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On the dimorphism of the males of *Maevia vittata*, a Jumping Spider.

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With 1 Figure in the text.

The Jumping Spider, *Maevia vittata*, is the only species of Araneina which exhibits a distinct dimorphism in the males.¹⁾ As is well known to Arachnologists, the males of this species are of two types, one variety being gray much like the female, and the other variety being pitch-black with three tufts of hairs on the anterior part of the cephalothorax; see Fig. A 5 and A 1. The first type I have called the "gray variety" and the second, the "tufted variety". Although it is stated by the PECKHAMS that the gray males never have tufts, in books upon spiders, it is often said that the two types merge into one another.

The Author has recently completed a study of the spermatogenesis of the two types of males (article in publication), and several points of difference were found between them, particularly,

1) The PECKHAMS (1889a) mention one other species of *Attidae*, *Zygoballus bettini*, in which the males fall into two classes. One class consists of very large males while the second class is made up of small individuals. From their description, I judge that the males are otherwise alike.

with regard to the presence of a pair of small chromosomes in the gray males, and the absence of these bodies in these tufted males. On this cytological basis, an attempt was made to explain the dimorphism. If intermediate forms exist, however, as stated by EMERTON, "Common Spiders", p. 60, then the explanation would have to be modified.

The present study was made in order to determine the exact nature of the dimorphism and the particulars in which the so called "Intermediate forms" differ from the typical males of both types. Two other points were investigated. First, the ratio of the females to males, in nature, and the ratio of the gray to tufted males. Second, observations have been made on the dancing of the two types, it being stated by the PECKHAMS (1889a) that the two varieties of males behave differently in this regard.

As far as I can determine, *Maevia vittata* was first described by HENTZ, in 1845, under the name of *Attus vittatus*, the gray male, and *Attus niger*, the tufted male. He assigns them, thus, to different species. C. KOCH, in his work entitled, "Die Arachniden", describes the gray male as *Plexippus undatus*, and the tufted male as *Maevia penicillata*. He assigns the two species to different genera.

The PECKHAMS (1889b), were the first to assign the two forms to the same species, *Astia vittata*. They remark that we have here males, "presenting two distinct varieties; the first has the thoracic part of the cephalothorax light brown, . . .; the second variety (*niger*), has the cephalothorax black, . . ." etc. Farther on, "Intermediate between these two varieties, is one which is nearly as dark as *niger* with pale legs but without cephalic tufts. . . . As this is an extremely common species, we have compared large numbers of them but have never found the tufts present in the first variety, which most resembles the female." "Attidae of North America", p. 70.

The dimorphic males have been described by many other authors, EMERTON (1891), SIMON (1903), etc.

My material has all been collected in a plot of woods near New Haven, by the usual method of sweeping the grass and low bushes with a net. An area, of perhaps two acres, was swept repeatedly, in this way, during the late afternoon. This is the best time for collecting, as far as the experience of the Author goes. Altogether, 156 specimens have been obtained, of which

82 were females and 74 males. Of the males, 40 were of the gray variety and 34 were tufted. Two very dark, so called, "Intermediate males" were obtained. The males were studied while alive and after preservation.

In the following study, it seems desirable to give a general description, with drawings, of a typical tufted male and a typical gray male, and then to point out the variations found in the two types. For minute characteristics of the species, etc., the reader is referred to the PECKHAM'S "Revision of the Attidae of North America".

Tufted Male.

The typical tufted male (Fig. A1), has a body which is an intense black in color. The legs are a light transparent yellow and they do not show any dark pigmentation, except just a trifle on the ventral surface of the coxa and at the tip end. The palps, seen from the front, are pitch-black, but on the inner surface, the pigmentation is less intense and we may even find yellow hairs next to the mandibles. This lighter color never, or very rarely, shows from the front with the appendages in their normal position. The most striking characteristic of the tufted male, however, is the presence of three tufts of hairs, which sit on the cephalothorax, just on a line with the anterior edge of the posterior eyes (Fig. A1). It should be pointed out here, that normally, these tuft soft hairs do not show from above because of the intense black of the anterior part of the cephalothorax. In the drawings, I have not put in the pigment of this region, in order that the character of the tufts might be more easily seen. In Fig. A1, the position of the tufts may be clearly made out; they project from the body at an angle of, perhaps, 45° .

To the casual observer, the tufted males are quite black, but if one is examined under a strong light, a definite pattern will be made out both on the cephalothorax and on the abdomen. This pattern becomes more apparent in alcoholic specimens (Fig. A1).

Gray Male.

The gray males (Fig. A5) are similar to the tufted males in size and shape. They are, as the name implies, of a general gray color, with a fairly definite pattern on the cephalothorax and abdomen, made up of spots which vary from a dark red to a deep

brown or black. The legs are a pale opaque white; on the ventral surface there are characteristic bands of pigment (Fig. A10), seen from above, the leg has a mottled appearance because of patches of pigment which lie at the base of the hairs (Fig. A9). The palps,

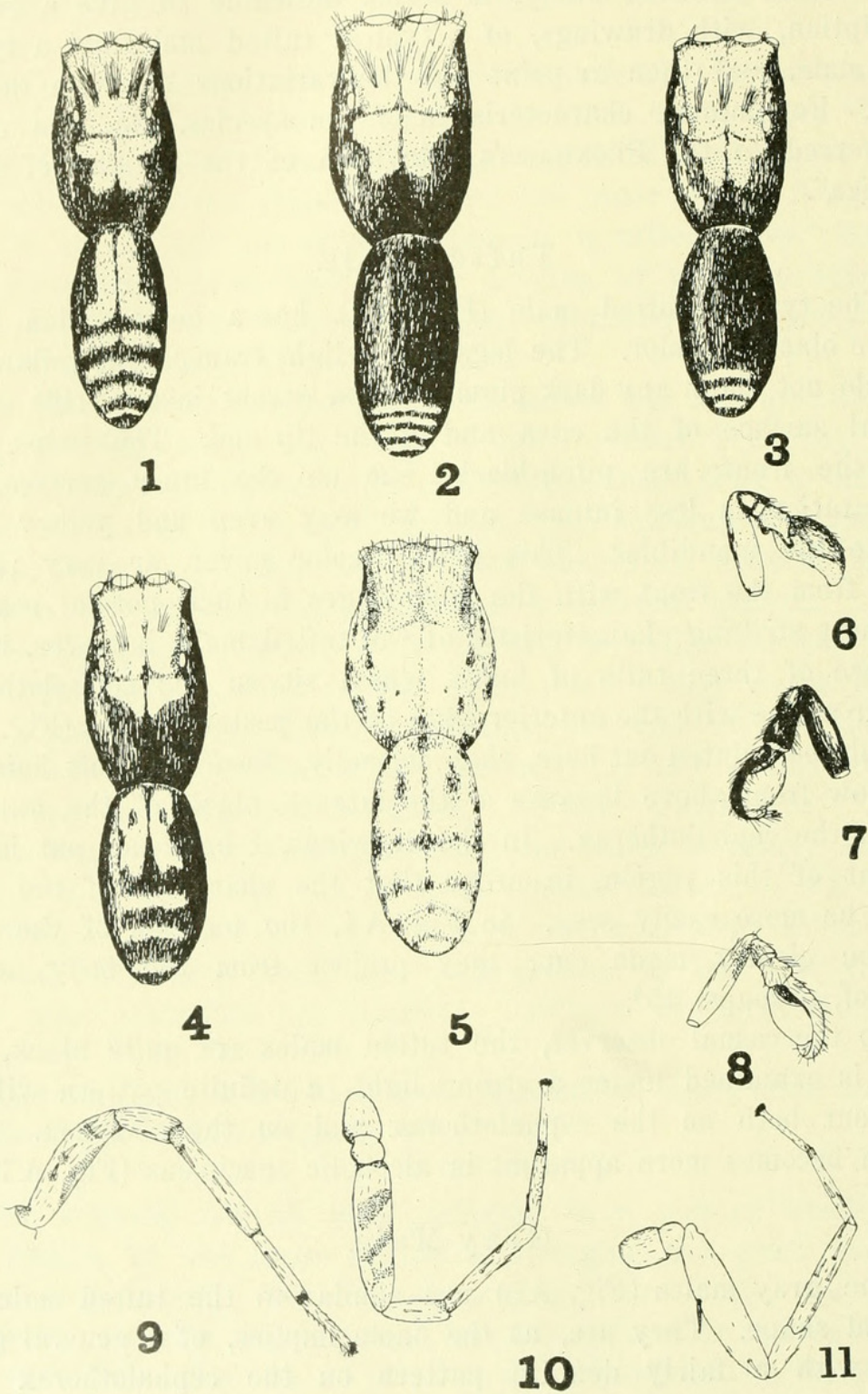


Fig. A.

seen from the front, are a bright orange color; on the inner side, next to the mandibles, there may be small patches of pigment, as shown in Fig. A 8.

As will be seen by the above description, the typical tufted male differs from the typical gray male in the following characteristics; body color, color and pigmentation of the legs, color of palps and in the possession of three tufts of hairs on the cephalothorax. A glance at Fig. A 1 and A 5 will make it clear that the patterns on the cephalothorax and abdomen are essentially similar. In studying the variations found in 54 specimens, the above order of discussion will be followed.

Body Color.

Tufted Males. The males of this type show a good deal of variation in the intensity of the body color. The black always predominates but in some of the specimens, which have been examined alive, the pattern on the abdomen was almost as conspicuous as in the typical gray male.

Gray Males. In the gray males there is a tremendous amount of variation in the general body color. It varies from a very light gray, through a brown to a black, which is almost as intense as that of the typical tufted male. In the case of the two "Intermediate males", the abdomens were quite black except for a few lighter spots lying on the edge of the dorsal side.

Color of Legs.

Tufted Males. The typical appearance of the leg of the tufted male, is shown in Fig. A 11. The general color is a light lemon yellow and no pigment is seen except on the coxa and at the tip end of the tarsus, as pointed out above. No variations from this was found in any of the 34 tufted males examined.

Gray Males. The typical leg of the gray male, in dorsal and ventral view, is shown in Fig. A 9 and A 10. The general color is a pale white and on the ventral side, especially of the femur, there are very definite and characteristic bands of pigment. The degree of pigmentation is subject to some variation in the individual cases but in none of the 40 gray males examined was the pigment ever absent. The legs of the very dark gray males were heavily pigmented.

Palps.

Tufted Males. The color of the palps, seen from the front, is an intense black in all of the cases examined. On the inner side, particularly at the base of the joints of the appendage, yellow hairs may be present. In one case, a trifle of this lighter color was seen from the front.

Gray Males. The palps of the gray males are a bright orange color. This was found to be invariably true, even for the very dark males. On the inner side there is a small amount of pigment on the basal joints (Fig. A 8).

Tufts of Hairs.

Tufted Males. The tufts of hairs, so characteristic for the males of this class, show some variation in the degree of development, but the position of these tufts is fixed and subject to slight or no variations. The degree of development of the individual tufts of hairs varied, though in most cases all three tufts were fully developed. Fig. A 1 shows a typical case, and Fig. A 2, A 3 and A 4 show variations in this condition. It should be mentioned here that in sweeping and in handling the specimens, the tufts of hairs are apt to be rubbed off. In making an examination of all the specimens, a strong arc-light was used as the source of illumination and then by means of a fairly high power lens on the microscope and tilting the specimen, I was able to see the sockets where the hairs normally sit. In cases where the hairs had been rubbed off, it was possible to still see the sockets and usually the broken stubs of the hairs. In no case of the 34 males examined, were the tufts entirely absent.

Gray Males. Out of the 40 males studied, not one of them showed any indication of the tufts of hairs such as are characteristic of the tufted males. The very dark males were like the typical gray males in this regard.

General Pilosity of Cephalothorax.

The general pilosity of all the specimens was carefully noted in order to determine if the tufted males exhibited this character to any marked degree. Altogether, 74 males and 82 females were examined with regard to this point. A good deal of variation was found in individual specimens, but the tufted males, except for the

three tufts of hairs, are normal in this respect. In most of the cases, the fine hairs on the cephalothorax of the tufted males were black while the same hairs were white on the gray male, but many exceptions were noted.

Patterns.

As pointed out above, the patterns on the abdomens of the two types of males is essentially the same. Much variation was noted for both the tufted (Fig. A 2, A 3 and A 4) and gray males. It is a well known fact that the patterns on the abdomens of spiders normally vary within wide limits, so that the variations noted for *Maevia vittata* are not significant.

It is evident from the above description, that the body colors of the two types of males are not distinct and that, in this character, the two varieties merge into one another, although typically, the two are very different.

In the color and pigmentation of the legs, the tufted and gray males are very different and I have found no form which bridged the gap. The coloration of the palps forms another character which would separate the two types. But it is the presence of the tufts of hairs in the tufted male and their absence in the gray male which forms the most striking and absolute distinction.

It is evident, then, that the tufted males and the gray males of *Maevia vittata* form two varieties which are distinct in the three characteristics given above and that there are no intermediate forms which would bridge the gap between the two. The so called "Intermediate Males" are nothing more than very dark gray males.

Practically nothing definite is known about the ratio of the males to females, in nature, in the species *Maevia vittata*, nor of the ratio of the two varieties of males to each other. The PECKHAMS (1909) are the only authors who mention the subject. On p. 453, they say: "In Wisconsin, the males (both forms) mature about the middle of June, the females a little later. For this month, they are common, there being about one female for three males, but towards the middle of July their number diminishes."

In my study on the spermatogenesis of this species, I have given certain cytological evidence which would lead us to suppose that the total number of males would be equal to the total number

of females. Furthermore, that the tufted males would be equally as numerous as the gray males.

During the past season (*Maevia* matures the latter part of May, here at New Haven), I have collected 156 specimens from the same area of land, and, that the theoretical expectations are fulfilled, is shown below.

Females	82
Tufted Males	34
Gray Males	40

Ratio of males to females; 82:74, which closely approximates the theoretical, 1:1.

Ratio of tufted males to gray males; 34:40, which also is close to the theoretical, 1:1.

Although the PECKHAMS state that the *Maevia vittata* is a very common form, the Author has found that they are very erratic in their distribution. It has often been noted, that, while specimens may be caught in one section of woods, they will be entirely absent from another tract of land, near by, which presents, as far as one is able to judge, just the same conditions for life.

Dancing of the Tufted and Gray Males.

Observations were made on the dancing habits of the two varieties of males while the Author was making matings, in order to test certain conclusions arrived at in the cytological study. I have had in the laboratory 9 gray males and 7 tufted specimens. These have been put with females, from time to time, and their behavior carefully noted.

The dancing of the male Jumping Spiders has been thoroughly described by the PECKHAMS (1889a and 1890). I quote from the former paper: "A description of the two males is unnecessary, since they are well represented in tab. 11. The two forms grade into each other, excepting that the three tufts of hairs are only found on the fully developed *niger* form. The *vittata* form, which is quite like the female, when he approaches her, raises his first legs either so as to point them forward or upward, keeping the palpi stiffly outstretched, while the tip of the abdomen is bent to the ground. This position he commonly takes when three or four inches away. While he retains this attitude, he keeps curving and waving his legs in

a curious manner. Frequently, he raises only one of the legs of the first pair, running all the while from side to side. As he draws nearer to the female he lowers his body to the ground, and, dropping his legs also, places the two anterior pairs so that the tips touch in front, the proximal joints being turned almost at right angles to the body (fig. 26). Now he glides in a semicircle before the female, sometimes advancing, sometimes receding, until at last she accepts his addresses. The *niger* form, evidently a later development, is much the more lively of the two, and wherever the two varieties were seen to compete for the same female, the black one was successful. He is bolder in his manners, and we have never seen him assume the prone position, as the red form did, when close to the female. He always held one or both of the first legs high in the air, waving them wildly to and fro, or, when the female became excited, he stood perfectly motionless before her, sometimes for a whole minute, seeming to fascinate her by the power of his glance." p. 33—34, Sexual Select. in Spiders (1889).

I have given this description of the PECKHAMS in full because it is the best account of the dancing which we have in the literature. My own observations on the tufted males are in entire accord with the PECKHAMS' account, except, that among my specimens, I did not notice that the tufted males were more aggressive in their attentions to the females than were the gray males. With regard to the dancing of the gray males, the behavior of the nine specimens, which I have had under constant observation for two weeks, is so different from the account given by the PECKHAMS that I cannot help but think that some mistake has been made by them in recording their observations. In all of my specimens, the prone position is the first to be assumed by the male when he recognizes the female. Then comes the raising of the front legs and the dancing, as described above. The only exception to this were cases where the female got quite close to the male before he recognized her. Then, the prone position was not assumed, but the anterior pair of legs were raised in the air and the dance proceeded as described.

The present study has made it clear that the two types of males are distinct as regards three characters and the method of their love dance. The very interesting question arises, what has been the origin of the tufted form since it is evidently, as the PECKHAMS have pointed out, a later development than the gray

males.¹⁾ There are two possible interpretations, the one being that the tufted male has arisen through sexual selection, the interpretation taken by the PECKHAMS, and the other is that this later form has arisen as a mutation.

It seems worth while to bring up the subject here, as there are certain observations which, it seems to me, totally eliminates the origin of the tufted males by sexual selection. It has often been observed in the laboratory, both by Professor PETRUNKEVITCH and by myself, that the females do not seem to show any preference for the tufted males and the same female has been observed to copulate with a tufted and a gray male within a period of five minutes. Furthermore, the species is very widely distributed throughout the United States. The PECKHAMS (1909), remark: "This is a very common species. Mr. BANKS has found it in Colorado, Mr. EMERTON in Massachusetts and Connecticut, and we have it from Georgia, Missouri, Wisconsin, Nebraska and Kansas" (p. 453).

It seems that if sexual selection were at work here, that it has had sufficient time to make the gray males very rare. As has been shown, they are equally as numerous as the tufted males. It might be mentioned here that the tufts do not seem to play any part in the mating of this variety with the females. Two of my matings have been made with tufted males, one of which had lost all three tufts, and the other specimen only had the right one left.

The other alternative, that this later form has arisen through a sudden discontinuous variation, seems the more satisfactory. The Author has suggested the cause of this dimorphism from a cytological study. It was found that the gray males carried a pair of small chromosomes, called "ctetosomes" because of their behavior, while the tufted males lacked these bodies. Furthermore, from a comparative study with species of twelve other families of spiders, it seemed probable that these ctetosomes were to be derived from a Y-chromosome, the primitive Arachnida having the XY condition in the male sex and the XX condition in the female. It was suggested that when the Y-chromosome became associated with the X or accessory chromosome, a condition we seem to have at the present

1) The reason for this, is, that among Jumping spiders, generally, the males are very much like the females before the latter have become mature. That the gray males of *Maevia vittata* are like the immature females, has been known for a long time and it would show that the former was an older type than the tufted male.

time in the gray male, that the males, which as a result of this association, lacked the Y-element, became the tufted males. From my study, it seems that this is really the condition of the tufted male.

It is a pleasure to express my thanks to Prof. PETRUNKEVITCH for the courtesy of his laboratory, in which the present work was carried on.

Submitted for publication,
July, 1913.

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Painter, Theophilus S . 1913. "On the dimorphism of the males of *Maevia vittata*, a Jumping Spider." *Zoologische Jahrbücher* 35, 625–636.

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