel plant, *Physianthus albens,* with insects hanging from the flowers; meetings, October 6 and 20, 1896.

On the breeding habits of beetles and exhibition of specimens; meeting, April 20, 1897.

On the protective habit of *Cotalpa lanigera* in drawing the edges of the leaves together; meeting, January 4, 1898.

Ceruchus piceus in decayed white birch; meeting, February 15, 1898.

Variety of *Spilosoma latipennis* with yellow forelegs; meeting, October 4, 1898.

Crioceris 13-punctata on Long Island, N. Y., and *Callida punctata* in Bronx Park; meeting, October 3, 1899.

Exhibition of all of the described species of *Saperda;* meeting, February 4, 1902.

The ear-wig, *Anisolabia maritima,* common along the East River under rubbish; meeting, March 4, 1902.

Exhibition of reared specimens of *Hydroecia appassionata,* a rare moth; meeting, October 21, 1902.

Exhibition of *Yama-mai* moths showing variations in color; meeting, January 20, 1903.

Food habits of *Goes pulverulenta;* meeting, April 7, 1903.

On the stridulation of *Cychrus viduus,* meeting, October 6, 1903.

Exhibition of species of *Saperda* from North America, Europe and Asia; meeting, December 4, 1904.

Louis H. Joutel.

Observations on white ants; meeting, December 19, 1905.

North American forms of the genus *Strategus;* meeting, December 18, 1906.

Exhibition of pamphlet by Spinola, 1839, wherein are described and figured a few species of peculiar Coleoptera; meeting, January 15, 1907.

The Ptinid beetle, *Gibbium scotias,* collected by Wm. T. Davis in the New York Produce Exchange; meeting, April 2, 1907.

Exhibition of Cynthia and Promethea moth hybrids with remarks on the same; meeting, May 21, 1907.

Some curious results of the crossing of Cynthia and Promethea moths and some interesting variations of Cynthia; meeting, November 19, 1907.

Differences in the color of adult moths affected by feeding the caterpillars in the dark; meeting, March 3, 1908.

On the habits of the white ant, *Termes flavipes;* meeting, October 19, 1909.

A Scarabaeid new to Long Island, *Trichius texanus* Horn, collected by Mr. Engelhardt; meeting, March 15, 1910.

Thelydrias contractus difficult to kill with bisulphide of carbon; meeting, May 3, 1910.

BIOLOGICAL NOTES ON CEUTORHYNCHUS MARGINATUS PAYKULL (COL.).[1]

By S. W. Frost.

Ithaca, N. Y.

During the past season the writer found the larvæ of a small beetle feeding on the ovules and seeds of the dandelion. This insect attracted much attention, for little seemed to be known about it. Specimens were sent to C. W. Leng, who identified them as *Ceutorhynchus marginatus* Payk., a European species heretofore unknown to America. The abundance of the insect, its interesting habits, and undoubted economic importance induced the writer to make a study of its life history.

At this point the writer wishes to express his thanks to Dr. Robert Matheson who has assisted greatly in correcting and arranging this paper.

Historical.

From an examination of the European literature it appeared that very little was known of the life history and habits of this beetle. It

[1] Contribution from the Entomological Laboratory of Cornell University.

was originally described by Paykull (1792). Since that time several systematic papers dealing with this group have been published by various authors among which Gyllenhal, Schultz, Weiss, Bedel, Rye, Perris, and Edwards are the most important. Practically nothing has been published on its life history. Kawall (1867) gives a few notes on the larva of *Cœliodes punctiger* Schh. (= *Ceutorhynchus marginatus* var. *punctiger* Gyll.) occurring in the heads of dandelions. Perris (1876) verifies Kawall's observations and states further that *C. marginatus* Payk. occurs in the heads of *Hypochœris maculata,* a plant belonging to the same group as the dandelion, *Taraxacum officinale.*

DISTRIBUTION.

This species is common throughout Europe. It has been recorded from England, Germany, France, Italy, Turkey and from several places in northern Africa. In this country, as far as known, it is not widely distributed. It has been taken in New York, Massachusetts and Ohio. The writer has found the species abundant at Ithaca, Dryden and Freeville, N. Y. Other collectors have taken it at Padlesford, Syracuse, Portage, Batavia, Sonyea, Holcomb, Nunda, and West Point, N. Y.

FOOD PLANTS.

The larva of *C. marginatus* feeds on the ovules and seeds of our common dandelion *Taraxacum officinale.* Kawall (1867) mentions the same food plant. Bargagli (1883) states that he found the larvæ working on a species of *Trifolium.* He also found the variety *C. marginatus punctiger* Gyll. feeding in the heads of *Taraxacum vulgare.* Perris (1876) and Bedel (1888) give *Hypochœris maculata,* a plant belonging to the dandelion group, as a food plant. Heretofore there has been no records of the feeding habits of the adults. An observer at Syracuse, N. Y., reported that the adults were found on lettuce and were causing serious injury. The writer has seen the adults feeding on the leaves and stems of the dandelion making large scars on the stems and eating out irregular patches on the under surface of the leaves (Plate III, fig. 4). They have not been observed feeding on lettuce though close search has been made about Ithaca.

It is interesting to note that most of the North American species of *Ceutorhynchus,* north of Mexico, which have been studied, forty-seven according to Chittenden, have been found on cruciferous plants. Blatchley and Leng (1916) state that *C. neglectus* probably feeds on *Polygonum sp.* The species of *Ceutorhynchus* occurring in Europe have been found on many plants other than the cruciferæ; Polygonum is mentioned by Blatchley and Leng, and Bargagli (1883) gives a long list of plants on which they occur.

This beetle is evidently capable of playing an important part in checking the spread of the dandelion. The writer has observed that an enormous amount of seed is destroyed by the larvæ of this beetle. When four or five larvæ are present a large percentage of the seeds are destroyed. During the egg-laying period one thousand four hundred dandelion heads were examined to determine the percentage of infestation. These were gathered from five different localities about Ithaca, N. Y., and are representative. Sixty-five per cent. of the dandelions were found to be infested. The preceding summer no counts were made but the writer is of the opinion that the infestation was even greater. The following table gives the counts made in 1916.

Number of Heads Examined.	Number of Heads Infested.	Number of Heads Free.	Percentage Infestation.
300	220	80	73%
300	158	142	52%
300	141	159	47%
300	261	39	87%
200	128	72	64%
1,400	908	492	65%

A number of counts was also made to determine the percentage of seeds eaten in a single flower head.

Number of Larvæ Present.	Total Number of Seeds.	Number of Seeds Eaten.	Percentage of Seeds Eaten.
2	198	38	24%
2	186	20	11%
4	162	84	51%
?	169	51	31%
2	166	86	51%
1	137	70	51%
?	169	63	35%
3	186	68	36%

Life History.

On April twenty-six the beetles were first observed coming out of their hibernating quarters. A few days later egg laying commenced. April thirtieth eggs were found abundant out of doors although pairs of beetles which were kept indoors did not commence laying until May 2. The writer had no difficulty in inducing the beetles to lay in captivity.

Copulation lasts for five or six minutes. The male grasps the female about the abdomen with his middle and hind legs. His front legs are stretched forwards and the claws are hooked over the front edge of the prothorax of the female. A few minutes after copulation the female becomes nervous and wanders over the dandelion bud and finally comes to rest at the base of the bud with her head downward. She here proceeds to bore a hole into the bud with her proboscis. At first she eats her way through the involucre, then works her beak between the ovules until she forces it down its entire length into the bud. This takes her about nineteen or twenty minutes, after which she turns about quickly and lays her eggs through the hole she has made. The number of eggs laid in a single puncture varies from one to five. From an examination of over two hundred dandelion heads two eggs were found to be the average number. It is not uncommon to find as many as three or four egg punctures in a single bud, so that a bud may contain as many as ten eggs. Infested buds are very conspicuous because of the black masses at their base formed by the milky fluid of the dandelion which oozes through the egg punctures and hardens on the outside.

The eggs are laid throughout a considerable period of time. A number of experiments were carried on to determine the oviposition period. All the beetles used in these experiments were collected before egg laying was observed out of doors. The first eggs laid in captivity were on the second of May. During May eggs were very abundant but in June egg laying was greatly reduced and in July only a few eggs were laid. Thus the oviposition period lasts a little over two months.

TABLE OF NUMBER OF EGGS LAID BY CEUTORHYNCHUS MARGINATUS PAYK.

Exp. No.	April.					May.														
	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B 19	..	×	..	..	..	..	..	..	2	4	4	5	2	5	6	3	..	3	..	..
B 20	..	×	..	..	♂♀D.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 21	×	..	..	..	..	..	..	4	3	6	2	..	2	..	1	..	..	..	..	..
B 22	×	..	..	..	..	..	..	..	1	♀D.	..	..	..	..	..	..	..	..	..	..
B 23	×	..	..	..	..	..	..	..	..	2	..	3	..	1	..	..	..	2	..	..
B 24	×	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	♀D.
B 25	×	..	..	..	..	..	..	..	..	5	3	2	2	3	..	1	..	1	1	..
B 26	×	..	..	..	..	..	2	5	5	2	2	2	..	..	..	2	..	1	..	..
B 27	×	..	..	..	..	..	..	..	..	..	..	..	1	3	..	..	..	..	..	..
B 28	×	..	..	..	..	..	..	5	2	2	♂L.R.	..	1	2	7	3	..	2	2	4
B 29	×	..	..	..	..	..	..	..	..	♀L.	..	..	..	..	..	..	..	..	..	..
B 31	..	..	..	..	..	×	..	..	..	2	..	3	1	C.8	5	2	2	4	3	4
B 32	..	..	..	..	..	×	..	..	..	2	..	3	2	2	1	1	..	3	.	2
B 45	..	..	..	..	..	..	..	..	..	×	6	4	2	6	4	..	..	4	7	4
B 50	..	..	..	..	..	..	..	..	..	..	×	1	1	1	1	..	..	..	..	..
B 64	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	..

Exp. No.	May.															June.						
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7
B 19	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 20	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 21	..	..	..	..	..	..	3	..	..	3	2	..	..	5	..	..	..	..	..	..	1	..
B 22	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 23	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 24	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 25	4	3	..	..	..	..	..	..	..	♂♀L.	..	..	..	..	..	..	..	..	..	..	..	..
B 26	..	..	..	..	3	..	2	..	..	..	C.3	..	..	2	..	..	..	7	..	..	..	..
B 27	C.	..	..	..	..	..	..	..	..	..	♂D.R.	..	..	..	..	..	..	..	..	..	..	..
B 28	4	..	..	2	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 29	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 31	2	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 32	2	..	..	..	..	..	2	..	..	..	..	..	..	..	..	4	..	..	..	..	2	..
B 45	6	5	..	2	..	..	2	2	5	..	4	..	..	..	2	..	5	..	..	3	..	..
B 50	..	..	..	..	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..	..	..	..
B 64	..	..	..	C.	..	..	1	..	..	..	C.	..	..	..	..	..	..	..	..	..	..	..

Exp. No.	June.																					
	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
B 19	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 20	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 21	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	♂L.R.	..	..	..	..	..	..
B 22	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 23	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 24	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 25	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 26	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 27	4	..	..	..	..	..	..	..	3	..	..	..	..	2	..	..	..	..	..	..	..	..
B 28	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	♂L.	..	..	..
B 29	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 31	..	..	..	..	..	..	..	..	C.	..	..	..	..	..	..	..	..	..	..	..	..	..
B 32	..	3	..	2	..	3	..	..	2	..	..	..	..	..	2	2	..	..	..	5	..	..
B 45	..	..	..	♀L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 50	..	♀D.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B 64	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

Exp. No.	June.	July.								
	30	1	2	3	4	5	6	7	8	9
B 19							♂ ♀ D.			
B 20										
B 21	2						1			
B 22										
B 23										
B 24										
B 25										
B 26			3		♀ D. ♂ L.					
B 27				♂ ♀ D.						
B 28										
B 29										
B 31		♂ D.								♀ D.
B 32						2				
B 45										
B 50										
B 64										

Exp. No.	July.									Total No. Eggs Laid.
	10	11	12	13	14	15	16	17	18	
B 19										35
B 20										0
B 21	♂ ♀ D.									36
B 22										1
B 23								♂ ♀ D.		8
B 24							♂ D.			2
B 25										25
B 26										43
B 27										13
B 28	♀ D.									38
B 29										0
B 31										38
B 32			♂ D.					♀ D.		47
B 45										73
B 50										8
B 64									♀ D.	1

× = Experiment started. C. = Copulation observed. D. = Dead. L. = Lost. R. = Replaced.

Many of the flowers are deformed by the egg punctures of the female. Punctures at the base of the bud in their normal position do not interfere with the development of the flower but frequently the female makes a puncture near the top of the bud. In this case the individual flowers of the head become distorted about the puncture and the dandelion does not develop symmetrically. There may be other reasons for deformed flowers but a puncture near the top of the bud is certain to interfere with the normal development of the flower.

The Egg.—The egg when laid is pale yellow or nearly transparent and looks like a minute drop of jelly. It is smooth, shining, and without any sculpturing. About a day before hatching the chitinized mandibles of the larva can be seen working beneath the egg shell. The shape of the egg varies somewhat. They are usually elliptical though frequently they tend towards ovoid. Length .67 mm., width .42 mm.

Larva.—The larva is perhaps the most conspicuous stage of this insect. The adults while abundant are only seen in early spring and even then they are shy and like to hide away at the base of the plant. During May and June one can pick up a dandelion bud most anywhere and be quite certain to find two or three fat grubs feeding on the seeds.

INCUBATION PERIOD OF CEUTORHYNCHUS MARGINATUS.

Exp. No.	Eggs Laid.	Eggs Hatched.	No. of Days.
B 30	April 30	May 5	5
B 35	May 2	" 5	3
B 53	" 6	" 11	5
B 63	" 8	" 13	5
B 69	" 22	" 28	6
B 3	" 24	June 1	8
B 6	" 24	" 1	8
B 7	" 24	May 30	6
B 78	June 23	June 29	6

The eggs hatch in three to eight days. Although the young larvæ take their first meal on the ovules they do not feed very much until the flowers have been fertilized and the seeds have commenced to develop. At this time the larvæ feed ravenously, seeming to be aware that they must hasten their growth before the seeds become hard and dried. They burrow into the seeds, eating out the contents and leaving nothing but the seed coats. A single larva requires from fifteen to twenty seeds for its development and when several larvæ are present nearly all the seeds of the flower head are eaten. If a dandelion head is opened at this time the presence of the larvæ is very evident for great masses of excrement and excavated seeds fill the head (Plate II, fig. 4).

The mature larva (Plate I, fig. 2) is a footless grub 5½ to 6 mm. long and 1½ mm. wide. It tapers gradually towards both ends and is widest about one third the distance from the caudal end. The divisions of the segments are distinct on the ventral side. On the dorsal side the segment are subdivided into smaller lobes, usually two. The last abdominal segment bears a fleshy proleg. The head is rather small and moderately chitinized. The eyes are missing and the antennæ are represented by a minute protuberance near the lower end of the frontal sutures.

The mandibles are not more heavily chitinized than the head except at the tips. These have two blunt teeth and a single seta on the outer margin. The epicranial suture is distinct; the main arm extends to about the middle of the head, and the two branches extend nearly to the inner angle of the mandibles where they curve inwards. The front is rather small, and bears a pair of setæ at its cephalic margin. The epicranium is not separated from the genæ by sutures. It bears on each side four setæ, one near the main arm of the epicranial suture and about the same distance from the point where the suture divides. A second seta laterad and slightly above the first. A third laterad of the branches of the epicranial suture, very close to it and about the middle of the suture. A fourth at the lower angle of the epicranium near the end of the epicranial suture. There are two setæ on the genæ, the first is at the side of the head and about half way between the first and third seta of the epicranium. The second is lateral and below the fourth seta of the epicranium. The clypeus is distinctly set off by sutures and is about three times as broad as long. The labrum is distinct and bears a pair of large median setæ and a small seta laterad of these. The under side of the labrum is complex. There are five pairs of sense cones and a pair on each of the outer margins.

Cocoon.—The cocoons (Plate III, fig. 5) are formed very shortly after the larvæ enter the ground. Several times I have noticed that larvæ, which had fallen from the flower heads, had, on the following morning, formed their cocoons. The cocoons are rather regular and oval and formed of particles of earth joined together by a viscous substance which also lines the cocoon on the inside. They are very hard and retain their shape after the beetles have emerged, which is from 26 to 33 days after the cocoon is formed.

Pupa.—About eleven days after the larva has formed its cocoon transformation takes place and a creamy white pupa is formed

(Plate I, fig. 3). There are thirty-four strong setæ which support the pupa within its cocoon. Fourteen of these are on the dorsal side, three pairs along the middle, three setæ on each of the posterior angles, and one seta on each of the anterior angles of the prothorax. On the head there are two pairs of setæ; one pair on the middle of the head directly forward and a single smaller seta on each side of the head. The beak has two pairs of setæ; one pair near the middle and a pair near the base. In addition to these there are a pair of setæ on the outer angles of each pair of legs. The antennæ appear to be joined near the base of the beak but as a matter of fact are joined near the tip, as in the adult, the long basal segment in the pupa being inclosed in the pupal skin. The last ventral abdominal segment bears a pair of chitinized hooks. Length 2.89 mm. Width, 1.97 mm.

Adult.—The adult (technically described by Blatchley and Leng, 1916, p. 444) is a small beetle about three millimeters long, broadly ovate with a distinct white patch at the base of the elytra. The head, upper parts of the thorax, elytra and legs are dark, almost black, and coarsely punctured, while the under side of the thorax and abdomen are covered with whitish scales. The beak is long and has a pair of elbowed antennæ inserted on the lower half (Plate I, fig. 4).

The adults are not very active and are rarely seen. They are shy and like to hide at the base of the plant. When the plant is jarred they drop to the ground, feigning death, the beak and legs drawn close to the body. They often remain on their backs for several minutes without moving.

There is but one generation a year and the species hibernate as adults. All the larvæ, under observation, formed their pupal cases immediately on entering the ground and emerged in 26 to 33 days. After the first two weeks of July no eggs or larvæ could be found out of doors. The beetles seem to have disappeared. All the beetles which had been laying in captivity died off during the early part of July. In the fall the beetles were found very abundant among the pine needles at the base of pine trees. On November a large number were separated from the needles. Again on February 1 the beetles were obtained by sifting the same kind of material. Trash from the fields where the beetles were abundant during the summer was examined without results. The beetles therefore leave the fields in fall and migrate to some sheltered place to pass the winter. The pine needles form a thick mat under the trees where *C. marginatus* was found very abundantly.

One cannot help but admire the way in which the transformations of this beetle have been so fitly adjusted to the development of the florescence of the dandelion. The early stages of the beetle and the formation of the flower are synchronous. In order to appreciate this it is necessary to recall the formation of the dandelion bud. It first appears as a minute shapeless bud hidden in a rosette of leaves below the surface of the ground. This bud soon pushes to the surface of the ground (Plate II, fig. 1) and becomes inviting to the beetles, for it is at this time that the adults lay their eggs in the buds. There is a comparatively short period of time in which the female must seek the bud and deposit her eggs. The eggs must be laid in the bud while it is still young. If they are not laid at this early stage the larvæ are unable to attain their full growth before the seeds ripen and become dried. Providing the eggs are laid at the proper time the larvæ attain their full growth by the time the seeds ripen and the characteristic white floats of the dandelion are formed. As the ripened seeds separate the larvæ crawl out and drop to the ground where they burrow into the soil for about an inch and form their cocoons.

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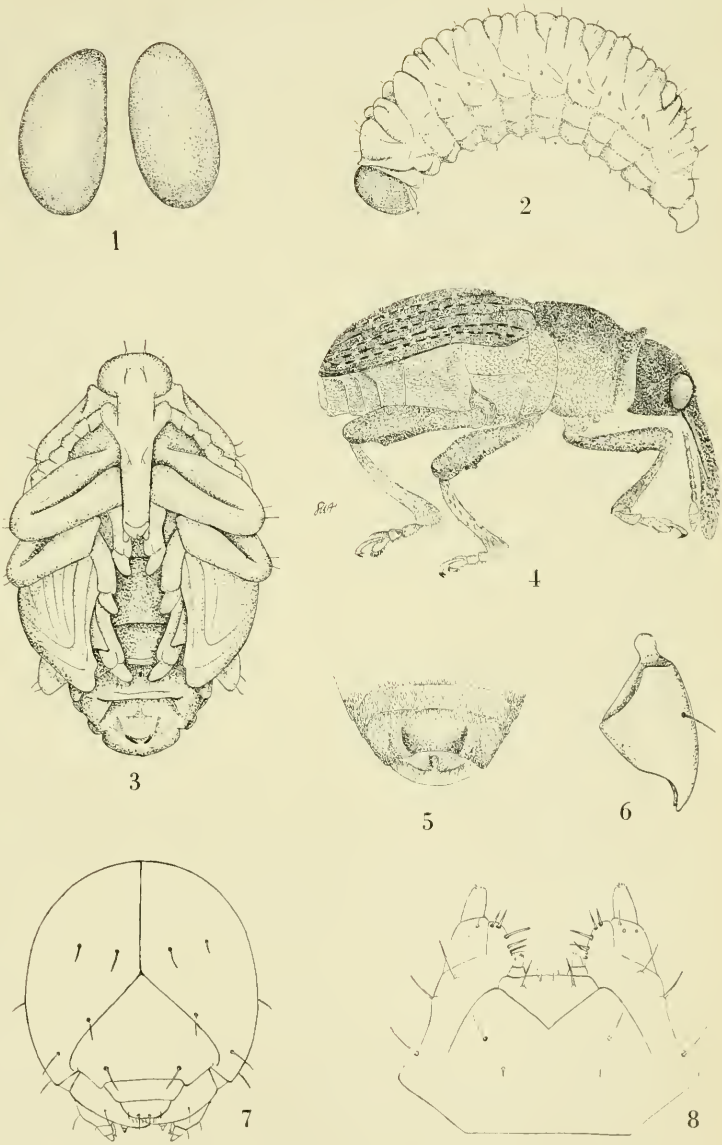

Ceutorhynchus marginatus Payk.

Ceutorhynchus marginatus Payk.

Ceutorhynchus marginatus Payk.

EXPLANATION OF PLATES.

PLATE 13.

Fig. 1. Eggs.
Fig. 2. Larva.
Fig. 3. Pupa.
Fig. 4. Adult.
Fig. 5. Pygidium of male.
Fig. 6. Mandible of larva.
Fig. 7. Head of larva.
Fig. 8. Labrum and maxillæ of larva.

PLATE 14.

Fig. 1. Dandelion rosette showing young buds at the time when the egg punctures are made.

Fig. 2. Dandelion bud showing egg puncture through the involucre; also blackened spots formed by the milky fluid of the dandelion which oozes through the egg punctures and hardens on the outside.

Fig. 3. Eggs in situ.

Fig. 4. Interior of flower head showing the work of the larva.

PLATE 15.

Fig. 1. Deformed dandelion flower (side view).
Fig. 2. Deformed dandelion flower (looking into the head).
Fig. 3. Adult.
Fig. 4. Work of adults on a dandelion leaf.
Fig. 5. Cocoons.

NOTES CONCERNING GASTROPHILUS HÆMORROIDALIS LINNÆUS (DIPT.)[1]

By R. R. PARKER,

BOZEMAN, MONT.

While studying the bionomics of the Rocky Mountain spotted fever tick in the Powder River Valley in eastern Montana, during the season of 1916, the writer was able to make several incidental observations on certain pests of cattle and horses. The most interesting of these concerned the nose fly, or redtailed bot, *Gastrophilus*

[1] Contribution from the Laboratory of the Montana State Board of Entomology, Bozeman, Montana.

hæmorrhoidalis Linnæus, and, to some extent, clear up the uncertainty concerning the reason why this fly is so obnoxious to horses.

On July 7, Mr. R. W. Wells, the writer's assistant, brought in a specimen of the nose fly captured just as it was about to "strike." At the end of the ovipositor was a minute black object, apparently an egg. Dissection of the abdomen proved this to be true and the peculiar shape of the egg at once suggested the cause of irritation to horses. Fig. 1 shows that it consists of two parts, an enlarged, laterally flattened portion and a slender, stalked portion. It seemed likely that if the latter should be thrust into the nose or lips of a horse, its penetration would undoubtedly cause a sharp pain sufficient to account for the nervous and sometimes uncontrollable fear shown by horses when the fly is "striking." The examination of several horses fully substantiated the supposition. Some eggs were found thrust in but a short distance, but most of them to the full length of the stalk. Due to their minute size they were somewhat difficult to discern, especially when the skin around the mouth was dark. They were found principally in the upper lip, but also in the lower lip and nostrils and doubtless may be inserted at other points near the mouth.

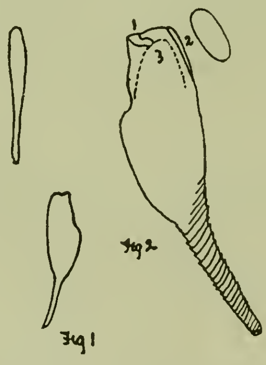

Fig. 1. Side and edge views of egg of *Gastrophilus hæmorrhoidalis.*

Fig. 2. Outline sketch of egg of *Gastrophilus hæmorrroidalis:* (1) Micropyle, (2) Cap in place and removed, (3) Developing embryo.

Eggs dissected from the abdomen averaged 1.35 millimeters in length, the stalked portion slightly more than .50 millimeter. Except near the extremity of the enlarged portion, the chorion seems to consist of chitinous bands. On the stalked portion these "bands" are widest and appear like a spiral, the margin farthest from the tip having the greater circumference. This gives the stalk the general appearance of a screw and the structure is patently adapted to hold the egg in the skin after insertion. Fig. 2 is an outline sketch to show the micropyle and the cap, the latter probably permitting the escape of the larva. Horses, immediately upon being "struck," often rub their noses and lips violently on the ground, posts, or other handy object. This action may loosen the cap, but apparently is not effective in dislodging the eggs.

Both males and females were seen in the vicinity of horses, the latter greatly predominating. There is some reason to believe that copulation takes place on the wing in the vicinity of horses, but sufficient observations were not made to feel certain on this point.

As noted at Powderville, Montana, the nose fly first appears about the middle of June and stays until the middle of July. This same period was that of greatest abundance for *G. equi* Fabricius and *G. nasalis* Linnæus. The latter two species were afterwards seen occasionally until shortly after the first of September, when the field work was brought to a close. During the time when the nose fly is abundant horses are often irritated even by the buzzing of blow flies and others that make a similar noise.

The above observations are interesting in view of the fact that it has been previously supposed that the eggs were fastened to hairs about the mouth, or according to one writer, in the vicinity of the anus. The fact that larvæ may be found attached to the rectum may have been responsible for the latter idea. Several lots of larvæ detached from the rectum and reared to the adult, proved to be *Gastrophilus hæmorrhoidalis*.

The writer acknowledges his indebtedness to Mr. R. W. Wells, who assisted him in most of the observations made.

NEW SPECIES OF THE FAMILY ELATERIDÆ (COL.).

By CHAS. SCHAEFFER,

BROOKLYN, N. Y.

Alaus zunianus Casey.

This species is placed as synonym under *lusciosus* in our list. However, two specimens from Arizona received from Mr. G. Franck and others which I have seen show sufficient differences from *lusciosus* to entitle it to be restored.

The thorax is more strongly sinuate before the basal angles, the outer antennal joints are slightly more transverse, the underside is covered with black scale-like hairs, with a large patch of white scale-like hairs on each side of prothorax and at sides of each abdominal segment a smaller white patch. The legs are covered with black hairs only and the last ventral segment is much more densely punctate with very few small punctures intermixed at middle.

Aptopus subcarinatus new species.

Elongate, piceous; antennæ, palpi, mandibles and legs testaceous; pubescence short, greyish. Head moderately closely punctate; antennæ reaching far beyond the hind angles of prothorax, third joint very distinctly shorter than fifth. Prothorax as long as wide at base; sides without acute margin, slightly arcuate to a little before basal angles; the latter divergent; surface unequally punctate, a few larger punctures intermixed with the smaller punctures; punctures well separated on the disk, a little more close near apex and sides; hind angles rather feebly carinate, the carina not acute and almost obliterated. Elytra about two and one half times as long as the prothorax; sides feebly arcuately narrowing to apex; striæ feebly impressed and with moderate punctures. Prosternum finely and sparsely punctate; propleuræ densely punctate with small punctures; metasternum moderately closely punctate and with larger punctures intermixed; abdomen finely and rather closely punctate. Length 8 mm.

Huachuca Mts., Arizona (Schaeffer).

Some specimens have the punctuation of prothorax a little stronger and closer, in these the dual punctuation is not so pronounced.

This species differs from *peregrinus* in more elongate form, shorter second and third antennal joints, finer and sparser punctuation and hind angles of prothorax distinctly divergent.

Aptopus rugiceps new species.

Elongate reddish brown; antennæ and legs slightly paler; pubescence short, yellowish grey. Head very densely and rather coarsely punctate, punctures partly confluent; antennæ reaching far beyond the basal angles of prothorax; third joint equal, or very nearly so, to the fifth joint. Prothorax subquadrate; sides without acute margin, slightly arcuate to a little before basal angles, the latter not, or extremely feebly, divergent; basal angles ebly carinate, the carina not acute; surface densely punctate, with uniform and moderately large punctures. Elytra about two and one half times as long as the prothorax at base; sides feebly arcuately narrowing to apex; striæ moderately coarsely punctate; intervals convex and sparsely and finely punctate. Prosternum closely punctate; propleuræ very densely subconfluently punctate; metasternum densely punctate; abdomen more finely punctate. Length 8 mm.

Huachuca Mts., Arizona (Schaeffer).

The differences between this species and *peregrinus* are slight consisting only in generally larger size and coarser, denser punctuation of head, prothorax and propleuræ.

Elater sanguinicollis new species.

Red; head, scutellum, elytra, prosternal spine, meso- and meta-sternum and coxal plates black. Head rather densely and moderately coarsely punctate. Antennæ reaching not quite to the hind angles of prothorax; not strongly serrate, joints slightly longer than wide; third joint not triangular and as long or nearly as long as the fourth joint. Prothorax not coarsely nor densely punctate, punctures as usual stronger at apex and sides; hind angles not bicarinate; pubescence red. Elytra with scarcely impressed striæ, the punctures moderate; intervals nearly flat and subrugosely punctate; pubescens short, black. Length 7.25 mm.

Beaver Valley, Utah (Doll & Engelhardt).

This species is best placed with *collaris* and allies, though the antennal joints, especially the outer are slightly longer, than in that species. In Leconte's table[1] it would go near *nevadensis* from which it differs in having a red abdomen, black pubescence of elytra and pale antennæ.

[1] Trans. Am. Ent. Soc., XII, 10.

In Dr. Leconte's table the majority of our species having the hind angles unicarinate are said to have the antennæ strongly serrate and the joints not longer than wide. However, *rubricollis, apicatus* and others have the joints rather longer than wide, especially the outer, and not strongly serrate. *E. xanthomus* is also out of place in the table as the third antennal joint is triangular in both sexes and ought to go therefore with *nigricollis, linteus, discoideus,* etc. In "Revision of the Elateridæ" Leconte describes the third joint correctly as triangular. These errors will cause a little trouble as also the omission of the number 13 in front of line 27 from the top in the table.

Elater oregonus new species.

Black; legs, prothorax above and below, except prosternum, red, antennæ brownish. Head somewhat coarsely, evenly punctate; antennæ feebly serrate; joints longer than wide, third joint a little longer than second, not triangular, both together a little longer than fourth. Prothorax rather feebly arcuate at sides; hind angles slightly divergent, unicarinate; disk rather sparsely punctate. Elytra nearly parallel to about middle, then feebly narrowing to apex; striæ moderately coarsely punctate, punctures finer towards apex; intervals flat, very sparsely and generally uniseriately punctured. Metasternum rather coarsely punctate, abdomen more finely. Length 7.5 mm.

Dilley, Oregon (coll. O. Dietz).

The elongate antennal joints and bicolored upper surface would place this species with *mixtus* and *pullus* in Dr. Leconte's table, from both it differs in its red prothorax and unicolored black elytra. The antennal joints are slightly more elongate than in any of these two species.

The prothorax is not entirely clear red, having on each side of middle near apex a faint, dark cloud, the posternum is reddish near apex and between the coxæ, the last two ventral segments are brown.

Megapenthes longicornis new species.

Narrow elongate, ferruginous, head piceous, underside, antennæ and legs paler. Head coarsely, densely punctate; antennæ very elongate in the male, shorter in the female, second and third joints small, third a little longer than second, both together shorter than the fourth in the male, but about as long as the fourth in the female. Prothorax gradually narrowing to apex; sides nearly straight in the male, feebly rounded in the female, hind angles not divergent; surface moderately coarsely punctate. Elytra nearly parallel to a little behind middle, then arcuately narrowing to apex; striæ moderately deeply impressed; intervals flat, not densely punctate, near base granulate-rugose. Prosternum and metasternum somewhat coarsely and sparsely punctate, abdomen more finely punctate. Length 8.75 mm.

Huachuca Mts., Arizona (Schaeffer).

A fairly common species. The antennal joints four to eleven of the male are very long, equal in length and not serrate; in the female the joints are shorter and gradually decreasing in length and the form, as usual, is more robust.

Megapenthes nigriceps new species.

Form of *rufilabris,* color ferruginous, head piceous near apex paler. Head coarsely and rather densely punctate; antennæ in the male as long as head and prothorax together, second and third joints, small, fourth joint longer than second and third joint together, joints elongate and feebly serrate. Prothorax gradually narrowing to apex, sides scarcely arcuate, hind angles bicarinate, the inner carina fine and very close to the lateral margin; surface punctate and moderately large, ocellate punctures. Elytra gradually narrowing from base to apex, striæ moderately deeply impressed and punctate; intervals flat, towards base granulate rugose, towards apex moderately not densely punctate. Prosternal side pieces more coarsely punctate than the prosternum; metasternum, densely and rather coarsely punctate, punctures coarser at sides than at middle; abdomen closely punctate. Length 8 mm.

Brownsville, Texas (Schaeffer).

The specimen described is a male and closely related to *rufilabris* from which it differs in color, longer antennal joints, coarser punctation of prothorax, relatively longer hind tarsal joints and rather deeply emarginate hind coxal plates. Both species, *rufilabris* and *nigriceps* have the hind angles of prothorax bicarinate and should be placed in section B of Dr. Leconte's table[1] with *angularis* which differs from both of these species in having the hind coxal plates truncate and a shorter third antennal joint.

Megapenthes tarsalis new species.

Form of *rufilabris,* black, front of head and prothorax yellowish-red, the latter above and below with a large, black spot, which extends narrowly to the anterior margin but not to the lateral nor basal margin; basal margin of elytra also narrowly reddish. Head densely punctate; antennæ with second joint very small, third nearly as large as the fourth, triangular. Prothorax as in *rufilabris* but hind angles not bicarinate; surface moderately densely punc-

[1] Trans. Am. Ent. Soc., XII, 6.

tate. Elytra gradualy narrowing from base to apex; striæ deeply impressed; intervals nearly flat, granulate-rugose. Metsternum rather coarsely and densely punctate. Abdomen more sparsely and finely punctate; first joint of hind tarsi very nearly as long as the following together. Length 6 mm.

Southern Pines, N. C. (A. H. Manee).

A neat little species, which was sent me several years ago, collected June 15, 1908. It resembles somewhat fully colored specimens of *rufilabris* in form and coloration but has a differently formed third antennal joint, a much longer first joint of hind tarsi and hind angles of prothorax unicarinate.

Diplostethus (Ludius) opacicollis new species.

Dark castaneous, underside, legs, antennæ and palpi paler, above and below rather sparsely clothed with short fulvo-cinereous pubescence. Head coarsely and closely punctate; antennæ extending to a little below the elytral humeri, strongly serrate, joints three a little longer than second, the two together nearly as long as the fourth joint, eleventh joint slightly longer than the tenth and feebly appendiculate. Prothorax convex, slightly broader at base than long, sides feebly converging to about one third from apex and then arcuately converging to apex; surface alutaceous, coarsely and closely punctate; hind angles strongly, obliquely carinate. Elytra about two and one half times as long as the prothorax and rather strongly narrowing to apex, sutural angles feebly rounded; surface punctate-striate; intervals flat, moderately coarsely punctate, the punctures not very closely placed and not smaller than those of the striæ, surface at base somewhat rugose. Prosternum shining and coarsely and moderately closely punctate; side pieces dull with smaller punctures, intercoxal process a little behind the coxæ suddenly and perpendicularly declivous, intercoxal portion of mesosternum as in *texanus*. Metasternum coarsely and not closely punctate. Abdomen more finely and sparsely punctate than the metasternum. Length 20 mm.

Nogales (type) (Nunnenmacher) and Huachuca Mts., Ariz. (Schaeffer).

This species is related to *texanus* and *peninsularis*. From the former it differs in the form of intercoxal process of prosternum and from *peninsularis* in having a dull, more densely punctate prothorax and the declivous portion of the intercoxal process of prosternum rounded in front above, which part forms in *peninsuaris* a small and rather sharp tooth. It seems to be also very close to the Mexican *setosus* but that species has apparently a longer fourth antennal joint and denser pubescence on upper and under surface.

Otto Schwarz in Genera Insectorum erects for our species of *Ludius* which have the intercoxal process of prosternum not suddenly and perpendicularly declivous a little behind the coxæ, the genus *Trichophorus* using *Ludius* Eschsch. for *Corymbites* Latr. Following strictly the law of priority he may have been correct, but I do not agree with him in placing our *Megapenthes tartareus, aterrimus, limbalis* and *Elater sturmii* also in the genus *Trichophorus.*

For those species having the intercoxal process of prosternum a little behind the coxæ suddenly and perpendicularly declivous he erected the genus *Diplostethus* and for the species having a parallel sided mesosternal fossa the genus *Parallelostethus.* Our *Ludius attenuatus* and five Asiatic species are referred to this latter genus.

Trichophorus carolinensis new species.

Very close to *texanus* from which it differs in narrower, more elongate form, slightly longer antennæ, prothorax more gradually narrowing to apex, generally more opaque surface and pubescence slightly erect. Length 18 mm. Width 5 mm.

Southern Pines, N. Carolina (A. H. Mance).

This species is apparently what Leconte, Horn and Candèze considered to be *hepaticus* a species which, according to Champion, differs generically from the North American species identified by Leconte, etc., as that species. The true *hepaticus* is placed by O. Schwartz in Genera Insectorum in the genus *Orthostethus* and only recorded from Brazil.

Besides the locality given above I have some specimens from Roanoke Isld. and Wilmington, N. C. (Engelhardt & Pollard), from S. Carolina and two smaller specimens from Florida.

Trichophorus substriatus new species.

Elongate, rufo-castaneous; underside antennæ and legs scarcely paler. Head moderately coarsely and densely punctate; antennææ reaching to the hind angles of prothorax, third joint a little longer than second, both together slightly shorter than fourth. Prothorax about as long as wide at base; hind angles acutely carinate; sides rather feebly converging to about apical fifth, thence feebly arcuate; surface moderately closely punctate. Elytra a little longer than twice as long as the prothorax at base, rather strongly narrowing to apex; punctate striate, the first two or three near sutural striæ obliterated, intervals flat and very closely punctate. Under side clothed sparsely with short, yellowish recumbent pubescence; prothorax beneath rather coarsely and closely punctate; metasternum rather finely punctate at middle, coarsely at sides; abdomen finely and rather sparsely punctate at middle, punctures much larger at sides. Length 13.5 mm. Width 3.75 mm.

Arizona, one male (coll. Dietz).

This species is readily distinguished from similar species by the feebly impressed and partly obliterated elytral striæ and shorter antennæ.

Trichophorus arizonensis new species.

Elongate, rufo-castaneous; underside, antennæ and legs scarcely paler. Head moderately coarsely and closely punctate; antennæ reaching a little beyond the basal angles of prothorax; third joint a little longer than second, both together slightly shorter than the fourth joint. Prothorax slightly longer than wide at base; sides slightly converging towards apex and near apex feebly arcuate; hind angles acutely carinate; surface with moderately coarse punctures. Elytra not quite two and one half times as long as the prothorax at base, punctate-striate, intervals rather flat and somewhat closely punctate, rugose near base. Prothorax beneath coarsely punctate; metasternum coarsely punctate, finely at middle; abdomen coarsely punctate on the first three segments at sides, finely at middle. Length 15 mm. Width 3.5 mm.

S. Rita Mts., Arizona, one male (Marsden).

This species resembles *substriatus,* described above, very much, but is a narrower and more elongate insect with longer antennæ and distinct elytral striæ.

Trichophorus variatus new species.

Elongate, dark castaneous to rufo-castaneous, underside, antennæ and legs slightly paler. Head coarsely and moderately closely punctate; antennæ reaching a little distance below the hind angles of prothorax, third joint a little longer than second and both together a little shorter than fourth. Prothorax as long as wide at base; sides rather feebly converging to apex; hind angles acutely carinate; surface not densely nor coarsely punctate. Elytra about two and one half times as long as prothorax; punctate-striate; intervals feebly convex, not very closely punctate and scarcely rugose near base. Prothorax beneath coarsely punctate, punctures generally rather widely separated; metasternum and abdomen more finely punctate than prosternum. Length 15 mm. Width 4.2 mm.

Brownsville, Texas (Schaeffer).

This is rather a common insect near Brownsville from May to August and a variable species regarding size and color. The smaller more reddish colored specimens resemble the two previously described species, *substriatus* and *arizonensis*, very much. From *substriatus* it differs in having ditinct elytral striæ and longer antennæ. *Arizonensis* is a narrower and more elongate insect having the side pieces of prosternum much more closely punctate than *variatus* and ventral segments one to four of abdomen with rather numerous large and somewhat perforate punctures at sides of which there are only a few in *variatus* and much smaller. The metasternum is also much more coarsely punctate than in *variatus*.

Orthostethus caviceps new species.

Very elongate, shining, black; rather sparsely clothed with short, yellowish-cinereous pubescence. Head coarsely and closely punctate, broadly excavate in front; antennæ of male extending to far beyond the hind angles of prothorax; joints two and three small, three a little longer than second, four to ten strongly pectinate, eleventh appendiculate, in the female shorter and strongly serrate. Prothorax slightly wider at base than long, obliquely narrowing to apex, hind angles long and acutely carinate and not incurved at tip, surface closely and coarsely punctate, punctures less closely on the disk, on the median line a more or less distinct smooth space; thorax in the female a little shorter and broader than in the male with sides near apex arcuate. Elytra a little more than three times the length of prothorax; gradually narrowing to a little beyond middle then a little more strongly narrowing to apex; sutural angles acute; surface moderately closely and coarsely punctate without striæ. Prosternum at apex and sides coarsely and closely punctate, smooth at middle; metasternum coarsely and closely punctate; abdomen moderately coarsely not closely punctate; last ventral segment at apex feebly emarginate in male, entire in female; mesosternum moderately raised, subhorizontal. Length, male, 23.5 mm., width 6 mm.; female, length 28 mm., width 7 mm.

Huachuca Mts., Arizona (Schaeffer).

Males of this species were taken frequently by beating oak while females were very scarce.

This species is very close to the Mexican *pectinicornis* and may prove on comparison to be the same. The Mexican *pectinicornis* was described from a single worn example, which may account for the color difference of elytra and underside. The Mexican species, however, is said to be somewhat thickly clothed with short, fine pubescence, the hind angles of prothorax incurved at tip and the prosternum coarsely and sparsely punctured, which all does not agree very well with the Arizona specimens.

The mesosternum in *caviceps* and apparently *pectinicornis* also is somewhat intermediate between the species of *Trichophorus* and *Orthostethus*.

Agriotes brunneus new species.

Form of *pubescens*, dark brown, antennæ and legs slightly paler, pubescens yellowish-cinereous, short and sparse. Head coarsely and closely punctate; antennæ with second and third joints nearly equal and each slightly smaller than fourth joint. Prothorax as long as wide at base; sides from the basal angles to apex feebly converging, near apex slightly arcuate, surface opaque and coarsely and closely punctate with large ocellate punctures, deeply impressed medially near base, hind angles feebly divergent and feebly carinate. Elytra a little less than two and one half times as long as the prothorax, sides very feebly arcuate; surface striate punctate, punctures elongate and close; intervals nearly flat, closely and rather finely punctate, near base rugose. Prosternum shining, coarsely and closely punctate, side pieces dull and slightly less coarsely punctate than prosternum. Metasternum and abdomen closely punctate, the latter more finely than the former. Length 11 mm.

Beaver Canon, Utah (Doll and Engelhardt).

This species is to be placed near *fucosus*. It is slightly more robust than that species and has an opaque and more densely punctate prothorax.

Glyphonyx bimarginatus new species.

Elongate, rufo-testaceous, prothorax and suture darker, legs and antennæ yellowish. Head coarsely and rather closely punctate; a small, longitudinal impression on the median line; anterior margin feebly angulate; antennæ reaching beyond the hind angles of prothorax, second and third joints equal. Prothorax nearly parallel-sided to a little before apex; hind angles feebly divergent; lateral carina long, extending nearly to the apical margin; inferior marginal carina strong and rather widely separated at apex from the lateral carina; surface closely punctate at sides with moderate punctures, which are sparser at middle, from the middle to nearly to base a smooth median line. Elytra gradually narrowing to apex; striæ rather coarsely and closely punctate; intervals feebly convex, sparsely and finely punctate. Prosternum sparsely punctate at middle, punctures a little larger at sides and apex; propleuræ a little more coarsely punctate than prosternum at sides; prosternal process acuminate, V-shaped and strongly margined. Metasternum coarsely and closely punctate; abdomen moderately closely and more finely punctate at middle. Length 5 mm.

Enterprise, Fla. (O. Dietz).

The long, nearly entire lateral carina and the rather feebly angulated anterior margin of head will principally distinguish this species from its nearest allies.

Glyphonyx quadraticollis Champion. Biol. Cent. Am. Col., III, 1, 536.

A species which I have taken commonly in the Huachuca Mts., Ariz., agrees very well with the description of this Mexican species, which is said to be also common and widely distributed in Mexico.

The color is piceous or reddish brown. Head coarsely and closely punctate. Prothorax subquadrate with sides parallel; lateral carina extending nearly to apex, the inferior marginal carina distinct and sinuate behind, surface coarsely and rather closely punctate. Elytra punctate-striate, striæ coarsely punctured; intervals feebly convex, somewhat rugosely punctate. Prosternum and propleuræ with somewhat coarse, not closely placed punctures, prosternal process acuminate. Length about 6 mm.

Huachuca Mts., Ariz. (Schaeffer).

The above described *bimarginatus*, which has also a long, nearly entire, lateral carina, differs from pale colored specimens of this species in having a longer and less coarsely punctured prothorax and a more finely punctate prosternum and elytral intervals.

Glyphonyx dubius new species.

Elongate, piceous, antennæ and legs paler. Head moderately coarsely, not closely, punctate; antennæ reaching slightly a little beyond the basal angles of prothorax, second and third joints subequal. Prothorax subquadrate; sides nearly parallel; hind angles feebly divergent, lateral carina long, nearly reaching to the apical margin; inferior marginal carina entirely obliterated behind; surface sparsely and rather finely punctate behind middle of disk, more coarsely and closely punctate at sides and apex. Elytra nearly two and one half times as long as prothorax at base; striæ punctate with moderately large punctures; intervals feebly convex, rather sparsely and finely and not rugosely punctate. Prosternum and propleuræ rather sparsely punctate; prosternal process acuminate V-shaped; metasternum at sides more closely punctate than prosternum; abdomen finely punctate at middle, more coarsely at sides. Length 6 mm.

Huachuca Mts., Arizona (Schaeffer).

This species looks very much like *quadraticollis*, mentioned above, but has a more finely punctate prothorax and elytra and the inferior marginal carina obliterated behind. It seems to agree with the description of the Mexican *brevicollis,* which has also the internal marginal carina obliterated behind, but the prothorax is not "considerably broader than long" in the Arizona specimen.

Glyphonyx ferruginosus new species.

Elongate, ferruginosus, antennæ and legs paler. Head moderately closely punctate; antennæ reaching to about the hind angles of prothorax. Prothorax subquadrate; sides parallel, near apex slightly arcuate, hind angles feebly divergent; lateral carina not extending to the middle, inferior marginal carina entire and slightly sinuate near base; surface with moderate, well separated punctures. Elytra not quite three times as long as prothorax; striæ with coarse punctures at base, finer towards apex; intervals feebly elevated and finely and sparsely punctured. Prosternum and propleuræ with well separated moderate punctures; prosternal process Y-shaped, metasternum more coarsely punctate at sides than prosternum, abdomen rather finely punctate. Length 4.75 mm.

Huachuca Mts., Arizona (Schaeffer).

This species resembles closely *testaceus,* but has a differently formed prosternal process, which is in that species V-shaped. It seems to agree also with the description of the Mexican *præcox* but the punctuation of the prothorax in the Arizona specimens cannot be called sparse and fine, the lateral carina does not extend quite to the middle, and the inferior carina is scarcely sinuate behind. All our species have a V-shaped prosternal process with the exception of *inquinatus,* if I have correctly identified that species, and *ferruginosus,* which have a Y-shaped prosternal process.

Plastocerus granti new species.

Elongate, very narrow; sparsely pubescent; dark castaneous, underside paler, legs, antennæ and palpi testaceous. Head very coarsely and densely punctate; eyes moderately prominent, width, as seen from the front, less than one half the interocular space; antennæ with third and fourth joints equal in size, fourth and following joints each with a moderately long ranius, the rami not as long as the interocular spase. Prothorax subquadrate, lateral margin acute, arcuate at about apical third and then feebly converging towards basal angles, which are rather strongly divergent and not carinate; surface coarsely and densely punctate, the punctures acellate and more crowded at sides than on the disk. Elytra a little wider than the prothorax in its widest part, sides feebly converging towards apex; surface punctate-striate, punctures moderate; intervals flat and rather sparsely punctate. Prosternum at about middle obliquely elevated into a moderately strong carina, rather sparsely punctate, sides pieces more coarsely and densely punctate; abdomen moderately punctate. Length 9 mm.

Southwestern Texas (Chapman Grant).

A narrower and smaller insect than our other species of *Plastocerus* from all of which it differs in the carinate prosternum. The antennal rami are shorter, less densely ciliate and with shorter hairs than in *schaumii* or *megalops* and are nearly as in *frater*.

THE ORDERS AND RELATIONSHIPS OF APTERYGOTAN INSECTS.[1]

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The ancestors of the Arthropoda were, in all probability, very similar to Annelidan worms, and, although the Annelida, like all recent forms, have developed many characters peculiar to themselves, certain members of the group have preserved some exceedingly primitive features, which enable us to infer what the ancestors of Arthropods must have been like.

Although the discussion of the probable lines of descent leading up to the development of the Insectan type of Arthropod is beyond the province of the present paper, it may be remarked that the "Apodidæ" have departed but little from the condition which was doubtless characteristic of the ancestral Crustacea, and such Crustaceans as *Apus* and *Branchippus* (which are not far removed from such Trilobites as *Triarthrus, Neolenus* and *Nathorstia*) have departed but little from the probable ancestral condition of Arthropods in general. These Crustacea and Trilobita, then, present as nearly as any Arthropods now known, the characters present in the earlier forms, and enable us to gain some idea of what the common ancestors of the Arachnida, Merostoma, Trilobita, Crustacea, "Myriapoda" (*sensu lato*), Hexapoda, etc., were like.

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

In the development of recent Arthropoda, the lines of descent which have the most closely paralleled the line of descent of the Insecta, are those of the Crustacea, Diplopoda, Chilopoda and Symphyla (see fig. 2). Indeed, the Crustacea, "Myriopoda" (*i. e.*, Chilopoda, Diplopoda, and Symphyla) and Insecta, may be regarded as forming the three apices of a triangle, each of whose apices is connected with the other two by mutual bonds of relationship. Among the Crustacea, the Arthrostraca (*e. g.*, *Anaspides, Koonunga, Bathynella*, etc.) and have retained certain characters suggestive of the ancestral condition of insects, but, on the whole, the "Myriopoda" (*sensu lato*) and *Scolopendrella* in particular, are more closely related to the Insecta than any other Arthropods.

The parts of the head, legs, and abdominal appendages of the Apterygotan insects are strikingly like the corresponding parts of the "Myriopoda," and even with regard to their embryological details, the Apterygota are very like "Myriopods," as has been pointed out by Philiptschenko, 1912, Lignau, 1911, Heymons, and others. Furthermore, the points wherein the Apterygota differ most from higher insects, are those wherein they approach more closely to the "Myriopoda" and Crustacea, and from the standpoint of comparative anatomy and embryology, there can be no doubt that the Apterygotan insects are the most primitive—and have therefore departed the least from the probable ancestral condition of insects in general.

Despite the fact that the paleontological record is confessedly incomplete, and notwithstanding the fact that such extremely fragile and rare insects (for they have apparently never been very numerous) could not be expected to leave many traces in the lower strata, which have been subjected to great pressure and upheaval, Handlirsch and his followers would use the lack of Apterygotan remains in the earlier strata as an argument against the view that the Apterygota should be regarded as the nearest living representatives of the ancestors of the Pterygotan forms. In their efforts to widen the gap between the Apterygota and Pteryigota, these authors would even go so far as to remove the Apterygota from the class Insecta (or Hexapoda) and would place them in a distinct class, or classes by themselves! The fact remains, however, that from a morphological point of view (and aside from the presence or absence of wings) there is an infinitely wider gap between the Blattidæ and Chalcididæ—

which Handlirsch and his followers unhesitatingly group in the same class—than there is between the Blattidæ and Lepismatidæ—which they would not group in the same class. In the same way, an immature Plecopteron such as a nymph of *Peltoperla*, is structually far closer to *Lepisma* than it is to *Pulex*, or any of the higher Pterygotan insects—and in the last analysis, comparative anatomy (whether it be the comparative anatomy of embryos, or of living or fossil adults) furnishes us with the only reliable material for determining relationships!

Since the Apterygotan forms, such as *Lepisma*, etc., are so closely related to the lowest Pterygota (such as the Blattidæ, nymphs of *Peltoperla*, etc.) and since the various Apterygotan groups are intimately bound together by intermediate forms—as is also the case with the Pterygotan groups—the attempt to place the Apterygota in a class, or classes, not included in the class Insecta, is wholly unwarranted, and fails to take into consideration the fundamental structural similarities which underlie all groupings based upon relationship! The Apterygota are as much "Insecta" as the Pterygota are, and if the Apterygota are to be split up into several "classes," then the Pterygota also must be split up into several "classes" in order to be consistent. This, however, is neither necessary nor desirable, since the grouping of the class Insecta into two sub-classes, the Apterygota (or Apterygogenea) and Pterygota (or Pterygogenea) is based upon structural similarities, and expresses the actual relationships with sufficient accuracy.

Prell's division of the Insecta into two subclasses, the *Anamerentoma* (Protura) which exhibit a postembryonic increase in the number of abdominal segments, and the *Holomerentoma* (all other insects), which exhibit no postembryonic increase in the number of abdominal segments, fails to take into consideration the close anatomical relationship of the Protura to such forms as *Tomocerus*, etc., which exhibit no such postembryonic increase in the number of abdominal segments; and while Prell's subdivision is very useful from the standpoint of the study of the different types of "metamorphosis," the old subdivisions Apterygota and Pterygota (proposed by Brauer, and modified by Lang) are more useful from the standpoint of the study of relationships. In this connection, it may be further remarked, that in such Dipterous larvæ as *Scenopinus*, *Thereva*, *Bibio*, *Ceroplatus,* etc., there is a sort of increase in the number of the abdominal segments, by the interpolation of "intercalary" segments, formed by the lengthening and demarcation of the intersegmental region—although this is not strictly comparable to the type of true segmental increase exhibited by the Protura.

Although the Apterygota form a well-defined group, quite distinct from the Pterygota, I do not know of any key which will enable one who has no preconceived idea of the true nature of an insect (especially with regard to the larval and wingless forms) to place it correctly in every case. I would therefore offer the following key as a purely tentative effort to supply this lack.

1. Mouthparts either retracted in cavity of head, or practically wanting, or not mandibulate 2
   Mouthparts not retracted in cavity of head, but mandibulate 3
2. Ventral region of the abdomen bearing either styli, vestigeal legs or ventral tube .... *Apterygota.*
   Abdomen without styli, vestigeal legs, or ventral tube .... *Pterygota.*
3. Abdomen with more than one pair of styli .... *Apterygota.*
   Abdomen with at most one pair of styli, usually none .... *Pterygota.*

The styli referred to in the preceding key, are paired, movable, spine-like appendages, borne at the posterior margin of certain of the abdominal sternites, and are not homologous wtih the entire vestigeal legs, but are appendages of the basal segment of the legs, and occur on the meso- and metathoracic coxae in such insects as *Machilis,* and on the basal segment of the leg in certain "Myriopoda." The vestigeal legs mentioned in the key are true leg-vestiges—whether they are homologous with the so-called false legs (pseudopodia) of larval Lepidoptera, etc., has been questioned. The ventral tube (which represents the united vestigial legs of the first abdominal segment) is an adhesive organ situated in the mid-ventral line of the first abdominal segment, and may be large and columnar, or it may be reduced to the merest vestige, requiring close scrutiny to detect it.

The Apterygota may be divided into two supersections, the *Eustyligera,* or styli-bearing Apterygota, and the *Astyligera,* or non-styli-bearing Apterygota, according to the presence or absence of styli in the two groups.

The styli-bearing Apterygota (Eustyligera) are also cerci-bearing in all cases thus far observed, the non-cerci-bearing form "*Aniso-*

sphæra" described by Tomosvary as related to the Lepismatidæ, having subsequently been proved to be a larva of the beetle *Cephennium*. The antennæ are usually well developed and consist of more than six segments. No postantennal organ has been observed in members of this group.

The second super-section, or non-styli-bearing group (Astyligera) usually lacks segmented cerci and forceps-like terminal abdominal structures, in addition to the styli. The "cerci" of *Tomocerus* and others of the group (to which Willem, Folsom, and others have called attention) are not segmented, and there is some question as to whether they are to be considered as strictly homologous with the true cerci of the other forms, although this point has not been sufficiently investigated to be definitely decided. The antennæ may be lacking in this group, but if present, are usually composed of not more than six segments—although an "annulation," or "ringing" of the terminal segments, sometimes occurs. The postantennal organ, or its homologue, is frequently present; but may be wanting.

All of the members of the non-styli-bearing group have mouthparts of the concealed type (*i. e.*, entognathous or cryptognathous) the mouthparts being retracted into the cavity of the head, as in *Eosentomon, Tomocerus, Entomobrya*, etc. On the other hand, some of the styli-bearing group have mouthparts of the concealed type (the mouthparts being retracted into the cavity of the head, as in *Campodea, Japyx*, etc.) while others of the group have mouthparts of the exposed type (ectognathous or gymnognathous) as in *Lepisma, Machilis*, etc.

There are apparently three main lines of evolution represented in the Apterygota. In other words, the Apterygotan insects group themselves about three principal centers. These are represented by the Protura (*e. g.*, *Eosentomon*, etc.) the Rhabdura (*e. g.*, *Campodea*, etc.) and the Thysanura (*Lepisma*, etc.) and the insects forming these groups may be regarded as representing the three principal sections of the sub-class Apterygota.

The lowest or most primitive section of the Apterygota comprises those insects which group themselves about the Protura (such as *Eosentomon, Acerentomon*, etc.) which have departed as little as any from the probable ancestral condition of the group as a whole. These insects form the section *Proturadelphia* or "Proturan-brotherhood" and are characterized as follows. Styli absent, and segmented cerci wanting, although unsegmented appendages termed "cerci" may be present in such forms as *Tomocerus,* etc. Mouthparts of the concealed type in all of the members of the group. Uropods, or true abdominal legs usually present, either in the form of the vestigeal abdominal legs of the Protura, or the modified abdominal legs which form the ventral tube (columella), tenaculum, and springing apparatus (or furcula) of the other members of the section. Antennæ may be absent as in the Protura, although Schepotieff, 1909, has figured and described them for "*Protapteron*"—but this is stated to be a "*lapsus calami,*" by Prell, and others. In other forms the antennæ are usually short and composed of only six segments—although an "annulation" of the terminal antennal segments occurs in certain members of the group. The so-called "pseudoculus" of the Protura, and the postantennal organ of the other forms, are doubtless the homologues of Tömösvary's organ in the "Myriopoda." In addition to this, the general character of the alimentary tract, the reproductive organs, the segmentation of the egg, and the embryological development, etc., of the members of this group, clearly suggest "Myriopodan" affinities. Some of the families contained in this section (which is the only non-styli-bearing one) are the Eosentomidæ, Acerentomidæ, Neelidæ, Sminthuridæ, Achorutidæ, Entomobryidæ, etc.

The second section (which is a division of the styli-bearing Apterygota) comprises those insects which group themselves about the Rhabdura (*Campodea,* etc.) forming the section *Rhabduradelphia,* or "Rhabduran-brotherhood." In some respects, such forms as *Anajapyx* are more primitive than the true Rhabdura (such as *Campodea*), but the term Rhabdura, being better known, has, on this account, been chosen to illustrate the group as a whole. In the insects belonging to this section, styli are usually borne on the first seven abdominal sterna, but may be lacking on the first (*Campodea*). Cerci, in the form of paired segmented caudal filaments, or modified to form the forceps-like terminal abdominal appendages of *Japyx,* etc., occur in all of the members of the group thus far observed; but a median unpaired terminal caudal filament (characteristic of the next group to be considered) is always wanting. All of the members of this section have mouthparts partially or wholly of the concealed type (entognathous or cryptognathous), but a postantennal organ is usually wanting. Eyes are absent in most of the members of the group. The antennæ are usually well developed and are usually composed of many segments. Segmented uropods may occur on the basal abdominal segment (as in *Campodea*) although they are usually greatly reduced or lacking. Eversible sacs, etc., are found on certain of the abdominal sterna in some members of the group. There is usually a "Y"-shaped suture in the meso- and metasternum (of the thorax), and a longitudinal cranial suture, together with a transverse occipital suture, usually occurs in the insects of this section. The tarsi are usually apparently one-segmented, and the abdomen is composed of ten or eleven segments. Maxillary palpi apparently one- or two-segmented. Abdominal ganglia seven or eight in number. The principal families of this section are the Campodeidæ, Projapygidæ and Japygidæ. The insects composing this group might in some ways be regarded as occupying a position somewhat intermediate between the insects of the first section (Proturadelphia) and the one next to be considered.

The third section (which is also a division of the styli-bearing Apterygota) comprises those insects which group themselves about the Thysanura (*Lepisma,* etc.) forming the section *Thysanuradelphia,* or "Thysanuran-brotherhood." Such forms as *Machilis,* or *Præmachilis,* are more primitive, or have departed less from the ancestral condition of the group, than the true Thysanura (such as *Lepisma*) have, but the designation Thysanura, being the best known of the terms applied to the members of the group, has been chosen to typify the section as a whole. Styli are found at least on the terminal abdominal segments of practically all members of the group, and in certain forms, such as *Machilis, Præmachilis,* etc., styli are borne on the coxæ of the meso- and metathorax as well. Unlike the insects of the preceding section, the members of this group usually possess a median unpaired caudal filament, in addition to the paired caudal filaments or cerci, although the cerci may be absent in rare instances (*Dasyleptus*). All of the insects belonging to this section have mouthparts of the exposed type (ectognathous or gymnognathous). Segmented uropods are usually absent, and postantennal organs are wanting in the members of the group. The eyes are usually well developed, although absent in some cases, and the antennæ are usually well developed and are composed of many segments in most insects belonging to this section. When the caudal filaments are short, the antennæ are usually correspondingly reduced. Protrusile sacs occur on certain of the abdominal sterna in some cases. Tarsi two or three-segmented, and abdomen with traces of eleven segments. Maxillary palpi four or five-segmented. Abdominal ganglia eight in number. Some of the families belonging to this section are the Machilidæ, Lepismatidæ, Gastrotheidæ, etc.

The relationships of these three lines of descent to the higher insects, and to the other Arthropods are rather puzzling. It may be remarked, however, that the Proturon type exhibits indications of affinities with such Plecoptera as *Capnia, Leuctra,* etc., on the one hand, and with such Crustacea as *Bathynella* and other Anomostraca on the other. The Rhabduron type offers suggestions of affinities with the Plecoptera (and the closely related Dermaptera) and with the Symphyla such as *Scolopendrella.* The Thysanuran type exhibits indications of a relationship with such Plecoptera as nymphs of *Peltroperla* on the one hand, and with certain Crustacea, such as *Ligia,* on the other. Since the Crustacea, "Myriopoda" and Insecta are so closely related, however, it is merely to be expected some of the Apterygota would retain characters suggestive of a relationship to the Crustacea while others show a marked relationship to the "Myriopoda," since all are connected by mutual bonds of relationship, and members of the Apterygota would naturally retain characters suggestive of both Crustacea and "Myriopods."

The Rhabduran section is, on the whole, more closely related to the Thysanuran section than to the Proturan section, but all three lines are rather sharply demarked and apparently represent three distinct lines of development, just as there are similar distinct lines of development in the Pterygotan insects. These three sections, too, exhibit differences of a greater value than that of distinct orders. Indeed, there is a far greater difference between *Machilis* and *Campodea,* than there is between *Perla* and *Phasma,* and the difference between *Machilis* and *Lepisma* (or *Nicoletia*) is as great, or greater, than that between *Merope* and *Sialis.* Furthermore, if the latter examples represent distinct orders, then *Machilis* and *Lepisma* should be placed in distinct orders, to be consistent. The value which one will attribute to these differences depends upon the individual himself, and as long as human nature remains as it is, we will have some who are "lumpers," and some who are "splitters." Of recent entomologists, however, those who are so "ultra-conservative" as to be unwilling to admit of more than one Apterygotan order, the "Aptera," are in a decided minority, and one is led to suspect that they have either not made a detailed study of the insects in question, or an overweening desire for "unity and simplicity" has caused them to cling to a system of classification but little removed from the ancient Linnean one!

As time goes on, and as the structural details of the Apterygotan insects have been more carefully worked out, it becomes more and more evident that the general superficial resemblances between many of the insects classed together in the older groupings, are far outweighed by the differences in their morphological details. I would therefore fully agree with Handlirsch and his followers (such as Brues and Melander, Escherich, etc.) in their contention that the heterogeneous collections of insects comprising the old "orders" should be re-grouped into several distinct orders whose members are more closely related.

In the following key, the greater part of the insects referred to belong to distinct orders although I would not maintain that this is true of all of them, as will be discussed later. In accordance with the quite widely accepted custom, I have designated the Apterygotan orders by terms ending in "-ura" (*e. g.*, Protura, Rhabdura, Thysanura, etc.), rather than by Handlirsch's terms ending in "-oidea," since the latter termination is preëmpted by groups of superfamily rank (*e. g.*, Muscoidea, Ichneumonoidea, etc.). Handlirsch's method of using a well-known family name to typify the group as a whole, however, has much to recommend it, since it is self-explanatory, I have therefore made use of a modification of this method in the following key, merely for the sake of convenience, using the termination "oides" (rather than the preëmpted termination "oidea") in connection with the name of a well-known family, thereby immediately calling to mind the representatives of the group as a whole.

1. Styli and segmented caudal filaments or terminal forceps present........2
   Styli and segmented caudal filaments or terminal forceps wanting........7
2. Mouthparts not retracted into cavity of head 3
   Mouthparts retracted or concealed in cavity of head....................5

3. With but one (the median) terminal caudal filament.
Dasyleptoides (Mononemura).
With three caudal filaments 4
4. Head in frontal view deeper than broad. Styliform appendage usually found on coxa of meso- and metathorax. Tarsi usually three-segmented.
Machioides (Trinemura).
Head in frontal view broader than deep. No styliform appendage on coxa of meso- and metathorax. Tarsi usually two-segmented.
Lepismatoides (Thysanura).
5. Styli present on first abdominal sternum. Abdomen with terminal forceps, or with segmented cerci 6
Styli wanting on first abdominal sternum. Abdomen with segmented cerci, whose terminal segment is imperforate .... **Campodeoides (Rhabdura).**
6. Abdomen with segmented cerci whose terminal segment is provided with an apical aperture ....**Projapygoides (Prodicellura).**
Abdomen with forceps ....**Japygoides (Dicellura).**
7. Vestigeal legs of first abdominal segment united and modified to form a ventral tube (in some cases reduced to a mere vestige). Antennæ usually present. Abdominal segments usually not exceeding six in number....8
Vestigeal legs of first abdominal segment not united to form a ventral tube. Antennæ usually absent. Abdominal segments usually nine to twelve in number ....**Eosentomoides (Protura).**
8. Abdomen sub-cylindrical: segments usually distinct.
Entomobryoides (Euarthrura).
Abdomen sub-globular: segments wholly or in part grown together.
Smithuroides (Synarthrura).

There is some doubt as to whether the fossil Dasyleptidæ constitute a distinct order, or are merely to be regarded as a suborder of the forms with three caudal filaments. The Projapygidæ also might better be regarded as a suborder of the Dicellura (Japygidæ), than as a distinct order. Brues and Melander group them with the Rhabdura (Campodeidæ) in an order in which the Japyigidæ are not included; but if the Projapygidæ are not to be considered as forming a distinct order, they should be grouped with the Dicellura (Japygidæ), since their affinities are with the Dicellura, rather than with the Rhabdura (Campodeidæ). Handlirsch and his followers regard the Entomobryidæ and Sminthuridæ as representing distinct orders, while Boerner (who gave them the names Arthropleona and Symphypleona) regards them as representing suborders rather than as distinct orders.

It is possible that such insects as *Troglopedetes* (family Troglopedetidæ), described by Joseph, may constitute an order or suborder; but, aside from the fact that they are strongly aberrant, blind forms, with four-segmented maxillary palpi, the known details of their anatomy are too meager to determine this point.

The relationships of the different groups are brought out in the following descriptions, in which are discussed the more important characters of the different groups, which could not be treated in detail in the preceding key.

NON-STYLI-BEARING APTERYGOTA (ASTYLIGERA).

I. *Section Proturadelphia.*

This section might be divided into two subsections, on the basis of the presence or absence of the ventral tube (or its homologue), but a further division is apparently unnecessary.

1. EOSENTOMOIDES (PROTURA).—Styli absent. Cerci, or forceps-like terminal abdominal appendages, ventral tube, and springing apparatus wanting. Mouthparts retracted in cavity of head. Labial palpi present. Mandibles and labium somewhat similar to those of *Tomocerus,* as is true of the ventral groove of the head region. Postantennal organ (the "pseudoculus") usually present. Eyes wanting. The antennæ described and figured for "*Protapteron*" (*Eosentomon*) by Schopotieff probably belong to some other insect, so that all members of the group thus far studied lack antennæ, the forelegs being modified to serve as tactile organs in the place of the lost antennæ. Abdominal segments of the adult insect usually twelve in number, although at first only nine—a postembryonic increase in the number of abdominal segments being peculiar to these insects. The basal two or three abdominal segments usually bear vestigeal legs. Abdominal ganglia usually six in number (*Acerentulus*). The principal families contained in the group are the Acerentomidæ and Eosentomidæ.

2. ENTOMOBRYOIDES (EUARTHRURA).—Styli absent. Segmented cerci, or forceps-like terminal abdominal appendages wanting. The uropods (or abdominal legs) of the first abdominal segment are more or less grown together and modified to form the ventral tube (columella) whose vesicles are usually short and sac-like. The

uropods of the third abdominal segment form the tenaculum, when present, and those of the fourth or fifth abdominal segment form the springing apparatus (furcula) when present. Mouthparts retracted in cavity of head. Labial palpi wanting. Postantennal organ usually present. Eyes present or absent. Antennæ usually four- to six-segmented. Head rounded and directed straight forward (prognathous) or obliquely downward. Body comparatively long, and the abdomen sub-cylindrical. Abdominal segments, which do not exceed six in number, usually free or distinct (whence the name Euarthrura). There is no postembryonic increase in the number of abdominal segments. Abdominal ganglia wanting, or united with the last thoracic ganglion. Heart with six pairs of ostia. The principal families of the group are the Achorutidæ and Entomobryidæ.

If the preceding group be regarded as of the value of an order, it might be divided into two suborders as follows: (*a*) The "Eupodura," including those forms in which the springing apparatus is usually well developed, and is generally attached to the penultimate segment (although in some Isotomas it is attached to the antepenultimate segment). The head is directed obliquely downward, and scales usually occur on members of this subdivision. Examples are *Isotoma, Orchesella,* etc. (*b*) The "*Pauropodura,*" including those forms in which the springing apparatus is reduced or wanting, and when present is attached to the antepenultimate instead of to the penultimate segment. The head is directed straight forward, the body is usually granular, and scales are absent. Examples are *Podura, Achorutes, Anurida, Neanura,* etc.

3. Sminthuroides (Synarthrura).—Styli absent. Segmented cerci, or forceps-like terminal abdominal appendages wanting. Uropods of first abdominal segment more or less grown together and modified to form the ventral tube, whose vesicles may be long and tubular, or short and sac-like. Springing apparatus usually present. Mouthparts retracted in cavity of head. Labial palpi wanting. Postantennal organ usually absent. Antennæ, with few exceptions, elbowed and four-segmented. Head rounded and usually vertical in position (*i. e.,* directed downward). Body short and abdomen sub-globular. Thoracic and abdominal segments more or less closely united (whence the name "Synarthrura"). No postembryonic increase in the number of abdominal segments. Abdominal ganglia

wanting (or united with the last thoracic ganglion). Heart extending backward only about one third the length of the abdomen, and with only two pairs of ostia. Tracheal system usually wanting, but when present is best developed in *Sminthurus* and *Sminthurides*. There is no anastamosing between tracheæ of opposite sides of body as in higher insects. The principal families of the group are the Neelidæ and Sminthuridæ.

Of the three groups mentioned above, the *Protura* are by far the most primitive, and have preserved many characters which were doubtless present in the ancestral insects. The *Euarthrura* (or Entomobryid group) are rather closely related to the Protura, but represent a somewhat degenerate and specialized offshoot which branched off from the Proturan line at a comparatively early period of development, and has become specialized in a different direction. The *Synarthrura* (or Sminthurid group) are very closely related to the Entomobryid group; but on the whole are more highly specialized than the latter.

STYLI-BEARING APTERYGOTA (EUSTYLIGERA).

II. *Section Rhabduradelphia.*

4. CAMPODEOIDES (RHABDURA).—Styli and paired segmented cerci present, but median caudal filament wanting. Mouthparts retracted into cavity of head. Apex of mandible dentate, with a dentate plate attached below it. Maxillary palpi one-segmented. Antennæ slender, many jointed. Eyes and postantennal organ usually wanting. Transverse occipital suture distinct, and occipital region comparatively large. Body not scaled. Abdomen composed of eleven distinct segments (the eleventh being very small and reduced). First abdominal segment with a pair of uropods, or vestigeal abdominal legs, but no styli occur on the first segment. Styli and protrusile sacs usually occur on abdominal segments two to seven, inclusive. The long slender segmented cerci have no opening at the tip of the terminal segment for the discharge of glands (as in the Projapygidæ). Anal laminæ distinct. Abdominal ganglia seven in number. Spiracles confined to the thoracic region (three in number). Malpighian tubes represented by papillæ. Ovaries simple, without ovarioles. Heart with nine pairs of ostia. This order contains the family Campodeidæ.

5. PROJAPYGOIDES (PRODICELLURA).—Styli and segmented cerci present, but median unpaired caudal filament wanting. Mouthparts retracted, and mandibles similar to those of the preceding group. Maxillary palpi two-segmented (?). Antennæ rather robust, or less slender than in preceding group. Eyes and postantennal organ usually wanting. Transverse occipital suture not distinct, and occipital region reduced. Body not scaled. Body composed of eleven distinct segments, the eleventh being reduced and covered by the tergum of the tenth. First abdominal segment with a pair of somewhat cylindrical or conical processes, one on each side of the midventral line: the first abdominal segment is also provided with a pair of styli (absent in the preceding group) which are somewhat long and cylindrical. Styli occur on abdominal segments one to seven inclusive. Two rather short, robust cerci composed of fewer segments (about six in all) than in the preceding group, occur in these insects, and the terminal segment of each cercus bears an opening at the tip for the discharge of glands. Anal laminæ distinct in adults. Seven abdominal ganglia. Seven pairs of spiracles in abdominal region. Malpighian tubules represented by five or six small short tubes or papillæ. Ovarioles present. Heart with nine pairs of ostia. Foregut extends posteriorly to the fifth abdominal segment. This group contains the family Projapygiidæ. Its position is intermediate between the Campodeidæ and Japygidæ, the type of mandibles, the segmented cerci, the presence of vestigeal malpighian tubules, etc., being Campodeidan characters; but the general character of the body (and its appendages, other than the cerci) is much more like that of the Japygidæ than the Campodeidæ, and if the group is to be regarded as a suborder rather than as an order, it should be placed with the Japygidæ in the order Dicellura, instead of with the Campodeidæ in the order Rhabdura—as Brues and Melander have done!

6. JAPYGOIDES (DICELLURA).—Styli present, but the cerci have become modified to form a pair of unsegmented terminal forceps-like structures. Median terminal caudal filament wanting. Mouthparts retracted. Mandibles with dentate apex, but the dentate plate found in the Projapygidæ and Campodeidæ is absent. Maxillary palpi two-segmented. Antennæ rather robust or less slender than in Campodeidæ. Eyes and postantennal organ usually absent. Occipital suture not distinct, and occipital region reduced. Body not

scaled. Abdomen apparently composed of ten segments, the tenth and eleventh being more or less closely united. First abdominal segment with two submedian hairy papillæ, and also bearing a pair of short stout spine-like styli (unlike the rather long slender styli of the Projapygidæ) which likewise occur on segments two to seven inclusive. The cerci are represented by imperforate forceps-like terminal appendages. Anal laminæ not distinct in adults. Eight abdominal ganglia. Seven pairs of spiracles in abdominal region. Malpighian tubules wanting. Seven ovarioles present. Foregut extending posteriorly only to metathorax (not to fifth abdominal segment as in Projapygidæ). This order contains the family Japygidæ (to which may be added the Projapygidæ, if the latter are not to be regarded as representing a distinct group).

The Campodeidæ are more primitive than the Japygidæ, although they are apparently not much (if any) more primitive than the Projapygidæ. The Projapygidæ, as was mentioned above, occupy a position intermediate between the Japygidæ and Campodeidæ. They are regarded by some investigators as the lowest of living insects but the Protura are more primitive in many respects (although they have become strongly modified in certain structural details). The Campodeidæ and Projapygidæ may possibly be regarded as occupying a position somewhat intermediate between the Protura and the next group to be considered.

III. *Section Thysanuradelphia.*

7. DASYLEPTOIDES (MONONEMURA).—This group comprises the family Dasyleptidæ founded on the fossil insect *Dasyleptus lucasi,* described by Brongniart as follows. Body cylindrical, tapering posteriorly, and terminated by a single multiarticulate filament, which is as long as the body. Antennæ and legs robust. Head quite large. Prothorax very short, and meso- and metathorax, which are of equal size, much longer than the prothorax. Abdominal segments ten in number, and equal in size; the last, which bears a multi-articulate filament, a little longer than the others. Some specimens appear to have abdominal plates similar to those found in *Machilis.* The entire body (antennæ, legs, thorax and abdomen) covered with numerous very short hairs. The body, including the terminal abdominal

filament, varies from fifteen to twenty-two millimeters in length. This insect resembles *Lepisma* and *Machilis* morphologically, but differs from them in many respects chief among which is the occurrence of but a single caudal filament. This group contains the family Dasyleptidæ. Although here ranked as an order, the group (which is related to the Machilidæ) may possibly be of the value of suborder only; but this point can be determined only upon a more detailed study than has been given the subject by Brongniart.

8. MACHILOIDES (TRINEMURA).—Three caudal filaments (a median unpaired terminal filament, and a pair of lateral filaments homologous with the cerci) occur in this group. Head usually directed downward (hypognathous), not flattened dorso-ventrally, but laterally compressed, in frontal view deeper than broad. Eyes usually large, and extending forward above the antennæ are approximate or almost contiguous above. They are composed of relatively numerous small ommatidia. Mouthparts of the exposed type: maxillary palpi usually seven-segmented. Pronotum usually shorter than mesonotum. Thoracic sterna not in the form of broad plates overlapping the coxæ somewhat laterally (as in the next group to be considered). Coxæ subcylindrical: those of the meso- and metathorax usually provided with styliform appendages. Tarsi usually three-segmented. Abdomen composed of eleven segments, the tergum of the tenth not partially covering the eleventh. Body subcylindrical, tapering posteriorly, and is usually clothed with scales. Insects usually capable of springing. Abdominal ganglia eight in number. Seven pairs of spiracles in the abdominal region. The tracheæ of one side of the body do not anastomose with those of the other side nor are those of the same side connected by longitudinal trunks, the tracheæ being arranged segmentally. There are twelve malpighian tubules. Ovaries wtih seven ovarioles. Heart with nine pairs of ostia. This group contains the family Machilidæ.

9. LEPISMATOIDES (THYSANURA).—Two segmented cerci, in addition to the median unpaired terminal caudal filament, occur in this group. The unpaired median filament according to Heymons, is merely a prolongation of the body which has become annulated, and is therefore not strictly comparable to the paired filaments, which are homologous with cerci. In this group, the head is usually directed forward (prognathous) and is flattened dorso-ventrally, in frontal

view broader than deep. Eyes, when present, always small and situated on the side of the head, never extending above the antennæ or approximate above. They are composed of relatively few, large, separate ommatidia. Mouthparts of the exposed type. Maxillary palpi usually five-segmented (six-segmented in *Thermophila*). Pronotum usually longer than, or as long as the mesonotum. The thoracic sterna usually in the form of broad plates projecting somewhat over the coxæ laterally. Coxæ usually broad and flattened; those of the meso- and metathorax devoid of styliform appendages. Tarsi usually two-segmented. Abdomen composed of eleven segments, the tergum of the tenth usually partially covering the eleventh. Body usually depressed, or flattened dorso-ventrally, thus differing from the more cylindrical Machilidae, although Ridley describes a specimen of *"Lepisma" corticula* of which he states that "the chief peculiarity of this *Lepisma* is its very rounded back, resembling that of a *Machilis* rather than that of a typical *Lepisma*." The body is usually scaled, although in such forms as *Nicoletia* and the Maindroniidæ, the scales are absent. Brues and Melander are thus not strictly correct in stating that in the members of this group "the body is always clothed with scales." The number of abdominal ganglia is eight, and there are eight pairs of spiracles in the abdominal region. The tracheæ anastamose ventrally with those of the opposite side of the body, and those of the same side are connected dorsally by longitudinal trunks. Malpighian tubules six in number. Ovaries with five ovarioles. Heart with nine pairs of ostia. The principal families of this order are the Lepismatidæ, Nicoletidæ, Maindroniidæ, and Gastrotheidæ. With regard to the Gastrotheidæ, it may be remarked that Silvestri, 1912_a, has shown that these insects belong to the Lepismid group, and that the supposed springing organ described by Casey is the ovipositor, which is somewhat similar to that of *Atelura* and related genera. Cook, 1901 (Proc. Ent. Soc. Washington, IV, p. 53) considered it so different from other insects that "he thought it necessary in consequence, to admit at least a new sub-order, which he would call Gastrotheoidea," and Handlirsch, 1906, raised it to an order, although he thought this a matter of some doubt. Silvestri, however, has shown that the insect in question is one of the Lepismid group.

SUMMARY.

The principal points brought out in the preceding discussion may be briefly summarized as follows. Crustacea (*e. g., Bathynella, Anaspides, Ligia,* etc.) "Myriopoda" (*Scolopendrella, Scutigera,* etc.) and the lower insects (*e. g., Eosentomon, Anajapyx, Machilis*) form the three apices of a triangle, each apex of which is connected with the other two by mutual bonds of relationship. These three groups are related to the Trilobita (such as *Triarthrus,* etc.), and through the Trilobites they are rather distantly related to Limulus and the Arachnids, but the Arachnid line of development diverges markedly from that of the three groups mentioned above as shown in fig. 2. The ancestors of Arthropods in general, were doubtless related to Annelidan worms and to *Peripatus.*

The Apterygota have retained characters suggestive of both Crustacean and Myriopodan affinities, and some of the Apterygotan lines of development are nearer to the Crustacea than to the "Myriopoda" in certain respects, while others are clearly much nearer to the "Myriopoda." The Apterygota as a whole doubtless arose from ancestors occupying a position intermediate between the Crustacean and "Myriopodan" lines of descent, as shown in the diagram, fig. 2). The Apterygota are much more primitive than their nearest Pterygotan relatives (the Blattids, Plecoptera and Ephemerids) and have departed the least from the probable ancestral condition of the Hexapoda, despite Handlirsch's contention to the contrary.

There are three main lines of development (possibly only two) in the Apterygota. These consist of the insects grouping themselves about the Protura, Rhabdura, and Thysanura, and they are divided into three sections termed the Proturadelphia, Rhabduradelphia, and Thysanuradelphia. The first group constitutes the non-styli-bearing Apterygota (Astyligera), while the last two constitute the styli-bearing Apterygota (Eustyligera). These may be further divided into seven or more orders represented by the Dasyleptidæ (?), Machilidæ, Lepismatidæ, Campodeidæ, Japygidæ, Eosentomidæ, and Entomobryidæ (with the Sminthuridæ ?).

As a whole, the Eosentomid group is the most primitive. The Entomobryids, Sminthurids, etc., are rather closely related to the Protura, but represent more or less degenerate offshoots which branched off at a comparatively early stage of development (see fig. 1).

The "Rhabduran" insects with their concealed mouthparts, vestigeal first abdominal legs, etc., appear to approach the Proturan forms on the one hand, and also lead up to the *Machilis*-like forms with well-developed cerci, styli, etc., on the other: so that they might be regarded as somewhat intermediate between the two groups, although their closest affinities are with the Thysanuran group (*i. e., Machilis, Lepisma,* etc.). Such forms as Anajapyx serve to connect the Campodeidæ with the Japygidæ.

The Thysanuran group (*Machilis, Lepisma, Nicoletia,* etc.) approaches quite closely to the lower Pterygotan forms, the Plecoptera, Blattidæ, and Ephemeridæ being as nearly related to them as any of the Pterygota.

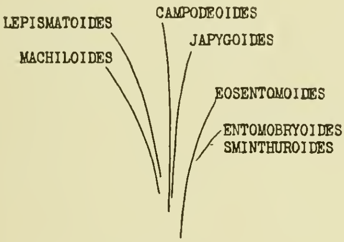

Fig. 1

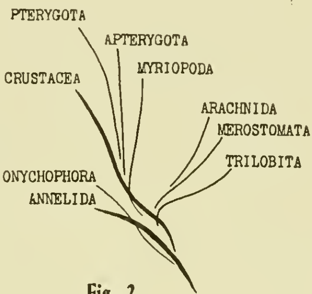

Fig. 2

The relationships of the principal Apterygotan groups are represented in fig. 1, while in fig. 2 the lines of descent of the more important groups related to the Insecta have been shown. It is impossible to represent the rather complicated interrelationships of the different groups in a figure drawn in one plane, since the various lines of descent approach one another from different angles, and it is practically impossible to represent this correctly without making such an intricate crossing of lines as to render the diagram almost unintelligible, and therefore useless. On this account, the discussion given above rather than the diagram, should be taken as setting forth the true relationships of the forms here described.

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THE ASH LEAF BUG, NEOBORUS AMOENUS REUT. (HEM.)[1]

By Edgar L. Dickerson and Harry B. Weiss,[2]

New Brunswick, N. J.

This species was described by Reuter, who adopted the manuscript name of Professor Uhler. In his paper, "Bemerkungen über Nearctische Capsiden nebst Beschreibung neuer Arten," in which the description appears under the name *Tropidosteptes amoenus,* he states that the above mentioned species is usually placed in American collections under the name *Neoborus saxeus* Dist., the light varieties under the name *Neoborus amoenus* Uhl., and that it cannot possibly be identical with Distant's species. He further states that in *Neoborus saxeus* Dist. (Biol. Centr. Amer. Rhyn. Heter., I, 1884), p. 276, T. XXVI, f. 5) the first antennal joint is pointed out as being longer and dark, the ground color of the beak pitch brown, the femoral joint chestnut brown, etc., and that the North American species must therefore be known as *Neoborus amoenus* Uhl., which is very variable in color, extending from the lightest varieties through all the variations to the darkest (see Uhler, *Neoborus saxeus,* Proc. Cal. Acad. Sc. (2), IV, 1894, p. 264), also that this species is distinguished from the remaining species of the genus by the light antennæ and by the colored tips of the sides of the pronotum, otherwise it conforms with them in all generic characteristics.

In Van Duzee's check list of the Hemiptera of America, North of Mexico, it appears as *Neoborus amœnus* Reut., with *saxeus* Uhl., as a name cited in error and the following varieties, *palmeri* Reut., *plagiata* Reut., *signata* Reut., and *scutellaris* Reut.

In the same list its distribution is roughly given as Canada, Eastern states to the Mississippi Valley and eastern Canada. Smith in "Insects of New Jersey" records it from New Brunswick on ash.[3] It has

[1] Identified by Mr. H. G. Barber.

[2] The arrangement of the authors' names is alphabetical only and indicates neither seniority nor precedence.

[3] It has been found by the authors on the white ash (*Fraxinus americana*), green ash (*F. lanceolata*), red ash (*F. pennsylvanica* (*pubescens*)), and the English ash (*F. excelsior* var. *pendula*).

however a much wider distribution in New Jersey, having been found by the authors at Somerville, Milburn, South Orange, Kingston, Springfield, Irvington, Rutherford, Morris Plains and Elizabeth, and is undoubtedly a well-distributed species.

When present in large numbers, the foliage of ash trees is damaged considerably by the adults and nymphs feeding on the undersides of the leaves, causing numerous white spots to appear on the upper surfaces. The nymphs and adults are quite active, move about rapidly and feed singly. In severe infestations, the leaves become dry and somewhat curled. This is especially true of young tender leaves which have been additionally injured by egg deposition. In the latitude of New Brunswick, N. J., there are two generations, the first adults appearing the latter part of May or the first of June. Eggs are deposited in the midribs of the younger leaves and hatch in from ten days to two weeks. Each nymphal stage requires from four to eight days depending on the temperature, the average length of time consumed from egg to adult being about five weeks. Adults of the first brood are usually plentiful about the middle of July at New Brunswick, those of the second brood appearing the latter part of August. In the more northern parts of New Jersey they appear from one to two weeks later. On account of the somewhat extended oviposition period, it is quite possible to find later stage nymphs and adults present at the same time.

Egg.—Length 0.4 mm., width 0.14 mm. The eggs which are translucent, flask-shaped, broad and rounded at the posterior ends are deposited in the midribs on the undersides of young, tender leaves. The whitish circular rim of the egg cap projects out a slight distance, but is effectively hidden by the pubescence on the midrib. In fact, on account of its hairy condition, the eggs as a rule are somewhat difficult to find especially if they are deposited close to the leaf surface. Where many eggs are deposited in a rib, the leaf becomes somewhat curled.

First Stage Nymph.—Length 0.6 mm. Body oblong, broadening posteriorly (in newly hatched specimens, narrowing posteriorly), obtusely pointed at both ends. Head triangular, eyes lateral, prominent, granular. Thoracic segments distinct, pro- and mesothorax of equal length, metathorax shorter. Abdominal segments distinct in newly hatched specimens, later becoming indistinct. Rostrum extending posteriorly beyond thorax.

Color.—Reddish brown, lighter posteriorly, light longitudinal median line on thorax, curved transverse line on vertex of head. Legs and antennæ white and somewhat hairy, more so on distal antennal segment.

Second Stage Nymph.—Length 0.9 mm. Body ovate, head triangular, eyes prominent, lateral granular. Thoracic segments distinct, broadest posteriorly. Prothorax longest, mesothorax slightly shorter, metathorax shortest. Abdomen rounded, broadest at middle, segments somewhat indistinct.

Color.—Head and thorax dark reddish brown, light median line on thorax, curved transverse line on vertex of head. Abdomen light reddish brown. Legs and antennae yellowish white. Hairs of appendages similar to those of first nymphal stage. Ventral surface reddish brown, sides and apex of abdomen lighter. Abdominal segments distinct, margins laterally. Rostrum extending to third pair of legs with apical two thirds yellowish white.

Third Nymphal Stage.—Length 1.3 mm. Body ovate, head triangular, eyes lateral, prominent, granular. Mesothorax longest, metathorax shortest of thoracic segments. Sides of thorax rounded, broadening posteriorly. Mesothorax broadest. Abdomen rounded, broadest anteriorly, segments distinct.

Color.—Head and thorax dark brown, with median, longitudinal, light line. Curved transverse line on head. Abdomen light reddish brown, darker transverse, broken lines on several segments. Legs and antennae yellowish white, darker than in preceding stages. Ventural surface reddish brown, sides and apex of abdomen lighter. Abdomen and thorax with distinct margin. Rostrum extending to third pair of legs, apical two thirds yellowish white.

Fourth Nymphal Stage.—Length 1.6 mm. Body oval, head triangular, eyes lateral, prominent, granular. Pro- and mesothorax of equal length, metathorax half as long. Thorax broadening posteriorly, at sides meso- and metathorax extending posteriorly. Mesothorax covering metathorax forming wing pads. Abdomen broadly rounded.

Color.—Head and thorax dark brown, almost black. Light median longitudinal line on thorax meeting curved, transverse line on head, which extends to lateral margins in front of eyes. Eyes slightly lighter in color than head. Abdomen light, reddish brown, with median, broad, transverse bands anteriorly. Legs and antennae light yellowish brown. Some nymphs of this stage have head light brown, thorax light, yellowish brown medially, dark, transverse, more or less broken bands extending across most of abdominal segments. Ventral surface yellowish brown except at margins of thorax. Rostrum extending to third pair of legs.

Fifth Nymphal Stage.—Length 2.3 mm. Body oval, narrowing anteriorly, broadest at apical third of wing pads. Head triangular, eyes lateral, granular, more pronounced than in preceding stage. Tip of each granule is black giving a mottled appearance. Prothorax broadest at posterior end, sides margined, straight. Mesothorax slightly longer than prothorax and covering metathorax save at center. Wing pads extending posteriorly half the length of the abdomen.

Color.—Head yellowish brown, with a median and lateral, longitudinal dark lines. Median line broadening transversely at base. Prothorax marked with dark bands at lateral and anterior margins and bands parallel to them. Wing pads mottled with darker markings at center and anteriorly. Abdominal segments darkened transversely. Entire dorsal surface light yellowish brown. Legs and antennae yellowish. Ventral surface yellowish white except at sides of thorax, which are reddish. Rostrum extending to between first and second pair of legs, apical two thirds whitish, tip black.

Adult.—In O. M. Reuter's paper, "Bemerkungén über Nearctische Capsiden nebst Beschreibung neuer Arten," published in Acta Societas Scientiarum Fennicae, Tom. XXXVI, No. 2, p. 48, there appears the following description of *Tropidosteptes amoenus* Reut.: "Oblongo-ovalis, colore variabilis, glaber, sat nitidus, superne, capite excepto, sat crebre et sat fortiter punctatus; rostro pedibusque lividis, extremo apice rostri articulique tertii tarsorum nigro, capite basi pronoti 3/7 angustiore, ab antico viso distincte transverso (♂) vel latitudine postica parum vel paullulum breviore, genis oculo paullo magis quam dimidio (♂) vel paullo (♀) humilioribus, vertice postice tenuissime (♂) vel tenuiter (♀) marginato, oculo æque lato (♂) vel hoc circiter 2/3 duplo latiore (♀), medio plerumque impressione longitudinali instructo; rostro medium vel fere apicem coxarum intermediarum attingente; antennis gracilibus, articulo primo capite ab antico viso paullo minus quam 1/3 breviore, secundo primo magis quam duplo et dimidio (♂) vel solum circiter duplo (♀) longiore et margini basali pronoti æquelongo (♂) vel hoc saltem 1/4–1/3 breviore (♀); pronoti latitudine basali circiter 1/3–2/5 breviore, sat crebre, fortiter punctato, strictura apicali versus latera gracilescente callis tertiam apicalem partem haud superantibus, lateribus apicem versus distincte calloso-marginatis, intra marginem longitudinaliter impressis; scutello paullo subtilius punctato; hemielytris abdomen longe superantibus, marginale costali modice rotundatis, crebre punctatis. Long. 5, lat. 2 1/10 (♂)–2 1/2 (♀) mm."

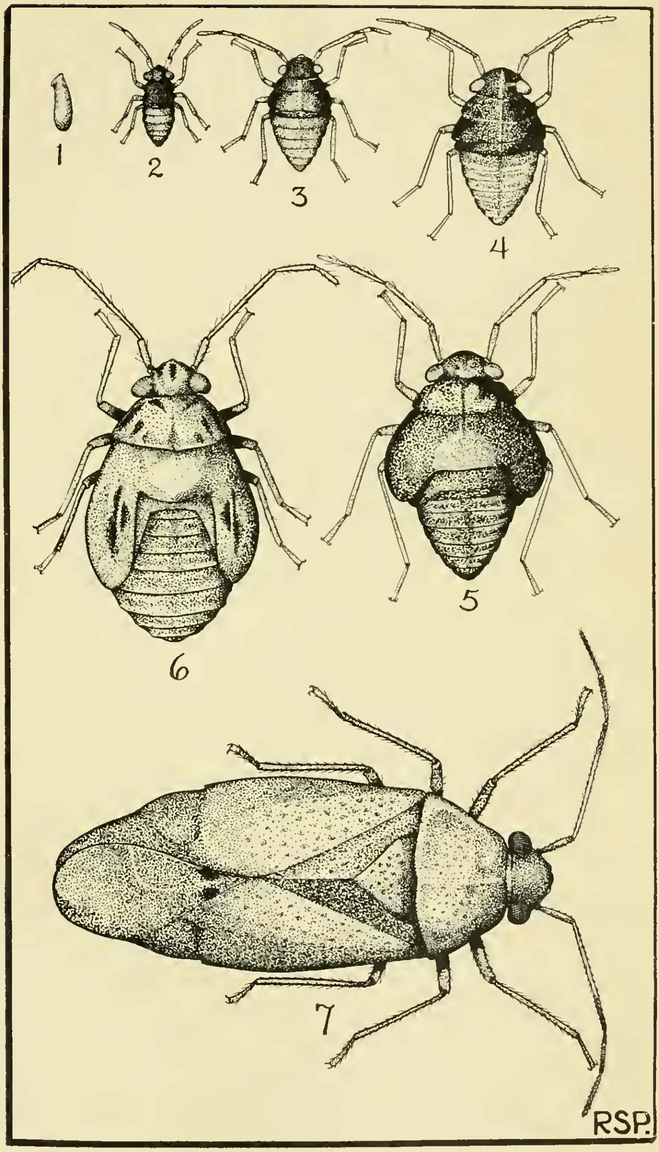
In the same article, there also appears brief discriptions of the varieties *palmeri, plagiata, signata, scutellaris.*

EXPLANATION OF PLATE 16.

Fig. 1. Egg.
Fig. 2. First stage nymph.
Fig. 3. Second stage nymph.
Fig. 4. Third stage nymph.
Fig. 5. Fourth stage nymph.
Fig. 6. Fifth stage nymph.
Fig. 7. Adult (female).

MISCELLANEOUS NOTES.

Some Respiratory Structures of Dragonfly Larvæ.—In the little Zygoptera or damsel flies, the respiratory arrangement is vastly different from that of other dragonflies. These nymphs all have three big flat external gills, forming a sort of triple tail at the end of the abdomen. But what is most strange is that these nymphs will live if the external gills are all broken off. I could find nothing in the way of discovered fact about these insects except the old statement that the blackwing, *Calopteryx,* had as a nymph three gills in his rectum. I dissected four of the common small Agrionidæ, including the common brown Lestes, blue Enallagma and others. Their rectum was the same as that of any insect, with just three glands in it; but in *Argia putrida,* I happened to work further forward, and in this creature I found that the intestine, just caudad of the Malpighian tubules, is expanded into a globular ampulla. On the surface of this ampulla are three fatty bags, well tracheated, one of



Neoborus amœnus Reut.

them midventral, the others laterodorsal. I do not know that this is respiratory in structure, but it suggests the folds of the Æschnine forms. I did not see any of these nymphs draw water into the anus, but I did notice that one lived nine days without external gills. In the nymph of *Calopteryx,* I found a similar ampulla, and stranger still, another one just like it, also in the rectum. The fatty bags seem to be projections into the lumen of the rectum, but do not hang free into it. They are covered by a tough chitinous epithelium. —STEPHEN G. RICH.

Rhynchophora in Maine.—While collecting in Cumberland Co., Maine, last summer, in the vicinity of Sebago Lake, I took the following weevils, which are not reported from that state in Blatchley and Leng's Rhyncophora of Northeastern America, viz.: *Apion puritanum* Fall, *Anthonomus hamamelidis* Pierce, *Balaninus obtusus* Blanchard.—ALAN S. NICOLAY.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY.

MEETING OF MAY 16, 1916.

A regular meeting of the New York Entomological Society was held May 16th, 1916, at 8:15 P. M., in the American Museum of Natural History, President Harry G. Barber in the chair, with 14 members and one visitor present.

The curator reported a revision of the Membracidæ of the Local Collection by Mr. Olsen.

Mr. Dow reported arrangements for Lahaway field trip, and the names of members who had indicated their intention of joining it for one or more days.

Mr. Davis called attention to the forest fires at Wading River, Long Island, often visited by our members, and spoke earnestly of the useless damage done to Long Island through such fires.

Mr. Leng exhibited a collection of the genus *Tetracha,* of which a great part was loaned by Mr. Harris, and called special attention to the recent increase in our knowledge thereof through the activity of Mr. Harris, Mr. Davis and the Museum expeditions of Dr. Lutz and Mr. Mutchler.

Mr. Davis commenting thereon spoke of the differences between *Tetracha carolina var. floridana Mss.* and allied forms and of comparisons he had made in Washington while visiting Dr. Schwarz.

Mr. Barber read a paper on Nabidæ, in which he reviewed the five genera and 22 species known from the United States, giving their distribution as follows:

**Carthasis rufo-notatus* Champ., Panama, D. C., Md., N. J. (*decorata* Uhler and *contrarius* Reuter being synonyms).

Metatropiphorus belfragei Reuter, Texas, Fla., N. C., D. C., N. Y., New Eng.

Phorticus collaris Stål, Texas, Mexico.

**Pagasa fusca* Stein (including *nitida* Stål as synonym). Eastern U. S., N. Y., N. J., Neb., Mo., Tex., Ariz.

P. pallipes Stål, western U. S.

**Nabis* (formerly known as *Reduviolus* Kirby) *subcoleoptratus* Kirby, N. E. U. S. (extremely common in Adirondack Mts.).

**N. ferus* Linn., common to U. S. and Europe.

N. capsiformis Germar, common to So. U. S. and Europe and almost cosmopolitan in tropical and sub-trop. regions.

**N. inscriptus* Kirby, common to No. U. S. and Europe.

N. limbatus Dahlb., common to No. U. S. and Europe, also Colo.

N. flavomarginatus Scholtz, No. U. S. and Europe, also Colo.

**N. annulatus* Reuter, E. U. S.

**N. propinquus* Reuter, E. U. S. (*vicarius* Reut.).

**N. roseipennis* Reuter, E. U. S.

**N. rufusculus* Reuter, E. U. S. (*assimilis* Uhl.).

**N. sordidus* Reuter, E. U. S. (*pallescens* Reut.).

N. heidemanni Reut., Cal.

N. kalmiæ Reuter, Wis.

N. constrictus Champ. (A Mexican species, specimens from near Washington, D. C., have been determined as such by Mr. Reuter.)

N. nigriventris Stål, S. W. U. S. and Mexico (*sericans* Reut.).

N. crassipes Reut., S. W. U. S. and Mexico.

N. chenkeanus Kirkaldy, So. U. S.

The species marked with asterisk have been found within 50 miles of N. Y. City, though in single instances in some cases. The New Jersey List cites most of them, though some are under synonymous names. It also cites *sericans* Reut. (a synonym of *nigriventris*) and *kalmiæ* Reut., neither of which are likely to occur so far east; *kalmiæ* being very close to *ferus*, the New Jersey record may be based on that species.

Mr. Barber spoke also of the predaceous habits of the species, of their occurring in both brachypterous and macropterous forms, and of their taxonomic characters, praising in this connection the work of the late O. M. Reuter of Finland.

In the discussion that followed, Mr. Barber was urged to prepare a synoptic key for the JOURNAL.

Mr. Mutchler exhibited the enormous larva of an African Goliath beetle, Dr. Bequaert spoke of their being found in decayed wood and of their being eaten by the natives, commenting on which Mr. Dow remarked that he had found the astringent taste of similar larvæ unpleasant.

Mr. Weiss exhibited the stages and work of the introduced boxwood leaf miner (*Monarthropalpus buxi* Lab.), now established at Rutherford, Eatontown, Far Hills, Gladstone and Peapack, in New Jersey.

Mr. Schaeffer recorded *Dermestes pulcher,* found at South Amboy, N. J., by Mr. Schott.

Mr. Davis exhibited Cicindelidæ obtained from Franklin Sherman, Jr., which will be recorded in Miscellaneous Notes, and a species of *Lyctus* found injuring shelves in the pantry of a house on Long Island.

MEETING OF OCTOBER 3, 1916.

A regular meeting of the New York Entomological Society was held Oct. 3, 1916, at 8:15 P. M., in the American Museum of Natural History; President Harry G. Barber in the chair, with 17 members and six visitors present.

The Curator announced the date for the first Saturday afternoon meeting, Oct. 28, and the subject, Bruchidæ.

Mr. Dow reported for the Lahaway Committee that the plantation formerly owned by the late J. Turner Brakeley had been bought by his onetime superintendent, Wm. H. Horner, and that visitors would be entertained by him at a rate of $7.00 per week. The Decoration Day outing had been attended for from one to four days by Mr. and Mrs. Dow, Mr. and Mrs. Leng, Dr. Bequaert and Messrs. Davis, Schaeffer, Olsen and Engelhardt. The collecting had proven far ahead of that found at Lakehurst, and the Weekly Messenger had been printing an account of the place and its visitors ever since.

Mr. Leng added an appreciation of Mr. Dow's hard work in making the excursion successful.

The Secretary read a letter from Mr. Joutel, dated May 16, announcing the death on May 1 of Julius Meitzen, aged 80 years, a former member of the Society, and on motion a minute is hereby entered expressive of the sorrow of the Society.

Mr. Davis announced the death, on Sept. 6, of Louis H. Joutel, aged 58, an active member and former Treasurer and Secretary of the Society, reading an account of his life and entomological achievements, which will be printed in the JOURNAL. On motion, the Secretary was instructed to write Mr. Joutel's sister, conveying the sorrow and sympathy of the Society.

Mr. Sherman announced the death, on Sept. 29, of Christopher H. Roberts, aged 64, a former President of the Society, and briefly reviewed his long connection with this and the Brooklyn Entomological Society and his work with aquatic coleoptera. Mr. Sherman engaged to write an obituary notice for the JOURNAL and the Secretary was instructed to write Mrs. Roberts.

The President then called for brief outlines of the Summer collecting accomplished by the members.

Mr. Sherman said he had spent ten days tramping and collecting Coleoptera in the White Mountains with Mrs. Sherman and Messrs. Dodge and Sheriff. He found the ponds too full for the best water beetle collecting but took an extraordinary number of *Carabus chamissonis* at Lake of the Clouds; and a specimen of *Cicindela longilabris* under a stone at over 5,000 ft. elevation. Mr. Sherman also exhibited the first description of Coleoptera in an American work, being the description of *Anisandrus pyri* by W. D. Peck, in an article entitled "On the Insects which Destroy the Young Branches of the Pear-tree and the Leading Shoots of the Weymouth Pine" in the Mass. Agl. Rep. and Journ. for Jan., 1817.

Mr. Olsen spoke briefly of his collections of Hemiptera in Massachusetts, Pennsylvania and Long Island, saying that he had not found insects numerous this year.

Mr. Dow said he had been on the go all summer, having made two trips to Claremont, N. H., two to Williamstown, Mass., and several to Lahaway; the specimens taken, of which he exhibited the first box, he placed entirely at the service of his friends, reserving only certain special desiderata for Messrs. Davis, Olsen and Bequaert.

Dr. Ottolengui, one of the charter members of the society, described his journey through Alberta, Vancouver, California and the Grand Canyon, his pleasant visits with Mr. Sanson at Banff and Van Duzee at San Francisco, and told of some of the rare *Plusia*, etc., he had secured, in part from Mr. Sanson. He dwelt especially on the abundance of *Pamphila* on a flowering hedge in Vancouver and again on blue aster-like flowers at Grand Canyon and on the number of Longhorn beetles found at dusk on the hotel wall in the Canadian Rockies.

Mr. Shoemaker spoke of his collecting experiences at Washington, D. C., in the Catskill Mts., and on Long Island, recording especially the capture of two butterflies, *Colias eurytheme* near east New York and *Apatura clyton*, found on silver poplar where beetles had caused the sap to flow, butterflies of southern distribution and rare on Long Island.

Dr. Lutz spoke of his journey with Mr. Rehn to Tucson and several of the mountain ranges of southern Arizona, leaving New York the latter part of June, and ending with a visit to Los Angeles and San Francisco, where he met Nunenmacher, Van Dyke, Van Duzee and other California entomologists at a meeting of the Pacific Entomological Society. He spoke especially of the excellent results of using a cheesecloth tent with lanterns inside for light collecting and of the insects collected at light in Texas while the train was detained in a swamp.

Mr. Engelhardt said his principal journey through southern California to Puget Sound was devoted mainly to marine invertebrates but with some entomological work included. Dr. Fenyes was visited in Pasadena, also Fordyce Grinnell, with whom he had a 30 mile walk through the Sierra Madre, and Dr. Van Dyke in San Francisco.

The ascent of Mt. Hood with blizzard weather alternating with a sunshine that brought out plenty of insects and a visit to Yosemite National Park were also features of his journey.

Mr. Harris described, as the principal result of several weeks in the White Mts., the location of *Cicindela ancocisconensis* on the watershed of the Israel River, a tributary of the Connecticut River, it having previously been known to occur in the White Mts. only in the Saco River valley, along the Glen Road near Ellis River, where his father found it in 1850. Mr. Harris exhibited also a box of *Cicindela limbalis* received from Col. Wirt Robinson, who had taken them at West Point, N. Y., and read a card from Dr. Walther Horn dated July 29, sending greetings to his American friends from the German field hospital on the Russian border.

Mr. Nicolay said his summer had been spent in Cumberland County, Maine, five miles from Sebago Lake; at Sudbury, Vermont, and at Lake Minnewaska, N. Y. In Maine the conditions proved similar to those found in northern New York, though the elevation was only 1,200 ft. Many good beetles were found, including *Anthophilax malachiticus* and *Pachyta rugipennis,* but black flies and mosquitoes were unpleasantly abundant.

Mr. Woodruff spoke of many short trips made to Litchfield, Conn., Yaphank, Rockaway, Lakehurst, sometimes with other collectors and particularly of the dragonfly results.

Mr. Davis in consideration of the late hour, spoke very briefly of his summer activity in North Carolina, Virginia, New Jersey and New York, but took pains to call attention to a specimen of *Papilio palamedes* found by Edward Burns, June 18, 1914, at Fort Wadsworth, Staten Island.

Mr. Dickerson said he had been in the field practically every day, engaged in nursery inspection work with Mr. Weiss, and would report later the more important results.

Mr. Leng exhibited European Rhynchophora found near Batavia, N. Y., wihle with Mr. Knight, Mr. Davis and Dr. Bradley in June; also an apparently new species of *Syncalypta* found at the same time.

Mr. Barber spoke enthusiastically of the collecting near Washington, D. C., and especially about the Great Falls.

Mr. Herbert Barber, upon the President's invitation, spoke also of the collecting about Washington and the species apparently brought there from considerable distances by the Potomac River; but said he was unable to devote much attention to it on account of the time required to find enough myriapods to feed the long-lived Lampyrid larvæ that were the special subject of his biological work, though rare species were occasionally thus found at night, as shown by a fine pair of *Cychrus ridingsii.* He said he now had the complete life history of one species of *Phengodes,* and partial histories of others.

Mr. Engelhardt proposed a trip to Yaphank for Sunday, Oct. 8, to show Mr. Barber that locality for *Phengodes.*

MEETING OF OCTOBER 17, 1916.

A regular meeting of the New York Entomological Society was held Oct. 17, 1916, at 8:15 P. M., in the American Museum of Natural History, President Harry G. Barber in the chair, with 20 members and five visitors, including Mr. W. S. Wright of San Diego, Cal., Dr. J. Bequaert and Mr. Edw. Burns, present.

Mr. Wunder exhibited the Society's album of photographs and Mr. Davis commented on the skill with which they had been mounted and labeled.

Mr. Dow spoke of the "Insects of Lahaway," reading extracts from the Allentown Messenger and exhibiting a box of specimens which he placed at the service of the members. In part he said that the collecting at Lahaway had been scarcely sampled, the more careful methods like sifting and sugaring having been greatly neglected; and in view of the great area of uncultivated land in that part of New Jersey, he felt that many interesting captures remained to be made.

Mr. Olsen exhibited the Hemiptera he had taken at Lahaway, representing 76 species and 53 genera, saying that they represented the usual run for the vicinity. He pointed out *Euschistus servus* and *Notonecta uhleri* as especially interesting captures.

Mr. Davis read an extract from his journal written after his return from the Decoration Day trip to Lahaway, in which the intermediate position of Lahaway between pure pine barren and better land to the west was indicated and its cranberry bogs and sandy patches were described, while its natural condition was reflected in the mention of deer, fox, coon, opossum, snakes and birds. The abundance of red cedar was stated to emphasize the difference between it and the white cedar swamps of Lakehurst; and the patches of lupine and *Cypripedium acaule* were recalled in connection with the sports their long undisturbed growth had developed. Mr. Davis exhibited the rare *Hyla andersoni*, which was quite common, a chain snake 39 inches long, a worm snake 12½ inches long (and exceeding the length stated in the books) as additional evidence of the almost virgin character of the great forests of Lahaway. He also showed many photographs taken during his visit, two maps of the region and a small part of the insects he had taken, pointing out especially an unusually dark specimen of *Cicindela rugifrons*, specimens of *Attelabus bipustulatus*, with oak leaf showing the half-moon shaped cut with which it commences to roll the leaf, *Mantispa interrupta*, collected by Mr. Dow in September and the following Orthoptera:

Gryllus assimilis Fabr.

Nomotettix cristatus cristatus Scudd.

Eutettix carinatus Scudd. Previously reported by Dr. Fox from Camden and Cape May Counties, N. J., but not recorded from the State in the N. J. List of 1910.

Arphia sulphurea Fabr.

Chortophaga viridifasciata DeGeer.

Hippiscus phoenicopterus Germ. Nymphs.

Atlanticus sp. Nymph.

Mr. Leng showed some of the beetles he had caught, calling attention especially to the Rhynchophora found on the pines, beach plums and huckleberries, among which were *Anisandrus pyri,* one of the first beetles described by an American author, and *Rhinomacer pallipennis,* one of the new species recently described by W. S. Blatchley.

Dr. Bequaert said he had taken a great quantity of Hymenoptera and Diptera, but unfortunately his unfamiliarity with the American species prevented a complete report. However, he could say that *Methoca bicolor,* of which the life history appeared in the August number of Psyche, was one interesting capture because as a parasite on Cicindela larvæ, it was always found in sandy places. *Melitara prodenialis,* raised by Mr. Olsen from larvæ found in *Opuntia* leaves was especially interesting among the Diptera.

Dr. Forbes said that in looking over the Geometers found by Mr. Davis he noticed an aberration of *Apœcasia deductaria* Walker that was remarkable for its suffused color.

Mr. Weiss exhibited the following insects of tropical American origin found in greenhouses in New Jersey:

Cholus cattleyæ Champion, and *Diorymellus lævimargo* Champion, new weevils recently described.

Diprion simile Hartig, a European sawfly found at Rutherford, South Orange and Elizabeth, N. J.

Tenthecoris bicolor Scott, found in Bergen Co., N. J.

Mr. Nicolay exhibited the green species of *Anthophilax* including the types of *hoffmani,* loaned by American Museum of Natural History; *viridis,* loaned by Mr. Shoemaker, and *malachiticus,* taken by himself in Cumberland Co., Maine, commenting on the constant difference between the two latter in the color of the legs.

Mr. W. S. Wright, upon invitation from the chair, spoke of the unusual character of California collecting, where four faunal zones could be found by going 60 miles from the coast, and where at times extraordinary numbers of specimens could be obtained. As instances he mentioned the late L. E. Ricksecker taking 1,700 moths in one night in September, 1911, in a trap, and his own experience in taking 500 day fliers in a three-days' trip in the mountains. Mr. Wright spoke also of the excellent collecting about San Diego and said he would always be glad to show visitors where the good places were.

Dr. Forbes spoke of *Pieris oleracea* as abundant in certain places in McLean bogs near Ithaca, N. Y., where it was evidently able to hold its own against *P. rapæ.*

Mr. Angell spoke of *Gymnetis sallei* and said the form occurring north of Mexico differed sufficiently to require a new name.

Mr. Davis showed a proof of photograph of the late Louis H. Joutel, prepared under Mr. Comstock's direction, and to appear in the JOURNAL. He spoke also of Mr. Sleight's illness and urged his friends to call on him at his residence, 95 Hamilton Ave., Paterson, N. J.

Mr. DeVyver spoke of the excellent conditions for collecting in the Interstate Park, describing the 28 days he spent there, during the early summer, about 3½ miles back in the woods from Tompkin's Cove, N. Y., of which most were rainy.

Mr. Beyer, upon special invitation by the President, regretted that his years prevented activity in the field; but in allusion to Mr. DeVyver's comments on the extreme rains of the early summer, recalled his contrary experiences in Lower California, when for six months no rain whatever fell.

Mr. Dow said that Mr. Grossbeck and he found no scarcity of rain in the Blue Mountains of Jamaica, where it actually rained every day, and the choice lay between roasting in a rain coat or getting a daily wetting. The reports of the local weather bureau show that such daily rains have continued for at least 15 years.

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Generic names begin with a capital, specific names with a small letter. New genera, subgenera, species, subspecies, varieties and *nomina nova* are printed in italics.

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