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ANNALS

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Volume III SEPTEMBER, 1910 Number 3

# THE PALPI OF MALE SPIDERS.

By John Henry Comstock.

## INTRODUCTION.

The remarkable modification of the palpi of the males of spiders into organs for the transference of the seminal fluid to the female at the time of pairing of the sexes attracted the attention of naturalists at a very early date; and the great variety of forms presented by these organs has led systematists to make much use of them in taxonomic work. In practically all of the more important works on the classification of spiders there are figures and descriptions of the palpi of males.

Notwithstanding the general recognition of the value of these organs for taxonomic purposes our knowledge of their structure is very inadequate. Several important contributions to this subject have been published and are well known, notably those of Westring ('61), Menge ('66), Bertkau ('75 and '78), Wagner ('87), Van Hasselt ('89), and Chamberlin ('04 and '08). Still we find, even in the more recent publications, figures of palpi given with almost no effort to identify their parts; and even when some of the parts are named we find different terms applied to homologous parts in the descriptions of different genera.

The necessity of selecting from the many terms that have been proposed for parts of the palpi, a set to be used in a handbook of North American Spiders that the writer has in preparation, and the need of terms for parts that have not been described, has led to the preparation of this paper. It is hoped that the publication of it may tend to bring about a greater uniformity in nomenclature and an increased use in systematic works of the extremely valuable characters presented by these organs.

THE MORE GENERALIZED TYPES OF PALPI.

In all spiders the external opening of the reproductive organs of the male is on the lower side of the adbomen near its base, in the epigastric furrow. Some time before pairing the seminal fluid is emitted from this opening and is stored in a tubular cavity in an appendage of the last segment of the palpus, where it is retained until the pairing of the sexes, and from which it then passes to the spermathecæ of the female. As the object of this paper is purely morphological the details of this transference of the sperm will not be discussed here; the reader is referred to the recently published papers by Montgomery ('03 and '10) for a review of the subject and for an account of original observations.

FIG. 1. Tarsus of *Filistata hibernalis;* 1, lateral aspect; 2, oblique view; 3, mesal aspect.

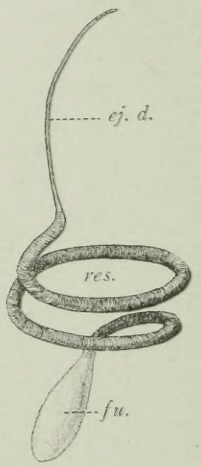


FIG. 2. Diagram of the receptaculum seminis.

The genital appendage of the palpus of the male is exceedingly complicated in structure in the more specialized spiders, as in the Argiopidæ; but it is comparatively simple in some of the more generalized families. A few illustrations of the simpler forms will be given here.

THE FILISTATA TYPE OF PALPUS.—In *Filistata hibernalis*, which is a very common house spider in the South, is found the most simple type of male palpus that I have seen among spi-

ders. In the males of this species, the distal end of the last segment of the palpus, the tarsus, contains a coiled tube (Fig. 1); this is the *receptaculum seminis* (Wagner '87). The proximal portion of this tube is slightly enlarged and ends blindly; the distal part is slender and extends through a slender, twisted prolongation of the tarsus ending at its tip by an open mouth. The modified terminal portion of the tarsus, which contains the receptaculum seminis, is the *genital bulb*. By looking directly at the tip of the palpus, instead of at one side of it, it can be seen that the base of the bulb is situated in a cavity in the end of the main part of the palpus (Fig. 1, *a.*). This cavity is the *alveolus* (Menge '66). The slender prolongation of the bulb, which contains the terminal portion of the receptaculum seminis is the *embolus* (Menge '66; *style*, Simon, '92). Except ing the specialization of the distal end of the tarsus, the segments of the palpus of *Filistata* resemble quite closely the corresponding segments of a leg, the relative length of the femur, patella, and tibia being quite similar; there is not the shortening of the tibia, which is so marked in many of the specialized forms, as in *Aranea* for example.

A study of the palpus of *Filistata* gives a clue to the probable course of the evolution of the genital bulb. It is evident that the bulb is a specialization of the tip of the tarsus, and its most striking feature is the presence within it of the coiled receptaculum seminis. Regarding the origin of the receptaculum seminis, the fact that it is furnished with a transversely striated intima, like the intima of a trachea, indicates that it is merely an invagination of the body-wall. In its primitive form, it was probably a cuplike depression in the tip of the tarsus.

In its most perfect form, as seen in the more specialized spiders, the receptaculum seminis consists of three quite distinct parts: first, the proximal end of it, the *fundus*, is enlarged so as to form a pouch, the wall of which is more delicate than that of the other parts (Fig. 2, *fu.*); I have not been able to see tænidia in the intima of this part, and infer that it serves as a compressible bulb; second, the intermediate portion, the *reservoir*, is a large coiled tube occupying the middle division of the genital bulb (Fig. 2, *res.*), in this part the tænidia of the intima are well-developed and are sometimes very prominent; third, the terminal portion constitutes the *ejaculatory duct*; this is the slender tube traversing the apical division of the bulb (Fig. 2,

*ej. d.*); the wall of this duct is often dark in color, which renders it easy to trace the course of the duct in an expanded bulb.

The tracing of the course of the ejaculatory duct is often the only method by which the embolus can be recognized in a complicated palpus; for when the embolus is small or when it is lamelliform a slender apophysis may be mistaken for it. Even Menge ('66), who proposed the term embolus for this part labels the terminal apophysis as embolus in several of his figures of *Epeira*.

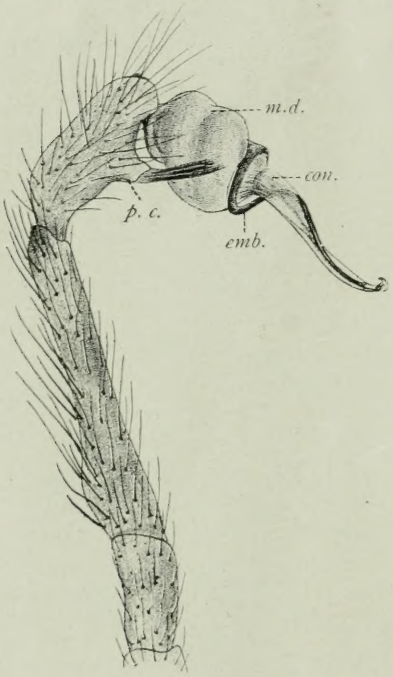


FIG. 3. Palpus of *Hypochilus thorelli*.

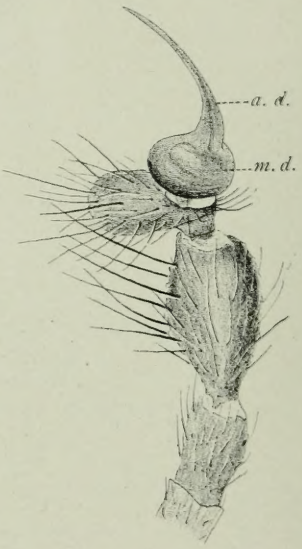


FIG. 4. Palpus of *Loxosceles rufescens*.

There is no reason to believe that the lumen of the receptaculum seminis communicates with the body cavity; the *meati sanguinis* described by Wagner ('87) do not exist.

After the stage represented by *Filistata* had been reached, a shifting in the position of the bulb occurred in most spiders. Instead of occupying a terminal position, at the tip of the tarsus, it has moved to one side of the tarsus in all spiders known to me except *Filistata*. In the tarantulas and in *Hypochilus thorelli*, the most generalized in many respects of the true spiders,

the genital bulb is nearly terminal but is, nevertheless, distinctly on one side of the tarsus (Fig. 3). In other spiders it has moved to a greater or less extent towards the base of the tarsus, which it has nearly reached in many, as for example in *Loxosceles rufescens* (Fig. 4). It has been suggested by Nelson ('09) that this shifting of the position of the bulb is for the protection of it from mechanical injury.

In *Hypochilus* (Fig. 3) and in *Loxosceles* (Fig. 4), the alveolus is comparatively small; but in many spiders it is large, resulting in the tarsus being more or less cuplike in form; this is shown in some of the figures of the more specialized palpi given later. This cuplike form of the tarsus as distinguished from its appendage, the genital bulb, suggested for it the name *cymbium* (Menge '66), which is the classical name of a small drinking vessel. The term *lamina*, proposed by Westring ('61) antedates cymbium; but I have adopted the later term, as it is the one in general use.

The well-known fact that tarsal claws do not exist on the palpi of male spiders is easily understood if we regard the genital bulb as a specialization of the tip of the palpus, as is indicated by the structure of the palpus of *Filistata* described above. Sometimes, as in *Lycosa*, the tip of the cymbium bears one, two, or three stout spines; these have been regarded as "transformed claws" (Chamberlin '08); it seems more probable for the reason given above, that these are secondarily developed structures instead of vestigial claws; in fact there are frequently strong spines distributed over the surface of the cymbium.

The genital bulb in *Filistata* is helicoid; this is due, so far as the larger basal part is concerned, to the fact that the wall of it is molded over the coiled receptaculum seminis; but the twisting of the bulb is continued to the tip of the embolus, although in this part, the receptaculum seminis is not coiled but extends in a nearly direct line. I know of no other case where the helicoid form of the genital bulb is so well-marked as here; but there is always a more or less spiral arrangement of parts.

The Tarantula Type of Palpus.—In those spiders that are commonly known in this country as tarantulas, and which represent the more generalized of the two principal divisions of the order Araneida, there exists a comparatively simple type of

palpus; but in none of them that I have seen, or of which I have seen figures, is it as generalized as is the palpus of *Filistata*.

In the palpi of the tarantulas, the genital bulb has migrated to one side of the tarsus; but it is still near the tip of this segment of the palpus (Fig. 5). A striking feature of the bulb is that it is divided into two distinct segments. The smaller basal segment may be termed the basal division of the bulb (Fig. 5, *b. d.*). The larger segment consists of two parts: a large stout part, which may be termed the middle division of the bulb (Fig. 5, *m. d.*), and a slender terminal portion, which may be termed the apical division of the bulb (Fig. 5, *a. d.*); there is, however, no distinct line between the middle and the apical divisions, the one gradually merges into the other; but in the more specialized palpi these two divisions are distinctly separated.

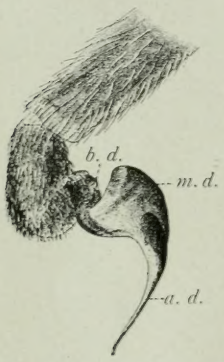


FIG. 5. Tarsus of *Eurypelma*.

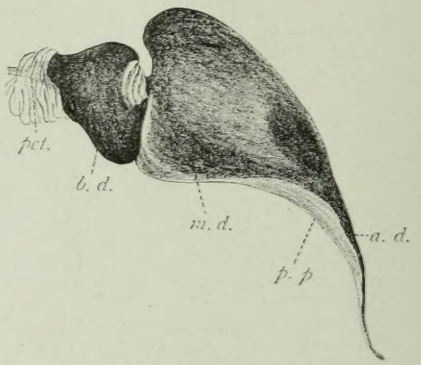


FIG. 6. Genital bulb of *Eurypelma californicum*.

In the articulating membrane which joins the bulb to the tarsus, there is on one side a distinct sclerite, which can be seen by removing the bulb from the alveolus (Fig. 6, *pet.*); this is doubtless homologous with what has been termed the *petiole* (Chamberlin '04) in more specialized palpi.

The greater part of the wall of the bulb in the tarantula type of palpus is very densely chitinized but there is a longitudinal area on the concave side of the middle and apical divisions which is comparatively soft (Fig. 6, *p. p.*); it may be that this part is distended by blood pressure at the time of pairing, as is the hæmatodocha in the more specialized palpi; but upon this point I have no data. This soft strip may correspond to that portion of the spiral type of embolus, described later, that I have designated the *pars pendula*.

The Palpus of Loxosceles.—In certain genera of the true spiders, the palpi are as simple as in the tarantula type. In *Loxosceles* of the family Scytodidæ, for example (Fig. 4), although the bulb has migrated nearly to the base of the tarsus; the bulb itself is very simple in structure. The basal division of the bulb is inconspicuous; the middle division is nearly spherical, and the apical division is long and slender. Here the receptaculum seminis is differentiated into the three parts described above; the reservoir is large, while the ejaculatory duct is very slender.

The Palpus of Dysdera.—In the family Dysderidæ two quite distinct types of palpi occur. In *Ariadna* the palpus resembles very closely that of *Loxosceles;* but in *Dysdera* it is of a very different form (Fig. 7); this is due to the fact that the apical division of the bulb is not slender, and is sharply differentiated from the middle division, its wall being much less densely chitinized. But there is on each margin a distinct sclerite; and this part of the bulb bears distinct apophyses. At the tip of the apical division there appears to be the beginning of a separation into embolus and conductor.

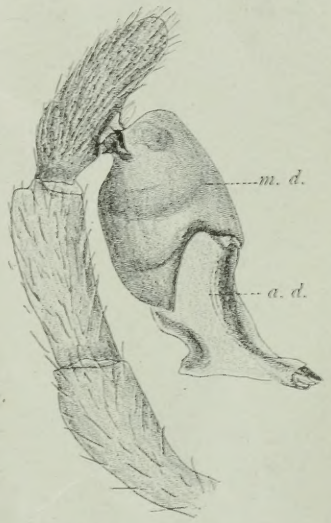


Fig. 7. Palpus of *Dysdera interrita*

A summary of the parts of the tarsus in the more generalized types of palpi of males is shown by the following table:

Body of tarsus or cymbium, containing the alveolus.
Genital bulb.
    Internal parts.
        Receptaculum seminis.
            Fundus.
            Reservoir.
            Ejaculatory duct.
    External parts.
        Petiole.
        Basal division.
        Middle division.
        Apical division or embolus.

THE INTERMEDIATE TYPES OF PALPI.

There are palpi which hold an intermediate position as regards complexity of structure between the comparatively simple tarantula type and the exceedingly complex forms to be described later. These intermediate types occur in widely separated portions of the araneid series; but agree in their more essential characteristics; for sake of brevity, I will discuss only a few examples of the intermediate types; and will then pass to a description of forms in which the maximum number of parts is found.

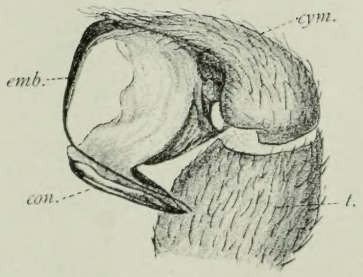


FIG. 8. Tarsus of *Atypus bicolor*.

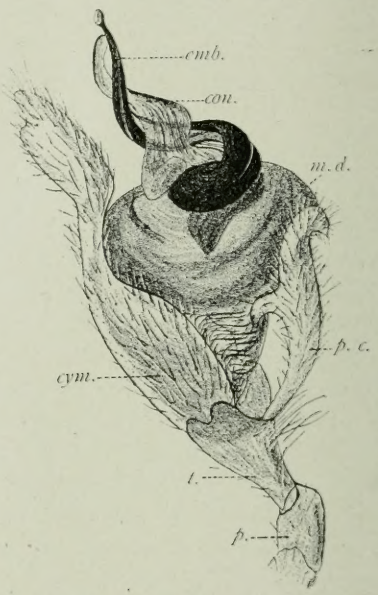


FIG. 9. Genital bulb of *Pachygnatha*, extended.

The most important characteristic of these intermediate types is that the apical division of the bulb is separated into two, more or less nearly, parallel parts. One of these parts contains the ejaculatory duct of the receptaculum seminis, this is the *embolus* (Menge '66); the other is intimately associated with the embolus and is known as the *conductor of the embolus*, or the *conductor of the style*, or, simply, as the *conductor*.

A comparatively simple example of this group of palpi is that of *Atypus bicolor*. Here the terminal part of the con-

ductor is a broad concave plate (Fig. 8, *con.*), in which the terminal portion of the embolus rests.

A more complicated form of the apical division of the bulb exists in *Hypochilus thorelli* (Fig. 3). Here the embolus is coiled about the conductor, the terminal part of which is concave so as to support the terminal portion of the embolus; the tip of the conductor bears a delicate membranous flap.

In *Hypochilus* the tarsus bears a branch which supports a prominent bunch of bristles (Fig. 3, *p. c.*); this may be a rudimentary form of paracymbium, a part that is well developed in *Pachygnatha*.

A somewhat similar condition exists in *Pachygnatha* (Fig. 9). Here the proximal part of the embolus is coiled about the conductor, which is a broad twisted plate; and the terminal portion of the embolus is supported by the corresponding part of the conductor. When at rest the apical division of the bulb rests in the concave tip of the cymbium; but in the specimen figured the bulb has been extended so to show the parts better; and the embolus and conductor have been separated at the tip.

In *Pachygnatha* the tarsus is divided into two distinct parts, which are joined by a movable articulation at the base. The larger part is the cymbium (Fig. 9, *cym.*) the smaller part, the *paracymbium* (Menge '66) or the accessory branch of the tarsus (Simon '92) (Fig. 9, *p. c.*). The cymbium and the paracymbium resemble the other segments of the palpus in the nature of their cuticula and in the fact that they are clothed with hairs.

The term conductor is in general use and was substituted for the term *spermophorum* of Menge, which was suggested by a misconception of the function of this part. As to the particular part to which the term should be applied there is no doubt. Menge ('66, Plate 15) clearly indicates, in his figures of the palpus of *Tetragnatha extensa*, the part to which he applied the term spermophorum; and the term conductor must be applied to the homologous part whenever it is used. This, however, has not been done; in many descriptions an entirely different part has been termed the conductor, merely because it is more or less nearly parallel with the embolus. A discussion of the function of the conductor is given later.

THE MORE SPECIALIZED TYPES OF PALPI.

In the development of the bulb of the male palpus in the more specialized families of spiders there has been evolved an exceedingly complicated organ, which is difficult to understand, on account of its small size and the fact that when at rest it is compactly folded. Fortunately when such a palpus is boiled in a solution of caustic potash (10%) the bulb expands so that its parts can be seen; and if preserved in glycerine, it remains flexible, so that it can be easily manipulated. The expanded bulbs figured below were prepared in this way. Even with the best of preparations, it is sometimes difficult to make out the relation of parts; this can be most easily accomplished by the use of a stereoscopic binocular microscope.

The extreme specialization of the palpi of males is marked chiefly by the development of hæmatodocha, to be described later, and by an increase in the number of distinct parts and appendages of the bulb. The maximum degree of specialization is to be found in the Araneinæ, of which the palpi of several species of *Aranea* are described later. The understanding of the relation of the parts of the bulb in this genus will be facilitated by a study first of a more simple form, such as is found in the Linyphiidæ.

THE LINYPHIA TYPE OF PALPUS.—The very common *Linyphia phrygiana* will serve as an example of the Linyphiidæ.

As in *Pachygnatha*, just described, the body of the tarsus of *Linyphia* consists of two parts; the *cymbium* (Fig. 10, *cym.*), and the *paracymbium* (Fig. 10, *p. c.*). The *alveolus* is a circular cavity near the base of the cymbium.

When the bulb is expanded, the three divisions of it are distinctly separated, there being a slender neck between the basal division (Fig. 10, *b. d.*) and the middle division (Fig. 10, *m. d.*), and also a similar slender neck between the middle division and the apical division (Fig. 10, *a. d.*).

The wall of the basal division of the bulb consists of two parts; the basal hæmatodocha, and the subtegulum.

*The basal hæmatodocha.*—The genital bulb is attached to the cymbium, within the alveolus, by means of a saclike structure, which, ordinarily, is inconspicuous or completely concealed by other parts of the bulb, but which is very conspicuous in the expanded bulb (Fig. 10, *b. h.*). This has been named the

*hæmatodocha* from the fact that at the time of pairing it is distended with blood (Wagner '97). The wall of the hæmatodocha appears to consist of elastic connective tissue; hence the name *spiral muscle* applied to it by Menge is inappropriate. In fact no muscle tissue has been found within the genital bulb. As similar extensible blood-sacs are present in more distal parts of the bulb of many spiders, I suggest that this one be termed the *basal hæmatodocha*.

FIG. 10. Expanded bulb of *Linyphia phrygiana*.

FIG. 11. Palpus of *Linyphia phrygiana*

*The subtegulum.*—The proximal end of the basal hæmatodocha is attached to the cymbium, the distal end, to a ringlike sclerite, for which I propose the term *subtegulum* (Fig. 10, *s. teg.*). The existence of a sclerite in this position was indicated by Wagner, and it is lettered in his figures *s. teg.*, but its ringlike form has not been described; in fact, Wagner states that the hæmatodocha ends in the tegulum.

*The middle division of the bulb.*—The middle division of the bulb (Fig. 10, *m. d.*) is that part which contains the chief portion of the receptaculum seminis, the *reservoir*; its wall is the tegulum, and it bears an appendage, the median apophysis.

*The tegulum.*—The term tegulum was applied by Wagner to all of the more densely chitinized parts of the wall of the genital bulb; but as it is desirable that the different sclerites should

bear distinctive names, I propose that this term be restricted to the sclerite that forms the wall of the middle division of the bulb. In *Linyphia*, the tegulum, in this restricted sense is a ringlike sclerite (Fig. 10, *teg.*).

*The median apophysis.*—Arising within the distal margin of the tegulum there is an appendage, only the tip of which is shown in the view of the bulb figured here (Fig. 10, *m. a.*); this is the *median apophysis*. In many spiders this appendage is very conspicuous; and to it have been applied several names. In fact in several instances a writer has applied different names to this part in his descriptions of different genera. Among the names that have been applied to it are *lamella characteristica* and *apophysis mediana* (Chyzer et Kulczynski '91), *clavis* and *unca* (F. O. Pickard-Cambridge '97–'05), and *scopus* (Chamberlin '04). The term median apophysis occurs frequently in descriptions, and is the older name for this part.

The median apophysis is articulated to the middle division of the bulb near the point from which the apical division arises; and in some cases, as in *Aranea*, it appears to be more closely articulated with a basal segment of the apical division, the radix, than it is with the tegulum.

*The apical division of the bulb.*—This division includes that portion of the bulb which lies distad of the middle division; it consists of two subdivisions: the conductor and the embolic subdivision. The embolic subdivision is traversed by the ejaculatory duct and is composed of several distinct parts. In fact the multiplication of parts of the embolic subdivision is the most characteristic feature of the more specialized types of palpi as contrasted with the intermediate types described above.

*The conductor.*—The conductor (Fig. 10, *con.*) is easily recognized by its relation to the embolus, which rests upon it, and by its membranous texture. Its attachment to the middle division of the bulb is by means of an exceedingly delicate membrane.

In *Linyphia* the embolus rests upon the conductor throughout its length; but in many genera the palpi of some of which are described later, the function of the conductor is evidently to protect the tip of the embolus in the unexpanded bulb. In many cases the embolus is very long while the conductor is short; but in every case the embolus in the unexpanded bulb occupies such a position that its tip is protected by the conductor.

In most cases the conductor can be recognized at a glance by its peculiar texture; sometimes it is chitinized to a considerable extent, but even then it usually has a membranous margin; and in any case it can be recognized by its relation to the tip of the embolus in the unexpanded bulb.

*The embolic subdivision.*—Closely connected with the membranous base of the conductor is the base of a separate subdivision of the apical division of the bulb; as this portion bears the embolus it may be termed the *embolic subdivision.*

*The radix and the stipes.*—Immediately following the membranous neck that connects the middle and the apical divisions of the bulb and parallel with the membranous base of the conductor, there are two segments of the embolic subdivision; to the basal one of these I apply the term *radix* (Fig. 10, *ra.*); and to the second, the term *stipes* (Fig. 10, *st.*). For a more distinctly segmented condition of the base of the embolic subdivision see the figures of *Aranea circulata* given later (Fig. 18 and 19), where the corresponding parts bear the same letters.

*The embolus.*—The organ through which the ejaculatory duct opens, the *embolus*, is comparatively simple in *Linyphia*, being a short spinelike part (Fig. 10, *emb.*).

*The lateral subterminal apophysis.*—In *Linyphia phrygiana* there is developed a remarkable platelike apophysis, which serves to protect the exposed face of the unexpanded bulb. In Figure 10 (*l. st. a.*), only the edge of this apophysis is shown; but in Figure 11, the broader face of it is represented. I designate this the *lateral subterminal apophysis* as it occurs on the lateral aspect of the unexpanded bulb, and also to distinguish it from an apophysis developed on the opposite face of the bulb in a subterminal position, which occurs in certain other genera.

*The terminal apophysis.*—The embolic subdivision ends in a strongly chitinized lobe, which may be designated the *terminal apophysis* (Fig. 10, *t. a.*). To apophyses of this kind Menge applied the term *retinacula;* but as this term predicates their function, which in some cases is obviously not that implied by the name, I prefer apophysis with a modifying term indicating the position of the particular apophysis described.

The Aranea Type of Palpus.—I have selected the palpus of *Aranea frondosa* (*Epeira strix*) as an example of an extremely specialized palpus. In Figure 12 the entire palpus, with the bulb unexpanded, is represented slightly twisted so as to show

FIG. 12. Palpus of *Aranea frondosa*.

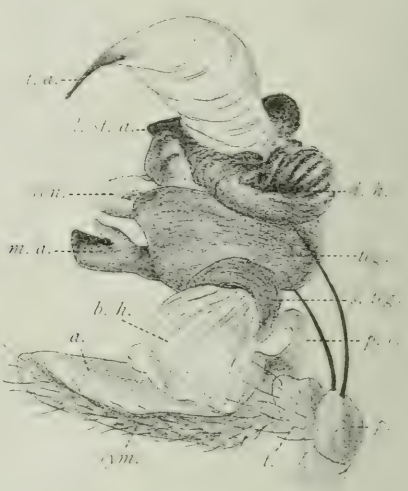


FIG. 13. Lateral aspect of an expanded bulb of *Aranea frondosa*.

FIG. 14. Mesal aspect of an expanded bulb of *Aranea frondosa*.

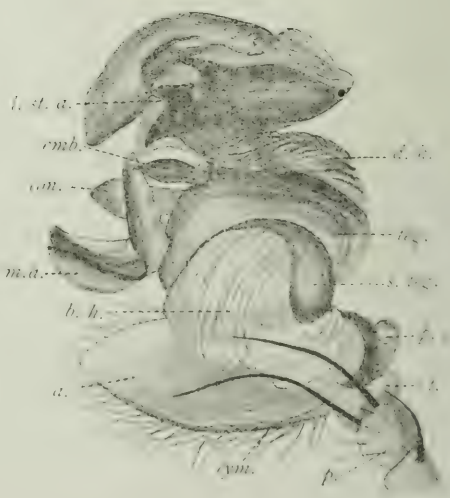


FIG. 15. Lateral aspect of an expanded bulb of *Aranea ocellata*.

the ventral aspect of the proximal segments and the lateral aspect of the bulb.

*The proximal segments of the palpus.*—This account of the palpi of male spiders is devoted almost entirely to a discussion of the parts of the tarsus, the proximal segments being well-understood; there are, however, a few features of these segments in the aranea type that merit attention here.

Upon the coxa there is a prominent spur, *the coxal spur* (Fig. 12, *c. s.*); and upon the inner side of the femur near its base, there is a groove, the *femoral groove*, into which the coxal spur fits when the palpus is extended forward. The presence or absence of this spur and groove is an important generic characteristic in the Araneinæ.

The patella bears two prominent spines at its apex (Fig. 12, *p.*). This is also true in the males of several other genera; but in the greater number of genera of the Araneinæ there is only a single spine in this position.

The most striking feature of the tibia is its shortness, being of about the same length as the patella.

*The tarsus.*—As in *Linyphia*, the tarsus of *Aranea* consists of two parts; the cymbium and the paracymbium. But in *Aranea* the paracymbium (Fig. 13, *p. c.*) is merely a prominent apophysis arising from the base of the cymbium and is not articulated with the cymbium by a movable joint as in *Linyphia* and in *Pachygnatha*. The alveolus is much more extended than it is in *Linyphia;* here it occupies nearly the whole length of the cymbium (Fig. 13, *a.*).

*The unexpanded bulb.*—In the unexpanded bulb of *Aranea frondosa*, the subtegulum (Fig. 12, *s. teg.*), tegulum (Fig. 12, *teg.*), and a terminal lobe of the apical division of the bulb, bearing a long and slender terminal apophysis (Fig. 12, *t. a.*) are visible. Two prominent appendages can also be seen; the median apophysis (Fig. 12, *m. a.*) and the conductor (Fig. 12, *con.*).

*The expanded bulb.*—Two figures of the expanded bulb are given here; Figure 13 represents the lateral aspect of the bulb, the aspect that is exposed when the bulb is not expanded; and Figure 14, the mesal aspect, the one that is next the cymbium in the unexpanded bulb.

The basal hæmatodocha is essentially the same as in *Linyphia* (Fig. 13 and 14, *b. h.*).

The subtegulum is a ringlike sclerite but its form is like that of a seal-ring being narrow on the mesal aspect of the bulb and wide on the lateral aspect (Fig. 14, *s. teg.*). This wider part of the subtegulum is all of it that is commonly observed and has been termed the *lunate plate* (Chamberlin '04).

The specimen represented in Figure 14 was more fully expanded than that used for Figure 13. In the more expanded specimen there is evident a large hæmatodocha between the subtegulum and the tegulum; this I designate the *middle hæmatodocha* (Fig. 14, *m. h.*). The dark axial object seen through the wall of the middle hæmatodocha is the fundus of the receptaculum seminis (Fig. 14, *fu.*).

The tegulum is also a ringlike sclerite, which is broad on the lateral aspect of the bulb (Fig. 13, *teg.*), and is narrow on the mesal aspect (Fig. 14, *teg.*).

The median apophysis (Figs. 12 and 13, *m. a.*) is a conspicuous appendage, which projects from the ventral side of the bulb. Although the position of this appendage in *Linyphia*, in which the middle and apical divisions of the bulb are distinctly separated, shows that the median apophysis is an appendage of the middle division, in *Aranea* it appears to be articulated with the base of a proximal segment of the apical division, the radix.

The conductor (Fig. 14, *con.*) arises at the base of the apical division and is closely connected with the tegulum.

The radix (Fig. 14, *ra.*) is much larger than in *Linyphia*. Here it forms the wall of one side of the basal segment of the embolic subdivision of the apical division. That this is the case is more clearly shown in the bulb of *Aranea circulata* (Fig. 18 and 19, *ra.*), where the segmentation of the embolic subdivision is much more marked.

The stipes (Fig. 14, *st.*) is also much larger than in *Linyphia;* it is articulated with the distal end of the radix. Like the radix, the stipes forms the walls of one side of a segment of the embolic subdivision of the bulb, a fact which is also well shown in the bulb of *Aranea circulata* (Fig. 18 and 19, *st.*).

The embolus is borne by the embolic subdivision distad of the stipes; it projects ventrad between the distal end of the stipes which is mesad of it, and the conductor, which is laterad of it in the unexpanded bulb. In the specimen represented in Figure 14, the distal end of the stipes and the embolus have been pushed away from the conductor in the expanding of the bulb.

*The distal hæmatodocha.*—The most striking feature of the embolic subdivision in the aranea-type is the presence of a large hæmatodocha, which when expanded over-shadows all other parts. This hæmatodocha I designate the *distal hæmatodocha* (Fig. 13 and 14, *d. h.*). It is doubtless due to the development of this hæmatodocha that the radix and the stipes are restricted to one face of their respective segments of the apical division in *Aranea frondosa*, the remaining parts of the wall of these segments forming a part of the distal hæmatodocha.

*The mesal subterminal apophysis.*—On the mesal aspect of the bulb, there arises from the distal hæmatodocha a prominent apophysis (Fig. 14, *m. st. a.*); this may be termed the *mesal subterminal apophysis.*

*The lateral subterminal apophysis.*—On the lateral aspect there is also an apophysis borne by the distal hæmatodocha (Fig. 13, *l. st. a.*); this may be termed the *lateral subterminal apophysis.*

*The terminal apophysis.*—In *Aranea frondosa*, the tip of the embolic subdivision of the bulb ends in a spearshaped apophysis (Fig. 13, *t. a.*); this may be termed the *terminal apophysis.*

The Palpus of Aranea Ocellata.—A glance at the palpus of *Aranea ocellata* (*Epeira patigiata*) will show that it is of essentially the same type as that of *Aranea frondosa* but is different in some details. It is figured here to illustrate the kind of variations in form that serve to distinguish closely allied species (Fig. 15.) The median apophysis differs markedly in form from that of *A. frondosa;* the tegulum bears a small but distinct apophysis; the lateral subterminal apophysis bears two prominent teeth; and the terminal apophysis is lacking, the embolic subdivision ending in a blunt lobe.

The Palpus of Aranea Circulata.—The most striking modification of the aranea type of palpus, taking the palpus of *Aranea frondosa* as typical, is that of *Aranea circulata*, which is the most complex palpus that I have studied. In the unexpanded bulb, there appears to be no resemblance to the bulb of *Aranea frondosa.* In *Aranea circulata* (Fig. 16 and 17), the bulb is very large and the cymbium comparatively small and narrow (Fig. 17, *cym.*). The basal hæmatodocha (Fig. 16, *b. h.*) is conspicuous, which is the result of the other parts of the bulb being twisted into unusual positions. The median apophysis is large and projects beyond the tip of the bulb (Fig. 16, *m. a.*).

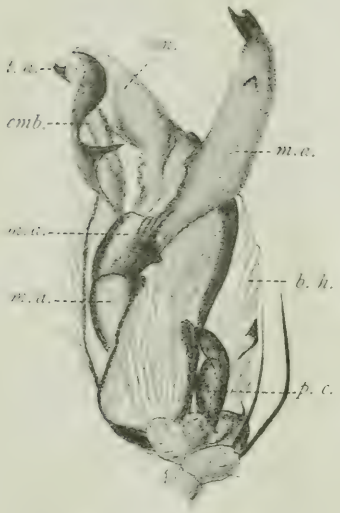


FIG. 16. Unexpanded bulb of *Aranea circulata*.

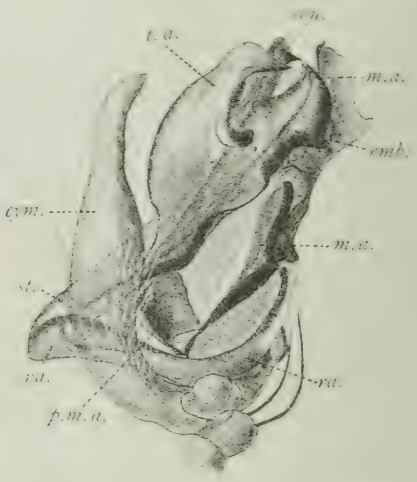


FIG. 17. Unexpanded bulb of *Aranea circulata*.

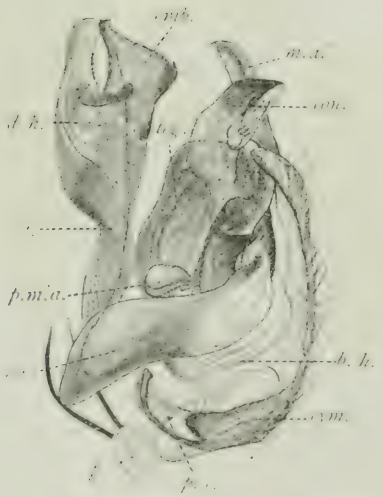


FIG. 18. Expanded bulb of *Aranea circulata*.

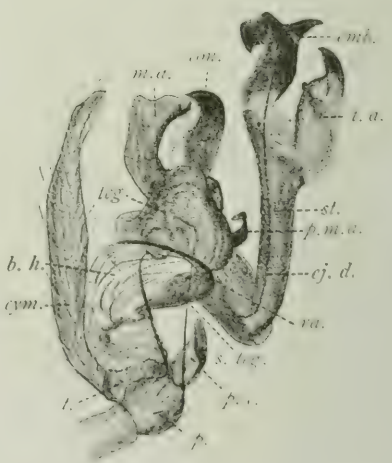


FIG. 19. Expanded bulb of *Aranea circulata*.

But the most remarkable feature is an elbowed structure on the mesal aspect at the base of the bulb (Fig. 17). The fact that the ejaculatory duct can be traced throughout the length of this elbowed structure gave the first definite clew to the relations of the parts of the bulb. The part containing the ejaculatory duct evidently pertains to the apical division of the bulb, although it appears to arise from the base of the bulb.

When the bulb of *Aranea circulata* is expanded and untwisted, as occurs in the process of expansion, the relation of the parts is more easily seen. Figures 18 and 19 represent two views of a preparation of this kind. If Figure 19 be studied it will be seen that the relations of parts are essentially the same as in *Aranea frondosa* (Fig. 14); the basal hæmatodocha, subtegulum, and tegulum follow in the same sequence; the median apophysis and the conductor project from beneath the tegulum in the corresponding positions, and the elbowed structure, which in the unexpanded bulb appears to arise at the base of the bulb is here clearly seen to be the embolic subdivision of the bulb. The most remarkable differences are the lack of a prominent distal hæmatodocha and the fact that the radix (Fig. 19, *ra.*) and stipes (Fig. 19, *st.*) are each a complete cylinder, instead of merely forming one face of the wall of a segment of the apical division, as in *Aranea frondosa*. At the distal end of the stipes, between this part and the embolus and the terminal apophysis, there is a vestigial distal hæmatodocha (Fig. 18. *d. h.*).

In this species there is an apophysis which like the median apophysis is joined by a flexible articulation to the tegulum within the cuplike cavity formed by the distal margin of the tegulum (Fig. 17 and 19, *p. m. a.*); this may be termed the *paramedian apophysis*. As I have not found this apophysis in other palpi, I do not consider it a fundamental part.

The Palpus of Aranea Gigas.—The preceding species, *Aranea circulata*, and several others, have been separated from *Aranea* by Pickard-Cambridge and placed in the resurrected genus *Eriophora* of Simon. The peculiar form of the genital bulb in *Aranea circulata* appears to sustain this separation. But in the palpus of *Aranea gigas* (Fig. 20 and 21) we find a form intermediate between the aranea type and what may be termed the eriophora type.

In the unexpanded bulb of *Aranea gigas* (Fig. 20) the parts are twisted so as to render the basal hæmatodocha conspicuous

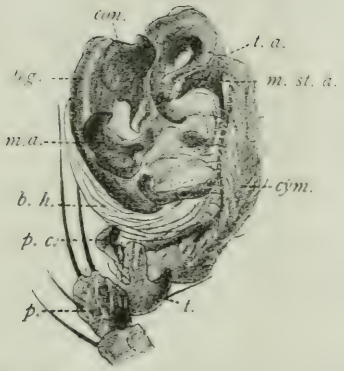


FIG. 20. Unexpanded bulb of *Aranea gigas*.

FIG. 21. Expanded bulb of *Aranea gigas*.

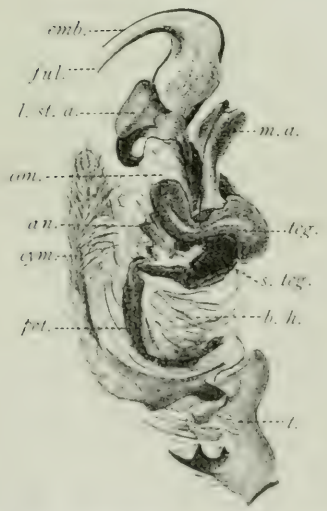


FIG. 22. Expanded bulb of *Dolomedes fontanus*.

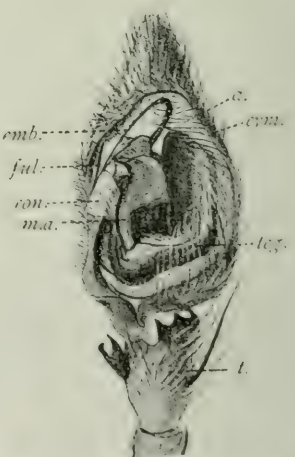


FIG. 23. Unexpanded bulb of *Dolomedes fontanus*.

as in *Aranea circulata;* but otherwise there is little similarity in appearance to either this species or to *Aranea frondosa.*

In the expanded bulb (Fig. 21) it can be seen that the embolic subdivision, is intermediate in form between the two types, resembling the aranea type in having a large distal hæmatodocha and a well-developed median subterminal apophysis; and resembling the eriophora type in the form of the embolus, which is lamelliform (Fig. 21, *2*). In the general view (Fig. 21) the embolus is covered by the tip of the stipes.

The Pisaurid Type of Palpus.—In the family Pisauridæ there is a type of palpus which, while it resembles the aranea type in its more general features, differs from that type in several important particulars. The palpus of *Dolomedes fontanus* (Fig. 22 and 23) may be taken as an example of this type.

A study of an expanded bulb of this species (Fig. 22) reveals the following characteristics: There is a well developed *petiole* of the bulb (Fig. 22, *pet.*), which, in this species, consists of two nodes with an unchitinized internode. The subtegulum bears very prominent *anelli* (Fig. 22, *an.*), which are described in a later paragraph. The *median apophysis* is prominent (Fig. 22, *m. a.*). The conductor (Fig. 22, *con.*) is extremely membranous. The *radix* and the *stipes* are not developed as distinct segments. The *embolus* is of the spiral type (Fig. 22, *emb.*) The *terminal apophysis* is modified into an organ for the support of the embolus (Fig. 22, *ful.*), which may be termed the *fulcrum* of the embolus. This type of terminal apophysis has been termed, incorrectly, the conductor. The true conductor in this species, as in all others studied, is an organ whose function is to protect the tip of the embolus in the unexpanded bulb. At the base of the terminal apophysis, at the point where the embolus arises, there is a lamelliform *lateral subterminal apophysis* (Fig. 22, *l. st. a.*).

In the unexpanded bulb (Fig. 23), the long *embolus* makes a curve in the distal end of the alveolus beyond the end of the bulb. The *fulcrum* is applied against the embolus on its concave side, and has a furrow on its distal face within which the embolus rests. The distal part of the *conductor* is wrapped about the tip of the combined embolus and fulcrum, serving, as in all other cases observed, as a protection to the tip of the embolus.

The Anelli of the Subtegulum.—In *Aranea*, the chitinized part of the wall of the basal division of the bulb, the subtegulum, is reduced to a ringlike sclerite (Fig. 24, *1.*); but in certain other genera, the subtegulum is cup-shaped or basketlike. In *Agelena nævia* (Fig. 24, *2*), one side of the subtegulum is greatly thickened; at the proximal end of this thickening, which corresponds to the lunate plate, there is a condyle, which articulates with the petiole; and at the distal end, there is a condyle, which articulates with the tegulum. The other side of the cuplike subtegulum contains in its wall several parallel, incompletely ringlike sclerites; these may be termed the *anelli* of the subtegulum. In *Dolomedes fontanus* (Fig. 24, *3*), the anelli of the subtegulum are greatly thickened and form prominent projecting ridges.

It is probable that the presence of the anelli of the subtegulum, and their nature when present will afford characters of use for taxonomic purposes.

Fig. 24. Three kinds of subtegulum.

The Different Types of Embolus.—The form of the embolus varies greatly in different species of spiders. Two principal types can be recognized, the connate and the free; and the free type includes three subtypes.

*The connate type of embolus.*—In the connate type, the embolus is not separate from the middle division of the bulb but is merely a more slender continuation of it, as in the tarantulas, *Loxosceles* (Fig. 4), and *Ariadna*.

*The free type of embolus.*—In the free type of embolus, there are one or more movable articulations between the embolus and the middle division of the bulb. In the free type, the embolus varies greatly in form; but the different forms can be grouped under three heads: coniform, lamelliform, and spiral.

*A coniform embolus.*—In this type, there may be a broadly expanded base; but the projecting part of the embolus is a straight or slightly curved cone. The embolus of *Aranea frondosa* (Fig. 25, *1*) is an example of this type.

*A lamelliform embolus.*—In this type the embolus is flattened, and may bear a greater or less number of apophyses; an example of this type is found in *Lepthyphantes minuta* (Fig. 25, *2*.)

*A spiral embolus.*—In the spiral type, as seen in *Agelena*, for example, the embolus is long, slender and coiled; and, in a well-expanded specimen, it is seen to be composed of three distinct parts: first, the wall of the convex side is densely chitinized, forming a gutterlike sclerite, which may be termed the *trunk of the embolus* (*truncus*) (Fig. 25, *3*, *t. e.*); second, the greater part of the wall of the embolus is membranous, and forms a loose flap along the concave side of the organ, which contains the ejaculatory duct; this flap (Fig. 25, *3*, *p. p.*) may be designated the *pars pendula* of the embolus; third, at the distal end of the pars pendula, there is a triangular, chitinized area, through which the ejaculatory duct opens (Figs. 25, *3*, *a. s.*), this may be termed the *apical sclerite* of the embolus.

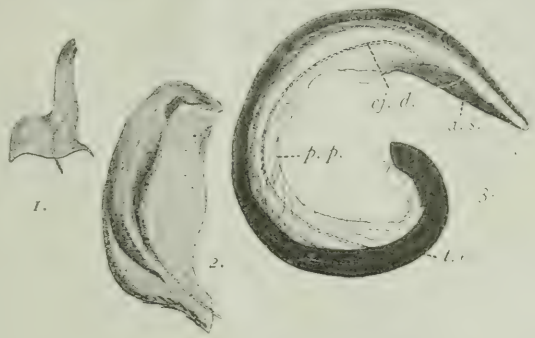


Fig. 25. Three types of embolus.

The pars pendula and the apical sclerite may be completely withdrawn into the trunk of the embolus, so that only the latter is visible; the embolus then appears to be merely a strongly chitinized style; it is in this condition that it is usually seen and described.

## CONCLUSION.

In the preparation of this paper many palpi other than those figured here have been studied; and it is believed that the series examined has been sufficiently large to warrant the conclusions given regarding the fundamental parts of the genital bulb. There remains to be determined the manner in which the different types of palpi have been specialized in other families of the order, and the details of the modifications characteristic of genera. This, however, is too great an undertaking to be attempted at this time, and must be left for those who monograph the different families.

I wish, however, to urge the importance of describing palpi from expanded specimens. A large proportion of the figures of palpi that have been published, being of unexpanded examples show comparatively little of the structure of this organ. The labor involved in expanding the bulb of a palpus is very little; a preparation can be made in five minutes; and in no other way can so much be done to make possible a description that will describe.

The following tabular statement shows the relations of the fundamental parts of the tarsus in the more specialized types of palpi; not all of these parts are invariably present, and frequently subordinate apophyses are developed.

Body of the tarsus.
- Cymbium, containing the alveolus.
- Paracymbium.

Genital bulb.
- Internal parts.
  - Receptaculum seminis.
    - Fundus.
    - Reservoir.
    - Ejaculatory duct.
- External parts.
  - Basal division of the bulb.
    - Basal hæmatodocha.
    - Petiole.
    - Subtegulum.
      - Lunate plate.
      - Anelli of the subtegulum.
  - Middle division of the bulb.
    - Middle hæmatodocha.
    - Tegulum.
    - Median apophysis.
    - Paramedian apophysis.
  - Apical division of the bulb.
    - Conductor.
    - Embolic subdivision.
      - Radix.
      - Stipes.
      - Embolus.
        - Body of embolus.
        - Pars pendula.
        - Apical sclerite of the embolus.
      - Distal hæmatodocha.
      - Lateral subterminal apophysis.
      - Mesal subterminal apophysis.
      - Terminal apophysis, sometimes developed into a fulcrum.

In conclusion I wish to acknowledge the very efficient assistance in the preparation of this paper, of Miss Anna C. Stryke, who prepared the illustrations for it.

## NAMES OF THE PARTS OF THE PALPUS AND ABBREVIATIONS USED FOR THEM IN THE ILLUSTRATIONS.

Accessory branch=paracymbium.
Alveolus, *a.*
Anelli of the subtegulum, *an.*
Apical division of the bulb, *a. d.*
Apical sclerite of the embolus, *a. s.*
Basal division of the bulb, *b. d.*
Basal hæmatodocha, *b. h.*
Clavis=median apophysis.
Conductor of the embolus, *con.*
Coxa, *c.*
Coxal spur, *c. s.*
Cymbium, *cym.*
Distal hæmatodocha, *d. h.*
Ejaculatory duct, *ej. d.*
Embolic subdivision of the bulb, *e. s.*
Embolus, *emb.*
Femur, *f.*
Fulcrum, *ful.*
Fundus of the receptaculum seminis, *fu.*
Lateral subterminal apophysis, *l. st. a.*
Lunate plate=subtegulum in part.
Median apophysis, *m. a.*
Mesal subterminal apophysis, *m. st. a.*
Middle division of the bulb, *m. d.*
Middle hæmatodocha, m. h.
Paracymbium, *p. c.*
Paramedian apophysis, *p. m. a.*
Pars pendula of the embolus, *p. p.*
Patella, *p.*
Peticle of the bulb, *pet.*
Radix, *ra.*
Receptaculum seminis, *r. s.*
Reservoir, *res.*
Scopus=median apophysis.
Spiral muscle=hæmatodocha.
Stipes, *st.*
Style=embolus.
Subtegulum, *s. teg.*
Tegulum, *teg.*
Terminal apophysis, *t. a.*
Tibia, *t.*
Trochanter, *tr.*
Trunk of the embolus, *t. e.*

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# NORTH AMERICAN PANISCINI.

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## INTRODUCTION.

The tribe Paniscini is rather a small one in this country, containing but two genera, and eleven species so far described. The external anatomy here given was prepared from our commonest species—Paniscus geminatus (Say)—added to by comparison in some respects with the corresponding structures in Opheltes glaucopterus (Linn). It was my intention when I commenced this paper to include a key to the species of Paniscus, but I have been unable to see specimens of all the species, and the entirely inadequate descriptions of several has made it impossible to prepare a key that would be strictly reliable. I have therefore included the original descriptions of the different species here, leaving it to others with better opportunities to prepare the key.

This paper has been prepared under the supervision of Dr. H. T. Fernald of the Massachusetts Agricultural College, and to him I wish to extend my heartiest thanks for his suggestions, verification of observations, and other assistance in the course of the work.

## EXTERNAL ANATOMY.

### HEAD.

The head is of medium size, and of the hypognathous type. It is slightly higher than broad, and when viewed from the front appears nearly circular in outline. From above, it appears slightly bi-concave; the anterior concavity being lost at the level of the insertion of the antennae and below them.

The compound eyes are large, extending from the top of the head to a point almost touching the base of the mandibles. Looking from the front these organs occupy half or slightly more than half of the front of the head; from the side view the eye takes up about two-thirds the width. The anterior margin of the eye, about one-third the distance from the top, is sharply excavated which is very noticeable. The antennæ are inserted at the line of these two indentations or very near it. The lateral margins appear nearly straight. Above the point of concavity,

the eye which is elliptical in form extends toward the middle of the head, somewhat, thus making the distance between these organs at the vertex, a little less than at any other point.

The cheek, which lies behind the eye, is nearly uniform in width from the top to the base, and is only slightly narrower below where it extends slightly beneath the eye. The face in general is clothed with a short thick mat of sericeous pubescence.

### CLYPEUS.

The clypeus, which is more or less irregular in outline, being rounded above (convex) and nearly straight along its free margin occupies about a third of the distance from the antennæ to the mandibles. On either side there is a projection, which extends just below the compound eyes, and about half way between the extremities of these projections and the dorsal edge of the clypeus are situated a pair of oval depressions, one on either side known as clypeal foveæ. The dorsal edge of the clypeus is marked by a transverse suture (or rather what was once apparently a suture, as there are no distinct sutures separating the clypeus from the frons) some little distance below the insertion of the antennæ. Between these there is quite a noticeable depression, the lower side of which is most pronounced.

### FRONS.

The frons may be regarded as extending upward from the clypeus to the ocelli, with a downward extension on each side of the clypeus, where it appears to meet the cheek just below the eye. About two-thirds of the whole distance from the dorsal line of the clypeus to the ocelli, is the place of insertion of the antennæ. That portion of the frons, from the antennæ extending downward, projects in front of the level of the eye, while the portion above the antennæ is slightly sunken behind this level.

### OCELLI.

The ocelli, which are of nearly equal size, are three in number, and are arranged to mark the corners of an equilateral triangle. The two lateral (posterior) ocelli nearly touch the compound eyes. An imaginary line passing through the posterior ocelli marks the vertex as treated in this paper. No sutures separating the vertex from the posterior portion of the head, above, of from the cheeks, behind the eyes, are present, and the limits of these parts are therefore somewhat indefinite.

The portion of the head, showing behind the compound eye, is termed the cheek, in this paper. The width of the cheek does not vary a great deal. The central portion, however, (that portion in the region of the attachment of the head to the thorax) is slightly wider than other parts.

LABRUM.

The labrum is attached to the lower, inner edge of the clypeus, leaving the outer edge of the clypeus well defined. In preserved specimens, the labrum is usually bent backward, at nearly right angles to the clypeus, with the mandibles closed over it, so that it is not accessible for study. For this reason, it has not seemed advisable to use it for analytical purposes.

MOUTH PARTS.

None of the mouth parts seem to be useful for the determination of the species and their description therefore is not included here. I might say, however, that possibly the mandibles, labial palpi, and maxillary palpi would be of use in the determination as in most of the insects examined, the palpi show to the full extent. Maxillary palpi five jointed, labial palpi four jointed.

The mandibles are somewhat curved, having two teeth, which are blackish to their bases. When the jaws are closed they overlap.

ANTENNÆ.

The antennæ are long. The basal portion of the bulb of the proximal segment or scape is rather small and articulates with the head in a socket. Its diameter, at this end, is about equal to its length to where it unites with the enlarged portion of the scape, but it is somewhat narrower toward the place where it enlarges into the scape proper. The bulb appears to be an entire segment, but this is not the generally accepted view. The scape which is the stoutest segment of the antennæ is somewhat smaller at its base, gradually increasing to the base of the next segment, the pedicel. This seems to extend down into the scape for some little distance. There is also a third segment before we come to the filament proper which is nearly twice as broad as long, and is called the ring joint. This seems to be rather unusual. The filament which consists of about fifty-four segments has those near the base a little longer than the others, gradually decreasing in length as we go towards its extremity.

THORAX.

The thorax in general is strongly compressed laterally, very finely pubescent, and is of a yellowish russet color.

PROTHORAX.

The prothorax, as seen from the side, is triangular in outline, marked by fine, distinct, oblique, transverse striations which are most noticeable near the lower anterior portion of the plate, while viewed from above it is a very narrow transverse band. Its anterior margin is straight and elevated, forming a flange, which projects slightly forward. Looking down from above, there can be easily detected with the aid of a microscope, a semicircular indentation or groove, which leads to the query, "Was this portion once a distinct plate representing a much reduced pronotum while the large triangular plate at the sides represented a much enlarged pro-pleuron?" It is set out very prominently from the mesethoracic plates by quite conspicuous sutures. The facial portion of the prothorax, lying just behind the head (episternum?) is somewhat hoof-shaped having a deeply impressed line extending from the point where the head joins the prothorax to a point near the insertion of the fore coxa, thus dividing it into right and left halves.

MESOTHORAX.

The mesonotum is a broad plate distinctly convex, lying between the fore-wings and extending forward to the dorsal portion of the prothorax. Starting near the anterior margin and at equal distances from the middle of the plates, are two lateral grooves known as the parapsidal furrows which curve slightly inward and extend nearly to the scutellum. These grooves become weak posteriorly, being only slightly noticeable after they have passed the middle of the plate. The anterior margin of this plate is bent slightly upward or reflexed, and this is continued around the sides as far back as the tegula, where it leaves the margin and becomes a distinct ridge which passes obliquely backward across the plate.

Directly behind the mesonotum already described, is the scutellum, the median portion of which is trapezoidal in outline, longer than broad, the longer base anterior, the shorter base being posterior and slightly over half the length of the former. Between the mesonotum and median portion of the scutellum

is a deep trough-like depression, whose ends are closed by a continuation backward onto the scutellum of the ridges, spoken of previously, which may be designated as the dorso-lateral ridges. On the mesonotum, just in front of the trough and branching off from the dorso-lateral ridge is a short oblique ridge which extends outward and forward to the insertion of the fore-wing. The sides of the trapezoid are continuations backward of the dorsal-lateral ridges. Near the rear margin of the scutellum these become lost. Along this margin there is a reflexed edge or flange which extends obliquely towards the insertion of the fore-wings.

The surface of the lateral portions of the scutellum lies at a sharp angle with that of the median portion (trapezoidal) and extends from the dorsal lateral ridge downward and forward to the base of the forewing. As already stated the hinder margin of this portion is reflexed nearly to the wing attachment. The mesothoracic pleuron is a large plate which lies below the wings, its posterior margin being approximately indicated by an oblique groove extending downward and backward from beneath the fore-wing to just beneath the hind wing where it bends a little more downward, and takes a nearly straight path to the meso-coxa. From here it passes forward, curving somewhat until about opposite the base of the fore coxa. It then turns sharply upward, and passing by the base of the fore-coxa follows along the edge of the prothorax to the base of the fore-wing.

There are several ridges and grooves on this plate, but nothing which can be termed a distinct suture, that is, dividing the pleuron into subordinate plates. The meso-coxa is attached near the extreme posterior edge of this plate, occupying about one-third of its width, which is somewhat greater ventrally than dorsally.

METATHORAX.

Just to the rear of the scutellum and below it is a narrow plate which extends from one hind wing to the other and is known as the post scutellum. The rear margin of this plate is reflexed as in the case of the rear margin of the scutellum, and extends forward nearly to the base of the hind wings.

The part of the metapleuron nearest the hind wing (episternum) is triangular in outline. The apex of the triangle extends ventrally and comes to a point just between the meso-

thoracic pleuron, and the metathoracic epimeron, while the base of the triangle lies dorsally below the furrow of the post scutellum.

The metathoracic epimeron is a large plate bordered on its dorsal side by the median segment, anteriorly by the metathoracic episternum above, and the mesothoracic pleuron below, while posteriorly it bears the coxa of the hind leg.

The median segment is a large arched plate distinctly striate above covering the area between the post scutellum, in front, and the petiole behind, and extending transversely from the metathoracic pleuron of one side to that of the other. A short distance behind the angle where the median segment, epimeron and episternum of the metathorax meet is an oval stigma on each side. Near the hinder margin of the plate, on each side, is a crescentic elevation, immediately behind which is a depression of the surface. Extending forward from this crescent to a point near which the median segment meets, the posterior dorsal angle of the metathoracic episternum is an elevated area, just below which is situated the dorsal edge of the stigma. This elevated area may be used for convenience as indicating the division between the dorsum and the sides of the median segment, though there is no evidence of a separation of these portions into separate plates.

At the extreme posterior end of the median segment there is a semi-circular carina which is quite prominent. The median segment is marked by fine, distinct, transverse striations and the metathorax, as a whole, is pubescent, and very finely punctured.

ABDOMEN.

This portion of the body has more or less of a russet brown color varying from a light yellowish brown, in some specimens, to a reddish brown, in others. The abdomen is composed of eight segments in both male and female, and is compressed laterally, more so ventrally than dorsally. The segments, as a general thing, decrease somewhat in length after the second one which is only about half as long as the first, but rapidly increasing in height up to the sixth inclusive, but the seventh and eighth are smaller.

The median segment has been included with the description of the metathorax. While it is undoubtedly the first segment of the abdomen, for convenience of description, we may consider

the segment, behind the thoracic mass, as a whole, as being the first segment. The first segment of the abdomen, counted in this way, is attached at the ventral side of the posterior end of the median segment. It is straight and nearly twice as long as the second segment. Just above its attachment to the median segment and below the dorsal portion of the posterior carina is a small but prominent muscle or funiculus, which is attached to the anterior dorsal portion of the ventral plate. A little in front of the middle of the segment, on each side, is an oval stigma, and situated about two-thirds the distance from the stigma to the posterior end of the thorax is an elliptical opening which, in some cases, apparently extends clear through the segment from side to side. On closer examination one will readily detect a thin membrane, stretched across this opening about in the middle of the body, separating it completely into right and left halves.

This opening is formed where the dorsal plate bends upward, and apparently leaves the ventral plate, only the thin membrane, already referred to, forming a connection between the two. It then turns downward and becomes closely connected with the ventral plate, again extending as narrow bands along the upper margins of the same plate nearly to the median segment. Viewed from above, the dorsal plate appears to divide just behind the funiculus, and extends as arms to the median segment, forming the lateral portions already described.

The ventral plate of the sixth segment is most prominent. From this portion of the sixth segment is protruded the ovipositor, and its palpi or feelers, which are hairy, except their basal portions which are concealed by the remaining segments. The ovipositor and feelers extend quite a distance beyond the extremity of the abdomen. On the eighth segment, a pair of cerci are situated at its extreme posterior margin, and approximately half way between the ventral and dorsal portions of this plate.

In the female the stigmata of the second and third segments are well in front of the middle, while the remainder are closer to the anterior margin, and none are perceptible on the last two segments. In the male the stigmata approach the anterior margins of the segments more and more passing backward, but they do not come close to it. On the seventh and eighth they appear to be absent.

The genitalia of the male protrude prominently between and beyond the last dorsal and ventral plates of the abdomen. The last segment in the males being noticeably shorter than the others, while in the females the last two are noticeably shorter.

All of the ventral segments of the abdomen are rather soft and membranous. The claspers are large and broad.

### WINGS.

The wings are quite large and colorless, with the exception of a yellowish tinge, produced by the presence of reddish brown nerves and numerous short hairs, generally distributed over both the upper and under surfaces. Cresson's nomenclature of wings is the one used in this paper.

### FORE WING.

Separating the marginal, or radial cell, from the median, or externo-medial cell, is a well-developed stigma, which is long, narrow and yellowish brown in color. It is considerably wider beyond its middle than before. The marginal or radial cell is lanceolate. The greater part of its anterior and longer side is formed by the costa and its remaining basal portion by the stigma. Posteriorly it is separated from the disco-cubital cell by the first abscessa of the radial nervure which runs from the stigma to the apex of the small triangular areolet. It is separated from the third submarginal cell by the second abscessa of the radial nervure, which is longer than the first, and is quite strongly bent at its origin where it forms approximately a right angle with the radial nervure. The median cell which is one of the largest of the wings is about four times as long as its greatest width. This latter dimension, occurring about three-fourths of the distance from the base of the wing to the outer end of the cell. It is separated from the sub-median cell posteriorly by the externo medial nervure and from the disco-cubital beyond by the basal nervure. The third side is formed by the costal and sub-costal nervures fused.

The costal cell is absent due to the fusing of the costal and sub-costal nervures, the sub-costal portion being however, more prominent than the costal. The disco-cubital cell which is probably the largest cell of the wing is irregular in outline, is bounded by five different nervures, namely, first abscessa of the radial, first transverse cubital, disco-cubital, discoidal and basal nervures, and a portion of the stigma.

Of the above, not mentioned before, the first transverse cubital separates this cell from the areolet. The disco-cubital nervure which separates it from the third discoidal cell has quite a prominent stump of a vein near its middle known as an abbreviated cubital nervure which extends into the cell. About halfway from this stump, to the triangular areolet is a short bulla. This cell is separated from the second discoidal cell by the discoidal nervure and receives but one recurrent nervure at the point where the disco-cubital and discoidal nervures meet. There is but one completely enclosed sub-marginal cell which is regarded as the second or areolet. It is small, approximately triangular and in all the specimens I have examined, the second transverse cubital nervure which separates this cell from the third sub-marginal cell has a bulla extending half way from the base to the apex of the triangle, beyond which the vein bends slightly, taking a straight line to the apex of the triangle.

The third sub-marginal cell is separated posteriorly from the second apical cell by the cubital nervure, and extends to the margin of the wing. Its other bounding lines have already been described. Submedian or internomedial cell is quite long and narrow, the externo-medial nervure separating it from the median in front, and the first abscessa of the anal nervure from the anal cell behind. Outwardly it is separated from the second discoidal cell by the transverse medial nervure which joins the externo-medial nervure just beyond the origin of the basal nervure, thus making it post fercal. The second discoidal cell is separated posteriorly from the anal cell by the second abscessa of the anal nervure which is about one-half the length of the first abscessa. Outwardly it is separated from the third discoidal cell anteriorly and first apical cell posteriorly by the first recurrent nervure, that portion of this nervure however separating it from the former is much shorter than the latter. The first recurrent nervure has a small bulla patch where it joins the margin of the wing. The third discoidal cell is separated posteriorly from the first apical cell by the first abscessa of the subdiscoidal nervure and outwardly from the second apical cell by the second recurrent nervure, at the center of which is a distinct bulla patch, while at its anterior extremity just below the areolet is another small bulla. The second apical cell is separated posteriorly from the first apical cell by the second abscessa of the sub-discoidal nervure which is much

shorter than the first abscessa, and extends to the margin of the wing. The anal cell is the longest cell of the wing. It is bounded, anteriorly, by the anal nervure and, posteriorly, by the margin of the wing which has a small fold near the extremity of the cell (frenal fold.) This cell extends to a point slightly beyond the outer end of the second discoidal cell. The first apical cell has already been described with the exception of mentioning that its posterior and outward boundary is formed by the margin of the wing.

HIND WING.

The costal cell is quite long extending somewhat over half the entire length of the wing, and it is, by far, the narrowest cell. It is separated, posteriorly, from the median cell, by the subcostal nervure. Anteriorly it is bordered by the costal nervure which extends somewhat less than half the length of the cell, and by the margin of the wing, which is a continuation of the latter. The marginal or radial cell is separated posteriorly from the median cell by the first abscessa of the marginal or radial nervure, and from the submarginal or cubital cell by the second abscessa of the same nervure. Its anterior and outward boundary is formed by the margin of the wing.

Six frenal hooks are found near the middle of the anterior margin of this cell. Submarginal or cubital cell is separated posteriorly from the discoidal cell by the second abscessa of the cubital nervure, inwardly from the median cell by the transverse cubital nervure, and extends outward to the margin of the wing. The median cell is the longest and largest cell of the wing. It is separated posteriorly from the submedian cell by the externo medial nervure and from the discoidal by the first abscessa of the cubital nervure. The submedian cell is separated posteriorly from the anal cell by the anal nervure and from the second discoidal cell by the first abscessa of the transverse medial nervure which is somewhat longer than the second abscessa, and forms with it approximately a right angle. Outwardly it is separated from the first discoidal cell by the second abscessa of the transverse medial nervure. The discoidal cell is separated posteriorly from the second discoidal by the discoidal nervure, and extends to the margin of the wing. Second discoidal cell is separated posteriorly and inwardly from the anal cell by the second abscessa of the anal nervure and extends to the margin of the wing.

TEGULÆ.

The tegula is a small chitinous plate, more or less triangular, with rounded corners, lying over the base of the fore wing. It is slightly sericeous, and to some degree arched.

LEGS.

The legs are quite long, rather slender, hairy, and all these segments beyond the femora are armed with spines to a greater or less degree. Coxa more or less bulb shaped. The two trochanters taken together are as long or a little longer than the coxa, and they are of about equal length in the hind leg, while in the middle and fore legs the outer segment is only about half the length of the other. Femur is second in length to the tibia, the longest segment, and in stoutness to the coxa which is the stoutest segment. The tibia is largest at its distal end. It is armed with spines above, below, and on the sides, these showing a partial arrangement into longitudinal rows. At its outer end where it joins the first tarsal segment is a circlet of spines, two of which are much longer and stouter than the others in the posterior and middle legs, which are called tibial spurs. The inner spur is nearly twice as long as the outer one. These spines are clothed with hairs. The fore leg instead of bearing two tibial spurs has one long spur-like appendage nearly half as long as the segment, curved for about one-third of its length from the base to the extremity, bearing hairs on its inner surface which in connection with a corresponding modification at the base of the first tarsal segment acts as a cleaning apparatus.

There are five tarsal segments. The first is by far the longest, being about twice as long as the second, and three times as long as the third which is about as long as the fourth and fifth taken together. The fourth segment is slightly shorter than the fifth. The first three segments are armed with spines beneath, on the sides and at their outer ends. The fourth segment is the shortest tarsal segment, and is provided with spines at its end where it joins the base of the fifth and last segment. The fifth segment is not armed with spines except for a few long spine-like hairs at its extremity where the pair of well developed claws and a pulvillus between them occur. On the under side of the claw are borne about twenty teeth.

SEXUAL DISTINCTIONS.

Aside from the presence of a sting in the females and of more or less copulatory organs in the male, other differences may be noticed in the sexes. Ocelli seem to be closer together in the male, and also to the compound eyes than in the females. The male has fifty-seven segments in the antennæ, and the female fifty-eight, but it would seem probable, considering the large number of segments that this might vary somewhat.

TABLE OF GENERA.

Terminal tooth of mandibles longer than the inner; cheeks and temples not broad; scutellum more or less margined laterally; transverse median nervure distinctly postfurcal to the origin of the basal nervure.....PANISCUS Gravenhorst.

Teeth of mandibles equal in length; cheeks and temples broad; scutellum not margined laterally; transverse medial nervure interstitual with the origin of the basal nervure, rarely slightly postfurcal.....OPHELTES Holmgren.

## DESCRIPTION OF SPECIES.

**Opheltes glaucopterus** (Linn). Description taken from Provancher.

Faune Entomologique Du Canada, II, 1883, p. 359.

Female—Length, 68 inch. Black variegated with red. Head varied with russet, except a black spot covering all the vertex and the back side of the head. Antennae russet, brown at the extremity, almost as long as the body. Thorax black; scales clear, a line before and another below, two lines on the back of the mesothorax, and its exterior borders, also sometimes the scutellum, all the legs with trochanters, the abdomen except the last three segments, of a yellowish russet color. Wings with the costa and the stigma yellow, the nervures brown; areola small, not petiolated, subtriangular; median nervure not appendiculate, arched. Metathorax bearing a little elevated canal in the middle, and a carinae on each side with another transversal at the apex, these carinaes being elevated in the form of acute tubicles in certain spots. Hind part (hind coxae) russet black at the base.

**Paniscus alaskensis,** Ashm.

Proceedings of the Washington Academy of Sciences, IV, 1902, pp. 237-8.

Male—Length 10 mm. Head yellow, with purplish-brown eyes, and very much as in PANISCUS GEMINATUS Say, except that the ocelli are not placed on a black spot, and the lateral ocelli do not quite touch the eye margin, as in that species. The thorax and abdomen are pale honey-yellow; a stripe on sides of prosternum, the lateral margins of the mesonotum, and a stripe on the parapsidal furrows behind, are yellowish-white; the apical transverse carina is indicated only laterally, being wholly obliterated medially, the surface of the metanotum before it being very finely, transversely aciculate, behind it polished and impunctate. Wings hyaline, the venation as in P. GEMINATUS, the costal vein and the stigma yellow, the subcostal vein and the internal veins being brown or brown black. External claspers similar to those in P. GEMINATUS but slightly narrower.

Type—Cat. No. 5688, U. S. Nat. Museum. From Kukak Bay, July 4. Five specimens.

**Paniscus albotarsatus** Prov.

Faune Entomologique Du Canada, II, 1883, p. 361.

Male—Length .40 inch. Beautiful yellow, face of a yellowish white, the ocelli black, contiguous with each other. Posterior tarsi white except at the base of the first segment; their claws (hooks) brown. Abdomen elongated, compressed; slightly arched, slim, scarcely tinged with brown at its extremity. Wings colorless, nerves brown; stigma yellow. Median nervure arched, without a rudiment of a nervure at its middle; areola subtriangular, very oblique, very small. G.

The color almost uniform, color of the species with its posterior tarsi which distinguishes it at first sight. In the female the abdomen is a little obscure towards the extremity, the ovipositor longer than the length of the abdomen.

**Paniscus albovarigatus,** Prov.

Faune Entomologique Du Canada, II. 1883, p. 361.

Female—Length .38 inch. Uniform, honey-yellow; the face below and above the antennae, the orbites all around the eyes, a line on the edges of the mesothorax prolonged to the tip of the scutellum, two lines upon the back of the mesothorax, a line below the anterior wings, a large spot lower upon the flanks (sides) with another smaller one below the posterior wings, of a beautiful white. Ocelli not touching the eyes, and also distant from each other. Metathorax uniform (simple, even) obscurely transversely aciculate; areola of wings small, triangular, pedunculated, slightly oblique, abdomen convex, compressed from the third segment, brownish in its posterior half. AC.

**Paniscus geminatus** (Say).

Faune Entomologique Du Canada, II, 1883, p. 360.

Female—Length .65 inch with a uniform yellowish russet tinge. Face a little clearer; ocelli contiguous with the eyes, and also with each other. Wings colorless, nerves black, stigma yellow. Median nervure strongly arched, with a rudiment of a nervure very apparent towards its middle. Metathorax pubescent, very finely punctured. Legs and posterior tarsi a little darker than the rest. Abdomen compressed, slightly convex, brownish at the extremity; ovipositor longer than the length of the abdomen. AC.

**Paniscus medius,** Ashm.

Proceediings of the California Academy of Sciences, IV, 1894, p. 128.

Female—Length 12 mm.; ovip. 2 mm. Brownish-yellow; face and clypeus yellowish white; ocelli large, prominent, the lateral touching the eye; eyes distinctly emarginate within; thorax smooth, trilobed; metanotum smooth, without a vestige of carinae; wings hyaline, the costa and stigma brownish-yellow, the other nervures black, the discoidal nervure with a distinct stump of a vein; abdomen twice as long as the head and thorax united, strongly compressed, viewed from the side,

not much broadened towards apex; the petiole is a little more than one-third longer than the second segment, with the spiracles placed at two-fifths its length, the second segment is about two and one-half times as long as wide at apex.

. Described from one specimen, from San Esteban (Haines).

This species resembles somewhat P. texanus, but is larger, differently colored, with a stump of a vein in the discoidal nervure, and with the segments of the abdomen relatively different.

**Paniscus melanostigma,** Cam.

Biologia Centrali Americana; Hymenoptera, I, 1886, p. 303.

Rufo-testaceous, mesonoto nigro; capite flavo; flagello antennarum fusco; alis hyalinis, stagmate nigro. Female.

Long. 15 millim.

Hab. Panama, Volcan de Chiriqui (Champion).

Face closely punctured; metathorax closely transversely striated. Areolet moderately large, straight, the recurrent nervure received a little beyond the middle; there is no branch on the cubital nervure.

Easily known from its allies by the black stigma and nervures. The petiole is longer compared to the second segment (the relative length of the two being as in *P. geminatus*) than in *P. tinctipennis*.

**Paniscus nigripectus,** Ashm.

Proceedimgs of the United States National Museum, XII, 1889, p. 425.

Female—Length 16 mm. This species is much more closely allied to P. geminatus than is P. texanus, and structurally it is almost identical, but the mesonotum, mesopectus, stigma, and veins are black; the lateral ocelli touch the eye; the stump of the vein at the middle of the cubitus is wanting, and the submedian cell is only one-third the length of the transverse median nervure longer than the median cell; the second abdominal segment is two-thirds the length of the petiole, the spiracles situated at about one-third its length.

Habitat.—Texas.

Described from one specimen in Belfrage Collection.

**Paniscus ocellatus,** Vk.

Proceedings Entomological Society of Washington, Vol. XI, 1909, p. 211.

Female—16 mm.; tegument pale castaneous to castaneous, orbital margin yellowish, tips of mandibles and edge of ocelli more or less blackish; wings faintly cloudy, transparent, stigma and costa pale, translucent, other veins mostly brownish or almost black; anterior ocellus elliptical, transverse, the shortest distance between the anterior ocellus and the nearest point on the eye; antennae 59-jointed, cylindrical, the joints well defined, the fifth to penultimate subequal and longer than wide at base, the apical joint rounded, subconical, a little longer

than the penultimate; discocubital vein with a trace of a stump, recurrent vein interstitial with the second transverse cubitus, aerolet quadrangular, metathorax transversely wrinkled above and with a parenthesis-shaped carina on each side; abdomen shining and with a bloom-like pubescence that is conspicuous only in certain lights, the rest of the body very similarly pubescent, the pubescence pale, seemingly tinged with golden.

Male—Very like the female, but with a yellow face and 56-jointed antennae; male paratopotype with a distinct stump of a vein.

Type.—Female and male and paratopotype, No. 12320, U. S. National Museum.

Type locality.—Wellington, Kans., E. G. Kelley, collector, Webster, No. 5431, U. S. Department of Agriculture, Bureau of Entomology.

**Paniscus subfuscus,** Cress.

Proceedings of the Entomological Society of Philadelphia, IV, 1865, p. 57.

Dull rufo-fuscous, legs and antennae paler; basal segments of abdomen piceous; wings hyaline.

Female—Dull rufo-fuscous, opaque; clypeus pale, pubescent; antennae as long as the body, slender, dull fulvous, slightly dusky at tips. Thorax with the dorsal lines deeply impressed; scutellum prominent, carinated on each side; metathorax minutely sculptured, incised at base, with a small acute tubercle on each side behind. Wings hyaline; nervures fuscous, stigma testaceous; areolet small, subpetiolated, oblique. Legs pale fuscous, the femora slightly dusky. Abdomen stout, arcuated, subcompressed, clothed with a very short, appressed, pale pubescence; 1st segment elongate, slightly broader at tip, with a faint tubercle on each side before the middle; 2nd segment about one-third shorter than the 1st; the three basal segments above, except the extreme base of the 1st, stained with piceous; apical margins of the remaining segments pale; ovipositor about as long as the 1st segment of the abdomen. Length 9 lines; expanse of wings 15 lines.

Collection.—Ent. Soc. Philad. One specimen.

This does not agree with the description of P. Rufus Brulle, which I have not seen, and which is said to inhabit Cuba.

**Paniscus texanus,** Ashm.

Proceedings of the United States National Museum, XII, 1889, p. 425.

Female—Length 9 mm. This species has probably been confused in our collections with P. geminatus Say; but besides its much smaller size it can be readily separated by the following differences:

The third joint of the antennae is only slightly longer than the fourth; the mesonotum is smooth without parapsidal grooves; the lateral keels of the scutellum become delicate posteriorly; the spiracles of the petiole are placed just anterior to the middle; the second abdominal segment viewed from above is trapezoidal but slightly longer than wide

and only half the length of the petiole; the basal joint of hind tarsi only twice the length of the second; the submedian cell is as long or slightly longer than the median cell, the length of the transverse median nervure; while whereas, in p. geminatus there is always a distinct stump of a vein at the middle of the cubitus, in P. texanus it is entirely wanting or only the base remains.

Habitat.—Texas.

Described from one specimen in Belfrage Collection.

**Paniscus tinctipennis,** Cam.

Biologia Centrali Americana; Hymenoptera, I, 1886, p. 303.

Fuscous, testaceo variegatus; capite flave; pedibus pallide testaceis, coxix posterioribus femoribusque posticis fuscis; alis fumatis, stigmate testaceo. Female, Long. 15 millim.

Hab. Panama. Volcan de Chiriqui 2000 to 3000 feet (Champion).

Antennae a little longer than the body, microscopically pilose; the flagellum dark fuscous, the scape testaceous. Head yellow, the occiput dark fuscous; the ocellar region black; the face obscurely punctured, projecting in the middle; mandibles testaceous, the tips black; palpi yellow. Thorax dark fuscous; a line on the pronotum, the sutures of the mesonotum, a mark below the tegulae, the sides of the scutellum, and the lower part of the metapleura, pale testaceous. Metathorax closely transversely striated. Abdomen fuscous, the base of the first three segments and their ventral surface pale testaceous. Wings with a fuscous tinge; areolet minute, not oblique; the recurrent nervure interstitial.

Differs from *P. geminatus* in the fuscous colour of the body in the wings having a decided smoky tinge, in the expansions on each side of the metathorax being much more distinct, in the abdomen being broader and not so compressed, and in the petiole being thicker and shorter compared to the second segment.

Index to Notes of Interest on Paniscus Not Included in This Paper.

1. Nuttal: Insects and Disease, p. 41, 1899.
2. Packard: Text book of Entomology, p. 517.
3. Proceedings of the Entomological Society of Washington, IV, pp. 45-47.
4. The Canadian Entomologist, XIX, p. 80.

INDEX TO LETTERING PLATES.

a, anal cell.
$a_1$, $a_2$, anal nervure (First and Second abscissas).
ab, abdomen.
ac, abbreviated cubital nervure.
ap, first apical cell.
$ap_1$, second apical cell.
aw, anterior wing.
b, bulb.
bn, basal nervure.
c, costal nervure.
$c_1$, costal cell.
cc, cerci.
cf, clypeal foveae.
cl, clypeus.
cla, claspers.
c + sc, costal and subcostal nervures blended.
cu, cubital or submarginal cell.
$cu_1$, $cu_2$, cubital nervure (First and Second abscissas).
$cu_3$, cubital nervure.
cx, coxa.
d, discoidal nervure.
$d_1$, discoidal cell.
$d_2$, second discoidal cell.
$d_3$, third discoidal cell.
dc, disco-cubital nervure.
$dc_1$, disco-cubital cell.
e, eye.
em, externo-medial nervure.
$em_1$, externo-medial or median cell.
ep, triangular plate, Epimeron?
epm, metathoracic epimeron.
eps, metathoracic episternum.
$eps_1$, hoof-shaped plate, Episternum?
f, funiculus.
ff, frenal fold.
im, interno-medial or submedian cell.
m, marginal or radial cell.
$m_1$, $m_2$, marginal or radial nervure. (First and Second abscissas).
mc, median cell.
md, mandible.
mn, mesonotum.
mp, mesothoracic pleuron.
ms, median segment.
o, ovipositor.
oc, ocellus.
p, parapsides.
ped, pedicle.
pn, pronotum.
po, palpi of the ovipositor with tactile hairs.
pset, postscutellum.
pt, antennal pit.
pw, posterior wing.
r, ring joint.
$re_1$, first recurrent nervure.
$re_2$, second recurrent nervure.
s, spiracle of median segment.
sc, subcostal nervure.
$sd_1$, $sd_2$, subdiscoidal nervure (First and Second abscissas).
scp, scape.

sct, scutellum.
sm, submedian cell.
$sm_2$, second submarginal cell or areolet.
$sm_3$, third submarginal cell.
sp, spiracle of abdomen.
st, stigma.
t, tegula.
tc, transverse cubital nervure.
$tc_1$, first transverse cubital nervure.
$tc_2$, second transverse cubital nervure.
tm, transverse medial nervure.
tm, $tm_2$, transverse medial nervure (First and Second abscissas).

## EXPLANATION OF PLATES.

The following figures were drawn with the Camera Lucida.

### Plate XXIV.

Fig. 1. Dorsal view of the thorax of Paniscus geminatus.
Fig. 2. Side view of the thorax of Paniscus geminatus.
Fig. 3. Anterior tibial comb of Opheltes glaucopterus.
Fig. 4. Anterior tibial comb of Paniscus geminatus.
Fig. 5. Side view of the anterior end of the first segment of the abdomen of Paniscus geminatus.
Fig. 6. Dorsal view of the anterior end of the first segment of the abdomen of Paniscus geminatus.

### Plate XXV.

Fig. 7. Anterior wing of Paniscus geminatus.
Fig. 8. Posterior wing of Paniscus geminatus.
Fig. 9. Anterior wing of Opheltes glaucopterus.
Fig. 10. Posterior wing of Opheltes glaucopterus.

### Plate XXVI.

Fig. 11. Posterior leg of Paniscus geminatus.
Fig. 12. Clypeus and labrum of Paniscus geminatus.
Fig. 13. Mandible of Opheltes glaucopterus.
Fig. 14. Mandible of Paniscus geminatus.

### Plate XXVII.

Fig. 15. Front view of the head of Paniscus geminatus.
Fig. 16. Side view of the head of Paniscus geminatus.
Fig. 17. Maxillae and labium of Paniscus geminatus.

### Plate XXVIII.

Fig. 18. Abdomen of Paniscus geminatus (female).
Fig. 19. Abdomen of Paniscus geminatus (male).
Fig. 20. Basal joints of the antenna of Paniscus geminatus.
Fig. 21. Claw of Opheltes glaucopterus.
Fig. 22. Claw of Paniscus geminatus.

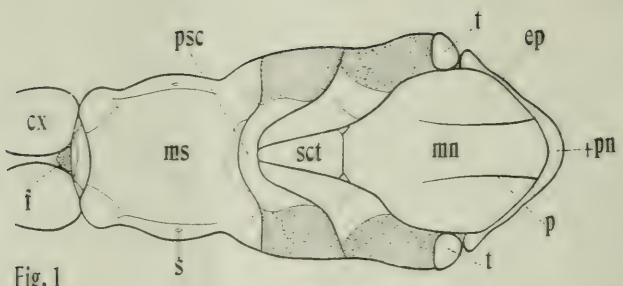



Fig. 1

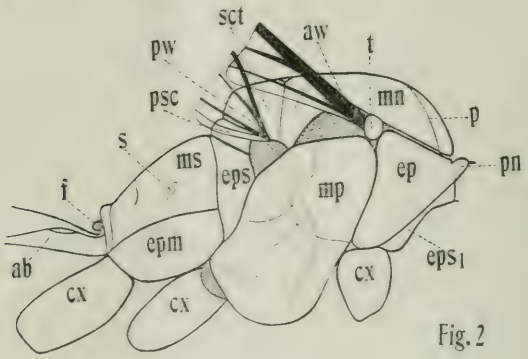


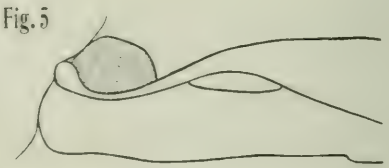

Fig. 2

Fig. 3



Fig. 4

Fig. 5



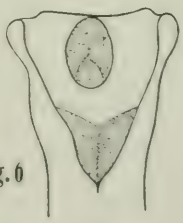


Fig. 6

E. D. Whit—.

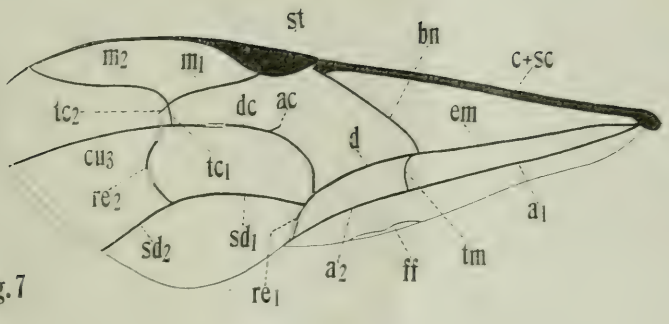



Fig. 7

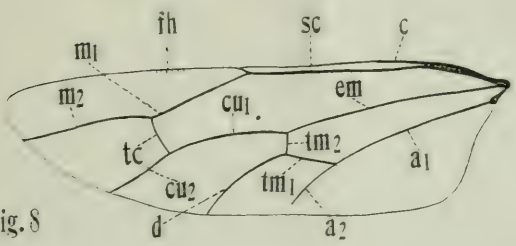



Fig. 8

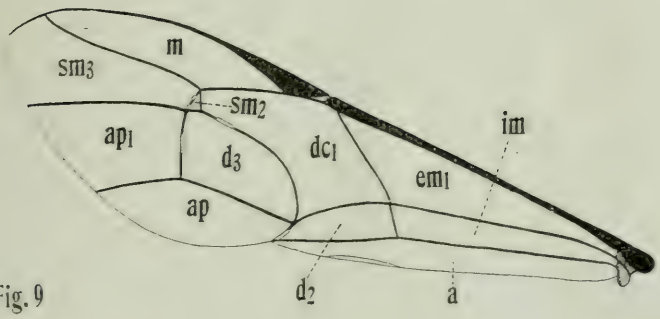



Fig. 9

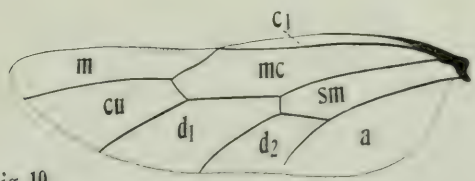



Fig. 10

*R. D. Whitmarsh.*

Fig. 11

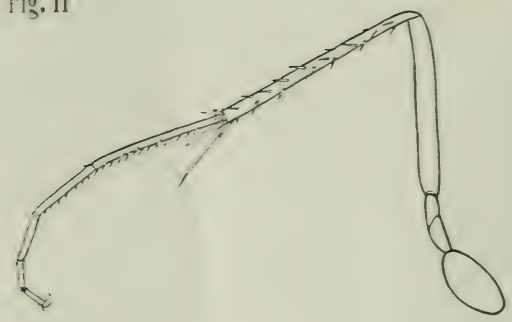


Fig. 12

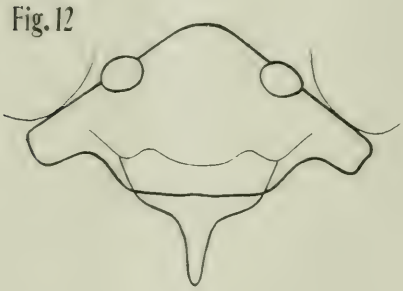


Fig. 13

Fig. 14

Fig. 15

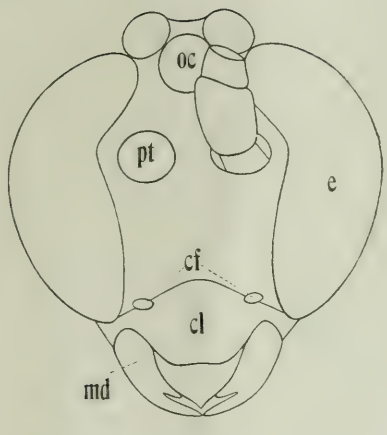



Fig. 16

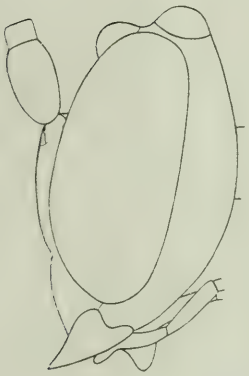
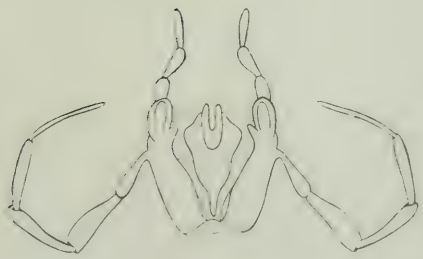


Fig. 17



*R. D. Whitmarsh.*

Fig. 18

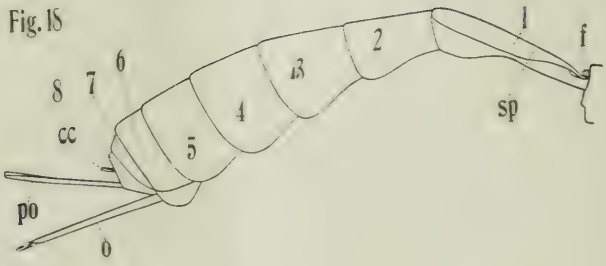



Fig. 19

Fig. 20

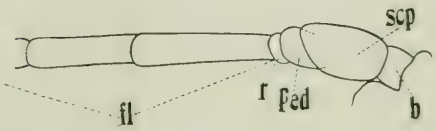



Fig. 21

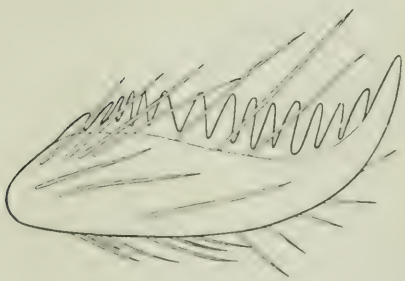
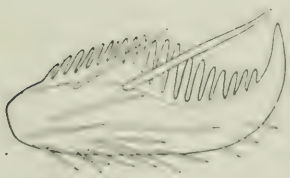


Fig. 22



R. D. Whitmarsh.

# THE REDISCOVERY OF A PECULIAR GENUS AND SPECIES OF ORIBATIDAE.

By H. E. Ewing,
Ames, Iowa.

Years ago Mr. Theo. Pergande made a drawing of a very peculiar species of the order Acarina. The specimens of this species were collected by Mr. E. W. Allis, at Adrian, Mich., in October, 1885. This acarid, with many others, it appears, was found in connection with a study of the eggs and larvæ of the 17-year locust. Some time later when Mr. C. L. Marlatt was ready to publish his bulletin upon the 17-year locust, he asked Mr. Nathan Banks to determine the Acarina for him. Mr. Banks looked over the mite figures (these were very accurately drawn, and represented beautifully the characters of the different species), and named what he could. It was Mr. Banks' intention to describe these species when he had examined the specimens. Later he did describe some of them, but the slide of this species he could not find!

Notwithstanding the fact that this slide was never found, the figure and name of this interesting species were published in Mr. Banks' treatise on the Acarina.* Whether or not Mr. Banks thought at the time his paper was published, that this genus was good, it is hard to tell. No comment whatever, is made upon this genus or species, and in his key to the genera of the *Oribatidæ* given on the opposite page from the picture, this genus is omitted.

While looking over some slides in the cabinet of the Department of Zoology, Iowa State College, I came across a slide of this species which had the following data upon it: "*In galls on elm twigs. Ames, Iowa, April 16, 1894.*" The slide contained about a dozen individuals well preserved but poorly mounted. I dissolved off the cover-glass and obtained the specimens without injury for my work upon the species. I found that this species represents in almost exact detail all the peculiar characters shown in Mr. Pergande's figure just referred to. These characters are given in the following pages.

*A Treatise on the Acarina, or Mites. Proc. U. S. Nat. Mus., Vol. XXVIII, p. 70, Fig. 136.

Now in regard to the question of who is to be given credit for the genus *Oripoda* for which this species stands as a type. Mr. Banks writes that he never has seen any of the individuals of this species, and that the species never has been described. Mr. Pergande was not a special student of the Acarina, and did not give a name to the species. While the author himself is the only one who has ever actually studied specimens of this species with the idea of finding out the systematic value of their characters, yet I am not responsible for the name or figure in any way. In the International Code, I can find nothing which states that the person who first describes, or in any way makes recognizable a new species or genus, must have actually seen the species he is naming or describing. Morally it does not appear proper to describe species upon secondhand information, still, some of the greatest advances in science are made in the interpretation of facts observed by others. Under these conditions, it appears to me that to give both Mr. Banks and Mr. Pergande credit for the genus and species is the best way out of the difficulty: in reality the conditions are very similar to a joint authorship.

The genus *Oripoda* I count as a very distinct and peculiar genus. The form and shape of the cephalothorax are entirely different from that of any other species of the *Oribatidae;* the queer shapes and forms of the segments of the second pair of legs represent a great exaggeration of the variations from the common type, as is shown in a few of the known species; while the whole body is drawn out to such an extent as to make the creature look out of all proportion when compared with the other members of the group. The genus may be described as follows:

Gen. Oripoda Banks and Pergande.

Pteromorphæ very long and narrow, extending almost the entire length of the body, and attached to the cephalothorax as well as to the abdomen. Cephalothorax very long and narrow with the sides almost parallel; covered above by a single, chitinous plate which projects slightly, like a hood, over the mouth-parts (Fig. 1). Cephalothorax completely bare above except for a single pair of bristles. Pseudostigmata entirely covered above by the pteromorphæ, and occupying an extreme postero-lateral position on the cephalothorax. Tarsi of the first two pairs of legs very short and truncate anteriorly (Figs. 5 and

6). Femora of second legs large, flattened and with a lateral blade-like expansion (Fig. 5).

The genus for which *Oripoda elongata* stands as a type will occupy a place next to the genus *Gymnobates* Banks, a genus represented by only two species, both of which are American. It shares with this genus the elongate form of the body and the truncate nature of the tarsi of the first two pairs of legs. The pteromorphæ represent an exaggeration of the form shown in *Gymnobates*, being extended farther forward and united by a transverse ridge at about the middle of the cephalothorax! It differs from this genus in having an elongate, cylindrical cephalothorax, entirely devoid of either the true or the lateral lamellæ; and in the structure of the second pair of legs. The species may be described as follows:

*Oripoda elongata* Banks and Pergande.

Light chestnut brown.

Cephalothorax very long, cylindrical, fully twice as long as broad; sides of cephalothorax almost parallel. No lamellæ, translamella or lamellar hairs present. A superior pair of bristles present, each pectinate, almost straight and about as long as the tibia of leg I. There is a slight, chitinous ridge connecting the two pteromorphæ, which passes transversely across the middle of the cephalothorax. Pseudostigmatic organs, short, capitate and entirely concealed by the pteromorphæ.

Abdomen cylindrical, about twice as long as broad. Pteromorphæ very long and narrow, extending the entire length of the abodmen and for about one-half the length of the cephalothorax. The abdomen bears dorsally about twenty rather small, slightly curved, pectinate bristles. There is an anterior lateral marginal pair; a dorsal pair; a posterior terminal pair; and about seven pairs situated upon or near the base of the pteromorphæ. Genital covers (Fig. 3) each about one-half as broad as long and semi-disc-shaped. They are situated over twice their length in front of the somewhat larger anal covers. Anal covers (Fig. 3) subrectangular in shape and almost approximate to the posterior margin of the ventral plate.

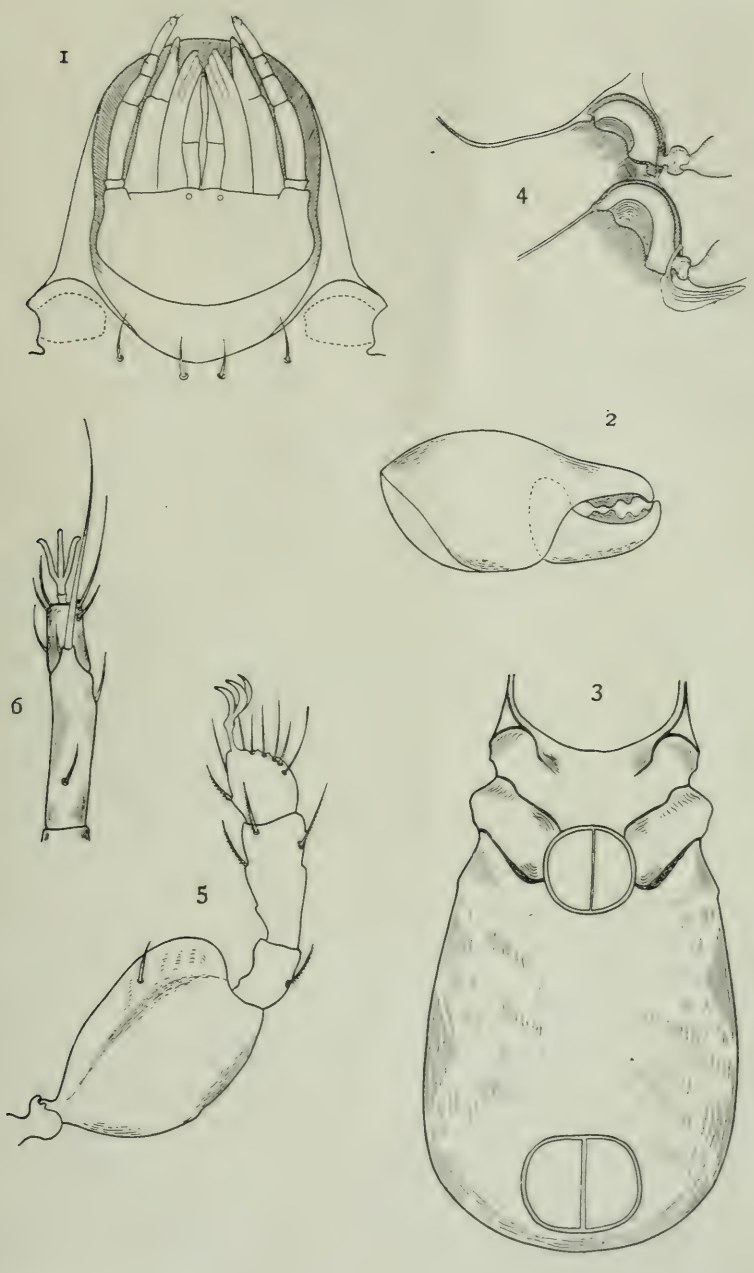
Anterior pair of legs extending about one-half their length in front of the tip of the cephalothorax; tarsus of leg I two-thirds as broad as long, truncate anteriorly; tibia twice as long as the

tarsus; genual slightly over one-third as long as the tibia; femur as long as tibia; coxa almost completely hidden in its socket (Fig. 4), where it has a double hinge upon which it rotates. Second pair of legs (Fig. 5) shorter than the first and normally bent at the genual; tarsus of leg II almost as broad as long; tibia much broader distally than proximally; genual slightly longer than broad; femur of a very peculiar shape, being much flattened, with an expanded latero-ventral margin; coxa as in leg I. The last two pairs of legs are of the common type; the last extending slightly beyond the tip of the abdomen. Ungues tridactyle; dactyles equally developed. Length 0.42 mm.; breadth 0.22 mm.

I have examined the mouth-parts of this species in hope that they would show some peculiarities, especially since this species has a rather extraordinary habitat, but they present the typical acarid form (Fig. 1); however, they are somewhat weaker than usual. The mandibles (Fig. 2) appear to be normal. The internal anatomy presents no special peculiarities. The organs are less compact than in the common species, as would be expected, because of the drawn-out form of the body. The ventriculus, or stomach, and its cæca appear to be rather small, but this is probably due to the shrinking of the tissues. In the females often there can be seen several large developing ova. The ovipositor is rather longer than usual.

Explanation of Plate XXIX.

Fig. 1. Mouth-parts as seen from below.
Fig. 2. Side view of one of the mandibles.
Fig. 3. Ventral surface of the body.
Fig. 4. The coxæ of legs I and II as seen from below, so as to show their double-hinged arrangement.
Fig. 5. Inside of leg II.
Fig. 6. Tarsus and tibia of leg I.




*H. E. Ewing.*

# A REVISION OF THE AMERICAN SPECIES OF PLATYMETOPIUS.

By E. P. Van Duzee,
Buffalo, N. Y.

The Hemipterous genus *Platymetopius* was founded by Burmeister in 1838 in his Genera Insectorum for the European *rostratus* H. S. and *vittatus* Fabr (=*undatus* DeGeer,) the former of which should doubtless be taken as the type. It is widely distributed in the palæarctic and nearctic regions. Twelve species have been recorded from the former and from the latter twenty-three are enumerated in the present paper. Three additional species have been described from tropical America, where the genus may be well represented.

This genus is easily distinguished from the allied Jassid genera by the long pointed vertex, the narrow front and the strong elytral venation. There are three anteapical and five apical areoles in the elytra of which the outer is broadly triangular; the second sector is connected with the branches of the first by two transverse veinlets and there is usually a series of eight or ten oblique veinlets crossing the costal areole. The elytra in the more typical species are more or less closely inscribed with fine brown or fuscous pigment lines and ornamented with a few oval or rounded whitish spots placed near the ends of the areoles of which those occupying the apex of the anteapical and the base of the apical are most regular and persistent. The angled base of the front usually has a concentric pale or white line a little below the sharp edge of the head where there is frequently a second line; these lines being accentuated by darker borders. In the paler faced species these lines may become obscure or entirely obliterated. In fully marked species there are usually five longitudinal pale vittæ on the pronotum and about five white calloused spots on the margins of the scutellum of which three are on the angles of the posterior field. The characters of the genitalia are quite distinctive in some of the species but in most they run so close that they are of little value for diagnostic purposes.

I do not now like to express any very decided views on the phylogeny of this genus but in a linear arrangement of the genera I would certainly place it between *Mesamia* and *Delto-*

*cephalus*. Through the former it is related to the *Dorydini* and through the latter with the *Athysanini*, while with this last tribe it is independently connected by genus *Scaphoideus*. I still adhere to the views expressed by me many years ago as to the value of the second cross nervure between the first and second sectors of the elytra as a diagnostic character in the Jassid genera. It is but one character among several which unite a fairly homogeneous group of genera with *Mesamia* at one extreme and *Deltocephalus* at the other. The form of the vertex alone can never be used for separating the Jassid genera into groups nor do I know of any other single character so available as is the elytral venation. That certain species of *Athysanus* or *Eutettix* show an occasional second cross nervure only proves to me that those genera have but recently developed from their parent stem and are still plastic. The whole group of genera included by me in the *Deltocephalini* and *Athysanini* seems now to be in their ascendancy and rapidly developing in both species and genera, many of which have not yet become well differentiated.

In the preparation of this paper I have had before me representatives of all but two of the described American species, *modestus* and *elegans*. The latter however is a distinct species well known to me and it has been included in the synoptical table. Of the others I have examined the types of all but *acutus* Say, *madgalensis* Prov. and *cinereus* O. & B., the two former of which certainly refer to our most abundant eastern species.

I wish here to extend my thanks to those who have assisted me with the loan of material. To Prof. Herbert Osborn I am indebted for a number of his types and the opportunity of examining all the material in his collection and in that of the Ohio State University at Columbus, Ohio; Dr. Ball has sent me his very valuable material in the genus including the types of the species recently described by him; and at the suggestion of Prof. Baker, Dr. Howard has kindly sent me the types of the three Baker species described in 1900 and with them examples of ten other species from the National Museum collection. In addition to this my own collection contains representatives of twenty species mostly in good series. From this material I have found it necessary to describe as new four species and one variety.

In preparing the following dichotomous table of the species I have used the most available characters I could discover. Many of these characters are obscure or difficult to express in words which is especially true of the markings of the vertex although these markings seem to be good and constant characters. It must be borne in mind that the vertex in the female is always longer and more acute at apex than in the male. Unfortunately the type of *tenuifrons* Baker was received too late to allow of its being included in the key to the species but its long vertex with a peculiarly broad and rounded apex and the brown face will readily separate it from *verecundus* to which it is most closely related.

KEY TO THE SPECIES OF PLATYMETOPIUS.

Elytra uniformly whitish-hyaline crossed by three narrow but usually well distinguished fuscous vittæ; oblique costal veinlets wanting; vertex rather short, 1. **hyalinus** Osb.

Elytra more or less hyaline, usually pigmented and veined or inscribed with fuscous with the costal areole hyaline and crossed, at least at apex, by oblique fuscous veinlets; never uniformly hyaline with narrow transverse vittæ....1.

1. Elytra quite uniformly colored or subhyaline with at most but slight veining toward the apex; oblique veinlets of the costa wanting anterior to the anteapical areoles....2.
–. Elytra white or whitish hyaline more or less clouded with fulvous or cinereous and inscribed with fulvous-brown or fuscous, at times almost entirely fulvous or black; oblique veinlets at least indicated in the costal areole 3.
2. Color a polished sub-hyaline brown; vertex large, parabolic, dull fulvous; clavus and a broad band across the anteapical areoles which extends back along the costa, whitish; face deep black with the edge and an angulate line white, conspicuous; length 4 mm.; inhabits California. 3. **majestus** Ball.
–. Color greenish or creamy white; vertex of the male short, about right-angled, of the female strongly produced, lineated at apex with brown and pale; elytra slightly infuscated at apex with about three oblique veinlets against the anteapical areoles; length 3½–4½ mm....2. **nigriviridis** Ball.
3. Elytra but partially clouded and inscribed, marked with a conspicuous yellow dorsal stripe along the closed elytra; inhabits California. 4. **elegans** VanD.
–. Elytra variously clouded and inscribed but without a conspicuous pale dorsal vitta....4.
4. Vertex flat, Thamnotettix-like, not depressed nor channeled toward its apex, anterior margin rounded to the front; pronotum and elytra recalling *Mesamia vitellina*, wanting the white areolar spots of *Platymetopius*. 13. **dorsalis** Ball.
–. Vertex more or less channeled toward the apex which may be depressed or produced and a little elevated; anterior edge thin, acute or subacute....5.
5. Face pale or yellow, usually more or less infuscated at base and sides, the former frequently marked with an angulate pale line....6.
–. Face entirely brown or fuscous....18.
6. Markings of the vertex in the form of lineations, usually a pale median line more distinct anteriorly and edged with brown, and a faint slightly divergent line either side....7.

–. Pale markings on the vertex taking the form of a broken transverse vitta before the eyes, more or less complete, the median line short and apical. 15.

7. Elytra subhyaline, either cinereous or fulvous, usually clouded and reticulated anterior to the anteapical areoles with the white areolar spots apparent; angular white line on the base of the front distinct (except in *latus*) ....8.

–. Elytra fulvous and opake anterior to the anteapical areoles, the white areolar spots obscure in the female, obsolete in the male.....14.

8. General color cinereous with the elytral markings and areolar spots distinct; beneath mostly black; face distinctly infuscated at base and sides.....9.

–. General color fulvous with the elytral markings usually indistinct and the lower surface pale; face but slightly infuscated on the sides, the angular basal mark nearly obsolete.....10.

9. Length 5 mm.; vertex of the male little longer than the width between the eyes, of the female somewhat longer; inhabits from Canada to Georgia. 5. **acutus** Say.

–. Length 4 mm.; vertex very long and pointed, at least twice as long as wide between the eyes; inhabits Florida.....9. **slossoni** VanD.

10. Face obscurely infuscated on the sides, the angular white line at base distinct. 11.

–. Face uniformly yellowish, the angular white line at base obsolete; vertex at least twice as long as wide between the eyes; elytral reticulations and areolar spots obsolete at least in the female.....7. **latus** Baker.

11. Length at least 5 mm.; general color fulvous.....12.

–. Length 3½-4 mm.; color cinereous, usually tinged with greenish. 10. **cinereus** O. & B.

12. Male plates short and broad, hardly passing the middle of the pygofers; areolar spots practically obsolete anterior to the anteapical areoles; general color darker, the males clearly marked.....8. **cuprescens** Osb.

–. Male plates long triangular, but moderately exceeded by the pygofers....13.

13. Last ventral segment of the female scarcely longer than one half its basal width; male plates narrow; pronotal vittæ usually distinct. 5. **acutus** var. **dubius** VanD.

–. Last ventral segment of the female long and narrowed to the nearly truncated apex; much longer than one half its basal width; male plates large and broad; pronotal vittæ obsolete .....6. **oregonensis** Baker.

14. Larger, 4½–5 mm.; valve of the male distinctly angled at apex. 12. **fulvus** Osb.

–. Smaller, 3–4 mm.; valve of the male scarcely angled at apex. 11. **angustatus** Osb.

15. Face pale or yellow, infuscated at the sides.....16.

–. Face entirely yellow, sometimes showing obsolete irrorations quite uniformly distributed .....17.

16. Vertex more obtuse; sides of the face distinctly and abruptly darker; the angulate pale line at base obvious across nearly the whole width of the face; vertex mostly black.....14. **frontalis** VanD.

–. Vertex more produced; face showing traces of darker irrorations especially at the sides; angulate basal line reduced to an angled transverse spot; vertex mostly white, the markings of the whole upper surface more strongly contrasting.....15. **nasutus** VanD.

17. Vertex longer, about as in *nasutus;* pleuræ and legs mostly fuscous brown; inhabits Florida to Colorado and Mexico.....16. **loricatus** VanD.

–. Vertex shorter, about as in *frontalis;* pleuræ and legs whitish or mostly so; inhabits Jamaica.....17. **nanus** VanD.

18. Male plates triangular, their apex acute or subacute; last ventral segment of the female long with its apical margin oblique either side of the middle which is distinctly produced and sometimes abruptly angled.....19.

–. Male plates short, transverse and rounded at apex, little exceeding the valve; last ventral segment of the female short, truncate, its hind margin a little sinuated.....24. **fuscifrons** VanD.

19. Larger; 5 mm.; white markings of the vertex scarcely forming a transverse vitta before the eyes, consisting of the apical line, a curved mark either side, and sometimes two dashes behind these, and four approximate marks on the base; inhabits eastern states and Canada.....21. **obscurus** Osb.
–. Smaller species, 3½–4 mm.; markings of the vertex forming a transverse vitta before the eyes.....20.
20. Vertex forming at least a right angle before, the apex subacute.....21.
–. Vertex short, rounded at apex.....23.
21. Vertex strongly produced, almost acute at apex, its length nearly or quite twice the width between the eyes; pale markings complete but not strongly contrasted; transverse vitta interrupted at the middle and sometimes on either side; inhabits Florida.....19. **verecundus** VanD.
–. Vertex shorter, scarcely more than right angled at apex.....22.
22. Vertex paler at base shading to fuscous anteriorly; transverse vitta of four subequal white dashes; apical dash short, isolated; areolar white spots few but well distributed over the elytra; inhabits California and Mexico. 18. **irroratus** VanD.
–. Form of *frontalis* nearly; general color darker or blackish-fuscous; areolar white spots clustered about the apical transverse nervures; white markings on the vertex consisting of the apical line, a marginal line either side, two larger spots representing the transverse vitta, and two others at the base; inhabits Kansas.....20. **scriptus** Ball.
23. Anterior edge of the head marked with five uniform contiguous white spots; angled white line on the base of the front represented by a small but distinct transverse spot; inhabits Jamaica.....23. **brevis** VanD.
–. Anterior margin of the head marked with a white apical point and an obscure pale patch either side about the ocelli; white mark on the base of the front represented by a short slender arcuated line; inhabits Guatemala. 22. **osborni** VanD.

### 1. **Platymetopius hyalinus** Osborn.

Ent. News, xi, p. 501, 1900.

This insect is quite aberrant in its genus by its uniformly whitish hyaline elytra crossed by three narrow fuscous bands. Prof. Osborn described it from a series taken from an imported tree at Washington, D. C., and strongly suspected that it might be an exotic form introduced with material added to the Botanical Gardens there. In that case it probably has become acclimated as Mr. C. W. Johnson has sent me a specimen he took near Philadelphia.

### 2. **Platymetopius nigriviridis** Ball.

Ent. News, xx. p. 163, 1909.

Another very distinct little species from California. It is of a pale straw color tinged with green especially on the head, anterior margin of the pronotum and abdomen. On the elytra there is a longitudinal line on the clavus, some of the discal nervures near the apex, about four of the oblique costal veinlets posteriorly, and a spot at the apex of the inner apical areole blackish. Face immaculate. Vertex of the male short, about right-angled at apex; of the female strongly produced but little shorter than in *slossoni*. The variety **dixianus** Ball is still

paler with the vertex of the female shorter and similarly lineated with fuscous at apex. This variety, of which I have seen only the types, is from Utah.

3. **Platymetopius majestus** Ball.

Ent. News, xx. p. 164, 1909.

A small but very distinct species thus far reported only from California. Its deep black face marked with a white basal edge and concentric line, the large pale yellowish parabolic vertex and the brownish iridescent and uninscribed elytra make its identification easy. I have seen only the types which were kindly loaned to me by Dr. Ball.

4. **Platymetopius elegans** Van Duzee.

Ent. Americana, vi, p. 94, 1890.

In this species there is a broad yellowish dorsal stripe from the middle of the vertex to the tip of the clavus. The corium is brownish-cinereous obscurely banded with whitish hyaline, the cinereous areas are minutely inscribed with fuscous, the apical submargin and some of the adjacent nervures are heavily embrowned and the clavus and disk of the corium are sprinkled with obscure rufous dots. The lower surface is yellowish with the base of the face cinereous and the angled pale line distinct. The vertex of the female is about one half longer than the width between the eyes. Length 5 mm. I have seen only the unique female type which was from California but among my Florida captures was one apparently scarcely mature specimen showing a similar yellow dorsal vitta, which I cannot identify with this species. It may represent a still undescribed form.

5. **Platymetopius acutus** Say.

Jl. Acad. Nat. Sci., Phila., vi, p. 306, 1831; Compl. Writings, ii. p. 382.
Platymetopius magdalensis Prov. Pet. Faun. Ent. Can. iii, p. 275, 1889.

This, our most widely distributed *Platymetopius*, seems to be the stem form from which have branched off most of the closely allied species found in this country, to all of which it is connected by certain variable characters. Its typical form, agreeing perfectly with Say's description, is found throughout the middle and northern states but in one form or another it occurs from the Atlantic to the Pacific coasts and from northern Quebec and British Columbia to, or nearly to the gulf coast. The typical form may be characterized as follows:

Vertex in the male a very little longer than broad between the eyes, in the female distinctly longer. Color: Vertex fulvous-brown finely

irrorate with testaceous forming a longitudinal line next each eye and another midway between that and the median sulcus; a line at apex, an oblique mark either side of this and four marks on the basal margin white bordered with piceous black. Pronotum fulvous-brown, closely, confluently irrorate with testaceous-white and showing five whitish longitudinal vittæ more or less conspicuous. Scutellum fulvous with four spots on the anterior field and the three angles of the posterior field whitish, outlined in black, the disk of the anterior field sometimes variegated with pale. Elytra white, rather closely inscribed with fulvous brown; nervures darker brown; costal area white crossed by nine or ten heavy oblique veinlets; round areolar white spots most conspicuous in the apex of the anteapical areoles, the base of the apical, and near the tip of the claval. Face light yellow, abruptly shading to fuscous on the base of the front and outer half of the cheeks, the former marked with a white angled line and a more slender one follows close under the anterior edge of the vertex; the lower continued as a longitudinal line behind the eyes. Beneath and legs deep black, more or less varied with whitish, the tibiæ white dotted with black at the base of the white spines. Genital characters. Male: Last ventral segment short, broadly and very obtusely excavated. Valve large obtusely triangular, apex rounded. Plates triangular, exceeding the valve by about its own length, their sides rectilinear or more generally slightly convexly arcuated to an obtuse apex, sometimes a little concave with their apex subacute; closely fringed with stiff bristles. Pygofers narrow, distinctly exceeding the plates. Female: Last ventral segment scarcely longer than one half its basal width, moderately compressed suggesting a median carina; viewed from directly below the hind margin is broadly rounded; oviduct scarcely exceeding the pygofers. Length about 5 mm.

Toward the north and west this species varies to a lighter almost fulvous color with little if any black beneath, the face is paler, scarcely shading to darker on the sides of the cheeks, and the vertex is more strongly produced, at least one half longer than broad between the eyes. I call this variety **dubius** to distinguish it from the typical form with which it is connected by almost insensible gradations. It in turn forms a connecting link with *oregonensis*, which however I believe to be a distinct species. I have listed this species as *latus* in Canadian Entomologist, xl, p. 157, 1908.

6. **Platymetopius oregonensis** Baker.
Can. Ent. xxxii, p. 49, 1900.

This species was described from two males from Oregon but Dr. Howard has sent to me from the Baker collection one male and one female marked as types. These agree in every particular with material in Dr. Ball's collection and my own from California, Utah, Colorado and New Mexico. In the male the

vertex is shaped almost exactly as in the male of *acutus*, but it is shorter than in the female *acutus* with which sex I assume Prof. Baker may have compared his specimens. The female has a much longer vertex, its length being somewhat more than twice its width between the eyes. In color this species is still paler than in the variety *dubius* of the preceding species. It is of a light fulvous, paler and almost immaculate beneath; the face is pale with but very faint infuscation on the base of the front and sides of the cheeks but with the angular white lines on the former distinct.

This species is best distinguished by the form of the genital pieces: The valve of the male is more angled and subacute at apex; the plates are larger with their outer margins distinctly concavely arcuated and their apices a little divergent and subacute. The last ventral segment of the female is conspicuously longer and narrower than in *acutus* with its apex slightly subangularly produced.

7. **Platymetopius latus** Baker.
Can. Ent. xxxii, p. 50. 1900.

I have one female of this species taken by Mr. W. J. Palmer of this city at Quinze Lake, Quebec, which agrees perfectly with Prof. Baker's Colorado type received from Dr. Howard. It may be distinguished by its fusiform shape, narrow pointed head with a vertex twice as long as its width between the eyes, the broad flaring elytra, the almost uniform coloring which is fulvous-brown above, without irrorations on the vertex, pronotum and scutellum, and almost without elytral reticulations or white areolar spots, the nearly concolorous nervures, those of the costal areole being a little more distinct, and the uniformly pale yellowish-testaceous coloring beneath with the base of the front darkened only at the extreme tip and not showing the angular white mark. Genital characters nearest to those of *acutus*; the last ventral segment a little more angled and the pygofers smaller. This is a rare species and probably is confined to northern Canada and the higher regions of the Rocky Mountains.

8. **Platymetopius cuprescens** Osborn.
20th Rept. N. Y. State Ent. p. 517, 1905.

Another closely allied species which comes nearest to *acutus* but has a longer and sharper vertex, about as in *dubius* and *oregonensis;* the elytra are more infuscated with but slight traces

of the white areolar spots. The face is pale yellow, but little darkened on the base of the front and sides of the cheeks, with the pale angular line distinct. The genital characters of the female are very close to those of *acutus*, but the last ventral segment is more carinated with its apex distinctly notched when viewed from below. In the male these characters are very distinctive. Last ventral segment longer, not shorter, than the preceding; valve shorter; plates much shorter, rounded, about two thirds the length of the valve; pygofers broad, exceeding the plates by about the length of the latter and similar to them in color and texture. Prof. Osborn's type was taken by me at Phoenicia, N. Y., I have taken another female at Niagara Falls and a male at Boulder, Colorado, and another at Ogden, Utah, and Mr. Palmer took one at Quinze Lake, Quebec.

9. **Platymetopius slossoni** n. sp.

Very close to *acutus* but smaller with a longer and more acute vertex and shorter male pygofers. Length 4 mm.

Vertex long and acute at apex, still longer than in *oregonensis* and *latus* rather more than twice as long as wide between the eyes and obviously longer than the pronotum and scutellum together; marked with three pale longitudinal lines as in *acutus;* the lateral curved, becoming approximate and parallel for a short space at base. Face light yellow with the angled base of the front and sides of cheeks broadly distinctly infuscated, the former with a very distinct acutely angled concentric white line which is projected to the apex of the head and is strongly reproduced behind the eyes. Pronotum with the longitudinal vittæ distinct as in *acutus*. Beneath and abdomen dark fuscous; in the female obscurely marked or irrorate with pale in places; last ventral segment shaped as in *acutus*, whitish at base with about four black ligulate marks on the basal margin. In the male the pectus and abdomen are deep black, obscurely marked with pale on the venter and at the tip of the valve; last ventral segment angularly but not deeply emarginate; valve triangular, subacute at apex; plates rather broad-triangular, on their sutural margin as long as the valve, their outer edges moderately sinuated and fringed with bristles, their apex a little narrower than in *acutus;* pygofers slightly but distinctly shorter than the plates which they scarcely exceed at the sides.

Described from one pair taken at Jacksonville, Fla., in May, 1910, by Mrs. Annie Trumbull Slosson whose enthusiasm and industry have added so much to our knowledge of the insect fauna of Florida and other parts of the eastern United States. I took a good series of what is certainly the same species at Crescent City, Sanford, Sevenoaks and Ft. Myers, Florida.

They differ only in being slightly larger and paler. This species is very close to *acutus* with which the typical form is almost identical in color and markings but its small size, remarkably long and acute vertex and the short male pygofers preclude its reference to that species.

10. **Platymetopius cinereus** Osborn & Ball.

Proc. Iowa Acad. Sci. iv, p. 193, 1897.

This is a very small and somewhat greenish species with a vertex formed about as in *acutus;* face greenish-white, very slightly infuscated on the base of the front where the angular white line is distinct; markings on the vertex and pronotum nearly obsolete but the five pale vittæ of the latter are generally discernable; abdomen mostly black in the male, rarely so in the female; elytra closely but lightly reticulated. Last ventral segment angularly produced in the female; valve of the male obtusely triangular; plates nearly as long as the valve on their suture, triangular, blunt at apex, considerably exceeded by the pygofers.

This, one of our smallest species, is found throughout the warmer portions of the central and southern states from Iowa to Florida.

11. **Platymetopius angustatus** Osborn.

20th Rept. N. Y. State Ent., p. 518, 1905.

Prof. Osborn has very kindly sent me one of his male types and I have examined the female in his collection. This is the smallest species known to me and has been reported from the type locality only: Long Island, N. Y. The female is distinctly larger with a longer vertex than the male. It has a light greenish color with coppery reflections; the round areolar spots of the elytra are confined to the apical and anteapical areoles; the costa is hyaline with the oblique veinlets dark and the abdomen is marked with black. The male is smaller with a much shorter vertex; its color is a bright fulvous becoming yellowish on the head; the elytra are subopake, almost unicolorous on their base but becoming recticulated with brown on their apical and anteapical areoles where the round white spots are fairly distinct; oblique veinlets of the costal areole almost obsolete. In both sexes the base of the front is feebly infuscated with the pale angular line discernible.

Last ventral segment of the female rounded. Valve of the male large scarcely angulate at apex; plates triangular, on their suture shorter than the valve; terminated by the long setæ; the brown apex of the pygofers much surpassing the plates.

12. **Platymetopius fulvus** Osborn.

20th Rept. N. Y. State Ent., p. 519, 1905.

This insect has about the form and size of *frontalis* but it is of a bright fulvous color with the elytra mostly opake and the markings almost or quite obliterated from the base nearly to the apex of the ante-apical areoles; vertex and scutellum more yellowish with indistinct pale vermiculate lines; oblique costal veinlets brown on a concolorous ground; face almost uniformly pale yellow with the basal angular pale line rarely indicated.

Last ventral segment of the female rounded behind with a blackish arcuate mark either side which gives it the appearance of being strongly produced on the middle. Valve of the male ovate-triangular, its margins arcuated to the obtuse apex; plates large, triangular, exceeding the valve by its own length; strongly ciliate on their outer margins; pygofers slender, longer than the plates.

Prof. Osborn's types were from Cold Spring Harbor, Long Island, N. Y. About Buffalo it is not uncommon among the hills at Colden and Gowanda and it has been reported from Pennsylvania and Ohio.

13. **Platymetopius dorsalis** Ball.

Platymetopius frontalis var. dorsalis Ball. Ent. News, xx, p. 164, 1909.

I cannot agree with Dr. Ball in placing this as a variety of *frontalis*. It seems to me very distinct and withall a difficult species to place. It is fulvous and pale yellow in color and has much the aspect of a small *Mesamia vitellina* but it has the vertex of a *Thamnotettix* and the front of a *Platymetopius*, to which genus I think it is most closely allied by its venation and structural characters. The anterior edge of the head is obtusely rounded as compared with the allied species. The lower surface, vertex and scutellum are pale yellow and immaculate. The pronotum and elytra are bright fulvous with coppery reflections, with the sides of the pronotum, costa at base, apical areoles and a vague saddle across the apical half of the clavus yellowish. I have seen only the unique type from Kansas kindly loaned to me by Dr. Ball.

14. **Platymetopius frontalis** Van Duzee.

Can. Ent. xxii, p. 112, 1890.

Common and widely distributed throughout a great part of the United States and Canada. This species may be distinguished by its stout form, short vertex and blackish color both above and below, with a clear yellow face which becomes infuscated at each side but scarcely at the pointed base where the angled lines are but poorly distinguished. The vertex has a white median dash at apex and a transverse vitta of similar marks across the disk before the eyes, more or less conspicuous. The pronotum sometimes shows faint traces of the five pale vittæ and there may be some white marks on the scutellum forming two broken longitudinal vittæ. Elytral areoles with pale reticulations about their margins, sometimes nearly obsolete in the males; round areolar spots well developed and conspicuous; costa white, the oblique veinlets heavy; apical areoles generally infuscated beyond the white basal dots, the extreme edge clear white. Male genital characters about as in *fulvus;* the valve broader and more rounded and the plates a little shorter; last ventral segment of the female short and broadly rounded on the apical margin. Dr. Ball has sent me for inspection a typical example of *frontalis* taken by Prof. Gillette in Mexico.

15. **Platymetopius nasutus** Van Duzee.

Bul. Buf. Soc. Nat. Sci. viii, No. 5, p. 64, 1907.

While very close to *frontalis* I believe this a sufficiently distinct species. The vertex is obviously longer and more pointed and there is much more white in the coloring of the upper surface. The vertex is mostly white with the apex and a transverse eroded vitta black, the former with a median line and two oblique dashes white; the pale basal portion is veined with fuscous and the white median area is crossed by a black longitudinal line either side of the middle; the pronotum is irrorated with white and fuscous with the anterior margin and depressed sides mostly white and the longitudinal vittæ scarcely indicated. The elytra are white with a few fulvous-brown areas in the areoles and with fuscous reticulations more or less extended, the white areolar spots being much obscured. Beneath black with the tibiæ and tarsi white, dotted with black; the femora sometimes largely invaded with white.

In this species the face while mostly yellow shows a strong tendency to a uniform fuscous irroration which becomes more conspicuous laterally (thus forming a connecting link with the group of brown-faced species), and the angled base may also be darkened, with a transverse crescentic white mark. The male plates are proportionately a little larger and more obtuse at apex than in *frontalis* and the last ventral segment of the female is shorter and more angled. The types of this species were from Jamaica and Colorado and I have seen others from California.

16. **Platymetopius loricatus** Van Duzee.

Bul. Buf. Soc. Nat. Sci., v., p. 205, 1894.

Allied to *nasutus* but sometimes smaller and showing strong indications of the frontal irrorations found in *fuscifrons*. Face in typical examples entirely pale yellow. Vertex shorter than in *nasutus* but longer than in *frontalis;* its markings substantially as in *frontalis* but here the white vitta consists in great part of two longer approximate and dislocated white dashes and a few minute irrorations, the base with two median white dashes. Pronotum with the five pale vittæ fairly distinct. Elytra mostly blackish as in *frontalis* but with the white areolar spots smaller and fewer anteriorly. Face frequently showing strong indications of fuscous irrorations, especially toward the base of the front where there is then a short angled white mark. Last ventral segment of the female short, its hind margin hardly angled at the middle, the lateral angles rounded. Valve of the male short and rounded or very feebly angled; the plates broadly but acutely triangular, scarcely longer on their suture than the valve; slightly exceeded by the pygofers. Described from California but I have seen others from Colorado, Florida, Orizaba, Mexico, and Gualan, Guatemala.

17. **Platymetopius nanus** Van Duzee.

Bul. Buf. Soc. Nat. Sci., viii, No. 5, p. 65, 1907.

Very close to *loricatus* but the colors are paler with the white elytral spots less distinct, the pleura are yellow with a brown cloud anteriorly, not black as in *loricatus*, and the vertex is a little shorter but similarly marked. The last ventral segment of the female is more produced. In the male the last ventral segment is subangularly excavated behind; the plates also are larger and white, surpassing the apex of the pygofers which is not the case in *loricatus*.

The aspect of these two species and the next shows a greater difference than is sustained by their structural characters and it is possible, but I hardly think likely, that material from intermediate localities may necessitate merging them in one. The smaller *nanus* has thus far been found only in the island of Jamaica.

18. **Platymetopius irroratus** n. sp.

Differs from *loricatus* in being paler in color and generally smaller and in having the hind edge of the last ventral segment of the female distinctly angled either side and the plates of the male proportionately shorter but equally acute at apex leaving the margins more deeply arcuated. In this form the face is always more or less irrorated with brown or fuscous or at times entirely pale brown irrorated with pale. In the paler individuals the facial irrorations are always more dense toward its angled base where the pale line is distinct. The vertex is somwehat shorter than in *loricatus* and the elytra are cinereous instead of almost black as in that species. It is close to *brevis* but may be distinguished by the longer vertex which is darkened at apex and marked with four white dashes as in *loricatus*. The genital characters are also quite different from *brevis*. Length 4 mm.

Dr. Ball has sent me a long series of this species taken at Chino, Riverside, Pasadena and San Diego, California, Phoenix, Arizona, and Ti Juana, Mexico.

19. **Platymetopius verecundus** n. sp.

Allied to *irroratus* and *obscurus* but with a longer vertex than in either. Length 3 1-2 to 4 mm.

Vertex about as in *oregonensis*, much produced and acute but distinctly shorter than in *slossoni;* in the female about twice as long as wide between the eyes. Clypeus much constricted near the base with its apex produced and rounded as in the allied species. Hind margin of the last ventral segment of the female distinctly angled and slightly produced at the middle and more obscurely angled on either side. Last ventral segment of the male subangularly emarginate; valve large, scarcely angled at apex; plates as in *loricatus*, a little longer than in *irroratus* and smaller than in *scriptus* and *obscurus*.

Color fulvous-brown with rather strong ornamentation. Vertex marked as in the allied species, the pale apical line more developed; transverse pale vitta sometimes almost entire or broken only by the fulvous median stripe and a brown line near it on either side, or there may be a second interrupting line exteriorly; base with a white median vitta bisected by a fuscous longitudinal line and sometimes terminated outwardly by a similar line. Pale vittæ of the pronotum distinct.

Scutellum distinctly fulvous with the extreme angles and two vittæ irrorate with white. Elytra strongly inscribed; the areolar white spots distinct; costal areole whitish with the oblique veinlets strong; apical areoles narrowly fuscous next to the slender white apical margin. Front fulvous-brown, obscurely irrorate with pale, the white angular mark on the base of the front well developed and reaching about one half way to the eyes. There are two white lines beyond the eyes and an obsolete oblique one at the upper angle of the loræ; pectoral pieces fulvous-brown, conspicuously paler beneath. Abdomen fuscous or brown, varied with pale. Legs pale dotted with fuscous.

Described from numerous examples taken by me in Florida and listed as "*obscurus* Osb.?" in my report on the Hemiptera taken at that time. The exact localities represented are Crescent City, Sanford, Sevenoaks, Clearwater and Estero. This species with *nanus* from Jamaica, *irroratus* from Mexico and *scriptus* from Kansas form a puzzling group of very closely allied forms which run into *loricatus* on one hand and *obscurus* on the other. Their genital characters vary slightly but are not sufficient for separating them. Students with "lumping" proclivities will doubtless place them as varieties of a single species.

20. **Platymetopius scriptus** Ball.

Ent. News, xx, p. 165, 1909.

Male: A little larger and darker with a shorter vertex than in the preceding two species. Closely allied to *frontalis* but with a brown front and differently marked vertex. Last ventral segment nearly as long as the preceding, broadly angularly excavated behind and distinctly carinate on the median line; valve large, produced but scarcely angled at apex; plates large, subacute at apex, sides nearly straight; on their suture much shorter than the valve; considerably surpassed by the pygofers. Color blackish fuscous, nearly as dark as in *frontalis*, paler on the scutellum; white areolar spots present in the apex of the anteapical and base of the apical areoles, elsewhere usually wanting. Face brown, coarsely irrorate with pale, the angular basal mark distinct. Pectus, abdomen and legs black; tibiæ mostly white dotted with black; median apical line and anterior edge of the vertex white; the latter forked about the ocelli and connected with a squarish white spot indicating the transverse vitta of *loricatus;* basal white dashes usually connecting with another exteriorly forming an irregular pale patch. Scutellar angles more or less conspicuously fulvous. Length 4 mm.

Known to me only from the five type specimens kindly loaned to me by Dr. Ball.

21. **Platymetopius obscurus** Osborn.

Ohio Nat. v. p. 274, 1905.

This species very closely resembles *acutus* in size, color, markings and shape of the vertex. The face however is fulvous-brown, coarsely irrorate with paler; the valve of the male is more angled, the plates are smaller and the hind edge of the last ventral segment of the female is more transverse and angled on either side. Length 5 mm.

Described from New York, Pennsylvania and Ohio. Mr. Palmer found it abundant at Lake Temagami, Ont., and Quinze Lake, Quebec. I took it at Sharon and Ipswich, Mass., and have examined others from Georgia.

22. **Platymetopius osborni** n. sp.

Near *brevis* but larger with a shorter vertex. Length 4 to 4 1-2 mm. Vertex scarcely longer than its basal width; anterior margin rounded, the angle at apex hardly indicated. Front broader than in *brevis*, its sides parallel or nearly so to the superior tip of the loræ, then abruptly narrowed to the clypeus. Genital characters substantially the same as in the allied species except that the last ventral segment of the male is shorter and the pygofers are longer, surpassing the plates. Last ventral segment of the female distinctly angled at about the middle of the latero-posterior margins where they are practically rectilinear in *brevis*. Color about as in *brevis* becoming paler in some females. Vertex fulvous-brown varied with darker, base with four pale marks; a line adjoining the eye and the broad apex ivory-white, the latter interrupted by a median vitta forked at apex and a small broken spot half way between this and the black ocelli. Face irrorate with fuscous points which become confluent on the front and base of the cheeks and omit the sides of the clypeus, a vitta on the loræ and another on the cheeks above its suture; pale angled line on the base of the front reduced to a small transverse spot less conspicuous than in *brevis*. Pronotum rather dark with the five pale vittæ distinct. Scutellum tinged with fulvous with a deeper fulvous mark within the lateral angles, the margin with five white spots. Elytra with strong nervures and recticulations, the latter forming a longitudinal median vitta in the anteapical areoles; apex infuscated with the extreme edge white as far as the outer areole; costa crossed by about ten oblique veinlets; the white areolar spots distinct. Beneath and legs varied with pale and fuscous; the disk of the pleural pieces and base of the venter infuscated. The female is paler but with all the markings indicated.

Described from one female and two males from Prof. Herbert Osborn and taken at Los Amates, Guatemala, January 17th and February 28th, 1905, by Prof. J. S. Hine. This can be confused with no species but *brevis* from which it may be

distinguished by its larger size, broader form, shorter and more rounded vertex, the brown vittæ in the anteapical areoles, the longer male pygofers, and the angle on the margin of the last ventral segment of the female. It has somewhat the aspect of *scriptus* but is very distinct in having a much shorter vertex, in the form of the last ventral segment of the male and in the more angled valve.

23. **Platymetopius brevis** Van Duzee.

Bul. Buf. Soc. Nat. Sci. viii, No. 5, p. 66, 1907.

This tiny species is very close to *osborni* but it averages a little smaller, the vertex is a little more angled, the transverse vitta is crowded close to the anterior margin of the vertex and consists of a pale cloud against each ocellus which may be obscurely connected to a pale basal mark either side of the middle. The anterior edge is white and calloused and is nearly or quite twice interrupted on either side forming five conspicuous white marginal spots. The general colors in this species are pale, largely obliterating the white areolar spots on the elytra. It has been found only on the island of Jamaica, unless a series from California in the Ball collection belong here.

24. **Platymetopius fuscifrons** Van Duzee.

Bul. Buf. Soc. Nat. Sci. v., p. 206, 1894.
Platymetopius abruptus Ball, Ent. News, xx., p. 165, 1909.

This is very distinct from any other known dark-faced species by the short transverse male plates and the short truncated last ventral segment of the female. In the male the front is almost black; the vertex is a little more than right-angled at apex and is obscurely marked, with the white apical line distinct. The male is deeply colored as in *frontalis* while the female seems to be paler than the female of that species, but in both sexes the white areolar spots are well developed. I have been unable to detect any characters by which to distinguish *abruptus*, the type of which Dr. Ball has kindly sent me for examination, from *fuscifrons*. This species inhabits Arizona and California.

25. **Platymetopius modestus** Stal.

Of. Vet.-Akad. Forh., xi, p. 255, 1854.

This species has not been recognized by later students and from the short description I am unable to place it in my synoptical table. I append a copy of Stal's description:

"Vertice thoraceque flavis, illo apicem versus concavo, longitudinaliter anguste nigrolineato, hoc basi virescente; hemelytris dilute virescentibus, nervis flavescentibus, margine costali albido-subhyalino; subtus dilute flavotestaceus. Long. 8, lat. 2 millim.—American, septentrionalis."

26. **Platymetopius tenuifrons** Baker.

Can. Ent. xxxii, p. 50, 1900.

The type of this species was received too late for its inclusion in the synoptical table. It belongs to the group of brown-faced species and really comes nearest to *verecundus* from which it differs at once by its much larger size and the still longer vertex. It has somewhat the aspect of the female *oregonensis* but the vertex is longer, broader, and more rounded at tip. The elytral reticulations and areolar spots are finer but distinct; the general color is more cinereous than fulvous; the front is fuscous-brown irrorated with paler and becomes darker or almost piceous at the pointed base below the short but distinct and acutely angled white line, and the lower surface of the body is varied with pale and brown. The last ventral segment of the male is about as long as the third and is broadly subangularly excavated; valve rather short and broadly rounded; plates broad-triangular and shorter than the valve. The pale pronotal vittæ are obvious but not conspicuous and the vertex is blackened on the immediate apex with a white point at tip and a pale marginal mark on either side and another half way to the eye. The unique male type was taken in November at Chapada, Brazil.

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