

THE ORB-WEAVER GENUS *MECYNOGEA*, THE SUBFAMILY METINAE AND THE GENERA *PACHYGNATHA*, *GLENOGNATHA* AND *AZILIA* OF THE SUBFAMILY TETRAGNATHINAE NORTH OF MEXICO (ARANEAE: ARANEIDAE)

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ABSTRACT. Several genera are described and illustrated, webs are pictured when known, and distributions are plotted. These genera include: *Mecynogea* with one species, *Nephila* with one, *Leucauge* with two, *Metellina* with three, *Meta* with two species (one of them new, from California caves, similar to a Mediterranean cave *Meta*), the new genus *Metleucauge* with one new North American species (others in eastern Asia), *Pachygnatha* with eight species, *Glenognatha* with two and *Azilia* with one North American species.

On the basis of numerous characters, it appears that Metinae is the primitive group, with the greatest number of plesiomorph characters, Tetragnathinae are specialized in one direction, Araneinae in another. Because of the numerous intermediate genera, it is best to combine the family Tetragnathidae with Araneidae, but to consider the group a subfamily.

INTRODUCTION

Hope of learning about the relationships among orb-weavers was the reason for combining revisions of diverse orb-weavers in this paper. The only genera of the Tetragnathinae not included here are *Dolichognatha* and the large genus *Tetragnatha*. No surprising discoveries were made, but evidence was provided in support of the classification of 19th century arachnologists.

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RELATIONSHIPS

One of the purposes of this revision was to learn about the relationships of *Meta* and *Tetragnatha*. It was for this reason that *Meta* and *Pachygnatha* and their relatives were revised together. *Mecynogea* was first thought close to *Meta*. It is clear now that it belongs to the Araneinae.

The characters that were chosen for studying relationships are the following (Table 1):

1. *Eye placement.* In *Meta* the median eyes are within their diameter of each other and about two diameters at most from the laterals. The laterals touch each other. This condition is found in *Meta* (Fig. 112), *Pachygnatha* (Figs. 163, 165) and also in *Zygiella* (revised previously) and various small-sized Araneinae, as well as in Linyphiidae and Theridiidae. It is believed the primitive condition of Araneoidea. The lateral eyes have further separated from the medians in many specialized Araneidae, e.g. *Araneus diadematus* and female *Nephila* (Fig. 34).

The lateral eyes are rarely separated. Separated lateral eyes are characteristic of *Azilia* (Fig. 294, 300) and *Tetragnatha* (and some genera not found in the north temperate region). It is possible that this is the ancestral condition, since uloborids and many other families have lateral eyes separate.

2. *Eye structure.* The canoe tapetum is characteristic of the Araneoidea. It is found in *Meta* and relatives, *Zygiella*, *Nephila* and in the lateral eyes of *Pachygnatha*.

In Araneidae there are two differences.

First, in all genera close to *Araneus* (that is, in most nearctic genera previously revised), the canoe tapetum of the posterior median eyes has shrunk, and the rhabdoms are arranged in looping rows toward the median (of the spider) (Fig. 11). In *Argiope* this condition is also found in the lateral eyes. Secondly, in the posterior eyes of *Pachygnatha* the tapetum has disappeared, and the eye is filled with looping rows of rhabdoms (Figs. 157, 161) which may resemble a maze (Fig. 159). In *Azilia* and *Tetragnatha* the tapetum has been lost in all secondary eyes, and in *Azilia* the rhabdoms are arranged in neat rows which turn at their ends (Figs. 299, 300). This is without doubt an improvement in eye structure (Homann, 1971), as it is accompanied by larger optic centers in the brain. But it is strange that a twilight and cave spider, *Azilia*, has lost the tapetum. *Glenognatha emertoni* has eyes like those of *Pachygnatha* with no canoe tapetum in the posterior median eyes; but here the cells in the rows of rhabdoms have a tapetum (Fig. 262).

The shrunk tapetum is found in that group of spiders with complicated palpi (see below) having many palpal sclerites. The tapetum is absent in those spiders in which the few palpal sclerites present have become modified. Therefore, it is believed that evolution went in two different directions from the more generalized *Meta* eyes.

3. *Trichobothria.* It is characteristic of the superfamily Araneoidea to have few leg trichobothria, and one diagnostic feature is the lack of trichobothria on tarsi where their presence might interfere with touching and measuring silk strands. In general there are trichobothria only on the dorsum and sides of tibiae, and usually there is one on the proximal half of the metatarsus (some Linyphiidae have more elaborate patterns of trichobothria). Specialized trichobothria are found on the third tibia of *Mangora*; they are very long, feathered and of unknown function. Also the fourth femur of *Leucauge* has

very fine, long trichobothria of unknown function (Figs. 50, 51). *Leucauge*, *Pachygnatha*, *Glenognatha* and *Tetragnatha* have several trichobothria dorsally at the proximal end of the femur, which is perhaps a specialization. Perhaps the presence of femoral trichobothria in Uloboridae indicates a hitherto unexplored relationship with *Tetragnatha*. In some adult *Pachygnatha*, spiders that make no webs, the trichobothrium has moved to the distal end of the metatarsus, a unique change.

4. *Male palpi*. The simplest palpi in Araneoidea are found in some theridiids (Levi, 1961) and in *Metellina* and *Leucauge*. The *Metellina* and *Leucauge* palpus has only a (spherical) tegulum with subtegulum and basal hematodocha, and bearing on the distal end an embolus held by the conductor (E, C in Fig. 59). The only specialized structure in the *Metellina* palpus is the elaborate paracymbium (P in Fig. 124).

The palpus has become specialized in two different ways: 1) Some species have acquired numerous sclerites. This is foreshadowed in *Metleucauge* (Fig. 149). However in *Araneus* and most relatives the bulb twists in such a way that the sclerites move from the tip of the bulb to the side facing the median. Also the folded hematodocha and tegulum face laterally (Figs. 13, 14). These modifications are characteristic of the relatives of *Araneus*; I do not know of any other group of spiders in which they are seen. *Zygiella* is intermediate: the tegulum has moved laterally, the embolus is still distal in both *Z. x-notata* and *Z. thorelli*. 2) In other genera the cymbium shrinks, the paracymbium becomes a separate sclerite, and embolus and conductor become more complicated structurally. This palpus is found in *Pachygnatha* (Fig. 177) and *Tetragnatha*.

5. *Female genitalia*. In *Meta* and *Metellina* the openings into the seminal receptacles are so close to the genital groove that the duct into the seminal re-

ceptacles may also be the fertilization duct. Wiehle (1967) described this and called it the semientelegyne condition. I am not certain this is correct; there might be two openings with adjacent ducts (Figs. 116, 120). In other Araneoidea, the two ducts (connecting and fertilization) always originate (or end) together on the seminal receptacles; when they are very short it may be difficult to tell whether one or two ducts are present. Again, there are two specializations: 1) The seminal receptacles move anteriorly, the epigynal openings may still only be slits on the posterior face of the base of the epigynum (e.g. *Araneus diadematus*, *Eriophora*). Characteristic of this group, related to *Araneus*, is the annulate scape. The scape is not always present but has been lost in heavily sclerotized species (e.g. *Mastophora*, *Gasteracantha*, Levi, 1978c); it is also absent in *Mecynogaea* (Fig. 1). It is of interest that some species of *Zygiella* have a scape. (These species belong to *Zygiella* due to the canoe-shaped eye tapetum and to a ventral apophysis or modifications of the tegulum of the palpus, the latter a unique synapomorphy found in most members of the genus.) 2) The second direction is the (perhaps) secondary loss of the epigynum. In *Pachygnatha* the anterior ventral cover of the epigynum grows posteriorly over the posterior ventral cuticle and forms two chambers: a posterior chamber whose dorsal wall is the ventral cuticle which retains the same setae pattern inside the chamber as outside (Figs. 182, 194). And there is an anterior chamber with the seminal receptacles on each side at the posterior edge. There appears to be a connecting duct from the posterior chamber into the seminal receptacles and a fertilization duct from the receptacles to the anterior chamber. The anterior chamber appears open in the middle toward the posterior one. This looks surprisingly similar to the *Meta* sections made and structures shown by Wiehle (1967, fig. 31). Of course this might be considered primitive. Further evidence

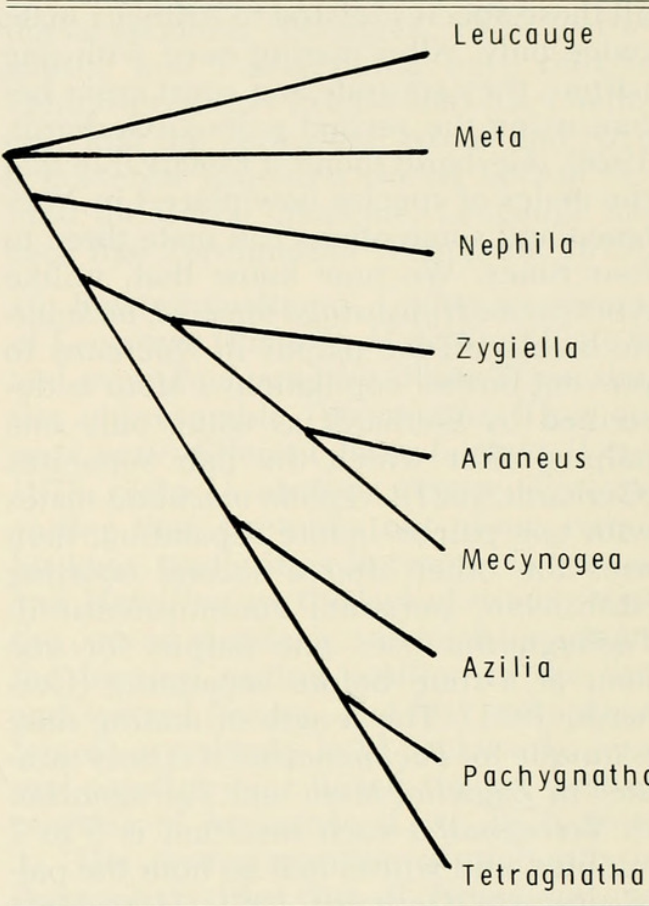
TABLE 1. CHARACTER STATES OF 11 GENERA: + PRESENT AND BELIEVED SPECIALIZED (APOMORPH); - NOT PRESENT AND BELIEVED PRIMITIVE (PLESIOMORPH); ± PRESENT IN SOME SPECIES. Abbreviations. L, left; LE, lateral eyes; M, median apophysis; PME, posterior median eyes; R, right; SR, seminal receptacles.

Presumed derived character state	Metellina								
	Araneus	Mecynogea	Zygiella	Nephila	Leucauge	Metleucauge	Pachygnatha	Azilina	Tetragnatha
1a lateral eyes distant from medians	±	-	-	+ in ♀	-	-	-	-	±
b lateral eyes separated	-	-	-	-	-	-	-	+	±
2a PME without canoe tapetum	-	-	-	-	-	-	+	+	+
b LE without canoe tapetum	-	-	-	-	-	-	-	+	+
c specialized canoe in PME	+	+	-	-	-	-	-	-	-
3 short trichobothria on femur	-	-	-	-	+	-	+	-	+
4a ♂ palpi with M	+	?	±	-	-	-	-	-	-
b large paracymbium	-	-	+	-	-	+	+	-	+
c paracymbium separate	-	-	-	-	-	-	+	-	+
d sclerites face mesally	+	+	±	-	-	-	-	-	-
e dissected cymbium	-	-	-	-	-	-	+	-	+
5a epigynum absent	-	-	-	-	-	-	+	-	+
b SR not sclerotized	-	-	-	-	+	-	-	+	-
c scape present	+	-	±	-	-	-	-	-	-
6 mating spiders do not separate between R and L palp use	-	?	-	?	?	-	+	?	+
7 clypeus low	+	+	+	+	+	+	-	+	+
8 ♂ chelicerae large, used in mating	-	-	-	-	-	±	+	-	+
9 ♂ coxal hook, 1st or 2nd leg modified for mating	+	-	-	-	-	-	-	-	-
10 ♂ endite with lateral tooth	+	-	-	-	-	-	-	-	-
11 labium wide	+	+	+	-	+	+	+	+	+
12a endites distally wide	-	-	-	-	-	±	+	+	+
b endites square	+	+	+	-	-	-	-	-	-
13 orb-web without open hub	+	+	+	+	-	-	-	+	-

TABLE 1. CONTINUED.

Presumed derived character state	Metellina Meta Metleu- cauge									
	Araneus	Mecynogea	Zygiella	Nephila	Leucauge	Metleucauge	Pachygnatha	Azilia	Tetragnatha	
14a tetraganathid silk measuring b araneid silk measuring	- +	- +	- ?	with 4th leg with 4th leg	+ -	+ -	- 0	+ -	+ -	
15 bulky ventral cecae	+ +	? +	+ +	?	- -	+ +	- -	? -	- -	
16 femora stretched when resting	- -	- -	- -	+	+ +	+ +	+ +	? -	+ -	

TABLE 2. CLADOGRAM OBTAINED BY WAGNER TREE ANALYSIS OF THE DATA IN TABLE 1 USING THE COMPUTER PROGRAM "WAGNER 78" DEVELOPED BY J. S. FARRIS (A LATER VERSION OF FARRIS, 1970). ALL CHARACTERS ARE WEIGHED EQUALLY (MINUSES AVOIDED, NO ZERO, PLUSES ARBITRARILY 2'S, VARIABLE CHARACTERS AS INTERMEDIATE 1'S). PREPARED BY M. STOWE.



that the loss of the epigynum is secondary is the presence of an epigynum in the related *Azilia* (Fig. 291) and *Dolichognatha* and the fact that in copulation only one male palpus is used at a time. In *Meta* and spiders with epigynum, palpi are alternated; in haplogyne spiders two palpi are used simultaneously (Gerhardt, 1921).

6. *Mating behavior.* The diversity of reproductive organs suggests investigating mating behavior. Male spiders of the haplogyne families use the two palpi simultaneously: the male's left palpus enters the right side of the genital opening, the right palpus enters the left side when the spiders mate facing each other. If tetraganathids are really haplogyne, one would expect a similar copulation. This how-

ever is not the case. Male theridiid and linyphiid spiders mate by alternating left and right palpi. The left is introduced in the left side of the epigynum, the right into the right side (Gerhardt, 1921). Gerhardt describes the copulatory behavior of various araneid genera. *Argiope* and all those species related to *Araneus* mate twice only. After mating once with one palpus, they separate and court again before using the second palpus (Gerhardt, 1926). (Gerhardt found it remarkable that the males of species now placed in *Nuctenea* and some others can mate three to four times. We now know that, unlike *Araneus* or *Hypsosinga* species, no sclerite breaks off the palpus in *Nuctenea* to prevent further copulations.) *Meta* is described by Gerhardt as using only one palpus, after which the pair separates (Gerhardt, 1927). *Nephila maculata* mates with one palpus before separating, then uses the other after a second courting (Robinson, personal communication). *Pachygnatha* uses one palpus for one hour at a time before separating (Gerhardt, 1921). The length of mating time is unique for *Pachygnatha*; it is only minutes in *Zygiella*, *Meta* and *Tetragnatha*. In *Tetragnatha* each insertion is 5 to 7 minutes, and within half an hour the palpi alternate (Gerhardt, 1921). Here *Meta* and *Araneus* species share a behavior which is perhaps primitive and closer to that of haplogynes, while tetragnathids eventually alternate palpi, approaching the perhaps more specialized behavior of theridiids and linyphiids. Unlike *Araneus* but like haplogynes, *Tetragnatha* in sperm induction use both palpi together (Gerhardt, 1927).

7. *Clypeus*. The clypeus is high (more than twice the diameter of the anterior median eyes) in most Araneoidea. The clypeus is low in *Metellina* and *Leucauge* (Figs. 47, 72), and in most relatives of *Araneus* (but not all, e.g. *Kaira*, *Scoloderus*). The clypeus is high in *Pachygnatha* (Fig. 162). Is this high clypeus secondary (as perhaps in *Scoloderus*) or

is it a primitive condition? The high clypeus of *Kaira* and *Scoloderus* certainly does not indicate relationship with *Pachygnatha*.

8. *Chelicerae*. Chelicerae of *Metellina* and *Leucauge* (Figs. 54, 72) are like those of other Araneoidea, but probably weaker and more generalized than those of *Araneus*, and possess only a slight proximal boss. *Araneus* relatives have a proximal boss, as do the enlarged chelicerae of *Pachygnatha*.

The enlarged chelicerae of the adult, especially adult males, are characteristic of *Tetragnatha*, *Pachygnatha* (Figs. 163, 166) and *Dolichognatha*, but not of *Azilia*. The large chelicerae couple when the animals mate. Enlarged chelicerae are also found in *Metellina curtisi* males (Fig. 73). The enlarged male chelicerae are a specialization. They are most modified in *Pachygnatha* and *Tetragnatha*.

9. *Legs*. In contrast, in *Araneus* and many related genera the sexes couple with legs. The first coxae of males have a hook that fits into a slit on the second femur. The legs of males are frequently modified in other ways, but not in the genera described in this paper. I believe the modifications of coxae and legs to be specializations, synapomorphies of the genera close to *Araneus*. (However, *Azilia* males have stronger macrosetae on legs than females.)

10. *Endite tooth*. An unusual modification found in males of *Araneus* and related genera (not in any of the genera considered here) is the lateral tooth on the endite (gnathocoxa), facing a tooth at the proximal end of the palpal femur. I consider the endite tooth and the one on the palpal femur synapomorphies of the *Araneus* group of genera.

11. *Labium*. The labium is longer than wide in most haplogyne spiders, probably a primitive condition. A long labium is found in *Nephila* (Fig. 24); in all other genera of Araneidae and Tetragnathinae examined, the labium is wider than long.

12. *Endites*. Endites (gnathocoxae) of haplogynes are usually longer than wide, perhaps a primitive condition. Of course most mygalomorph spiders do not have pedipalpal coxae with endites. *Meta* have long endites which I believe to be the primitive type (Fig. 121). Endite form also appears to have specialized in two different directions. In *Leucauge* (Fig. 53), *Metleucauge* (Fig. 144), *Pachygnatha* (Fig. 153) and *Tetragnatha* the endite is distally wider than proximally, a synapomorphic state. Perhaps the long endites evolved with the elongated chelicerae. The endite of *Araneus* and relatives is as wide as long, very heavy (Fig. 6; Levi, 1968, fig. 65), a specialization in another direction. The *Nephila* endite is heavy, widest near the tip of the labium (Fig. 24). The long endites of *Metepeira* are unusual for a genus otherwise close to *Araneus*.

13. *Orb-webs*. Studies of araneoid orb-webs have been of surprisingly little help in providing data for phylogenetic studies (Levi, 1978a, 1978b). Apparently, araneoid webs, the design of which is important in determining the kinds of prey captured, have undergone frequent and diverse evolutionary changes as a result of strong competition for prey (Levi, 1978b). Adult *Pachygnatha* species have no webs; close relatives in *Glenognatha* do. *Tetragnatha* and all *Meta* relatives have a loose web with an open hub, perhaps a synplesiomorph condition. The web of *Nephila* is believed specialized (Plate 2) and is quite different from that of the related *Nephilengys* (M. Robinson, pers. comm.). The *Mecynogaea* web is specialized: a dome that lacks viscid silk (Plate 1); and that of *Zygiella* lacks viscid silk in an upper sector of an orb. The webs of relatives of *Araneus* exhibit great diversity (Levi, 1978b).

14. *Silk handling*. An interesting character was recently found by Eberhard (in manuscript): species related to *Meta* and *Tetragnatha* measure webs one way;

most species, all related to *Araneus*, measure another way; and *Nephila* measures with the fourth leg.

15. *Ceca*. The ventral intestinal ceca run only to the coxae of legs in *Araneus*, *Zygiella* and *Meta*. These genera have one bladder-like cecum in front of the dorsal apodeme (Palmgren, 1978). *Tetragnatha* and *Pachygnatha* have bulkier ventral ceca that extend into the chelicerae and the pedipalpal coxae, and have a posterior unpaired dorsal cecum behind the dorsal apodeme. *Leucauge* has ceca like *Tetragnatha* (Palmgren, 1979).

16. *Resting position*. Living specimens of *Leucauge* (Plate 3), *Metellina* (Plate 6) and even *Pachygnatha* (Plate 7) are similar and resemble *Tetragnatha*. They appear very different from *Larinia* (Levi, 1975, plate 1), another narrow, elongate spider that stretches out along twigs. Striking similarities between *Leucauge* and *Metellina* are the lack of strong setae, the curved metatarsi, and most important, the forward resting position of the first and second femora. The first and second femora are always held backwards, femoral-patellar joint flexed, in the resting position of Araneinae (Levi, 1975, plate 1). The resting position of uloborids in the web is like that of *Leucauge* and *Meta*.

Holding the anterior legs pulled in, in the Araneinae, may be the primitive condition, as it is the more widespread posture in the Araneoidea; projecting femora would represent a specialized posture. Since the pulled-in legs permit only small clearance between the leg articles for the lateral eyes to function, the lateral eyes touch each other. The great distance of the lateral eyes from medians in many Araneinae is no doubt an adaptation to this resting position, making it easier for the laterals to function. The separation of the lateral eyes in *Azilia* and many Tetragnathinae is made possible by the resting position: the anterior legs stretch forward, leaving the eyes a larger clearance in which to function.

17. *Silk glands.* Kovoov (1972) wrote that *Araneus* and *Argiope* have two kinds of aciniform silk glands, *Meta* and *Zygiella* [Zilla, sic] only one kind. Aciniform glands produce silk used in wrapping prey.

In summary, it appears that those genera close to *Meta* have most characters considered primitive (Table 1). Those of *Tetragnatha* and *Pachygnatha* are specialized in one direction, while those close to *Araneus* are specialized in another. This differs from previous conclusions regarding Tetragnathidae as the most primitive group.

CLASSIFICATION

One easy and fashionable solution to these phylogenetic problems is to declare that each one of the genera or groups of genera (Table 1) differs from the others and has to be placed in its own family. Unfortunately, this is not a useful method to solve the problems of relationship, and I prefer instead to place all in the family Araneidae (perhaps the other extreme). The family Araneidae can then be split into three subfamilies. But this division is not so clear-cut as that of families should be. The oldest name of the included family group name has to be used for each of these three taxa: Araneinae, Metinae, Tetragnathinae. Although Thorell (1869) and Simon (1894) discussed similar problems, more genera are now known and better understood than were known to them. Although closer to *Araneus* than to *Meta*, the following genera seem to be distinct: *Mangora*, *Argiope*, *Mecynogea* and *Cyrtophora*. *Nephila*, which is closer to *Meta* than to *Araneus*, may belong to a special group of the Metinae. This will be followed up in future research.

Subfamily Araneinae

Diagnosis. Secondary eyes with canoe tapetum, posterior median eyes with the canoe narrow and looping rhabdom

rows toward the median of the spider (Fig. 11). Lateral eyes often some distance from medians. [*Cyclosa* is an exception to this eye morphology, but the eye description (Homann, 1971) may be in error.] Palpus with sclerites moved to median surface of bulb, the folded hematochoa and tegulum facing laterally (Figs. 13, 14). Paracymbium a small hook at cymbium base. The epigynum often has an annular scape. Males mate with one palpus at a time, the pair separating between copulations. Complete absence of trichobothria on femora. Chelicerae very strong with proximal boss. Endites short and square. Males often with hook on coxa one and with first or second legs modified to hold female when mating. In resting position first and second femora are directed posteriorly, the femoral-patellar joint flexed.

Comment. There are several genera which may be nuclei of subgroups: 1) *Gea* and *Argiope*; 2) *Mangora*; and 3) *Mecynogea* and *Cyrtophora*.

Subfamily Metinae

Diagnosis. Secondary eyes with canoe tapetum (Figs. 48, 49). Lateral eyes always close to medians (except in *Nephila*). Palpus usually very simple with embolus held by conductor, a spherical tegulum and subtegulum, other sclerites usually absent (Figs. 58, 59). Paracymbium often elaborate but attached to cymbium (Fig. 124). Epigynum very simple; fertilization ducts may be absent. Males mate with one palpus at a time, separating from female before using second. Endites long. Webs with open hub (Plates 4, 5, 6). Resting position with first and second femora extended forward (Plates 3, 6).

Comment. Kaston (1948) mentions lack of grooves on the sclerites above the book-lungs. I am not certain whether this is always so.

Zygiella is best placed with the Metinae, even though some species have a scape in the epigynum. The unique teg-

ulum of the male palpus of most species is evidence that those species with and without scape belong together. Also intermediate is the lateral position of the tegulum in the palpus. The embolus and conductor however are distal, not mesal. The leg resting position of *Zygiella* is like that of the Araneinae.

Nephila may belong in a separate subgroup or subfamily.

Subfamily Tetragnathinae

Diagnosis. Canoe tapetum lost in at least posterior median eyes (Figs. 157, 161, 300), usually lost in all secondary eyes (Fig. 299); rhabdoms arrange themselves in looping rows. Palpus similar to that of Metinae but cymbium reduced, and paracymbium usually a free sclerite (Fig. 177) (not in *Azilia*). Epigynum very simple or secondarily lost. After using one palpus repeatedly, the mating male alternates to use the other palpus. Endites long (Figs. 153, 257, 298). Trichobothria on base of femora (not in *Azilia*). Male chelicerae usually large, engaged with those of female when mating. Webs usually with open hub (not *Azilia*). The resting spider has the femora extended forward.

Comments. The genera *Pachygnatha*, *Azilia*, *Mimognatha*, *Glenognatha*, *Dolichognatha* and *Tetragnatha* belong here, but *Azilia* appears close to *Leucauge*.

RELATIONSHIP TO OTHER FAMILIES

The genera of Theridiidae closest to Araneidae are *Enoplognatha* and *Robertus* (and perhaps *Steatoda*). Both are closest to the Metinae because the bulb has not turned, as in Araneinae, and the cymbium is not modified, as in Tetragnathinae. The paracymbium is on the lateral edge of the cymbium, but not at the base. Both have a colulus. In other theridiids the paracymbium is a hook on the upper edge of the alveolus of the cymbium behind the bulb. Other genera

also lack a colulus. Unlike *Meta*, the genera *Enoplognatha*, *Robertus* and *Steatoda* have diverse sclerites, radix and median apophysis in the palpus.

At the time I studied the Theridiidae, I presented a series from *Theridula* to *Enoplognatha* (Levi, 1961) showing the origin of various sclerites from the simple palpus, including the origin of the paracymbium from a hook behind the bulb (Levi, 1961, fig. 6). All the spiders with the simplest palpi lacked a colulus. I thought that the colulus, found in all other Araneoidea, was perhaps not a primitive structure at all, as postulated, and not a homolog of the cribellum. Evidence from Glatz (1973) indicates that the muscles of the cribellum do in fact correspond with those of the colulus even though *Uroctea*, closely related to *Oecobius* (Oecobiidae), lacks a colulus while *Oecobius* has a cribellum. Adult male uloborids may lack a cribellum as well as a colulus. Could neoteny explain the apparent paradox that the species with the simplest palpi lack this structure?

Characteristically all theridiids, with rare exceptions, have each chelicera drawn out proximally to a point hidden by the often transparent clypeus (Levi and Levi, 1962, figs. 9–21). This point, a place of muscle attachment, is missing in *Meta*, *Araneus* and *Linyphia* (Levi and Levi, 1962, figs. 23–28) and in the specialized theridiid chelicerae of *Dipoena* and *Euryopsis* used for ant predation. But the drawn-out chelicerae are also present in some other araneoid families such as Mysmenidae and Nesticidae, and in the elongated chelicerae of *Mimetus* (Mimetidae). Only rarely do we see indications of this drawn-out chelicera in the Araneidae (Fig. 251). Although the proximally truncate chelicerae are a good distinguishing character of the Araneidae, they are also found in Linyphiidae.

While nesticid and mimetid palpi can be derived from a *Meta*-like palpus, so can the very simple palpus of the large linyphiid *Pimoa*. If the complicated

palpi of various araneoid families can be derived from a *Meta* and *Leucauge*-like palpus, might the ancestors of other araneoid families perhaps have made orb-webs, and might not the orb perhaps be the primitive web, the linyphiid and theridiid web specialized? The other as yet unsolved question is the relationship between the Araneoidea and the uloborids, which, like tetragnathids (but not other Araneoidea), also have trichobothria on the fourth femur and rest with the first two femora stretched forward.

METHODS OF STUDY

Examination Dish. To avoid unnecessary transfers of spider parts from a dish containing sand or from a dish with depressions in black paraffin (the first has disturbing reflections, the second insufficient light to see outlines), a new dish was made. A stender dish (inside diameter 50 mm, height 17 mm) with a ground glass cover was partly filled on one side with white paraffin available from grocery stores and on the other side with black paraffin, available from biological supply houses. To start, black paraffin was poured into the dish temporarily divided by cardboard. After a few minutes of cooling, the white was poured in on the other side and the cardboard removed. While still soft, various size depressions were made into paraffin to support spiders.

Measurements. Total length measurements of *Pachygnatha* were made, without the chelicerae, measuring from clypeus to posterior tip of the abdomen. About 10 specimens of each sex from different localities were measured to obtain total length. While going through the available collections, measurements of noticeably larger and smaller specimens were also recorded. Often, smaller and larger specimens were found throughout the range of the species. If there were geographic size differences, these were noted.

Genitalia. The female genital area of *Pachygnatha* was cut off, the tissue around the genital structure removed with sharpened needles, and the exposed genitalia submerged in clove oil for clearing and examination. Examination was done optimally when only partly cleared. After the clove oil was removed by washing in alcohol, the genital area was mounted from alcohol on a microscope slide into Hoyer's medium and examined in a Leitz-made Smith interference microscope.

Eyes. The eyes were examined in reflected light for tapetum, then cut off. The tissue behind was carefully teased away while placed above a light background, until the pigment outlining the rhabdoms became visible. This was done under a dissecting microscope. The illustrations are diagrammatic and composite, showing the tapetum in reflected light, the rows of rhabdoms in transmitted light. The left posterior median eyes are illustrated looking down vertically into the eye. The right posterior median is illustrated at its normal angle to the left eye (Fig. 300). The left lateral eyes are illustrated looking vertically into the eyes, as if both were facing the same direction.

Neotypes of Names. Article 75 of the International Code of Zoological Nomenclature (1961) restricts the use of neotype designation "only in connection with revisions in exceptional circumstances when a neotype is necessary in the interest of stability of nomenclature." Because of the confusion in the application of names in the genus *Pachygnatha*, neotypes were designated for two species in accordance with qualifying conditions of Article 75.

Tracheae. The tracheae of *Pachygnatha* and *Glenognatha* were examined by mounting the spiders on a microscope slide after most internal organs were teased away (some with venter, some with dorsum facing up). They were not boiled in sodium hydroxide since these tracheae are only lightly sclerotized.

Araneinae Latreille, 1806

Mecynogea Simon

Hentzia McCook, 1894, American Spiders, 3: 244.

Type species by monotypy *Epeira basilica* McCook. Name preoccupied by *Hentzia* Marx, 1883.

Mecynogea Simon, 1903, Ann. Soc. Entom. Belgique, 47: 25. Type species designated by Petrunkevitch, 1928, Trans. Connecticut Acad. Sci., 29: 135, *M. bigibba* Simon, 1903, from Brazil. The name is feminine.

Allepeira Banks, 1932, Publ. Oklahoma Biol. Surv., 4: 23. New name to replace *Hentzia* McCook, preoccupied.

Diagnosis. *Mecynogea* differs from the related tropical *Cyrtophora* in the closely grouped eyes (Figs. 5, 8), in the more slender legs (Figs. 5, 7, 12) and in the shape of the abdomen whose sides are always more or less parallel (Figs. 5, 6). *Mecynogea* differs from most other araneid genera in the close spacing of the eyes, in the elongated abdomen, and in the slender, almost linyphiid-like legs with macrosetae. It differs from *Leucauge* and *Mangora* in its lack of the long trichobothria.

Coloration. Carapace light in most species, with lateral black longitudinal bands on thorax and a median longitudinal black line (Fig. 5). Abdomen with white or silver bands and black marks on dorsum and sides (Fig. 5). Venter dark, usually with a pair of longitudinal white or silver bands which may be broken (Fig. 6).

Structure. Carapace highest in head region with a shallow, indistinct thoracic depression, very narrow in front (Fig. 5). Height of clypeus less than diameter of anterior median eyes (Fig. 8). Eyes subequal in size, anterior median eyes sometimes slightly larger than others, especially in males; anterior lateral eyes sometimes slightly smaller. Eyes closely grouped, anterior median eyes their diameter apart, less than their diameter from laterals (Figs. 5, 8). Posterior median eyes their diameter or slightly more apart, the same distance from laterals. Posterior median eyes with characteristic narrow canoe tapetum and loops of rhab-

doms as in species related to *Araneus* (Fig. 11). Chelicerae strong, endites almost as wide as long (Fig. 6). Legs slender, with long macrosetae, but no long trichobothria (Figs. 5, 7, 12). First leg longest, third shortest, second and fourth subequal in length, second leg of male being slightly longer than fourth. Abdomen almost three times as long as wide, sometimes with anteriodorsal humps, and with rounded posterior overhanging spinnerets (Figs. 5–7), widest anterior of middle (Fig. 5), at a slight angle to prosoma (Fig. 7). Males only slightly smaller than females. No leg articles modified (Fig. 12).

Genitalia. Female epigynum always has a projecting hood with a depression posteriorly containing the openings (Figs. 1–4). There is no scape. The seminal receptacles appear to be two dumbbell-like structures grown together (Fig. 3).

Femur of male palpus without proximal tooth (present in most Araneinae), and the endite lacks the facing tooth. Palpal patella with only one macroseta (Figs. 12, 14). The palpal structures (Fig. 15) are difficult to homologize with those of other araneids; they appear close to those of *Cyrtophora* and *Leucauge*. The homologies of Exline (1948) are almost certainly in error. *Mecynogea lemniscata* has a conductor (C in Fig. 15) and, unlike *Cyrtophora* species examined, there is no median apophysis. The filamentous embolus (E) is held by a structure which is probably not a terminal apophysis as thought by Exline (1948). This embolus is surprisingly similar to that of *Leucauge venusta*. Separated above the tegulum (T) at the base of the part which forms the embolus is a sclerotized loop, perhaps the radix. The filiform embolus of *Cyrtophora moluccensis* is also supported over part of its length by a basal outgrowth, and the palpus also has a sclerotized plate which is the radix. There is another lobe of uncertain homology above the embolus (Fig. 15).

Species. All species examined are very similar, but differ in structure of the

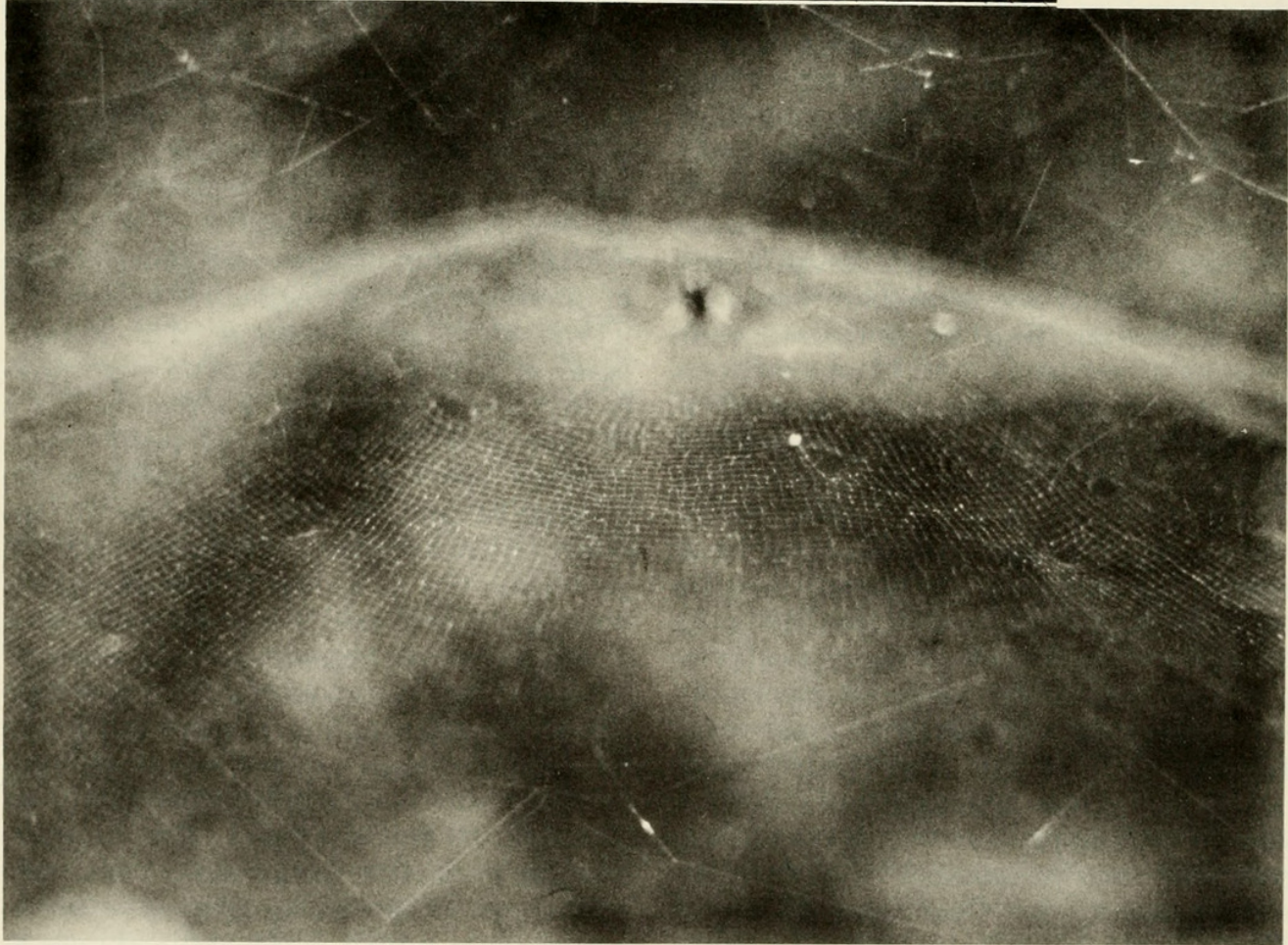
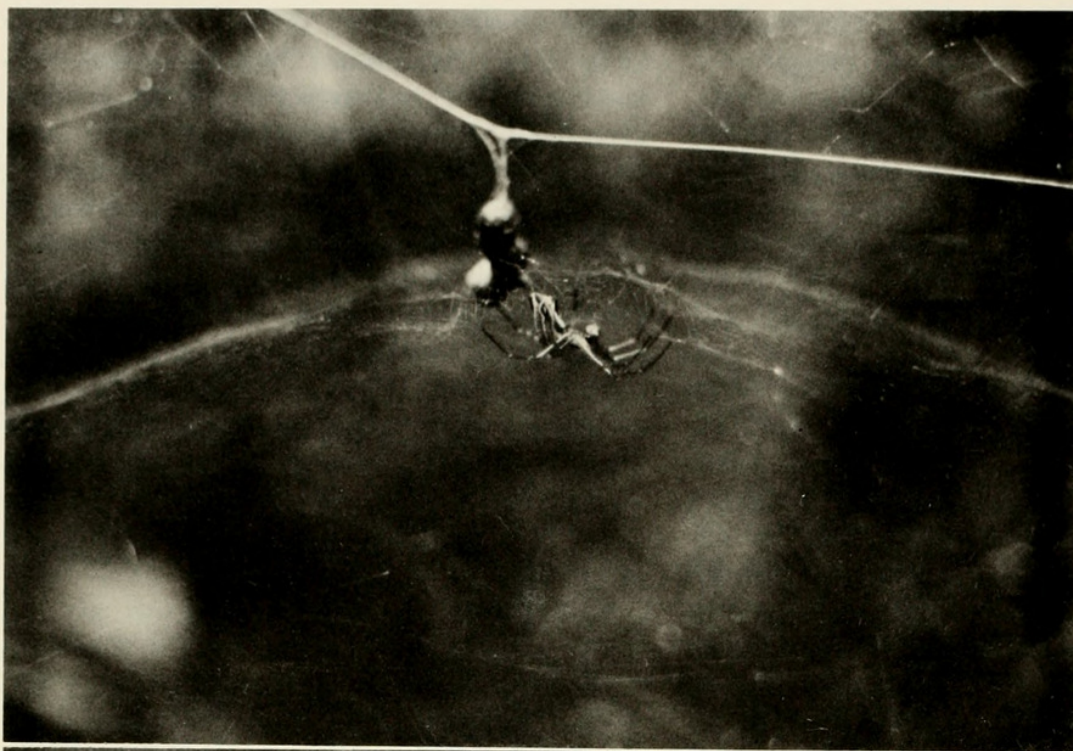
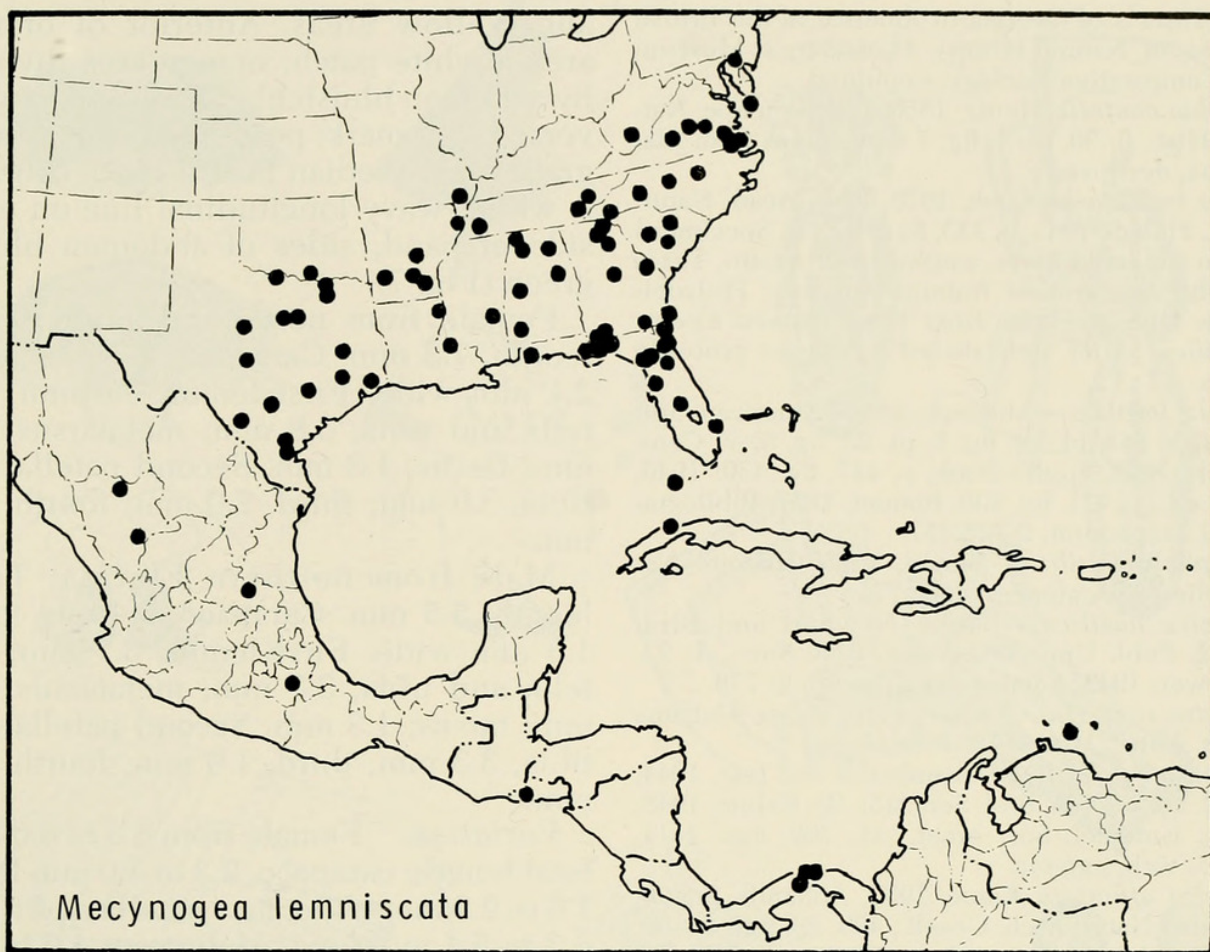


Plate 1. *Mecynogea lemniscata* (Walckenaer), above, female under web with three egg-sacs above; below, detail of web showing very small mesh. Web with dew.



Map 1. Distribution of *Mecynogea lemniscata* (Walckenaer).

genitalia and in the shape of the egg-sac. There may be half a dozen to a dozen species, all American, described in various genera. Most species are tropical or south temperate.

Natural History. *Mecynogea* makes webs like *Cyrtophora* (Plate 1) but no *Mecynogea* species are known to be colonial. The web is a small-mesh horizontal dome, lacking sticky silk. It has a barrier web above and below (Plate 1 and Exline, 1948).

Relationship. The canoe tapetum in the posterior median eyes and the looping rows of rhabdoms (Fig. 11) place *Mecynogea* in the Araneinae. Only *Cyrtophora* has a similar web, and the genitalia of *Cyrtophora* and *Mecynogea* can be derived from a common ancestor. The two genera are not close to each other however, although there is one species [*M. guianensis* (Keyserling)] (= *Cyrtoph-*

ora grammica Simon) which has intermediate genitalia. *Mecynogea* is not close to *Araneus* and other Araneinae. The palpal parts can at present not be readily homologized with those of palpi of the *Araneus* group. There is a resemblance of *Mecynogea* with *Mangora*: the shape of the abdomen and its angle to the prosoma, the many erect macrosetae on the legs (Fig. 7) and the narrow head. Whether this is superficial or an indication of relationship is not presently known. We will know more about the relationship after the tropical American *Cyrtophora* and *Mangora* have been studied.

***Mecynogea lemniscata* (Walckenaer)**
Plate 1; Figures 1–15; Map 1

Linyphia lemniscata Walckenaer, 1841, Histoire Naturelle des Insectes Aptères, 2: 263. Name for illustration fig. 25, J. Abbot, 1792. Drawings of

the Insects of Georgia in America in the British Museum, Natural History. Photocopy at Museum of Comparative Zoology, examined.

Linyphia conferta Hentz, 1850, J. Boston Soc. Natur. Hist., 6: 30, pl. 4, fig. 7. Specimens from Alabama, destroyed.

Epeira basilica McCook, 1878, Proc. Acad. Natur. Sci., Philadelphia, p. 133, figs. 1–3, ♀. Specimens from Colorado River, southwest of Austin, Texas in the Academy of Natural Sciences, Philadelphia. One specimen from Texas marked *Epeira basilica* found and labeled by me as probable type.

Hentzia basilica:—McCook, 1893, American Spiders, 3: 244, pl. 14, fig. 2, pl. 23, fig. 8, ♀. Comstock, 1913, Spider Book, p. 417, fig. 430; 1940, rev. ed., p. 431, fig. 430. Bonnet, 1957, Bibliographia Araneorum, 2(3): 2157.

Cyrtophora basilica:—Simon, 1895, Histoire Naturelle des Araignées, 1(4): 771.

Allepeira basilica:—Banks, Newport and Bird, 1932, Publ. Univ. Oklahoma, Biol. Surv., 4: 23. Roewer, 1942, Katalog der Araneae, 2: 778.

Allepeira conferta:—Archer, 1940, Paper Alabama Mus. Natur. Hist., 14: 24.

Allepeira lemniscata:—Chamberlin and Ivie, 1944, Bull. Univ. Utah, Biol. Ser., 8(5): 93. Exline, 1948, Ann. Entomol. Soc. Amer., 41: 309, figs. 1–14, ♀, ♂, web, egg-sac.

Allepeira affinitata Kraus, 1955, Abhandl. Senckenberg. Naturforsch. Gesell., 493: 26, figs. 54–56, ♀, ♂. Male holotype from El Salvador in the Senckenberg Museum, Frankfurt, examined. NEW SYNONYMY.

Note. I follow here Exline (1948), who is the first revisor, in using Walckenaer's name *lemniscata*. The use of any other name for this species, although perhaps applied with more certainty, would not help the name stability. Abbot described the web of the spider, on the page facing the illustration, named by Walckenaer.

An old fashioned, unnecessarily detailed description of this species is found in Exline (1948).

Description. Living specimens. Legs, carapace, sternum greenish. Three longitudinal black bands on carapace (Fig. 5); sternum black on each side (Fig. 6). Femora with indistinct dark longitudinal lines. Median dorsal abdominal band laterally framed by a red line enclosing or-

ange-yellow areas. Anterior of orange area a white patch; orange area divided by a median bluish black line and a transverse black mark; posteriorly orange area grades into median bluish black (Fig. 5). A white, wavy longitudinal line on each side of band; sides of abdomen bluish green (Fig. 7).

Female from northern Florida. Total length, 7.2 mm. Carapace, 2.7 mm long, 2.1 mm wide. First femur, 3.6 mm; patella and tibia, 3.8 mm; metatarsus, 3.2 mm; tarsus, 1.3 mm. Second patella and tibia, 3.0 mm; third, 2.0 mm; fourth, 3.2 mm.

Male from northern Florida. Total length, 5.5 mm. Carapace, 2.4 mm long, 1.8 mm wide. First femur, 3.7 mm; patella and tibia, 3.7 mm; metatarsus, 3.6 mm; tarsus, 1.3 mm. Second patella and tibia, 3.3 mm; third, 1.9 mm; fourth, 3.0 mm.

Variation. Female from 6.3 to 8.6 mm total length; carapace, 2.3 to 4.0 mm long, 1.6 to 2.9 mm wide; first patella and tibia, 3.3 to 5.4 mm long. Male from 4.0 to 6.6 mm total length; carapace 1.9 to 3.5 mm long, 1.4 to 2.4 mm wide; first patella and tibia, 3.2 to 5.5 mm long. The smallest specimens came from the northernmost localities, Delaware and Virginia; the largest from the Gulf Coast, Mexico to Panama and Cuba.

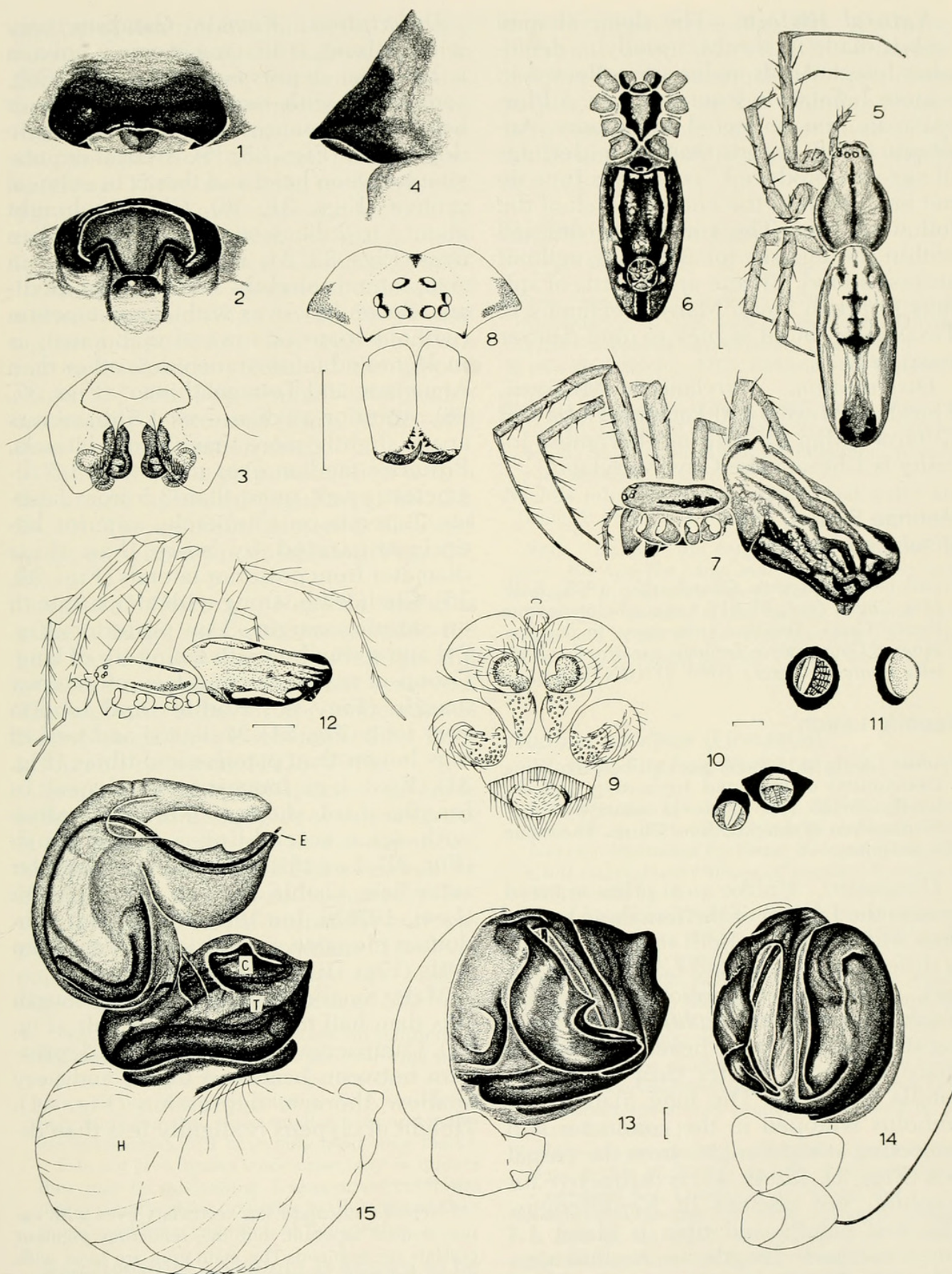
Diagnosis. Female. *Mecynogea lemniscata* lack bands on legs and have only some indistinct longitudinal lines on the femora; they differ from other species in the shape of the depression in the epigynum in posterior view (Figs. 2, 3); the male differs from other species in the shape of the sclerite, which holds the embolus filament and is visible in mesal view (Fig. 13).

→

Figures 1–15. *Mecynogea lemniscata* (Walckenaer). 1–11. Female. 1–4. Epigynum. 1. Ventral. 2. Posterior. 3. Posterior, cleared. 4. Lateral. 5. Dorsal. 6. Ventral. 7. Lateral. 8. Eye area and chelicerae. 9. Spinnerets. 10. Left lateral eyes. 11. Posterior median eyes. 12–15. Male. 12. Lateral. 13–15. Left palpus. 13. Mesal. 14. Ventral. 15. Mesal, expanded.

Scale lines. 0.1 mm; except Figures 5–8, 12, 1.0 mm.

Abbreviations. C, conductor; E, embolus; H, hematodocha; T, tegulum.



Natural History. The dome-shaped web is made in shrubs, usually in deciduous forest. Adult males are collected in various habitats in June and July. A Florida male was collected in January. Anderson (1978) reports that the spiderlings of egg-sacs produced "as early as June do not emerge until the end of March of the following year. The young are confined within the egg-sac for 290 days without access to food." There are records of spiders in urban areas. Many specimens in Texas were found as prey in mud-dauber wasp nests.

Distribution. Maryland to Missouri, Florida to Mexico and Panama, Cuba and Curaçao (Map 1). The northernmost locality is Chesapeake City, Maryland.

Metinae Simon, 1894

Misplaced species

Pseudometa biologica Chamberlin, 1925. Bull. Mus. Comp. Zool., 67: 217. Female holotype from Pacific Grove, Hopkins Laboratory, in the Museum of Comparative Zoology, examined, = *Zygella x-notata* (Clerck). NEW SYNONYMY.

Nephila Leach

Nephila Leach, 1815, Zoological Miscellany; being Descriptions of New and Interesting Animals, London, 2: 133. Type species by monotypy *Nephila maculata* (Fabricius) from China. The name is feminine.

Diagnosis. Unlike most other araneid genera the labium of the female is longer than wide (Fig. 24). Both sexes of *Nephila* differ from the related *Leucauge* in the lack of femoral trichobothria. Female *Nephila* differ from *Nephilengys* in lacking strong setae on the head; also the carapace length is shorter than the fourth patella and tibia. The long filamentous embolus wrapped in the conductor and projecting at right angles from the palpal axis (Figs. 21, 22, 42, 43) is distinctive for *Nephila*, not present in *Nephilengys*. The first patella and tibia is about 1.4 times carapace length, in *Nephilengys* only 1.2. The first tarsus is about 1.7 times patella and tibia length, that of *Nephilengys* only 1.2.

Description. Female. Carapace very wide in front, with a transverse groove as a thoracic depression (Figs. 33, 36), sometimes with two horns in posterior head region anterior to the thoracic depression (Figs. 35, 36). An oval depression between head and thorax in cervical groove (Figs. 31, 36). Clypeus height about 1 to 2 diameters of anterior median eyes (Figs. 23, 34, 35). Eyes subequal in size, laterals slightly smaller than medians. Secondary eyes with canoe tapetum (without loops or rows of rhabdoms), as in *Meta* and most Araneoidea, other than Araneinae and Tetragnathinae* (Figs. 37, 38). Anterior median eyes 1.5 diameters apart, slightly more than 3 from laterals. Posterior median eyes more than 1.5 diameters apart, more than 3.5 from laterals. Laterals on a tubercle, anterior laterals separated by more than their diameter from posterior laterals (Figs. 33, 36). Chelicerae strong with about 3 teeth on anterior margin, 3 on posterior (Fig. 24) and a smaller tooth facing tip of fang. Group of setae covering face of anterior margin (Fig. 34). Endites and labium very long (Fig. 24). Metatarsi and tarsi of legs longer than patellae and tibiae (Fig. 31). First legs longest, second next in length, third shortest. Metatarsi often with setae resembling a bottle brush (Fig. 31). Leg tips have the sustentacular setae less visible than in other genera (Levi, 1978b), but they are present. Abdomen elongate, cylindrical, longer than wide (Figs. 19, 20, 31, 32, 41).

Male. Smaller than female, total length less than half total length of female (Fig. 41). Carapace with some shallow depression between head and thorax and very shallow thoracic depression (Fig. 41). Height of clypeus is slightly less than di-

* *Nephila maculata* has secondary eyes with canoe-shaped tapetum, but the reflecting pigment crystals are reduced. The main eyes are large with many rhabdoms, the secondary eyes small with few. The eyes are not like those of *Araneus*, but like those of *Meta* (Homann, by correspondence, October, 1979).

anterior median eyes. Anterior median eyes slightly the largest, less than their diameter apart, the same distance from laterals. Posterior median eyes their diameter apart, 1.6 diameters from laterals. Anterior and posterior lateral eyes touching. There are no leg modifications; the trochanters may appear notched. In several species studied, the males come in various size classes (Gerhardt, 1929).

Genitalia. The epigynum consists of a transverse fold (Figs. 16–18, 28–30) and a groove in posterior view with the opening on each side ventral in the groove (Figs. 18, 30). The seminal receptacles are heavily sclerotized (Figs. 16, 28) and there is a fertilization duct.

The duct of the palpus is coiled within the almost spherical tegulum (Figs. 22, 25, 43). The embolus filament is held and wrapped within the conductor (Figs. 25, 26).

Natural History. *Nephila* females make a large web with many radii, the hub located above center (Plate 2), and with the temporary spiral not removed. The web and behavior of *N. maculata* of New Guinea have been studied by Robinson and Robinson (1973, 1976).

Species. Perhaps 20 species of *Nephila* are found in the tropics of various parts of the world, only one in the Americas, *N. clavipes*. They have been revised by Dahl (1912), the African species by Benoit (1962, 1964). Unfortunately, both papers lack essential illustrations. The long paper by Dahl is of limited use and is out-of-date (freely translated, p. 80):

"In order to facilitate species recognition by the amateur, I proceeded on the following principles: 1) the species are grouped by their occurrence in our [German] colonies; 2) I considered only large females, since smaller ones and males are overlooked; 3) I have only used color marks.

I do not give figures since especially in spiders they may be misleading. Unimportant color and marks usually show up better in illustrations than those used for recognition of the species."

Relationship. *Nephila* is known to be close to *Nephilengys*. Although quite similar in structure, *Nephilengys* makes a more conservative orb-web, more like

that of other Araneidae (M. Robinson, personal communication). *Leucauge*, judging by the unusual structure of the palpus, the base of the embolus located between tegulum and cymbium (Figs. 25, 26 and 58, 59), is also close to *Nephila*.

Nephila maculata Fabricius Figures 16–22

Aranea maculata Fabricius, 1793, Entomologia Systematica, 2: 425. [Not *A. maculata*, Olivier, 1789 = *Steatoda albomaculata* (De Geer).]

A. pilipes Fabricius, 1793, Entomologia Systematica, 2: 425.

Nephila maculata:—Leach, 1815, Zool. Misc., 2: 134, pl. 110. Dahl, 1912, Mitt. Zool. Mus., Berlin, 6: 35, 52. Bonnet, 1958, Bibliographia Araneorum, 2: 3074.

Nephila pilipes:—Roewer, 1942, Katalog der Araneae, 1: 929.

Note. Despite the original homonymy of the name, the specific name *maculata* has been used in almost all literature except Roewer.

The type species of the genus is found from China and India to the southwestern Pacific Islands. It is common in New Guinea and the Philippines.

Nephila clavipes (Linnaeus) Plate 2; Figures 23–43; Map 2

Aranea clavipes Linnaeus, 1767, Systema Naturae, 12th ed., p. 1034. Name given to specimens from Jamaica illustrated by Patrik Browne, 1756, *The Civil and Natural History of Jamaica*, London, p. 419, pl. 44, fig. 4.

Aranea longimana Fabricius, 1781, Species Insectorum, Hamburg et Kilonii, 1. Aran. p. 536. Specimens from Cayenne.

Nephila plumipes:—C. L. Koch, 1839, *Die Arachniden*, 6: 138, pl. 529. Not *N. plumipes* (Latreille).

Nephila wilderi McCook, 1893, American Spiders, 3: 251, pl. 7, figs. 1, 2, pl. 23, figs. 6, 7, ♀, ♂. Syntypes from southern Atlantic and Gulf coasts to southern California and West Indies, lost. [The California specimens probably belonged to the Marx collection.]

Nephila wistariana McCook, 1893, American Spiders, 3: 252, pl. 23, figs. 2, 3, ♀, ♂. Syntypes from Caribbean Sea, Louisiana and Texas, lost.

Nephila concolor McCook, 1893, American Spiders, 3: 256, pl. 23, fig. 1, ♀. Female from southern California, erroneous G. Marx locality, lost.

Nephila clavipes:—McCook, 1893, American Spiders, 3: 255, pl. 24, fig. 1, ♀. F. P.-Cambridge, 1901, Ann. Mag. Natur. Hist. (ser. 7), 7: 325, pl. 7, figs. 1–4, ♀, ♂; 1904, Biologia Centrali-Amer-

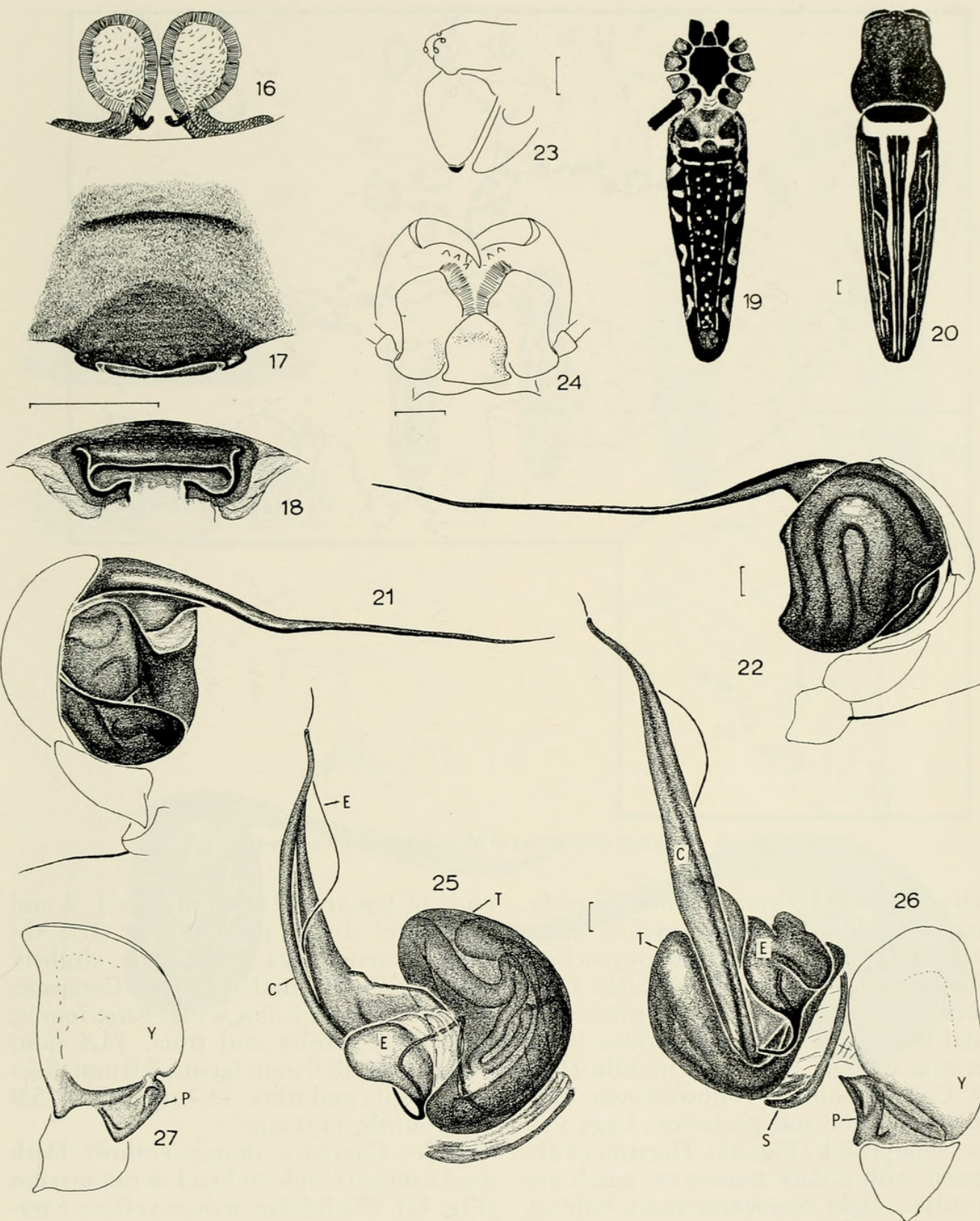


Plate 2. *Nephila clavipes* (Linn.) web. Web dusted with cornstarch.

icana, *Araneidea*, 2: 448, pl. 42, figs. 23, 24, ♀. Dahl, 1912, *Mitt. Zool. Mus. Berlin*, 6(1): 46, 73, 75, ♀. Comstock, 1912, *The Spider Book*, p. 426, figs. 437-441, ♀, ♂, web. Petrunkevitch, 1930, *Trans. Connecticut Acad. Sci.*, 30: 247, figs. 101, 102, ♀, ♂. Comstock, 1940, *The Spider Book*, p. 440, figs. 437-441, ♀, ♂, web. Roewer, 1942, *Katalog der Araneae*, 1: 932. Bonnet, 1958, *Bibliographia Araneorum*, 2: 3068. Archer, 1958, *Amer. Mus. Novitates*, no. 1958: 2, figs. 1, 2, ♀, ♂.

Wiehle, 1967, *Senckenbergia Biol.*, 48: 194, fig. 49, ♀.

Nephila thomensis Benoit, 1963, *Entom. Mitt., Zool. Staatsinst. Zool. Mus. Hamburg*, 2(41): 5, figs. 1-3, ♀. Female holotype and paratypes from São Tomé, Africa, 28.III.1898, in the Zoologisches Staatsinstitut und Zoologisches Museum, Hamburg, paratype examined. NEW SYNONYMY.

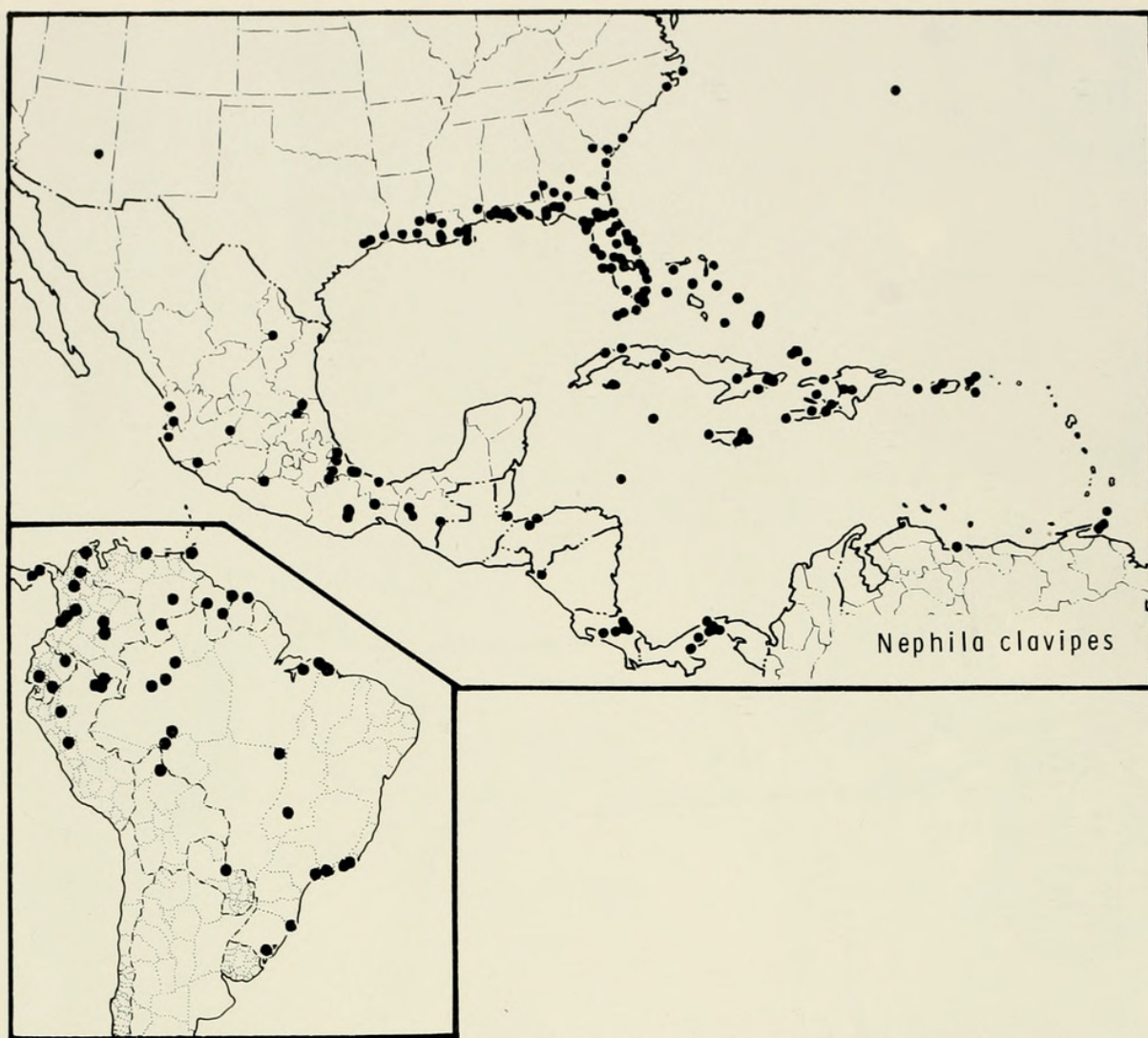


Figures 16-22. *Nephila maculata* (Fabricius) female from Philippines, male from Java. 16-20. Female. 16-18. Epigynum. 16. Dorsal, cleared. 17. Ventral. 18. Posterior. 19. Ventral, legs removed. 20. Dorsal, legs removed. 21, 22. Left male palpus. 21. Mesal. 22. Lateral.

Figures 23-27. *N. clavipes* (Linnaeus). 23, 24. Female. 23. Head and chelicera. 24. Labium and endites. 25-27. Left palpus expanded. 25. Submesal. 26. Dorsal. 27. Cymbium, ventral.

Scale lines. 1.0 mm; Figures 21-22, 25-27, 0.1 mm.

Abbreviations. C, conductor; E, embolus; T, tegulum; P, paracymbium; S, subtegulum; Y, cymbium.

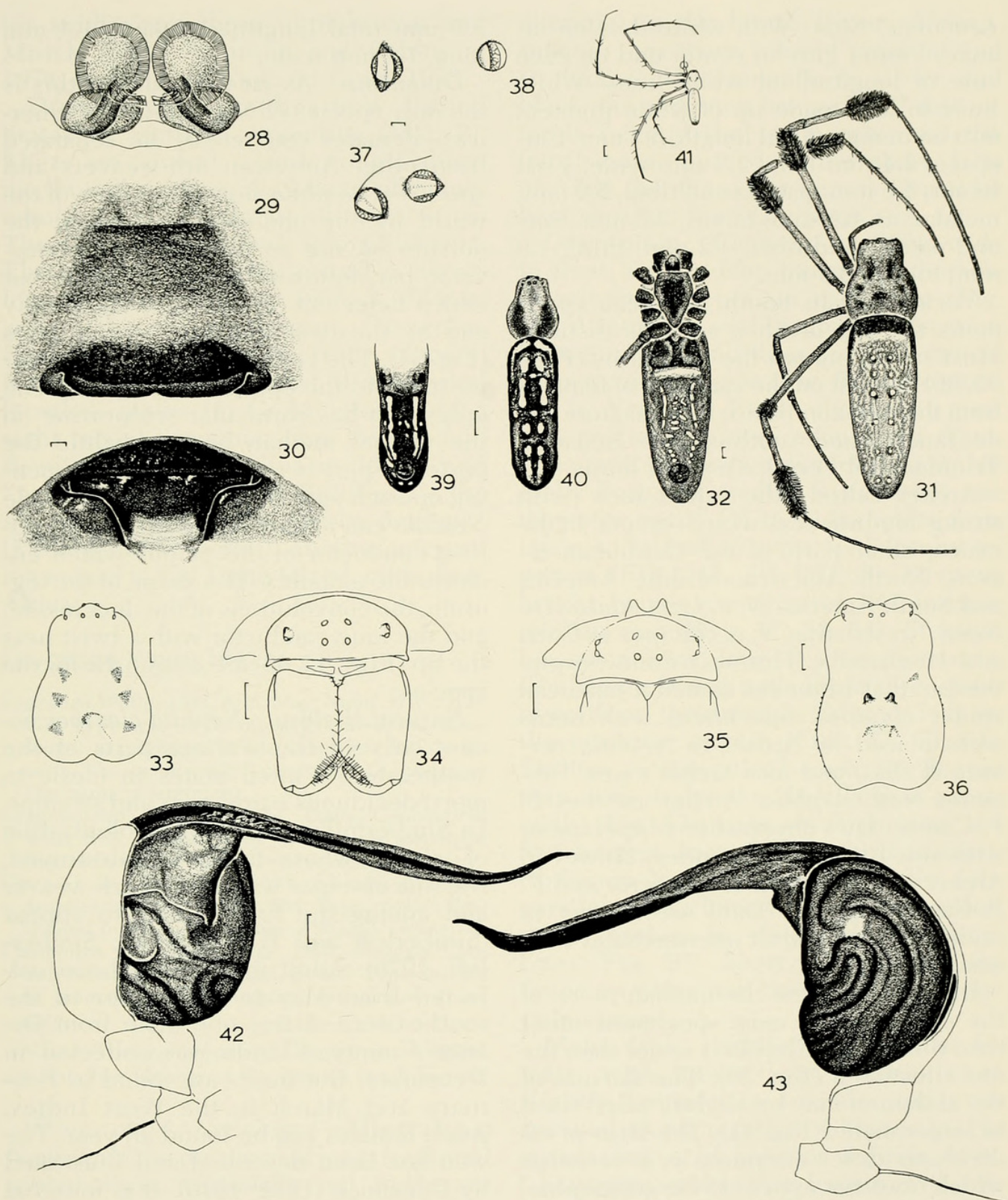


Map 2. American distribution of *Nephila clavipes* (Linnaeus).

Description. Female from Florida. Carapace yellow-brown covered by white setae; three pairs of dark brown patches; thoracic groove also dark (Fig. 31). Chelicerae, endites, labium dark brown with distal edge of labium and endites light; sternum orange, darker in middle (Fig. 32). Coxae ventrally yellow-brown, dark brown anterior and posterior. Legs yellow; setae black (Fig. 31). Dorsum of abdomen with a dark transverse patch anteriorly, a light transverse mark behind, and pairs of light spots posteriorly (Fig. 31). On venter two parallel longitudinal light lines with intervening irregular white marks (bordered by dark) (Fig. 32). Indistinct white marks in a marbelized pattern on sides. Living specimens are greenish. Legs with tufts of hair on distal

ends of femur and tibia of legs 1, 2 and 4, but not always present (Fig. 31). Abdomen overhangs spinnerets slightly (Fig. 32). Total length, 23.0 mm. Carapace, 8.4 mm long, 5.4 mm wide. First femur, 14.2 mm; patella and tibia, 14.4 mm; metatarsus, 18.0 mm; tarsus, 3.6 mm. Second patella and tibia, 11.4 mm; third, 5.8 mm; fourth, 11.0 mm.

Male. Carapace orange-yellow. Dark marks on each side of head in depression (Fig. 41). Chelicerae orange-yellow. Sternum orange with white pigment in center, some dark opposite each coxa. Legs orange-yellow. Dorsum of abdomen has a shiny, dark cardiac mark and scattered small white pigment spots in two longitudinal bands on each side (quite variable). Posterior tip of abdomen dark as in



Figures 28-43. *Nephila clavipes* (Linnaeus). 28-38. Female. 28-30. Epigynum. 28. Dorsal, cleared. 29. Ventral. 30. Posterior. 31. Dorsal. 32. Ventral. 33-36. Carapace. 34, 35. Head and chelicerae. 33, 34. (Florida). 35, 36. (Iquitos, Peru). 37. Left lateral eyes. 38. Posterior median eyes. 39, 40. Juvenile. 39. Ventral. 40. Dorsal. 41-43. Male. 41. Dorsal. 42, 43. Left male palpus. 42. Mesal. 43. Lateral.

Scale lines. 1.0 mm; Figures 37, 38, 42, 43, 0.1 mm.

Leucauge. Sides with white dots on orange. Venter gray in center and on each side of longitudinal white lines. White lines in turn made up of white pigment dots on orange. Total length, 5.8 mm. Carapace, 2.4 mm long, 1.7 mm wide. First femur, 5.3 mm; patella and tibia, 5.0 mm; metatarsus, 6.8 mm; tarsus, 2.2 mm. Second patella and tibia, 4.2 mm; third, 1.9 mm; fourth, 3.3 mm.

Variation. In South American specimens the leg brushes are less distinct. Most surprising are the two horns (Figs. 35, 36) present on the carapace of females from the Amazon Basin; females from Rio de Janeiro and southwestern Ecuador, Trinidad and Peru have small horns.

Archer called "the tufted race [with strong leg-brushes] which occurs in Jamaica, other parts of the Caribbean region, North America, Middle America and South America *N. c. fasciculata* (De Geer)," restricting *N. c. clavipes* to Cuba and Hispaniola. This was done despite the fact that Linneaus named a Jamaican spider *clavipes*. Specimens with horns were placed by Archer in *Nephila cornuta* (Pallas) and into Archer's new subgenus *Nothonephila*. Archer ascribes F. P.-Cambridge's observation of specimens with small horns to juveniles. However, Archer's observations are in error and F. P.-Cambridge and Dahl are correct in saying there are adult intermediates with small horns.

In posterior view the median piece of the epigynum in most specimens other than those from Florida is wider than the one illustrated (Fig. 30). The dorsum of the abdomen may be slightly sclerotized in larger males (Fig. 41). The sizes of individuals differ enormously, a variation which does not appear to be geographic. Females measured 19 to 34 mm total length; carapace, 6.8 to 12.1 mm long, 4.9 to 8.6 mm wide; first patella and tibia, 12.5 to 19.4 mm. Southeastern males measured 4.6 to 10.5 mm total length; carapace, 1.8 to 4.5 mm long, 1.5 to 3.1 mm wide; first patella and tibia, 3.4 to 10.3 mm. A male from British Guiana was

2.6 mm total length; carapace, 1.4 mm long, 1.1 mm wide.

Diagnosis. As far as is known this is the only species of *Nephila* in the Americas. Females can readily be separated from other American orb-weavers and species of *Nephila* from other parts of the world by the abdomen coloration, the dorsum having an anterior black transverse bar, followed by both a white bar which fades out on the sides posteriorly and by the two irregular rows of spots (Fig. 31). The venter also has a white bar posterior to the epigynum (Fig. 32). The epigynum has cornicular sculpturing on the ventral median portion, while the posterior part is smooth, with the opening on each side (Figs. 29, 30). The male *Nephila* can readily be recognized by the long conductor of the palpus which encloses the embolus. The shape of the tegulum, the convolutions of the duct inside, and the long conductor with a twist near the tip (Figs. 42, 43) are diagnostic for the species.

Natural History. *Nephila clavipes* occurs only in the warmer parts of the southeastern United States in mesic to moist deciduous hardwoods and swamps. In Simberloff's studies of recolonization of islands whose fauna was destroyed, *Nephila clavipes* was the first orb-weaver and among the first spiders to appear (Simberloff and Wilson, 1970; Simberloff, 1976). Adult males have been collected from May to September in the southeastern states; one male from Orange County, Florida was collected in December. But males are found in February and March in the West Indies. Adult females can be found all year. The web has been described and illustrated by Comstock (1912, 1940). It is found at 1 to 6 m heights. It is 60–90 cm in diameter, the hub near the top, and contains many radii (Plate 2). The temporary spiral is not removed and a barrier web may be next to it. Only parts of the viscid spiral are replaced at a time; it is not remade daily like that of most orb-weavers. The silk is yellow. The important behav-

ior studies are those of Robinson and Mirick, 1971, Robinson and Robinson, 1974, and Christenson and Goist, 1979.

Distribution. Southeastern United States to northern Argentina (Map 2). There are several records from California, but all are from the Marx Collection, whose locality data is often in error. There are no recent finds from California. The most northwestern record is Showlow, Arizona, 28 August 1965, ♀ (F. Matzone); the most northern, Orracoke, Blackbeards Hammock, Hyde County, North Carolina, 25 August 1976, several females, males (J. Coddington) and a sight record "common near the coast in Beaufort, North Carolina in 1966," and "in 1976 when I visited Beaufort . . . the same places were occupied by *Argiope*" (P. Weygoldt, in letter). Another interesting record is São Tomé Island, off Gabon, Africa.

Leucauge White 1841

Leucauge White, 1841, Ann. Mag. Natur. Hist., 1(7): 473. Type species by monotypy *Linyphia* (*Leucauge*) *argyroabpta* White from near Rio de Janeiro. The name was first proposed as a subgenus. The name is feminine.

Argyropeira Emerton, 1884, Trans. Connecticut Acad. Sci., 6: 331. Type species by monotypy *Epeira hortorum* Hentz (= *Leucauge venusta*).

Opas O. P.-Cambridge, 1889, Biologia Centrali-Americana, Araneidea, 1: 184. Type species designated by F. P.-Cambridge, 1903, *O. lugens*.

Plesiomete F. P.-Cambridge, 1903, Biologia Centrali-Americana, Araneidea, 2: 438. Type species by monotypy and by original designation *P. argyra*.

Note. The specimens of *L. argyroabpta* (White) are lost. The identity of the species is not known.

Diagnosis. *Leucauge* differs from *Nephila* in the presence of long, feathered trichobothria, proximally and on the anterior surface of the femur of the fourth leg (Figs. 50, 51, 67). Also the labium of *Leucauge* is wider than or as wide as long, rather than longer than wide (Fig. 53). Close to *Leucauge* are two genera, *Alcimosphenus* (with two species in the West Indies) and the neotropical *Mecynometa*. Both also have the rows of trich-

obothria on the fourth femur. *Alcimosphenus* has more colored pigment and is darker. *Mecynometa* is silver and black, the abdomen having a tail that extends beyond the spinnerets, and the fourth coxae spaced farther apart. It is possible that these two genera cannot be kept separate from *Leucauge*.

Description. Carapace relatively wide in front, with a deep transverse thoracic depression, deeper on each side (Fig. 50). A round or oval diagonal depression between head and thorax in the cervical groove on each side (Fig. 50) (also present in *Nephila*). Eyes subequal in size. Anterior median eyes about their diameter apart, one to two diameters from laterals. Posterior median eyes about one diameter apart, 1.5 to 2 diameters from laterals. Secondary eyes with canoe tapetum (Figs. 48, 49, 65, 66). Clypeus height equals diameter of the anterior median eye (Figs. 47, 54, 64). Sternum has some setae, longest setae anteriorly. Chelicerae strong with about three pairs of teeth on the anterior, three or four on the posterior margin (Figs. 47, 53, 64). Endites of the palpal coxae are longer than wide and wider distally than proximally (Fig. 53). Legs are fairly long, the first longest, second next, third shortest. Abdomen longer than wide, sides subparallel with characteristic silver coloration, broken in several longitudinal lines (Fig. 50). Short trichobothria are found on tibiae and base of femora, none on metatarsi.

Male. Only slightly smaller than female, with longer legs. Median eyes slightly larger than laterals, and eyes grouped closer together. Clypeus height equals radius of anterior median eyes. Chelicerae weaker than female, with two anterior teeth, two to four posterior. Except for increased length, no other leg modifications. Color is like that of the female.

Genitalia. Epigynum with two ventral lateral openings leading into sclerotized and variable pockets (difficult to discern) (Figs. 45, 46). Fertilization ducts

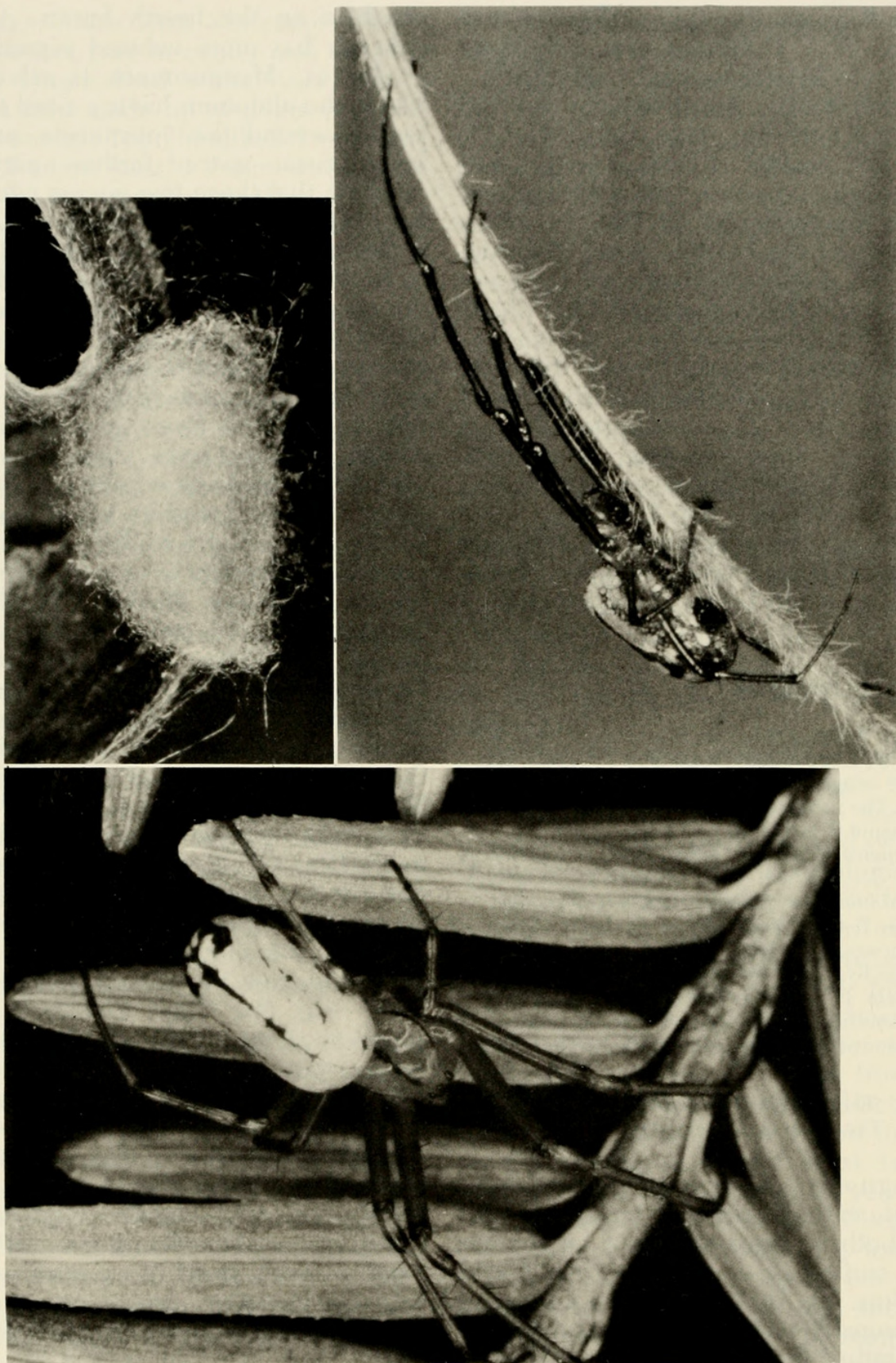


Plate 3. *Leucauge venusta* (Walckenaer), female. Upper left egg-sac, with inner silk orange colored; diameter 7 mm. Upper right, specimen from Florida; below, specimen from Massachusetts.

present (Fig. 44). Seminal receptacles unusually thin-walled (Figs. 44, 60) and sometimes appear partly digested in alcoholic collections. Thin-walled receptacles are also found in *Azilia*; the significance of the similarity is not known.

Palpus very simple with a large spherical tegulum containing coiled duct (Figs. 56–59, 70). Embolus with an ovate base and a thread-like tip held by a conductor; conductor coiled around thread (Figs. 58, 59, 69, 71).

Species. *Leucauge* species are mainly tropical, world-wide. They differ only slightly in coloration and in proportions of the epigynum; and in the shape of the male bulb and conductor of the palpus.

Natural History. *Leucauge* makes large orbs, most horizontal, with many radii and large numbers of sticky threads (Plate 4). Some species are colonial.

Relationship. *Leucauge* has at various times been placed with *Tetragnatha*. Palmgren (1979) suggests using some internal characters to show relationship with *Tetragnatha*. The short trichobothria at the base of the femora are also like those of *Tetragnatha*. However, other characteristics indicate that *Leucauge* is more closely related to other genera. The eye structure indicates the genus is close to *Meta*; *Leucauge* is obviously a close relative of *Nephila*. The structure of the palpus of *Nephila* and *Leucauge* is very similar: the base of the embolus hidden between cymbium and bulb is an unusual specialization found in both genera. The long endites are characteristic of both genera, the pair of depressions between head and thorax characteristic of both. Male *Nephila* have the abdomen shaped like that of *Leucauge* and also have a darker posterior end. A third genus belonging to this group is *Nephilengys*. *Nephila* and *Nephilengys* differ by lacking *Leucauge*'s rows of trichobothria on the fourth femur and by having giant females and dwarf males.

- 2(1). Epigynum with median depression (Fig. 45); middle of venter of abdomen with tiny silver specks and two triangular marks (Fig. 51); Ontario, eastern states to California (Map 3) ----- *venusta*
 - Epigynum with a median cone (Figs. 61–63); venter of abdomen with two longitudinal silver lines, without silver specks in between (Fig. 67); Florida (Map 3) -- *argyra*
 3(1). Palpal tibia as long or longer than cymbium (Fig. 56); cymbium without dorsal hook (Fig. 57); Ontario eastern states to California (Map 3) ----- *venusta*
 - Palpal tibia shorter than cymbium (Fig. 68); cymbium with a dorsal hook (Fig. 69); Florida (Map 3) ----- *argyra*

Leucauge venusta (Walckenaer)

Plates 3, 4; Figures 44–59; Map 3

Epeira venusta Walckenaer, 1841, Histoire Naturelle des Insectes Aptères, 2: 90. Name given to Abbot's illustration of Georgian Spiders, p. 13, fig. 113. Photocopy in the Museum of Comparative Zoology, examined.

Epeira hortorum Hentz, 1847, J. Boston Soc. Natur. Hist., 5: 477, pl. 31, fig. 19. Females from the United States, destroyed.

Argyropeira hortorum:—Emerton, 1884, Trans. Connecticut Acad. Sci., 6: 332, pl. 37, figs. 29–32, ♀, ♂. Keyserling, 1893, Spinnen Amerikas, 4: 333, pl. 17, figs. 246. Emerton, 1902, Common Spiders, p. 192, figs. 446, 447, ♀.

Argyropeira venusta:—McCook, 1893, American Spiders, 3: 242, pl. 20, figs. 1–6, ♀, ♂.

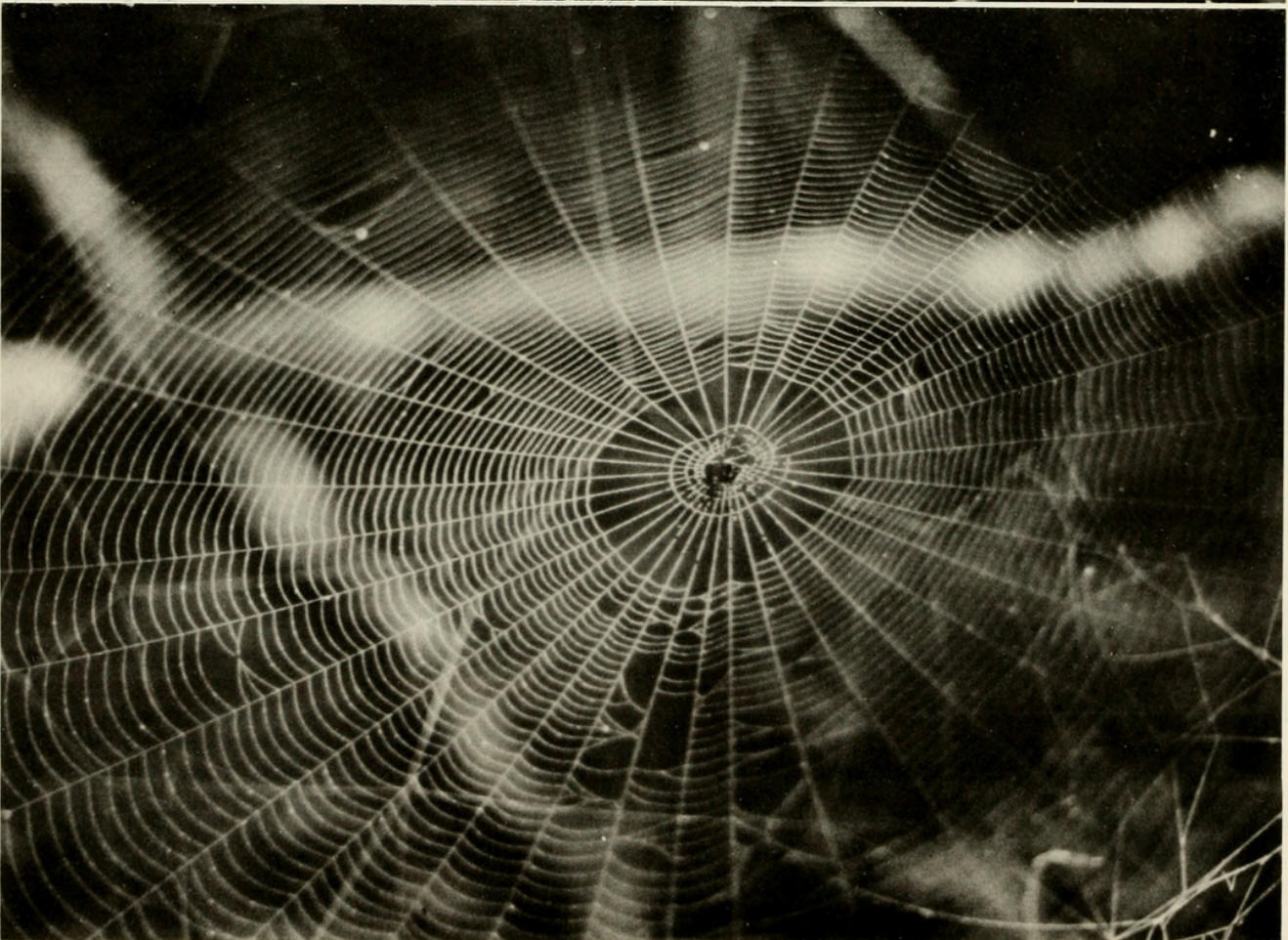
Leucauge venusta:—F. P.-Cambridge, 1903, Biologia Centrali-Americana, Araneidea, 2: 441, pl. 42, figs. 1, 2, ♀, ♂. Comstock, 1912, *The Spider Book*, p. 422, figs. 429, 434–436; 1940, rev. ed., p. 436, figs. 429, 434–436, ♀, ♂, web. Roewer, 1942, Katalog der Araneae, 1: 1012. Kaston, 1947, Bull. Connecticut Geol. Nat. Hist. Surv., 70: 265, figs. 836–837, 843–846, ♀, ♂. Bonnet, 1957, Bibliographia Araneorum, 2: 2477.

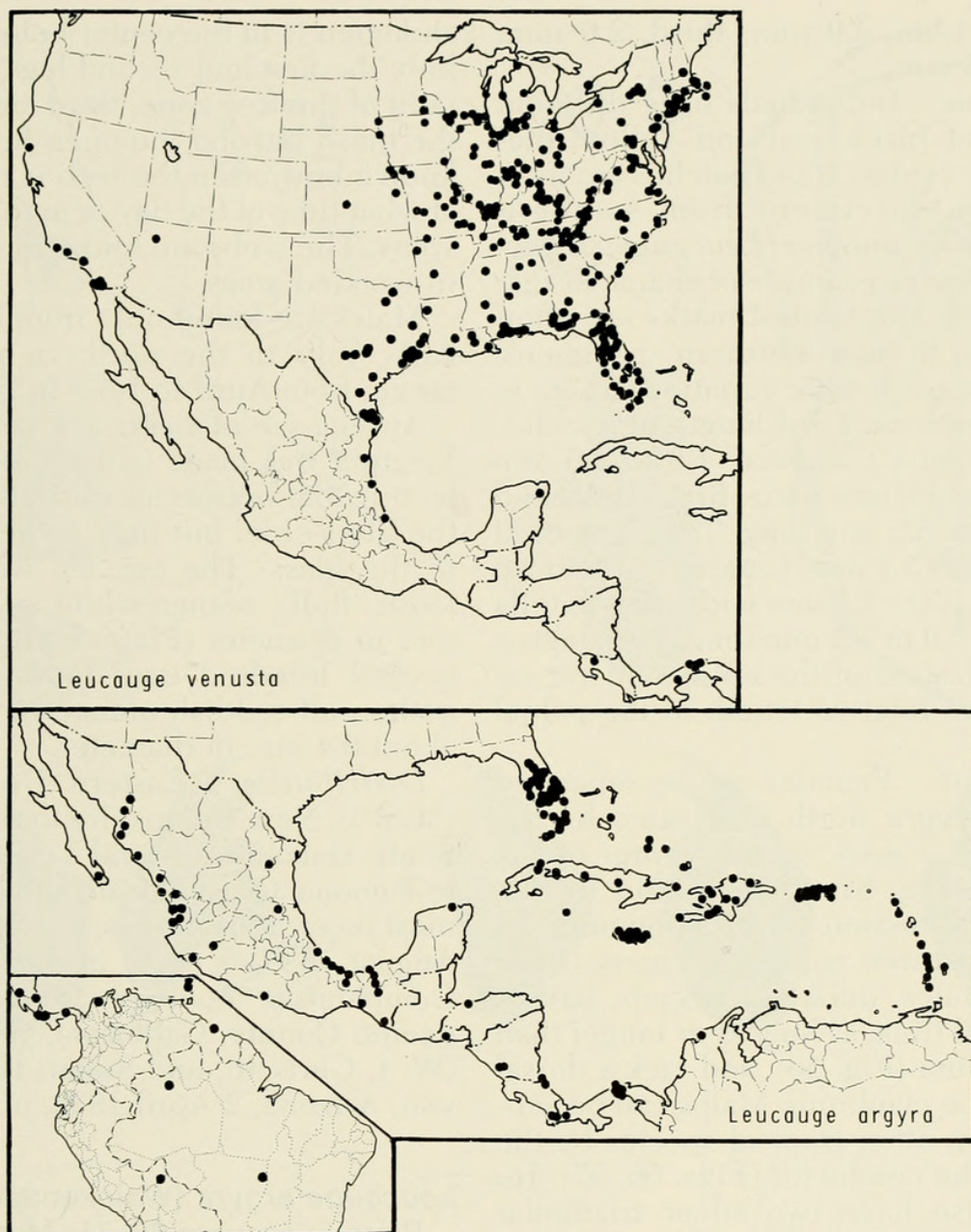
Leucauge (Argyropeira) mabelae Archer, 1951, Amer. Mus. Novitates, no. 1487: 6, figs. 1, 2, ♀, ♂. Male holotype from Sarasota, Sarasota County, Florida in the American Museum of Natural History, examined. NEW SYNONYMY.

Description. Female from Florida. Carapace, sternum, legs orange-brown when in alcohol, green in life. Labium and endites with some black pigment. Dorsum of abdomen silver, made of tiny coalescing spots; no spots in midline, and in branches from midline (Fig. 50). On sides posteriorly, living specimens have yellow pigment which gives a golden iridescent color. Some also have red pig-

KEY TO *LEUCAUGE* SPECIES NORTH OF MEXICO

1. Females and juveniles ----- 2
 - Males ----- 3





Map 3. Distribution of *Leucauge venusta* (Walckenaer) and *L. argyra* (Walckenaer).

ment. Posterior of abdomen black. Venter with two silver triangles containing fused pigment spots, often red to orange in living specimens (Fig. 51). More scattered silver pigment outside the triangles, green and some black pigment in living specimens. Total length, 5.9 mm. Carapace, 2.2 mm long, 1.7 mm wide. First femur, 4.2 mm; patella and tibia, 4.8 mm;

metatarsus, 3.8 mm; tarsus, 1.3 mm. Second patella and tibia, 3.7 mm; third, 1.5 mm; fourth, 2.9 mm.

Male from Florida. The abdomen narrows posteriorly, unlike that of the female. Total length, 5.2 mm; carapace, 2.0 mm long, 1.7 mm wide. First femur, 5.8 mm; patella and tibia, 6.9 mm; metatarsus, 6.5 mm; tarsus, 1.6 mm. Second pa-

←

Plate 4. *Leucauge venusta* (Walckenaer); webs from Florida, diameter of viscid area about 28 cm. Upper web without spider; lower web with spider in hub. Web dusted with cornstarch.

tella and tibia, 4.9 mm; third, 2.0 mm; fourth, 3.5 mm.

Variation. Individuals have different amounts of black, red and yellow pigment. The ventral silver patches are most distinct in specimens from southern states, where another *Leucauge*, *L. argyra*, occurs (an example of character displacement). The ventral marks are often obliterated in more northern specimens. There is considerable variation in size in most collections. Total length of females, 3.7 to 8.0 mm. Carapace, 1.6 to 2.5 mm long, 1.2 to 1.9 mm wide; first patella and tibia, 3.4 to 5.5 mm long. Total length of males, 3.2 to 5.1 mm. Carapace, 1.6 to 2.2 mm long, 1.3 to 1.7 mm wide; first patella and tibia, 5.0 to 7.3 mm long. The degree of sclerotization of the epigynum varies, as does the relative length of the palpal tibia.

Diagnosis. Females can be separated from *L. argyra* north of Mexico by the subtriangular mark on the venter of the abdomen (Fig. 51, Plate 3) and by the shallow depression of the epigynum divided into three superficial parts (Figs. 45, 46). Males, unlike *L. argyra*, have a long palpal tibia, as long as or longer than the cymbium (Fig. 56), and lack a dorsal hook on the cymbium. Males can be separated from other tropical species by the shape of the conductor (Figs. 56, 57). Juveniles also have two silver triangular patches on the underside of the abdomen (Fig. 51), while those of *L. argyra* have two longitudinal lines. *Leucauge venusta* is often confused with *Mangora maculata*. *Mangora* has the trichobothria on the third patella and tibia, *Leucauge* on the fourth femur; the genitalia also differ.

Natural History. The webs have been described by Emerton (1902), Comstock (1913) and Kaston (1947). The webs are horizontal to near vertical with an irregular barrier web below. The orb has an open hub, about 30 or more radii, a wide free zone and more than 60 spirals (Plate 4). There are no scaffolding threads left in the web. The tip of the

abdomen is in the center below the open hub, the first and second legs rest on the radii of the free zone, third and fourth on the mesh beyond the open hub. It is not known how often the web is remade and at what time of the day or night the spider spins. The webs are found in low bushes in wooded areas.

Males are found only from late May to early July in the northern part of the range, from April to June in Florida.

An egg-sac of *Leucauge venusta* from Virginia was made in June inside a collecting vial between a curled up leaf and the glass side, but only loosely attached to the glass. The egg-sac was made of loose, fluffy orange-white silk, was 8–9 mm in diameter (Plate 3) and contained several hundred eggs loosely stuck together, all reddish orange in color, each about 0.4 mm in diameter.

Distribution. Eastern United States (Map 3), New Hampshire to southeastern South Dakota to central Texas and south to Panama. Coast of California. Northernmost records are Hollis, New Hampshire, August 1888, ♀ (Fox) in the Museum of Comparative Zoology; Longvale, Mendocino County, California, June 1952, ♀ (W. J. Gertsch); and Supai, Havasu Canyon, Arizona, 2 April 1934, juv. (J. Lutz).

Leucauge argyra (Walckenaer)

Plate 5; Figures 60–71; Map 3

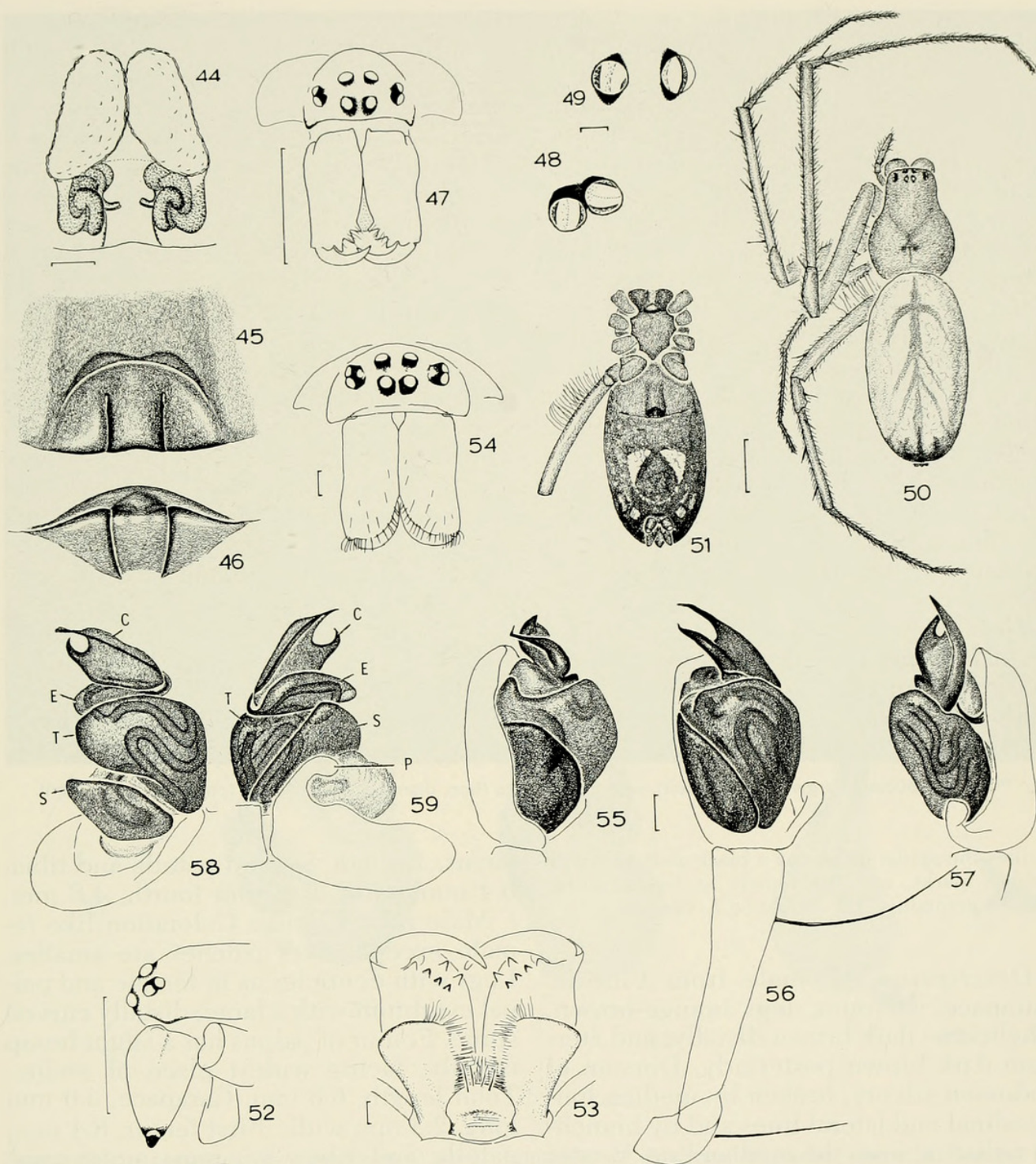
Tetragnatha argyra Walckenaer, 1841, *Histoire Naturelle des Insectes Aptères*, 2: 219, pl. 19, fig. 1, ♀. Walckenaer had specimens from Guadeloupe in the Antilles which are lost.

Linyphia aurulenta C. L. Koch, 1845, *Die Arachniden*, 12: 127, pl. 1049. Female from St. Thomas. DOUBTFUL NEW SYNONYMY.

?*Linyphia ornata* Taczanowski, 1874, *Hor. Soc. Ent. Ross.*, 10: 66. Female from Cayenne and St. Laurent de Maron in French Guyana in the Polish Academy of Sciences, Warsaw.

Meta argyra:—Keyserling, 1880, *Verhandl. Zool. Bot. Gesell. Wien*, 30: 563, pl. 16, fig. 12, ♀, ♂.

Argyropeira argyra:—McCook, 1893, *American Spiders*, 3: 243, pl. 24, figs. 2, 3. Keyserling, 1893, *Spinnen Amerikas*, 4: 343, pl. 18, fig. 253, ♀, ♂. Simon, 1894, *Histoire Naturelle des Araignées*, 1: 730, fig. 806, ♂.



Figures 44–59. *Leucauge venusta* (Walckenaer). 44–53. Female. 44–46. Epigynum. 44. Dorsal, cleared. 45. Ventral. 46. Posterior. 47. Eyes and chelicerae. 48. Left lateral eyes. 49. Posterior median eyes. 50. Dorsal. 51. Ventral. 52. Head and chelicera. 53. Labium and endites. 54–59. Male. 54. Eyes and chelicerae. 55–59. Left palpus. 55. Mesal. 56. Ventral. 57. Lateral. 58, 59. Expanded. 58. Ventral. 59. Dorsal.

Scale lines. 0.1 mm; Figures 47, 50–52, 1.0 mm.

Abbreviations. C, conductor; E, embolus; P, paracymbium; S, subtegulum; T, tegulum.

Plesiometa argyra:—F. P.-Cambridge, 1903, *Biologia Centrali-Americana, Araneidea*, 2: 438, pl. 41, figs. 15, 16, ♀, ♂. Comstock, 1912, *The Spider Book*, p. 424; 1942, rev. ed., p. 438. Bonnet, 1958, *Bibliographia Araneorum*, 2: 3709.

Leucauge argyra:—Petrunkevitch, 1930, *Trans. Connecticut Acad. Sci.*, 30: 265, figs. 119, 120, ♀, ♂. Roewer, 1942, *Katalog der Araneae*, 1: 1009.

Note. *Linyphia aurulenta* had previously been synonymized with *Leucauge venusta*. But Koch de-

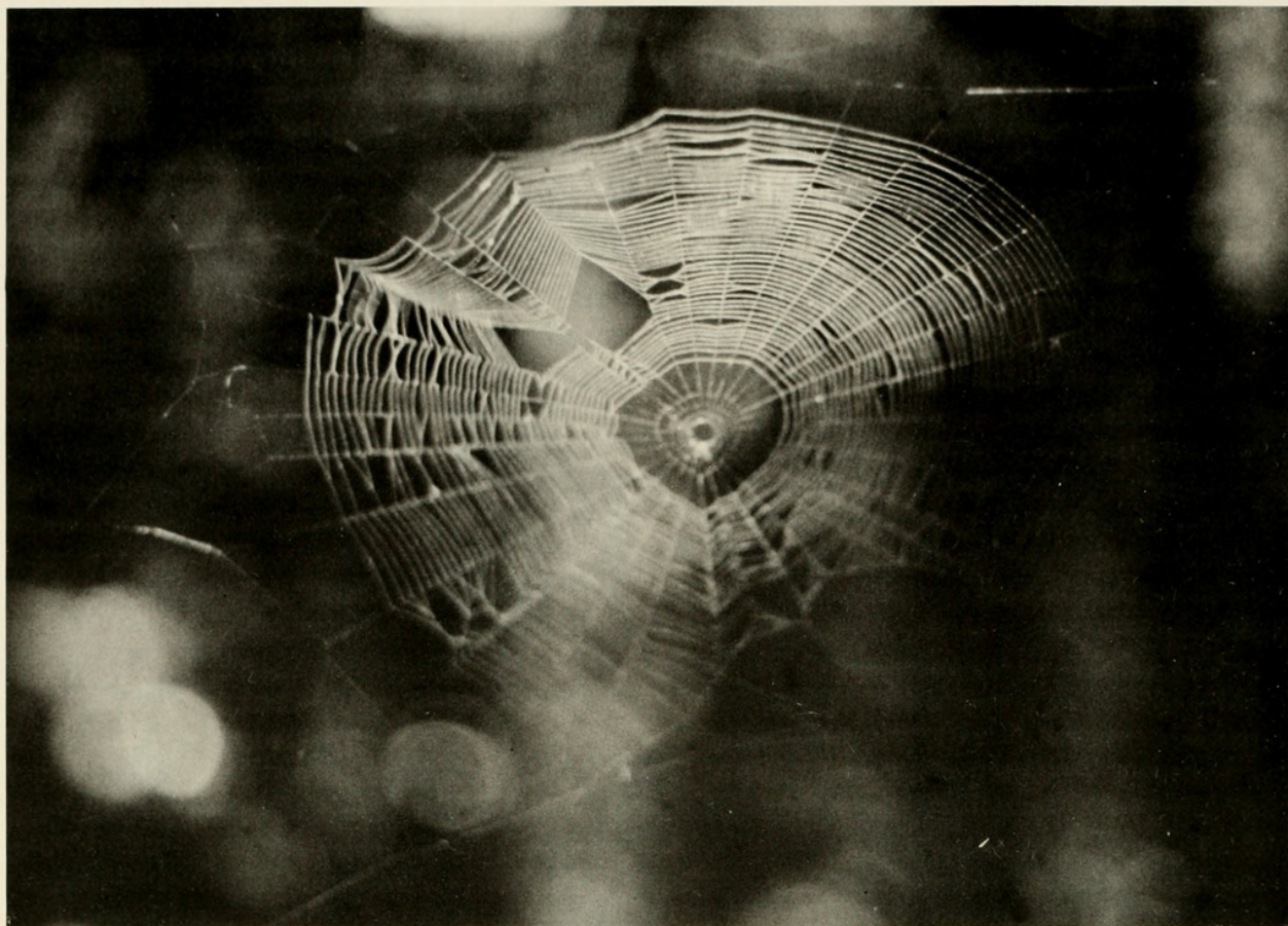


Plate 5. *Leucauge argyra* (Walckenaer), web from Puerto Rico, diameter about 50 cm (photo J. Coddington).

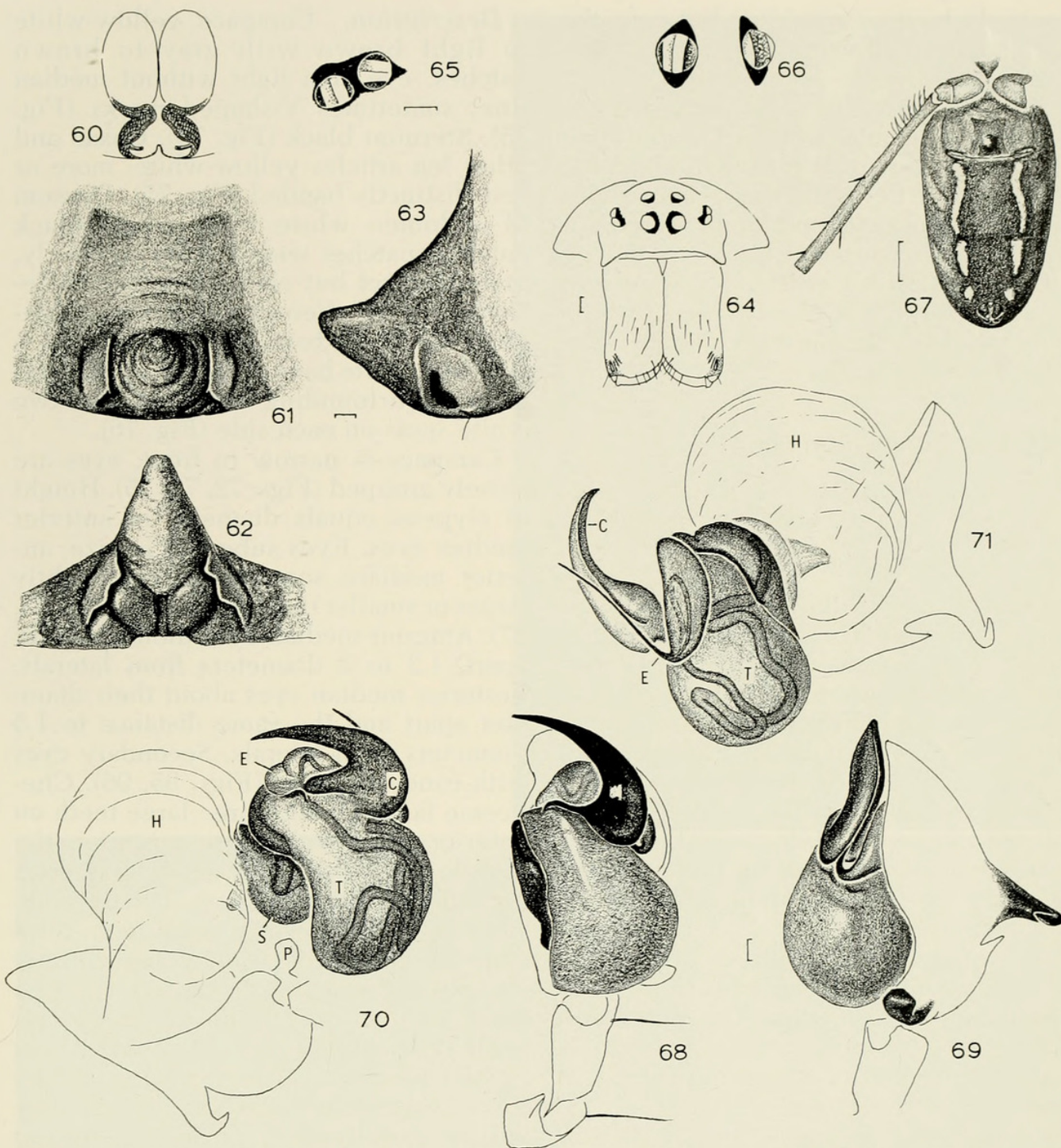
scribes the spider as having a black abdomen with golden marks, and the female as having cone-shaped genitalia. This cannot be *L. venusta*.

Description. Female from Florida. Carapace, sternum, legs orange-brown. Chelicerae dark brown distally, and sternum dark brown posteriorly. Dorsum of abdomen silvery, broken by median longitudinal and lateral lines and by branches radiating from the median line. Venter with two silver lines, one on each side, separated by brown and black pigment. Living specimens have orange-red patches (Fig. 67). The first and second legs have rows of denticles on the venter of tibiae and metatarsi. Total length, 9.1 mm. Carapace, 3.2 mm long, 2.3 mm wide. First femur, 8.0 mm long; patella and tibia, 8.8 mm; metatarsus, 8.8 mm;

tarsus, 1.9 mm. Second patella and tibia, 6.4 mm; third, 2.4 mm; fourth, 4.8 mm.

Male from Florida. Coloration like female except silver patches are smaller. Legs with denticles as in female and palpal cymbium with a large, distally curved spine. Femur of palpus has a slight hump distally, facing widest place of endite. Total length, 6.6 mm. Carapace, 3.0 mm long, 2.3 mm wide. First femur, 8.4 mm; patella and tibia, 9.2 mm; metatarsus, 10.0 mm; tarsus, 2.3 mm. Second patella and tibia, 7.2 mm; third, 2.8 mm; fourth, 4.9 mm.

Variation. Individuals have a variable amount of black pigment. There is considerable variation in size. Females vary total length, 4.5 to 10.0 mm; carapace 1.9 to 3.6 mm long, 1.3 to 2.7 mm wide; first patella and tibia, 4.9 to 9.6 mm long. Males vary total length, 4.1 to 6.3 mm; car-



Figures 60-71. *Leucauge argyra* (Walckenaer). 60-67. Female. 60-63. Epigynum. 60. Dorsal, cleared. 61. Ventral. 62. Posterior. 63. Lateral. 64. Eye region and chelicerae. 65. Left lateral eyes. 66. Posterior median eyes. 67. Ventral. 68-71. Male left palpus. 68. Ventral. 69. Lateral. 70, 71. Expanded. 70. Ventral. 71. Dorsal.

Scale lines. 0.1 mm; Figure 67, 1.0 mm.

Abbreviations. C, conductor; E, embolus; H, hematodocha; P, paracymbium; S, subtegulum; T, tegulum.

apace, 1.9 to 3.0 mm long, 1.6 to 2.4 mm wide; first patella and tibia, 5.1 to 8.1 mm long.

Diagnosis. The female *L. argyra* is separated from all other species of *Leu-*

cauge by the cone-shaped epigynum (Figs. 61-63), the male by the dorsal hook on the cymbium (Fig. 69) and the large sclerotized sickle-shaped conductor (Figs. 68, 70). Juveniles, unlike those of *L. ve-*

nusta, lack silver speckling between the two longitudinal ventral lines on the abdomen.

Natural History. *Leucauge argyra* makes a horizontal web in woods (Plate 5) and mangroves. It has been collected in sugar cane fields in Puerto Rico. Males have been collected in March, November and December in Florida.

Distribution. Central and southern Florida, Gulf Coast, West Indies, Mexico to South America, most abundant in the West Indies (Map 3).

Metellina Chamberlin and Ivie

Metellina Chamberlin and Ivie, 1941, Bull. Univ. Utah, biol. ser., 6(3): 14. Type species *Metellina curtisi* (McCook) by original designation. The generic name is feminine.

Diagnosis. Unlike *Meta* and *Metleucauge*, the *Metellina* abdomen is longer than wide, dorsoventrally slightly flattened, widest anteriorly sometimes with small humps (Fig. 75). The venter has a median longitudinal black band with a white line on each side (Fig. 76). Unlike tropical *Chrysometa*, there are no silver spots on the abdomen. The chelicerae have only 3 teeth on the posterior margin (Fig. 74, 88); *Meta* and *Metleucauge* have four.

The male and female genitalia are weakly sclerotized compared to those of *Meta* and *Metleucauge*. The epigynum has at most a simple depression with a lightly sclerotized lip containing the openings on the ventral surface (Figs. 78, 90, 102, 109). The paracymbium of the male palpus is lightly sclerotized (Figs. 84, 92, 104, 107, 111), as are the conductor and base of embolus (C, E in Figs. 99, 100, 104, 111). Unlike the tropical *Chrysometa* the lateral side of the cymbium is not divided, lobed or indented (Figs. 85, 93), except for the basal paracymbium.

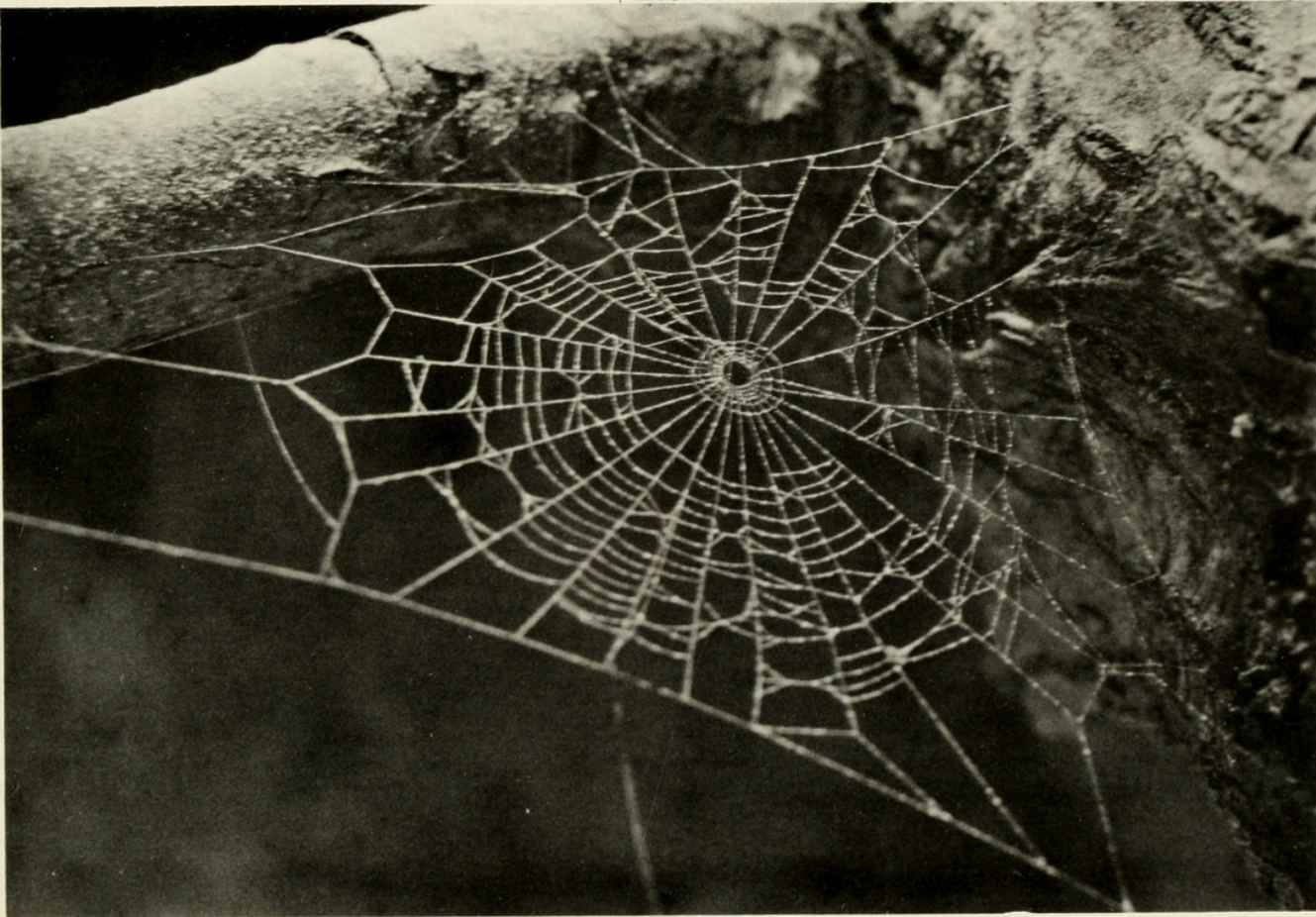
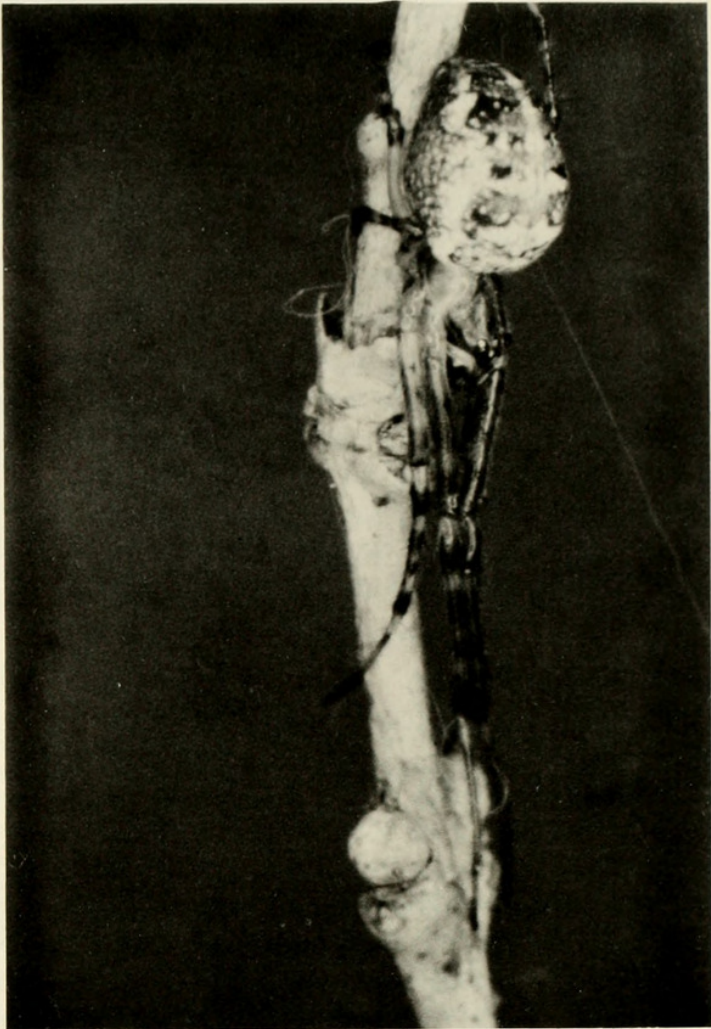
Description. Carapace yellow-white to light brown with gray to brown patches, eye area light without median line; sometimes V-shaped marks (Fig. 75). Sternum black (Fig. 76). Coxae and other leg articles yellow-white, more or less distinctly banded (Fig. 75). Dorsum of abdomen white with paired black patches, patches widest apart anteriorly, more distinct but closer together posteriorly (Fig. 75). Venter with a median longitudinal black band, bordered on each side by a white band (Fig. 76); spinnerets and ring surrounding them dark with two white spots on each side (Fig. 76).

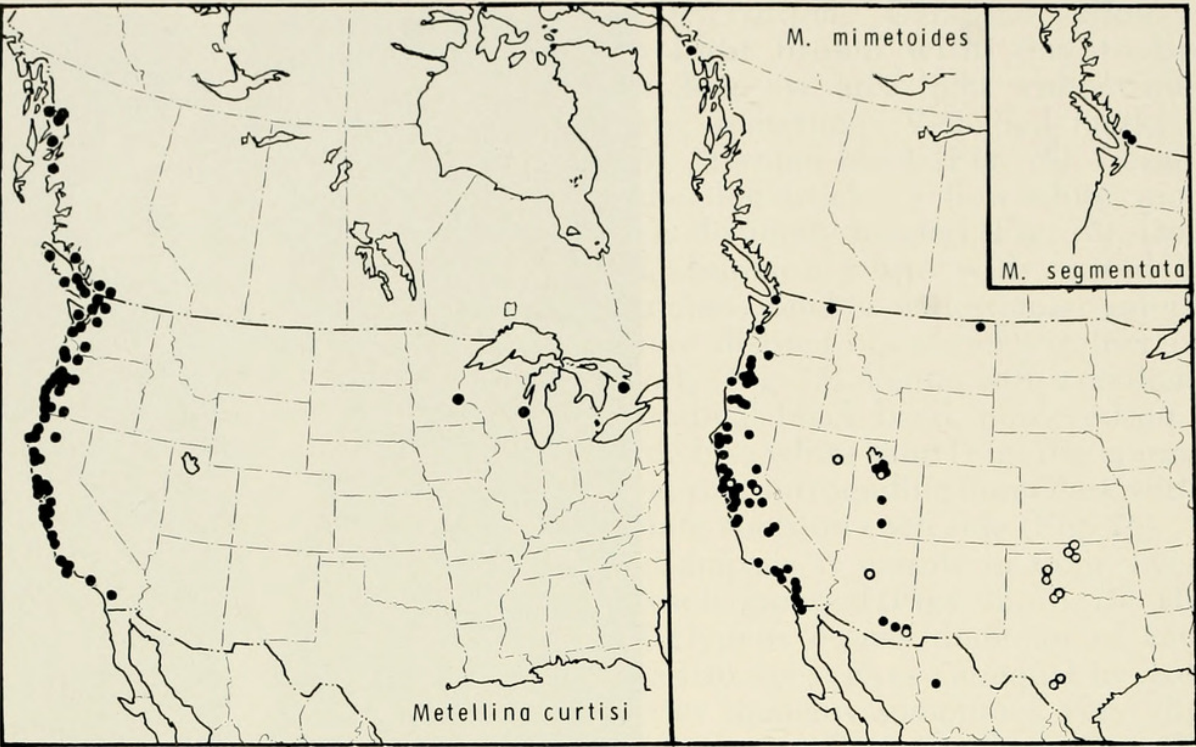
Carapace is narrow in front, eyes are closely grouped (Figs. 72, 73, 75). Height of clypeus equals diameter of anterior median eyes. Eyes subequal in size, anterior medians sometimes very slightly larger or smaller than others (Figs. 72, 73, 87). Anterior median eyes their diameter apart, 1.3 to 2 diameters from laterals. Posterior median eyes about their diameter apart and the same distance to 1.5 diameters from laterals. Secondary eyes with canoe tapetum (Figs. 95, 96). Chelicerae fairly strong; three large teeth on anterior margin, three on posterior, the middle one small (Figs. 74, 88). Endites longer than wide, widest distally (Fig. 76). First leg longest, second next, third shortest. Abdomen oval, dorsoventrally slightly flattened, widest anteriorly (Fig. 75).

Short trichobothria are on palpi, leg tibiae and metatarsi, none on femur. The tibiae have 6 to 8 trichobothria widely spaced dorsally, and one trichobothrium dorsally on base of metatarsus.

Males may be larger than females (*M. curtisi*) or only slightly smaller than females; the chelicerae may be enlarged (*M. curtisi*). Males have narrower abdomen. They lack the tooth on the proximal end of the palpal femur and its matching

→





Map 4. Distribution of *Metellina curtisi* (McCook), *Metellina mimetoides* Chamberlin and Ivie and American distribution of *M. segmentata* (Clerck). Open circles are cave records of *M. mimetoides*.

tooth on the endite. None of coxae or legs are modified.

Genitalia. The female epigynum has a lightly sclerotized median ventral depression (Figs. 78, 90, 102, 106, 109) with lateral openings leading into heavily sclerotized seminal receptacles (Figs. 77, 79, 89, 101, 105, 108). Although Wiehle (1967) could not find fertilization ducts in the *Meta* group of species (examined by sectioning the spiders), I think there are such ducts, but the lightly sclerotized flattened ducts may be difficult to discern.

The male palpi are also lightly sclerotized. The conductor (C in Figs. 99, 100) is a lobe from the tegulum supporting the distal part of the embolus (E); the base of the embolus is also a lightly sclerotized, almost spherical lobe. The paracymbium is large and has two branches (Figs. 84, 92, 104, 107, 111).

Species. The species, except European *M. merianae*, are difficult to separate. I know of only 5: *M. merianae*, *M. mengei* and *M. segmentata* in Eurasia;

M. curtisi and *M. mimetoides* in western North America. The Eurasian *M. segmentata* is introduced in British Columbia.

Natural History. The species have a near vertical web with an open hub (Plate 6). The American species are found in dark humid situations and *M. mimetoides* is common in caves.

KEY TO METELLINA SPECIES NORTH OF MEXICO		
1.	Females	2
-	Males	4
2(1).	Epigynum with a median, bordered depression (Figs. 78, 80, 82, 90)	3
-	Epigynum with pair of shallow unbordered depressions (Fig. 102); British Columbia	<i>segmentata</i>
3(2).	Depression usually without median septum; width of depression about 1.2 times length (Figs. 78, 80, 82)	<i>curtisi</i>
-	Depression with median septum and width of depression about 2.5 times length (Fig. 90)	<i>mimetoides</i>
4(1).	Tibia of male palpus (when in ventral view) hardly longer than wide (Figs. 91, 92)	<i>mimetoides</i>
-	Tibia of male palpus distinctly longer than wide (Figs. 83, 84, 104)	5

- 5(4). Conductor in ventral view in transverse position with distal edge shallow, concave (Fig. 104); British Columbia ---- *segmentata*
 - Conductor in ventral view in transverse and mesal position, distal edge strongly concave (Fig. 84) ----- *curtisi*

***Metellina curtisi* (McCook)**

Plate 6; Figures 72–86; 95–98; Map 4

Epeira peckhamii McCook, 1893, American Spiders, 3: 189, pl. 18, figs. 5, 6, ♀, ♂. Male, female from Biscayne Bay, Florida (G. Marx) [locality in error] and Wisconsin (G. Peckham). Two female syntypes in Academy of Natural Sciences, Philadelphia, examined. NEW SYNONYMY.

Pachygnatha curtisi McCook, 1893, American Spiders, 3: 271, pl. 26, fig. 5, ♂. Fragments of 3 male syntypes from California in the Academy of Natural Sciences, Philadelphia, examined and labeled as types.

Meta curtisi:—Gertsch and Ivie, 1936, Amer. Mus. Novitates, 858:20.

Metellina curtisi:—Chamberlin and Ivie, 1941, Bull. Univ. Utah, biol. ser., 6(3): 15, fig. 20, ♀.

Note. The illustration of the male *E. peckhami* is doubtless this species. The epigynum illustrated does not fit, the body of the female illustrated does, and so do the two surviving specimens. Since the species has been cited in the literature as *M. curtisi* I will keep this name, although *E. peckhami* has page priority. According to ICZN Art. 24, the first reviser can choose the name that provides most stability.

In collections, specimens had been erroneously determined as *Cyrtophora californiensis* by Banks and Chamberlin; *C. californiensis* Keyserling is a *Eustala*.

Description. Female from Oregon. Total length, 5.0 mm. Carapace, 1.9 mm long, 1.5 mm wide. First femur, 2.5 mm; patella and tibia, 3.3 mm; metatarsus, 2.4 mm; tarsus, 1.2 mm. Second patella and tibia, 2.5 mm; third, 1.3 mm; fourth, 1.9 mm.

Male from Oregon. Chelicerae enlarged (Figs. 73, 74). Three teeth on anterior margin; on posterior one large tooth near base of fang and two additional smaller teeth (Fig. 74). Total length, 4.3 mm. Carapace, 2.2 mm long, 1.6 mm wide. First femur, 4.0 mm; patella and tibia, 5.3 mm; metatarsus, 4.2 mm; tarsus, 1.7 mm. Second patella and tibia, 3.8 mm; third, 1.8 mm; fourth, 2.6 mm.

Variation. Males are generally slightly larger than females. Total length of females, 3.4 to 5.5 mm; carapace, 1.4 to 2.3 mm long, 1.2 to 1.7 mm wide; first patella and tibia, 2.7 to 3.7 mm long. The largest specimen came from Alaska. Males 4.0 to 7.3 mm total length; carapace, 1.8 to 3.0 mm long, 1.5 to 2.1 mm wide; first patella and tibia, 4.5 to 8.0 mm long.

Diagnosis. *Metellina curtisi* female differs from *M. mimetoides* in the shape of the epigynum, a depression hardly wider than long (Figs. 78, 80, 82). The male has the palpal tibia about twice as long as wide (Figs. 83, 84), unlike *M. mimetoides*, which has the tibia hardly longer than wide.

Natural History. Adult females have been found from January to September; males from January to August, most common in April to July. Adults disappear in fall and early winter in Oregon and California. Females are adult in September in Alaska. Collecting sites are: walls of shed and shrubs in British Columbia, rain forest in Washington, and in redwood forest in Oregon and California. Other specimens have been collected in insect flight trap, in dense forest; small webs near ground among shrubs and grasses. Don J. Boe (personal communication) observed webs in relatively dark places, out of sunlight, near water 23 miles north of Santa Barbara, and Big Sur, California 60 to 250 cm above ground. The webs were 10 to 18 cm diameter and 0 to 10° from vertical. One web was horizontal, had 19 to 25 radii, 11 to 19 spirals above, and 15 to 23 below the hub. The hub is open (Plate 6).

Distribution. Pacific coast from southern Alaska to southern California (Map 4). The southernmost record is from San Jacinto Mts., Riverside County, California, August 1958 (E. I. Schlinger); other unusual records are Minneapolis, Minnesota, November 1930, ♀ (W. J. Gertsch); Wisconsin, syntypes of *M. peckhami* (G. W. Peckham); and Horn-

ings Mills, Ontario, 19 June 1927, ♀ (T. B. Kurata).

***Metellina mimetoides* Chamberlin and Ivie**

Figures 87–94; Map 4

Metellina mimetoides Chamberlin and Ivie, 1941, Bull. Univ. Utah, biol. ser., 6(3): 15, fig. 19, ♀. Female holotype from Mount Diablo, California, in the American Museum of Natural History, lost.

Note. Some specimens of this species had been determined as *Cyrtophora californiensis* by Banks.

Description. Female. Female has more black pigment than *Metellina curtisi*. Total length, 5.0 mm. Carapace, 1.8 mm long, 1.5 mm wide. First femur, 2.4 mm; patella and tibia, 3.3 mm; metatarsus, 2.4 mm; tarsus, 1.0 mm. Second patella and tibia, 2.7 mm; third, 1.3 mm; fourth, 1.9 mm.

Male. The chelicerae of the male are smaller than those of the male of *M. curtisi* (Figs. 87, 88). Total length, 3.8 mm. Carapace, 1.9 mm long, 1.6 mm wide. First femur, 3.3 mm long; patella and tibia, 4.1 mm; metatarsus, 3.5 mm; tarsus, 0.9 mm. Second patella and tibia, 3.2 mm; third, 1.5 mm; fourth, 2.0 mm.

Variation. Total length of females, 3.3 to 6.0 mm. Carapace, 1.6 to 2.7 mm long, 1.2 to 2.0 mm wide; first patella and tibia, 2.6 to 4.3 mm long. Total length of males, 3.1 to 4.9 mm. Carapace, 1.5 to 2.4 mm long, 1.2 to 1.9 mm wide; first patella and tibia, 3.0 to 5.2 mm long. All the largest specimens came from caves of the eastern part of the range of the species. Unlike *M. curtisi*, the males are slightly smaller than females and there is much less variation in size.

Diagnosis. *Metellina mimetoides* female has a septum in the epigynum depression, the sides of the depression directed laterally. The total width of the depression is more than twice its length (Fig. 90). Unlike *M. curtisi*, the male has the palpal tibia hardly longer than wide (Figs. 91, 92), while that of *M. curtisi* is about twice as long as wide. The male chelicerae are not much longer than those of the females and have three

equally spaced teeth (Figs. 87, 88); in *M. curtisi* the chelicerae are much larger and the space between the distal teeth is wider than the space between the proximal. Both sexes are more pigmented and the markings more contrasting than those of *M. curtisi*.

Natural History. This species has been found in webs on woodpiles and in shacks, aboard ship in a Los Angeles dock, under an overhanging rock ledge, and in oak-grassland in the Santa Catalina Mountains, Arizona. Many of the easternmost records of this species come from caves (open circles, Map 4). The males are commonly collected while sweeping vegetation. I suspect its habitat is similar to *M. curtisi*, but its distribution is more southern.

Distribution. From southern Alaska, Pacific coast to northern Baja California, as far west as Utah and in caves from Nevada to Oklahoma, Texas to Sonora (Map 4).

***Metellina segmentata* (Clerck)**

Figures 99–104; Map 4

Araneus segmentatus Clerck, 1757, Aranei Suecici, p. 45, pl. 2, fig. 6, ♀, ♂. Female and male specimens from Sweden.

Aranea reticulata Linnaeus, 1758, Systema Naturae, p. 619. Specimens from Sweden.

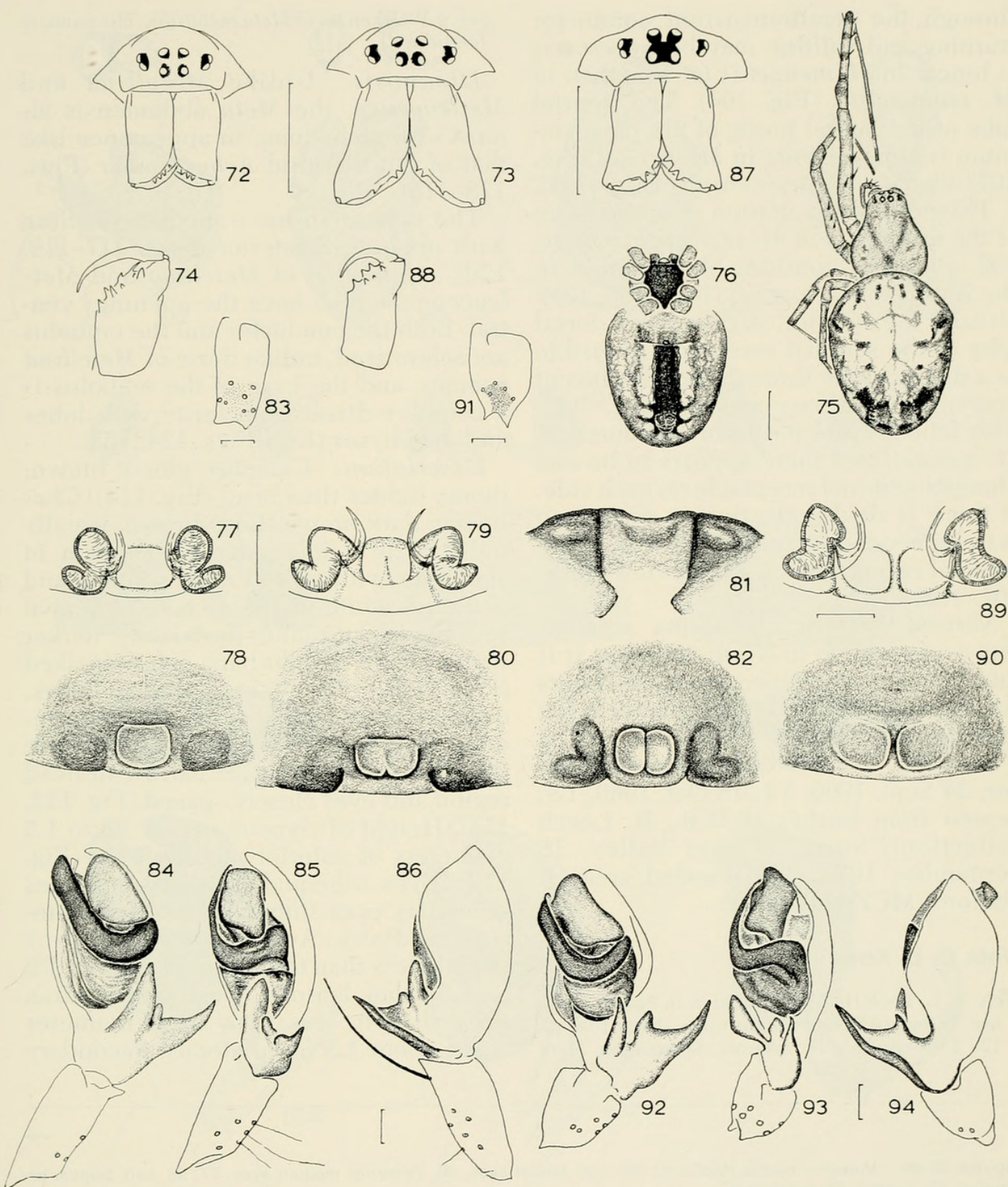
Meta reticulata:—Wiehle, 1931 in Dahl, Tierwelt Deutschlands, 23: 119, figs. 192–197, ♀, ♂. Roewer, 1942, Katalog der Araneae, 2: 915.

Meta segmentata:—Locket and Millidge, 1953, British Spiders, 2: 115, figs. 75, 76B, 77A, D. Bonnet, 1957, Bibliographia Araneorum, 2(3): 2797. Locket, Millidge and Merrett, 1974, British Spiders, 3: 64, figs. 36a, 37b,d, ♀, ♂.

Note. All older North American records are from misidentified specimens of the two native species.

Diagnosis. *Metellina segmentata* differs from the two other North American species by lacking a bordered depression in the epigynum (Fig. 102) and by having a wide palpal conductor in transverse position (Fig. 104).

This species can be separated from the European *M. menzei* (Figs. 105–107) by the structure of the seminal receptacles and the shorter length of the palpal embolus (Figs. 101, 104). The embolus seen



Figures 72–86. *Metellina curtisi* (McCook). 72, 73. Eye region and chelicerae. 72. Female. 73. Male. 74. Male chelicera, posterior view. 75, 76. Female. 75. Dorsal. 76. Ventral. 77–82. Epigynum. 77, 79. Dorsal cleared. 78, 80, 82. Ventral. 81. Posterior. 77, 78. (Mendocino County, California). 79–81. (Yamhill County, Oregon). 82. (Friday Harbor, Washington). 83–86. Left palpus; 83. Tibia, lateral. 84. Ventral. 85. Lateral. 86. Dorsal.

Figures 87–94. *M. mimetoides* Chamberlin and Ivie. 87. Male eye region and chelicerae. 88. Male chelicera, posterior view. 89, 90. Epigynum. 89. Dorsal, cleared. 90. Ventral. 91–94. Palpus. 91. Tibia, lateral. 92. Ventral. 93. Lateral. 94. Dorsal.

Scale lines. 0.1 mm; Figures 72–76, 87, 88, 1.0 mm.

through the semitransparent conductor (turning and shifting may be necessary) is longer in *M. mengei* (Fig. 107) than in *M. segmentata* (Fig. 104). The ventral lobe of the lateral prong of the paracymbium is more distinct in *M. mengei* (Fig. 107) than in *M. segmentata* (Fig. 104).

There is little variation of appearance of the epigynum of *M. segmentata* (Figs. 102, 103), but considerable variation in the European *M. mengei* (Figs. 105, 106). Usually the anterior, slightly more dorsal lobe of the seminal receptacle is visible as a distinct lobe through the translucent epigynum in *M. segmentata* (Fig. 102). This lobe is more posterior and dorsal in *M. mengei*, and there appears to be one elongate seminal receptacle on each side. If there is doubt, clearing or dissection may be needed to see differences of the seminal receptacles in dorsal view (Figs. 101, 105).

Natural History. *Metellina segmentata* is not native to North America; it is introduced in the Vancouver area. Habits are reported in Wiehle (1931) and Locket and Millidge (1953).

Records. *British Columbia.* Vancouver, 24 Sept. 1966, 1♀; 18 Oct. 1969, 1♂, beaten from bushes (P.D.B., R. Leech collection); Surrey, Fraser Valley, 18 September 1976, 3♀, wooded area (J. Stafford, MCZ collection).

Meta C. L. Koch

Meta C. L. Koch, 1836, *Arachniden in Panzer, Faunae Insectorum Germaniae initia*, Heft 134, pl. 12. Type species by original designation *Meta*

fusca Walckenaer (= *Meta menardi*). The name is feminine.

Diagnosis. Unlike *Metellina* and *Metleucauge*, the *Meta* abdomen is almost as high as long, in appearance like that of the theridiid *Achaearanea* (Figs. 113–115).

The epigynum has a median swelling with openings posterior (Figs. 117–119, 129), unlike that of *Metellina* and *Metleucauge*, which have the openings ventral. Both the conductor and the embolus are sclerotized, unlike those of *Metellina* species, and the base of the embolus is a complex dissected sclerite with lobes and apophyses (E in Figs. 124, 125).

Description. Carapace glossy brown; thorax lighter than head (Fig. 114). Chelicerae dark brown. Legs brown, usually indistinctly banded darker. Dorsum of abdomen with paired dark patches and scattered white pigment spots on brown to gray background; posteriorly darker with transverse light bars; sides streaked (Figs. 113, 114). Venter gray to black, quite variable, usually with two longitudinal light bands consisting of tiny white pigment spots. Carapace narrow in head region and eyes closely spaced (Fig. 112, 114). Height of clypeus equals 1.2 to 1.5 diameters of anterior median eyes (Fig. 112). Eyes subequal in size, sometimes secondary eyes slightly larger than anterior medians. Anterior median eyes slightly less than their diameter apart, 1.2 to 1.5 from laterals; posterior median eyes slightly less than their diameter apart, about 1.5 from laterals. Secondary



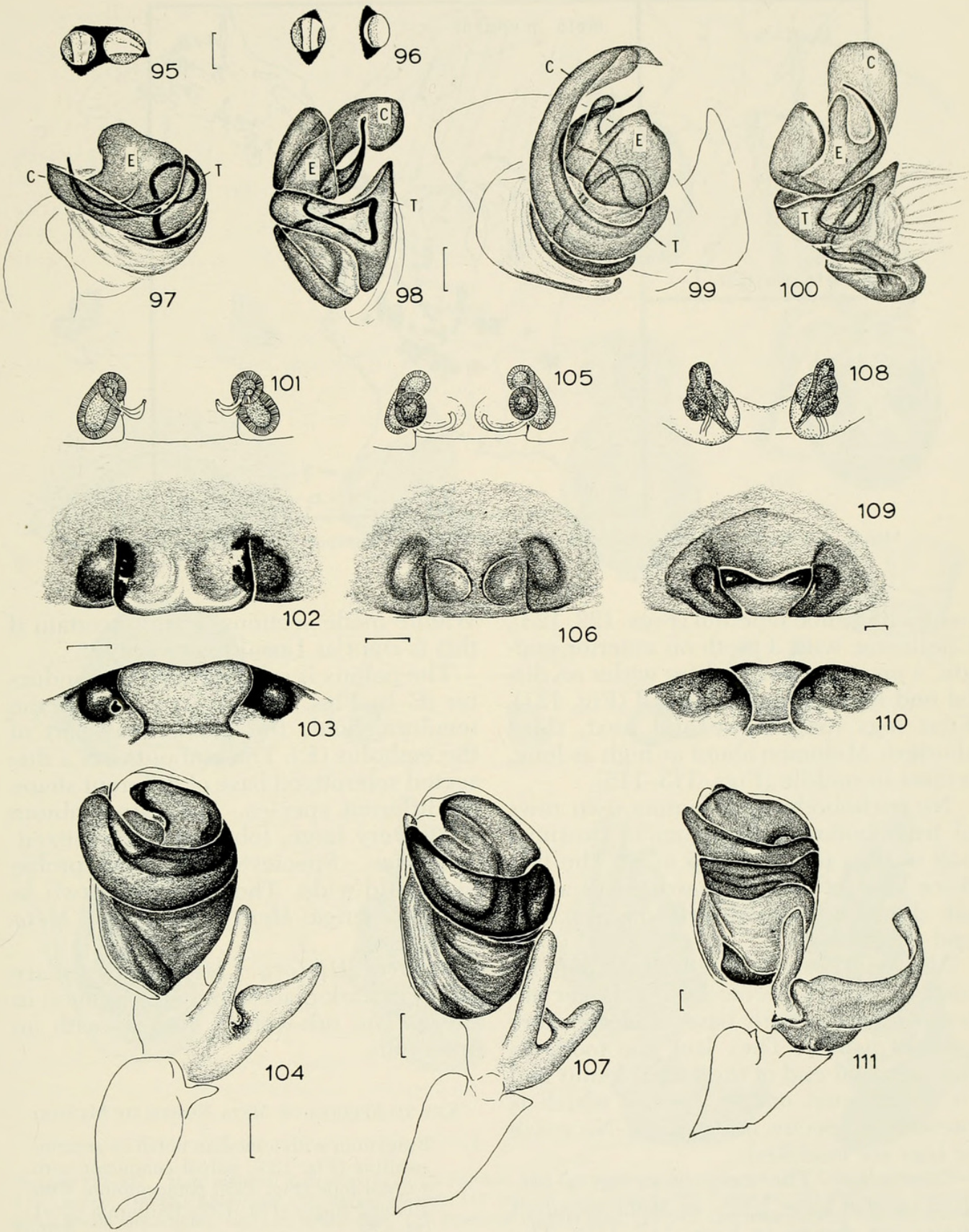
Figures 95–98. *Metellina curtisi* (McCook). 95. Left lateral eyes. 96. Posterior median eyes. 97, 98. Left palpus, expanded. 97. Ventral. 98. Subdorsal.

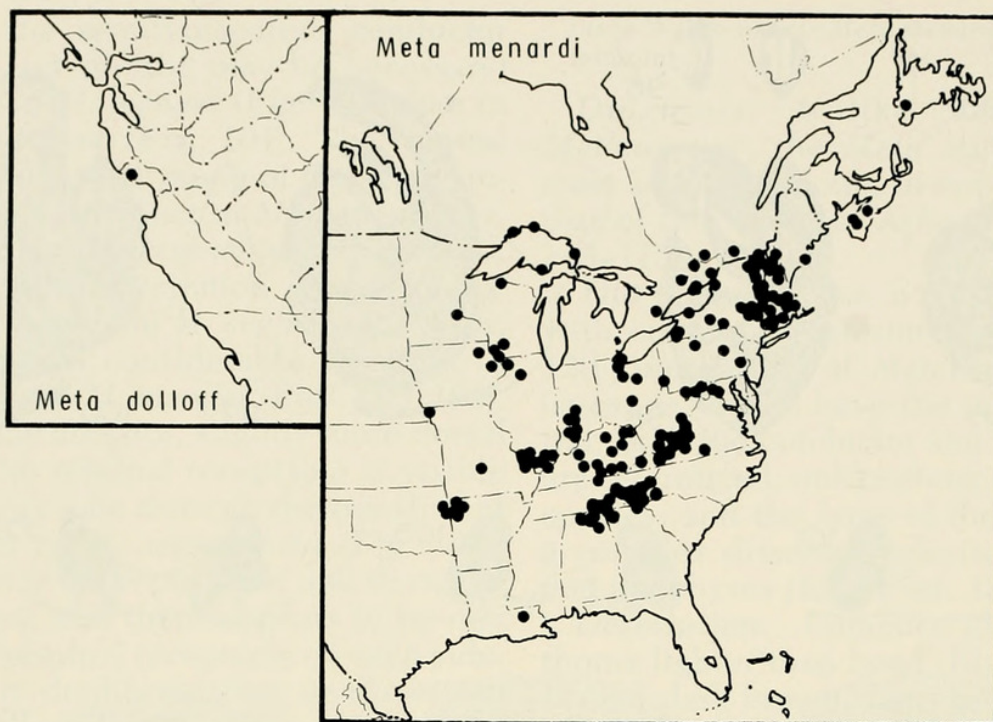
Figures 99–104. *M. segmentata* (Clerck). 99, 100. Left palpus, expanded. 99. Ventral. 100. Dorsal. 101–103. Epigynum. 101. Dorsal, cleared. 102. Ventral. 103. Posterior. 104. Left male palpus, ventral.

Figures 105–107. *M. mengei* (Blackwall) of Europe. 105, 106. Epigynum. 105. Dorsal, cleared. 106. Ventral. 107. Palpus, ventral.

Figures 108–111. *M. merianae* (Scopoli) of Europe. 108–110. Epigynum. 108. Dorsal, cleared. 109. Ventral. 110. Posterior. 111. Palpus, ventral.

Scale lines. 0.1 mm.
Abbreviations. C, conductor; E, embolus; T, tegulum.





Map 5. Distribution of *Meta dolloff* new species and American distribution of *M. menardi* (Latreille).

eyes with canoe tapetum (Figs. 122, 123). Chelicerae with 3 teeth on anterior margin, 4 on posterior. Endites wider on distal end than on proximal end (Fig. 121). First legs longest, second next, third shortest. Abdomen about as high as long, widest in middle (Figs. 113–115).

No trichobothria on femora, two rows of trichobothria on dorsum of proximal half of tibia (altogether 5 or 6). The first three legs (of *Meta menardi*) have a single dorsal trichobothrium on proximal end of metatarsus.

Males are slightly smaller than females. The chelicerae have a larger anterior hump at their bases and are more curved distally. They lack the tooth on the proximal end of the palpal femur and its counterpart on the endite, which is present in species of *Araneus*. No coxae or legs are modified.

Genitalia. The epigynum has a median ventral lobe, hairy in *Meta menardi* (hairs not shown in Figs. 117–119). The openings are on the posterior face (Figs. 118–120). According to Wiehle (1967) there are no separate fertilization ducts.

Wiehle made sections; I am uncertain if this is right as I could not verify it.

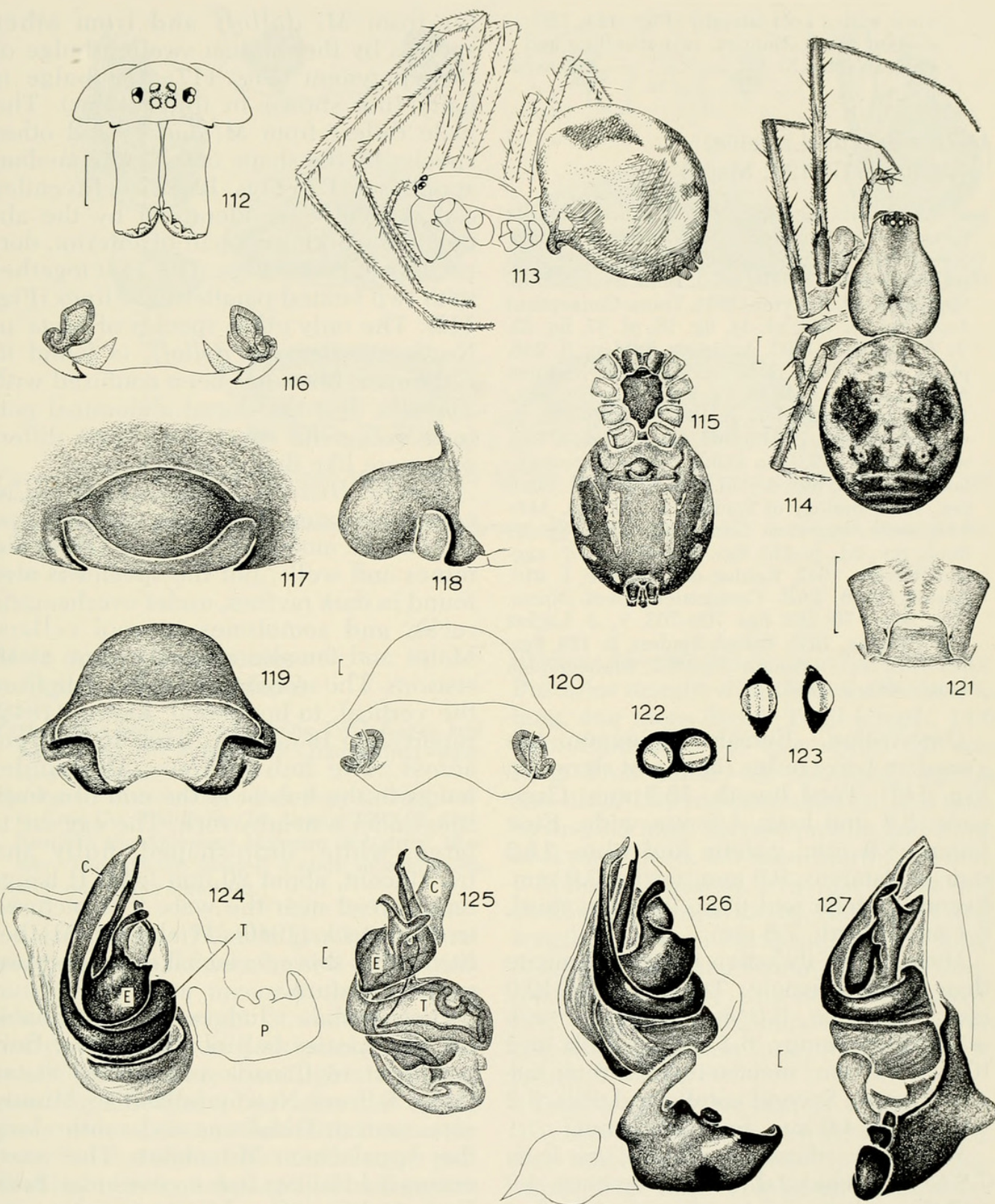
The palpus is sclerotized. The conductor (C in Figs. 124, 125), a lobe of the tegulum, holds the filamentous part of the embolus (E). The embolus has a dissected sclerotized base of different shape in different species. The paracymbium (P) is very large, lobed and sclerotized.

Species. Species of *Meta* are probably world-wide. There are only two in North America: *Meta menardi* and *Meta dolloff*.

Natural History. *Meta* species are found in dark places, and are common in caves. The orb-web is vertical with an open hub.

KEY TO SPECIES OF *META* NORTH OF MEXICO

1. Epigynum with a median notch in anterior swelling (Fig. 133); palpal conductor with a distal lobe (Fig. 135); paracymbium with a lateral finger (Fig. 135); California caves (Map 5) ----- *dolloff*
- Epigynum with a median, anterior, rounded, hairy swelling (Figs. 117–119); palpal conductor with narrowed tip at an angle (Figs. 124, 126); paracymbium in ventral



Figures 112-127. *Meta menardi* (Latreille). 112-123. Female. 112. Eye region and chelicerae. 113. Lateral. 114. Dorsal. 115. Ventral. 116-120. Epigynum. 116. Dorsal, cleared. 117. Ventral. 118. Lateral. 119. Posterior. 120. Posterior, cleared. 121. Labium and endites. 122. Left lateral eyes. 123. Posterior median eyes. 124-127. Left male palpus. 124. Expanded, ventral. 125. Expanded, lateral. 126. Ventral. 127. Lateral.

Scale lines. 0.1 mm; Figures 112-115, 121, 1.0 mm.

Abbreviations. C, conductor; E, embolus; P, paracymbium; T, tegulum.

view with a keel laterally (Figs. 124, 126); eastern North America, cave-dwelling and epigean (Map 5) ----- *menardi*

Meta menardi (Latreille)

Figures 112–127; Map 5

Aranea menardii Latreille, 1804, Histoire Naturelle Générale des Crustacés et des Insectes, 7: 266.

Specimens described from le Mans, France, lost.

Meta menardi:—Thorell, 1870, Rem. Syst. Europ. Spiders, p. 38. Emerton, 1884, Trans. Connecticut Acad. Sci., 6: 328, pl. 34, fig. 18, pl. 37, fig. 33, ♀, ♂. McCook, 1893, American Spiders, 3: 246, pl. 22, figs. 4, 5, ♀, ♂. Keyserling, 1893, Spinnen Amerikas, 4: 313, pl. 16, fig. 231, ♀, ♂. Emerton, 1902, Common Spiders, p. 190, figs. 443–445, ♀, ♂. Wiehle, 1927, Z. Morphol. Ökol. Tiere, 8: 513, web. Wiehle, 1931, in Dahl, Tierwelt Deutschlands, 23: 128, figs. 4c, 5b, 205–209, ♀, ♂. Nielsen, 1932, Biology of Spiders, 2: 502, figs. 344–346, webs, egg-sacs. Comstock, 1940, Spider Book, rev. ed., p. 433, figs. 431–433, ♀, ♂, egg-sac. Roewer, 1942, Katalog der Araneae, 1: 916. Kaston, 1948, Bull. Connecticut Geol. Natur. Hist. Surv., 70: 223, figs. 700–703, ♀, ♂. Locket and Millidge, 1953, British Spiders, 2: 119, figs. 78, B, C, ♀, ♂. Bonnet, P., 1957, Bibliographia Araneorum, 2: 2787.

Description. Female. Epigynum has a median hairy bulge (hairs not shown in Fig. 117). Total length, 12.5 mm. Carapace, 5.8 mm long, 4.5 mm wide. First femur, 8.9 mm; patella and tibia, 11.2 mm; metatarsus, 9.0 mm; tarsus, 3.0 mm. Second patella and tibia, 9.4 mm; third, 6.1 mm; fourth, 7.8 mm.

Male. The abdomen is more elongate than that of female. Total length, 10.0 mm. Carapace, 5.0 mm long, 3.7 mm wide. First femur, 8.1 mm; patella and tibia, 10.4 mm; metatarsus, 8.8 mm; tarsus, 2.9 mm. Second patella and tibia, 8.2 mm; third, 4.9 mm; fourth, 6.3 mm.

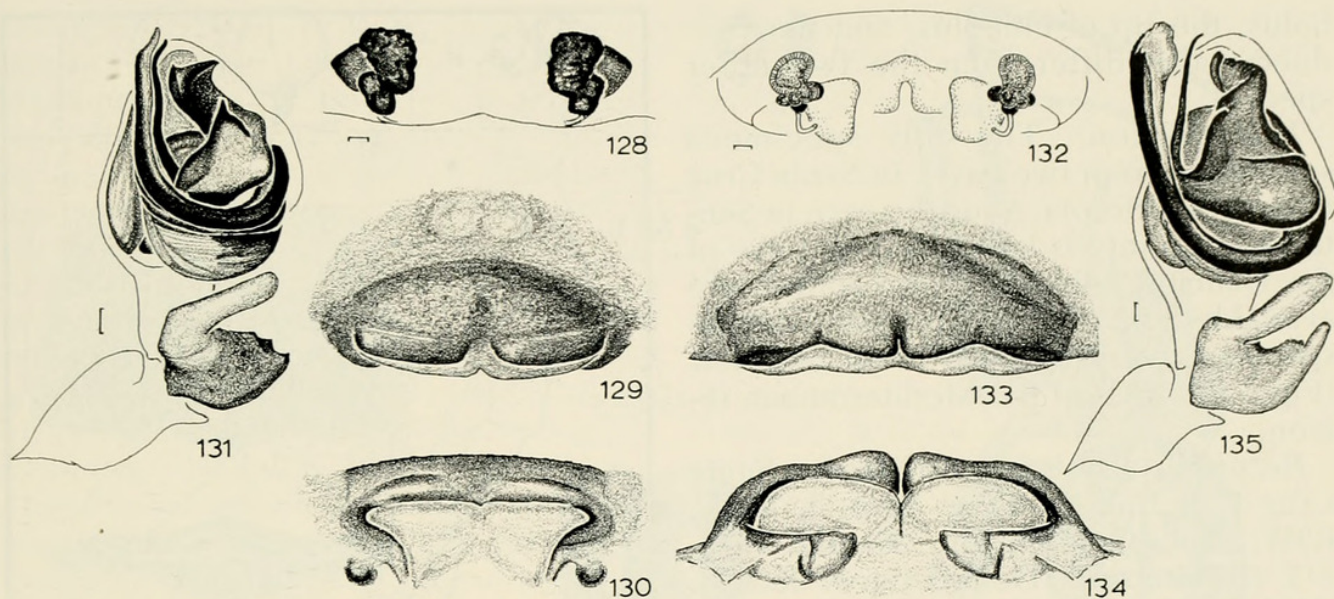
Variation. Females vary in size from 7.8 to 13.7 mm total length; carapace, 4.0 to 5.9 mm long, 3.3 to 4.5 mm wide, first patella and tibia, 8.2 to 11.5 mm long. Males vary in size from 7.0 to 10.1 mm total length; carapace, 3.7 to 5.2 mm long, 3.0 to 4.0 mm wide; first patella and tibia, 8.3 to 11.6 mm long.

Diagnosis. *Meta menardi* females dif-

fer from *M. dolloff* and from other species by the median swollen bulge of the epigynum (Fig. 117); the bulge is hairy (not shown in illustrations). The male differs from *M. dolloff* and other species by the shape of the huge median apophyses (P in Figs. 124, 126). Juveniles can generally be identified by the abdominal markings: a pair of anterior, dorsal dark patches (Figs. 113, 114) together with two ventral parallel light lines (Fig. 115). The only other species of *Meta* in North America, *M. dolloff*, is found in California. *Meta* has been confused with *Zygiella*. But the dorsal abdominal pattern of *Zygiella* species is always different, more like that of *Metleucauge*.

Natural History. Many specimens in collections come from deep within caves, around the mouth of caves, and from old mines and wells; but the species is also found in dark ravines, under overhanging rocks, and sometimes in cool cellars. Males and females appear mature at all seasons. The web is at a slight angle from the vertical, to horizontal. Kaston (1948) reports 8 to 18 radii in an orb 15 to 30 cm across. The hub is open. The spider hangs in the hub or at the end of a trap-line under a nearby rock. The egg-sac is large, white, drop-shaped, fluffy and translucent, about 20 mm long. It hangs on a thread near the web; it is pictured in Comstock (1940). Wiehle (1931) believes that this species takes at least two years to mature.

Distribution. Judging from its habitat, the species is probably native. Eurasia, eastern Canada and United States (Map 5) from Newfoundland to Minnesota, eastern Oklahoma and south along the Appalachian Mountains. The westernmost localities are a cave near Rock Port, Atchison Co., Missouri, 6 November 1904, 30 December 1904 (C. R. Crosby, Cornell Univ. Coll.), Three Forks Cave, Gittin Down Mountain, Adair Co., Oklahoma, 1 August 1959, ♀ (J. Black, AMNH); southernmost is Baton Rouge, Louisiana (Gibbeau, Cornell Univ. Coll.).



Figures 128–131. *Meta bourneti* Simon (Mediterranean). 128–130. Epigynum. 128. Dorsal, cleared. 129. Ventral. 130. Posterior. 131. Left male palpus.

Figures 132–135. *M. dolloff* new species. 132–134. Epigynum. 132. Dorsal, cleared. 133. Ventral. 134. Posterior. 135. Left palpus.

Scale lines. 0.1 mm.

Meta dolloff new species Figures 132–135; Map 5

Pseudometa biologica:—Graham, 1967, Caves and Karst, 9: 17. Not *P. biologica* Chamberlin (= *Zygiella x-notata*).

Holotype. Male holotype from Empire Cave, Santa Cruz Co., California, 26 August 1963 (R. Graham), in the American Museum of Natural History. The specific name is a noun in apposition after one of the localities.

Description. Female paratype. Carapace, sternum, labium brown. Coloration much like *Meta menardi*, leg banding less distinct. Dorsum of abdomen anteriorly with a pair of dark patches; in between patches are two light triangles, pointing anteriorly, one after the other; posteriorly abdomen has dark transverse bars. Sides streaked. Venter has two parallel light lines on dark gray. Head region of carapace very narrow; thoracic depression a deep pit. Eyes subequal in size. Anterior median eyes slightly less than their diameter apart, 1.3 from laterals. Posterior medians their diameter apart, 1.4 from laterals. Chelicerae very strong, with a basal boss. Three teeth on anterior

margin, two together near base of fang. Posterior margin with three teeth close to fang, one more distal. Total length, 14.0 mm. Carapace, 6.3 mm wide, 5.0 mm long. First femur, 9.6 mm long; patella and tibia, 12.9 mm; metatarsus, 10.3 mm; tarsus, 3.5 mm. Second patella and tibia, 10.2 mm; third, 6.6 mm; fourth, 9.0 mm.

Male. Coloration, eye placement and cheliceral teeth as in female. Total length, 11.0 mm. Carapace, 5.9 mm long, 4.5 mm wide. First femur, 10.2 mm long; patella and tibia, 13.3 mm; metatarsus, 11.7 mm; tarsus, 3.2 mm. Second patella and tibia, 10.6 mm long; third, 6.2 mm; fourth, 7.9 mm.

Diagnosis. *Meta dolloff* females, unlike those of *Meta menardi*, have a median notch at the anterior lip of the epigynum (Fig. 133). The notch is narrower than that of *M. bourneti* (Fig. 129). The paracymbium of the male palpus has a large ventral finger and a smaller lateral one (Fig. 135), while that of *M. bourneti* (Fig. 131) and *M. menardi* (Fig. 126) has only a ventral one. The structure of the distal projection of the base of the em-

bolus, the tip of embolus, and the conductor also differ from the two other species.

Distribution. The only specimens seen come from two caves in Santa Cruz County, California. A nearby cave in Santa Cruz County is known as the Cave of the Dancing Spiders, but no spiders are available from it. It is of interest that this species is very close to *Meta bourneti* (Figs. 128–131) of the Mediterranean region.

Records. Paratypes. *California*. Santa Cruz Co.: Empire Cave, Sect. 3, T11S, R3W, Santa Cruz Quadr., 26 Aug. 1963, 3 ♀ (R. Graham); Dolloff Cave, Sect. 3, T11S, R3W, Santa Cruz Quadr., 28 Aug. 1963, ♀ (R. Graham).

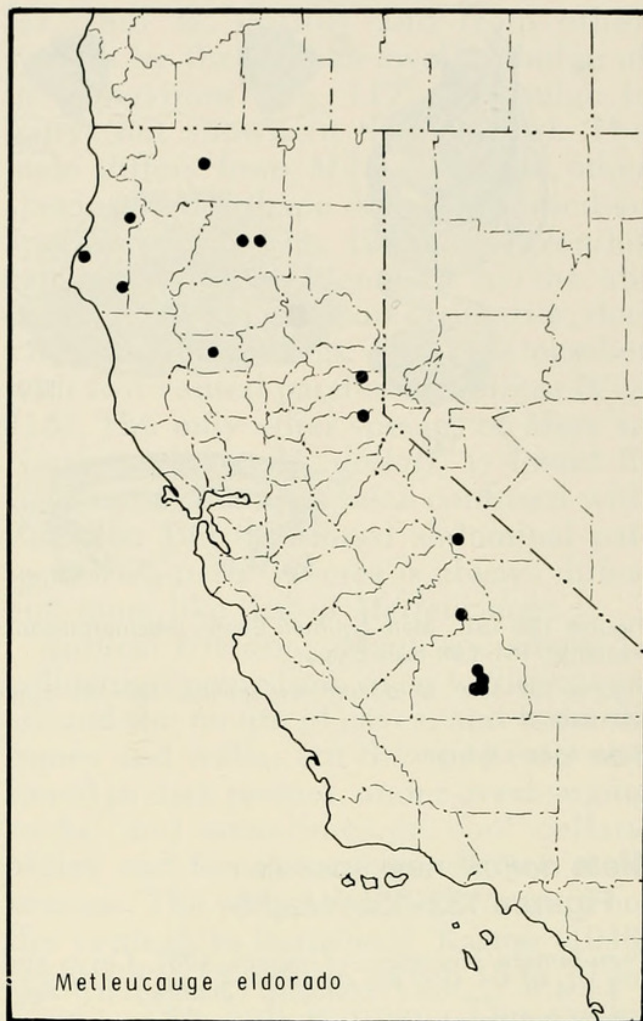
Metleucauge new genus

Type species. *Metleucauge eldorado*. The generic name is feminine.

Diagnosis. The abdomen, unlike that of *Metellina* and *Meta* species, is ovoid, dorsoventrally flattened, and widest in the middle (Figs. 142, 143). The epigynum is a flat sclerotized structure, unlike that of *Meta* and *Metellina*, and has pockets on the sides of the venter (Figs. 137, 138). Unlike those of related genera, the articles of the palpus are elongated, and the palpal trochanter has a distal spur (Figs. 145, 151). The paracymbium is reduced (P in Figs. 146, 147, 149); the large tegulum shows the coiled duct, resembling *Leucauge* species; and the expanded palpus shows the presence of conductor, embolus and an additional sclerite (Figs. 148–150), unlike *Leucauge*, *Meta* and *Metellina*.

Trichobothria are absent from the femur; there are two rows of dorsal trichobothria on basal third of tibiae, and there is one trichobothrium dorsally on proximal end of metatarsus.

Males slightly smaller than females, having elongate palpal articles and a spur distally on the long palpal trochanter (Figs. 145, 151). Males do not have coxae or legs modified.

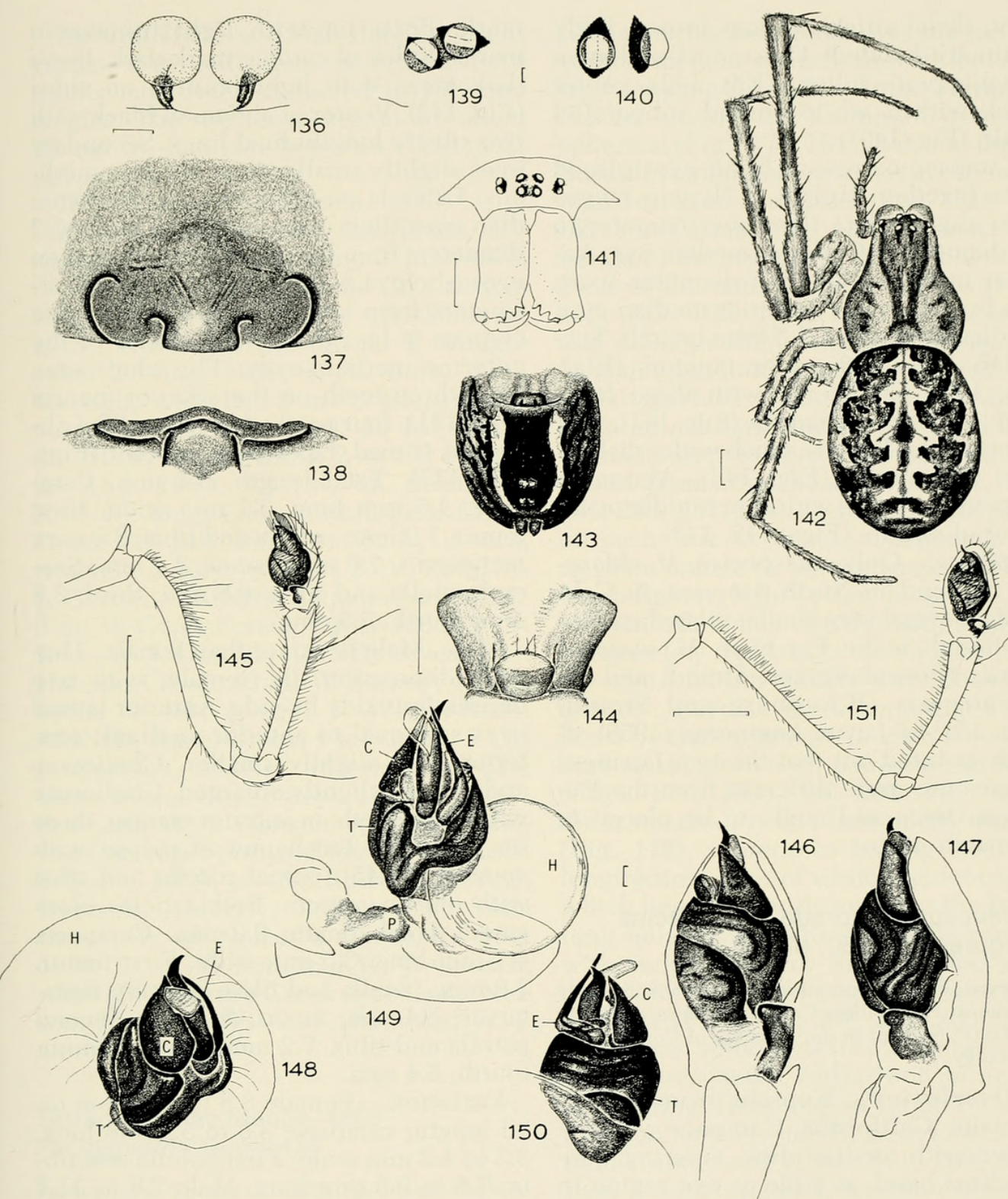


Map 6. Distribution of *Metleucauge eldorado* new species.

Genitalia. The epigynum is a sclerotized plate with the openings in slits on each side on the venter leading into lightly sclerotized seminal receptacles (Figs. 136–138). Again, I am uncertain if there are separate fertilization ducts, but I think these are present (Fig. 136).

The palpus differs from that of *Meta* or *Metellina* in having a much smaller paracymbium (P in Figs. 146, 147, 149), in having the duct in the tegulum (T) coiled as in *Leucauge*, and in having the conductor or embolus base broken, forming an additional sclerite (Figs. 148–150). The homology of this sclerite is not certain.

Description. Carapace brown, thorax light on each side, rim of thorax and thoracic depression darkest (Fig. 142). Chelicerae brown. Sternum dark. Coxae



Figures 136–150. *Metleucauge eldorado* new species. 136–144. Female. 136–138. Epigynum. 136. Dorsal, cleared. 137. Ventral. 138. Posterior. 139. Left lateral eyes. 140. Posterior median eyes. 141. Eye region and chelicerae. 142. Dorsal. 143. Ventral. 144. Labium and endites. 145–150. Left male palpus. 145. Ventrolateral. 146. Ventral. 147. Lateral. 148–150. Expanded. 148. Ventrolateral. 149. Dorsal. 150. Mesal.

Figure 151. *M. kompirensis* (Bösenberg and Strand), new combination, left palpus, subventral (Japan).

Scale lines. 0.1 mm; Figures 141–145, 151, 1.0 mm.

Abbreviations. C, conductor (uncertain); E, embolus; H, hematodocha; P, paracymbium.

light; distal articles of legs brown, fairly distinctly banded. Dorsum of abdomen variable with folium (Fig. 142), venter black with 2 white curved subparallel marks (Fig. 143).

Carapace narrow in front; eyes placed close together. Height of clypeus ranges from slightly less than one diameter to 1.5 diameters of anterior median eye. Anterior median eyes their diameter apart, two from laterals. Posterior median eyes 1.3 diameters apart, 1.5 from laterals. Secondary eyes with canoe tapetum (Figs. 139, 140). Chelicerae with three large teeth on anterior margin (Fig. 141), four on posterior. Endites much wider distally than proximally (Fig. 144). Abdomen longer than wide, widest in middle or anterior of middle (Figs. 142, 143).

Species. Only one species, *M. eldorado*, is found in North America, in California. Several very similar related species are found in the Far East: *M. yunohamensis* (Bösenberg and Strand) and *M. kompirensis* (Bösenberg and Strand) (Fig. 151) of Japan. Yaginuma (1958) already pointed out that the two Japanese species are quite different from the European *Meta* and ought to be placed in a separate genus.

Metleucauge eldorado new species Figures 136–150; Map 6

Holotype. Female from rock on river bank, Sequoia National Park, Tulare County, California, 20 July 1968 (P. Nelson) in the Museum of Comparative Zoology.

Description. Female from King's Canyon, California. Carapace yellow-brown with median dark, tapering, longitudinal band, as wide as eye region in front and enclosing a light streak (Fig. 142). Margin of thorax with a narrow line; on side of thorax a dark "W," light towards median, fading into sides. Dark carapace areas with setae. Dark rings around eyes. Clypeus light. Chelicerae, endites, labium brown. Sternum dark, lightest in center. Legs banded. Dorsum of abdomen with branching, light cardiac

mark. Posterior with light transverse marks. Sides of cardiac mark dark, these dark areas with light borders on sides (Fig. 142). Venter of abdomen black with two silvery longitudinal lines. Secondary eyes slightly smaller than anterior medians. Laterals on tubercles. Anterior median eyes their diameter apart, about 1.2 diameters from laterals. Posterior median eyes about 1.5 diameters apart, 1.5 diameters from laterals. The height of the clypeus is less than the diameter of the anterior median eyes. The chelicerae have three teeth on the anterior margin (Fig. 141), four on the posterior. The abdomen is oval, tapering to a point (Figs. 142, 143). Total length, 9.4 mm. Carapace, 4.5 mm long, 3.7 mm wide. First femur, 7.0 mm; patella and tibia, 8.9 mm; metatarsus, 7.6 mm; tarsus, 2.4 mm. Second patella and tibia, 6.6 mm; third, 3.8 mm; fourth, 5.5 mm.

Male. Male is darker than female. Thoracic depression like female, with two depressions side by side. Anterior lateral eyes subequal to anterior medians; posterior eyes slightly smaller. Chelicerae and endites slightly enlarged. Chelicerae with three teeth on anterior margin, three on posterior. Trochanter of palpus with spur (Fig. 145); palpal patella and tibia with one macroseta. Both articles elongated. Total length, 9.0 mm. Carapace, 4.7 mm long, 3.5 mm wide. First femur, 7.6 mm; patella and tibia, 9.4 mm; metatarsus, 8.4 mm; tarsus, 2.7 mm. Second patella and tibia, 7.2 mm; third, 3.6 mm; fourth, 5.4 mm.

Variation. Female 8.8 to 11.3 mm total length; carapace, 3.9 to 5.2 mm long, 3.3 to 4.2 mm wide. First patella and tibia, 7.6 to 9.6 mm long. Male 7.8 to 11.7 mm total length; carapace, 3.9 to 6.2 mm long, 3.1 to 4.8 mm wide; first patella and tibia, 9.2 to 11.5 mm long.

Diagnosis. The shape of the epigynum (Fig. 137), the shape of the sclerites in the palpus (Figs. 146, 147) and the shape of the trochanter tooth (Fig. 145) distinguish the species from the Asian *Metleucauge*.

Natural History. Males are almost as common in collections as females. All adults have been collected in July and August. The species makes an orb about 28 cm in diameter between rocks near streams.

Distribution. California.

Records. Paratypes. California. El-dorado Co.: W. of Kyburz, 3 July 1978, ♀ (D. Boe, MCZ). Glenn Co.: Brittan Ranch, 18 May 1968, ♂ (R. Hansen, CAS). Humboldt Co.: 10 mi E Bridgeville, 20 Aug. 1959, ♂ (V. Roth, W. J. Gertsch, AMNH); 2 mi S Blocksburg, stream under Alderpoint, 19 July 1968, 1 ♀ (H. B. Leech, CAS); 2 mi SE Hoopa, 23 Aug. 1969, 1 ♂ (M. M. Bentzien, EMUC). Kings Canyon Natl. Park: Cedar Grove, 16 July 1952, ♀ (W. J. Gertsch, AMNH); 5 July 1956, ♀, ♂ (V. Roth, W. J. Gertsch, AMNH); Sequoia Natl. Park: 3 mi W Giant Forest, 9 July 1958, ♀ (V. Roth, W. J. Gertsch, AMNH). Shasta Co.: Hatchet Creek, 10 mi W Burney, 1 Aug. 1953, ♀ (W. J. and J. W. Gertsch, AMNH); Hazel Creek, 4 July 1952, ♀ (W. J. Gertsch, AMNH). Sierra Co.: The Cups, Sierra City, 6 Sept. 1959, ♀, ♂ (V. Roth and W. J. Gertsch, AMNH). Siskiyou Co.: Ney Springs, 5 mi W Mt. Shasta, 2 Sept. 1959, ♂ (V. Roth and W. J. Gertsch, AMNH). Tulare Co.: Soda Creek, W of Nelson's Camp, 11 July 1958, ♀, ♂ (V. Roth and W. J. Gertsch, AMNH); McIntire Creek near Camp Nelson, 11 July 1958, ♀ (V. Roth and W. J. Gertsch, AMNH).

Tetragnathinae Menge, 1866

Pachygnatha Sundevall

Pachygnatha Sundevall, 1823, Specimen Academicum Geneva Araneidum p. 16. Type species *P. clercki* by monotypy. The name is feminine.

Diagnosis. *Pachygnatha* differs from the *Meta* group of genera in lacking tapetum in the posterior median eyes, and in having the rhabdoms arranged in rows which loop (Figs. 157, 159, 161). Unlike *Tetragnatha*, the lateral eyes still have the canoe tapetum (Figs. 156, 158, 160).

Glenognatha has similar eyes but has the ventral median spiracle moved anteriorly. *Pachygnatha* differs from *Tetragnatha* in having the abdomen ovoid to spherical (Figs. 171, 184, 244), and differs from all similar genera in having the sternum surround the coxae (Fig. 152). Unlike most Araneinae and Metinae, the height of the clypeus is equal to 2 diameters of the anterior median eyes (Figs. 154, 155, 162, 163). Like *Tetragnatha* and *Glenognatha*, female *Pachygnatha* lack an epigynum (copulatory pores).

Description. Carapace with median longitudinal dark band, and a band from thoracic depression anteriolateral between thorax and head (Figs. 171, 184, 196, 208, 232, 244). Indistinct dark patch on each side of thorax. Chelicerae and sternum orange to brown; coxae and legs much lighter, light yellow to orange, not banded. Abdomen dorsum with a folium bordered by dark marks with adjacent silver spots, folium usually with lobes posteriorly. Cardiac mark sometimes outlined by dark pigment, or with a median dark mark; often with paired white spots (Figs. 171, 184, 196, 208, 232, 244). Sides streaked; venter indistinctly marked (Fig. 172), sometimes having two fine longitudinal lines of white pigment spots which bend anteriorly and pass the booklung spiracles laterally (Fig. 185); usually with indistinct dark lines behind genital opening and dark pigment above genital area (Figs. 172, 209, 221, 233, 245). Carapace smooth without setae, but sometimes with indistinct punctate sculpturing. Head region set off by a depression on each side in groove between thorax and head (Figs. 171, 208, 244). Eyes closely grouped, median eyes their diameter apart, 1.5 to 2 diameters from laterals. Height of clypeus 2 to 3 diameters of anterior median eyes. Chelicerae very large and heavy, always with 3 teeth on anterior margin in female, usually 4 on posterior (3 in *P. autumnalis*) (Figs. 154, 155, 162). Those of male modified and expanded, sometimes with a spur outside, above base of fang (Figs. 215,

227). Southern females of *P. furcillata* also have a spur in this location (Fig. 165). Labium large, endites very long (Fig. 153), and sternum surrounding coxae varies (Fig. 152) slightly in different species. Sternum may be truncate or notched between posterior coxae (Fig. 152). All legs rather thin and lacking macrosetae, but with several trichobothria on femur at base; dorsally, several on tibia and usually one on metatarsus (Fig. 173). Abdomen subspherical, slightly flattened dorsoventrally (Figs. 171, 184). Book-lung spiracles rebordered, posterior median spiracle close to spinnerets (Figs. 168, 172, 217, 221).

Males are the same size as females, unlike most araneid spiders. The chelicerae are often enlarged and bent (Figs. 163, 203, 239).

Genitalia. The palpus is very simple but can be derived from a *Meta*- and *Leucauge*-like structure. There is a spherical tegulum (T in Fig. 177); from its tip there is only a long embolus (E) supported by a conductor (C). The cymbium (Y) is much modified and narrow, and the paracymbium (P in Fig. 177) is a free sclerite.

The female genitalia can easily be derived from the simple epigynum of *Meta*. A ventral lobe overhangs the original openings; a new median opening is posterior and separate from the book-lung spiracle. This leads into a chamber whose dorsal roof is a continuation of the ventral body wall, with continuous setation (Figs. 169, 170, 182, 183). Anterior of this new chamber is a second (perhaps the original) opening on each side lead-

ing into the very short connecting duct to a seminal receptacle. This in turn apparently leads into a very short fertilization duct to the anterior median chamber. The median chamber appears open toward the posterior. *Pachygnatha tristriata* appears to lack seminal receptacles (Figs. 242, 243). The use of only one palpus in mating (Gerhardt, 1921) rather than both simultaneously, as in haplogyne spiders, is further evidence that the epigynum is secondarily lost.

Species. *Pachygnatha* species are found in Eurasia, Africa and North America. None are known from the American tropics. There are eight species in North America, one of which is shared with Eurasia. Many European species have been illustrated by Wiehle (1963), others from the Iberian peninsula by Senglet (1972).

Diagnostic Species Characters. The males of each species are best separated by the palpi. The shape of the conductor and embolus and the paracymbium are diagnostic in ventral view (Figs. 176, 237, 249), but the paracymbium shows more variation than the embolus tip. Chelicer-al modifications are variable and, although useful, are not the best diagnostic characters (Figs. 162–167).

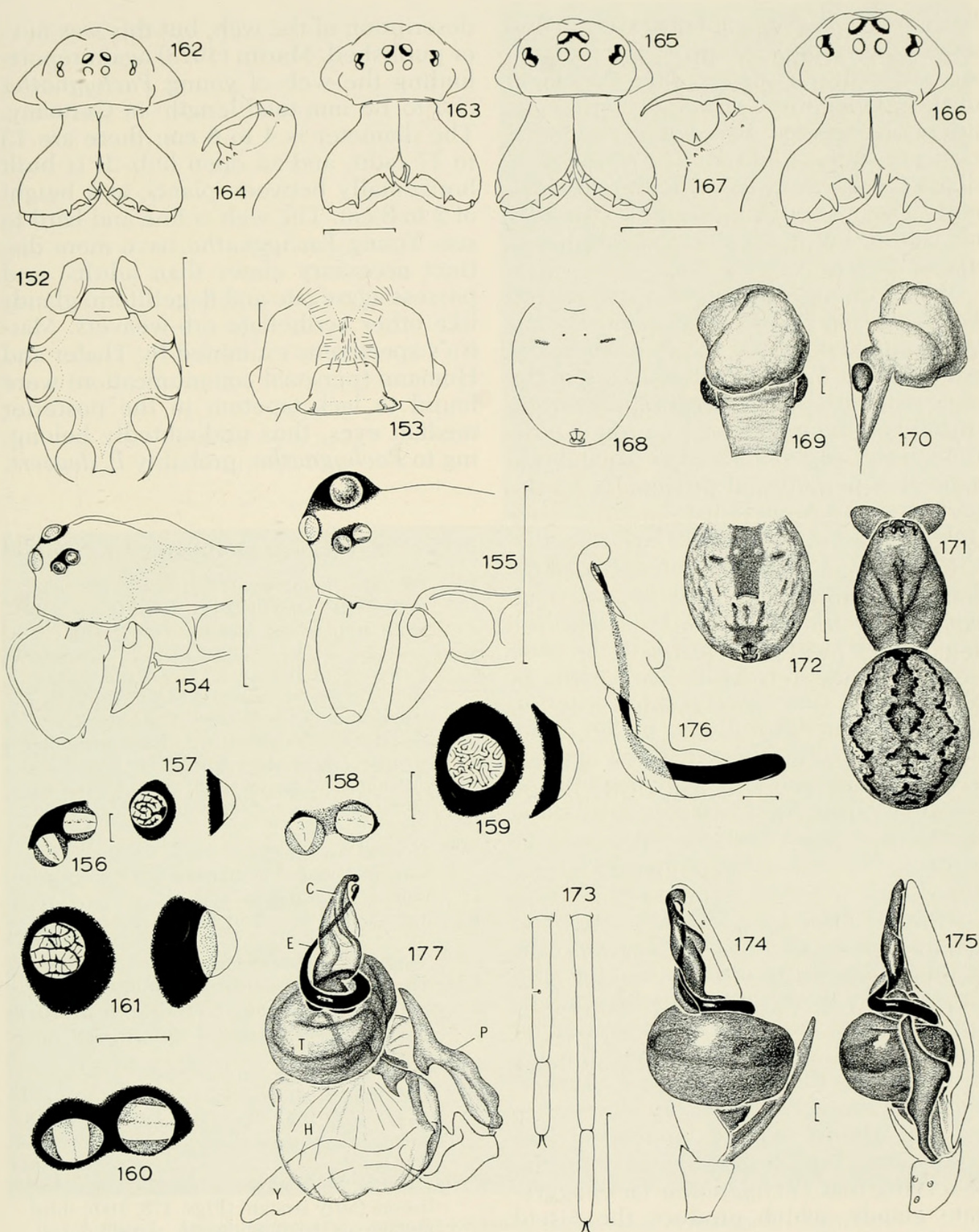
Females may be difficult to separate. Chelicerae show considerable variation, but are always more elaborate in *P. furcillata*; southern *furcillata* females even have a spur on the anterior face above the base of the fang (Fig. 165). Trichobothria are present or sometimes absent on metatarsus (Figs. 173, 210, 222). Since their

Figures 152–161. Morphology of *Pachygnatha*. 152. Sternum of *P. autumnalis*. 153. Labium and endites of *P. autumnalis*. 154, 155. Head and chelicerae. 154. *P. furcillata*. 155. *P. autumnalis*. 156–161. Secondary eyes. 156, 158, 160. Left laterals. 157, 159, 161. Posterior medians. 156, 157. *P. furcillata*. 158, 159. *P. autumnalis*. 160, 161. *P. xanthostoma*.

Figures 162–177. *P. furcillata* Keyserling. 162, 163, 165, 166. Eye region and chelicerae; 164, 167. Left chelicera, posterior view. 162, 165. Female. 163, 164, 166, 167. Male. 162–164. (Central New York State). 165–167. (Florida). 168–173. Female. 168. Position of genital opening. 169, 170. Internal genitalia. 169. Dorsal. 170. Lateral. 171. Dorsal. 172. Abdomen, ventral. 173. Left third and fourth metatarsus, dorsal. 174–177. Left male palpus; 174. Ventral. 175. Lateral. 176. Embolus and conductor, ventral. 177. Expanded, subventral.

Scale lines. 0.1 mm; Figures 152, 154, 155, 162–168, 171–173, 1.0 mm.

Abbreviations. C, conductor; E, embolus; H, hematodocha; P, paracymbium; Y, cymbium.



hairs are short, they are not as easy to find as in other groups; those of the metatarsus are easiest to locate. The placement of the trichobothria is not as constant as might be expected; that of the third metatarsus of *P. furcillata* may be in the middle of the article or closer to the proximal end. The placement was first carefully measured, but was found too variable to use as diagnostic character.

It is of interest that the two specialized *Pachygnatha*, *P. autumnalis* and *P. tristriata* (judged by the shape of the carapace and by the unusual structure of the male palpus), also have the trichobothrium distally on the metatarsus, a unique position in the superfamily. The trichobothrium is usually found proximally on the metatarsus in Araneoidea.

The seminal receptacles are of a distinct shape in *P. autumnalis* (Fig. 207), and the anterior soft parts appear diagnostic (Figs. 169, 170, 182, 183, 194, 195). The genital opening may be in the middle of the abdomen (Fig. 193), while in others of the same species more anterior, depending on the fullness of the abdomen. The width of the opening appears diagnostic, as well as its distance from an imaginary line between the book-lung spiracles or from the two small muscle sclerites between the spiracles (Figs. 181, 193).

Natural History. All *Pachygnatha* species are found in moist places on the ground (Plate 7); adults have lost the ability to make webs. *Pachygnatha* adults have reduced accessory claws needed for handling silk. I have examined the leg tips of a less than half-grown *P. autumnalis* and found the accessory claws present but almost smooth, appearing like other setae. Wiehle (1963) cites Apstein, observing that *Pachygnatha* lacks aggregate glands, which produce the viscid droplets on silk.

Balogh (1934) observed young to make webs. Wiehle (1963) questioned this observation and cites Homann raising *Pachygnatha* to the third molt without seeing webs. Balogh promised a further

description of the web, but this was never published. Martin (1978) again reports finding the web of young *Pachygnatha* (1.3 to 1.8 mm total length) in Germany. The diameter is 4 to 6 cm; there are 13 to 17 radii, and an open hub. It is built horizontally between plants, at a height of 2 to 8 cm. The web is fine and hard to see. Young *Pachygnatha* have more distinct accessory claws than adults, and possess aggregate and flagelliform glands like other ecribellate orb-weavers. Martin's specimens examined by Thaler and Homann (personal communication) were found to lack tapetum in the posterior median eyes, thus undoubtedly belonging to *Pachygnatha*, probably *P. degeeri*.

KEY TO FEMALE *PACHYGNATHA*

1. Posterior median eyes 2 to 3 times diameter of posterior laterals (Figs. 155, 202); only 3 teeth on posterior margin of chelicerae ---- *autumnalis*
- Posterior median eyes 1 to 1.5 times diameter of posterior laterals (Figs. 154, 214); 4 teeth on posterior margin of chelicerae ---- 2
- 2(1). Genital area covered by a thin, triangular sclerite longer than wide (Fig. 241, 245); dorsum of abdomen with two curved longitudinal lines, not wavy behind (Fig. 244) ---- *tristriata*
- Genital area without such sclerite (Figs. 229, 233); dorsal abdominal lines wavy behind or broken (Fig. 232) ---- 3
- 3(2). Total length less than 4.2 mm ---- *xanthostoma*
- Total length more than 4.5 mm ---- 4
- 4(3). Trichobothrium dorsally on fourth metatarsus (Fig. 234); Alaska, Canada ---- *clercki*
- Fourth metatarsus never with trichobothrium (Fig. 173) ---- 5
- 5(4). Head with bulge on each side (Figs. 154, 162, 165); chelicerae elongated and curved (Figs. 162, 165); trichobothrium on third metatarsus dorsal and near middle of article (Fig. 173) ---- *furcillata*
- Head without bulges (Figs. 178, 190); chelicerae fairly straight (Figs. 178, 190); third metatarsus trichobothrium posterodorsal, twice as far from distal end of article as from proximal end (Figs. 186, 198) ---- 6
- 6(5). Genital opening one to 1½ times its width distant from two tiny sclerites between book-lung spiracles (Fig. 181); in middle or closer to sclerites between book-lungs than to spinnerets (Fig. 181) ---- *brevis*

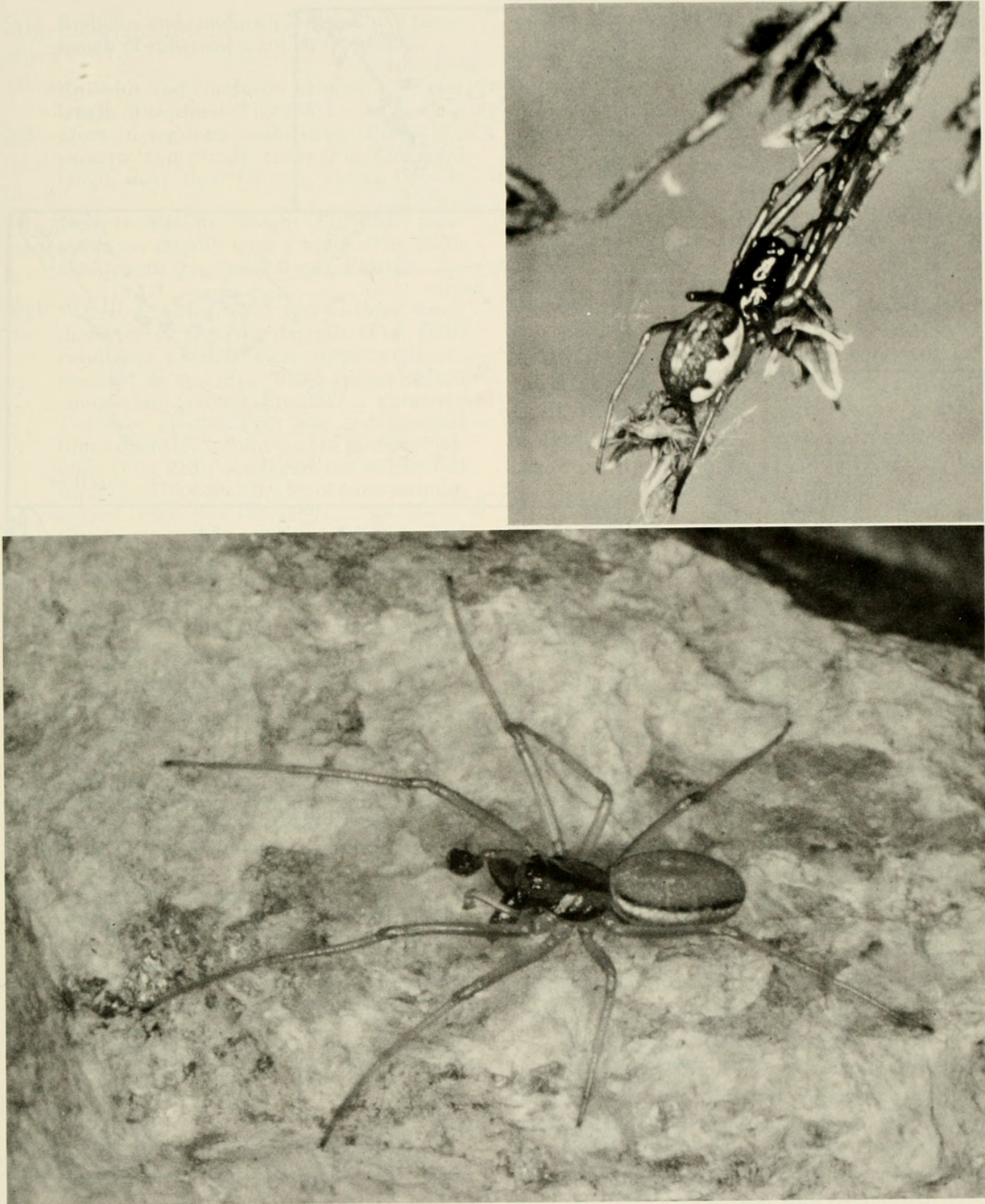
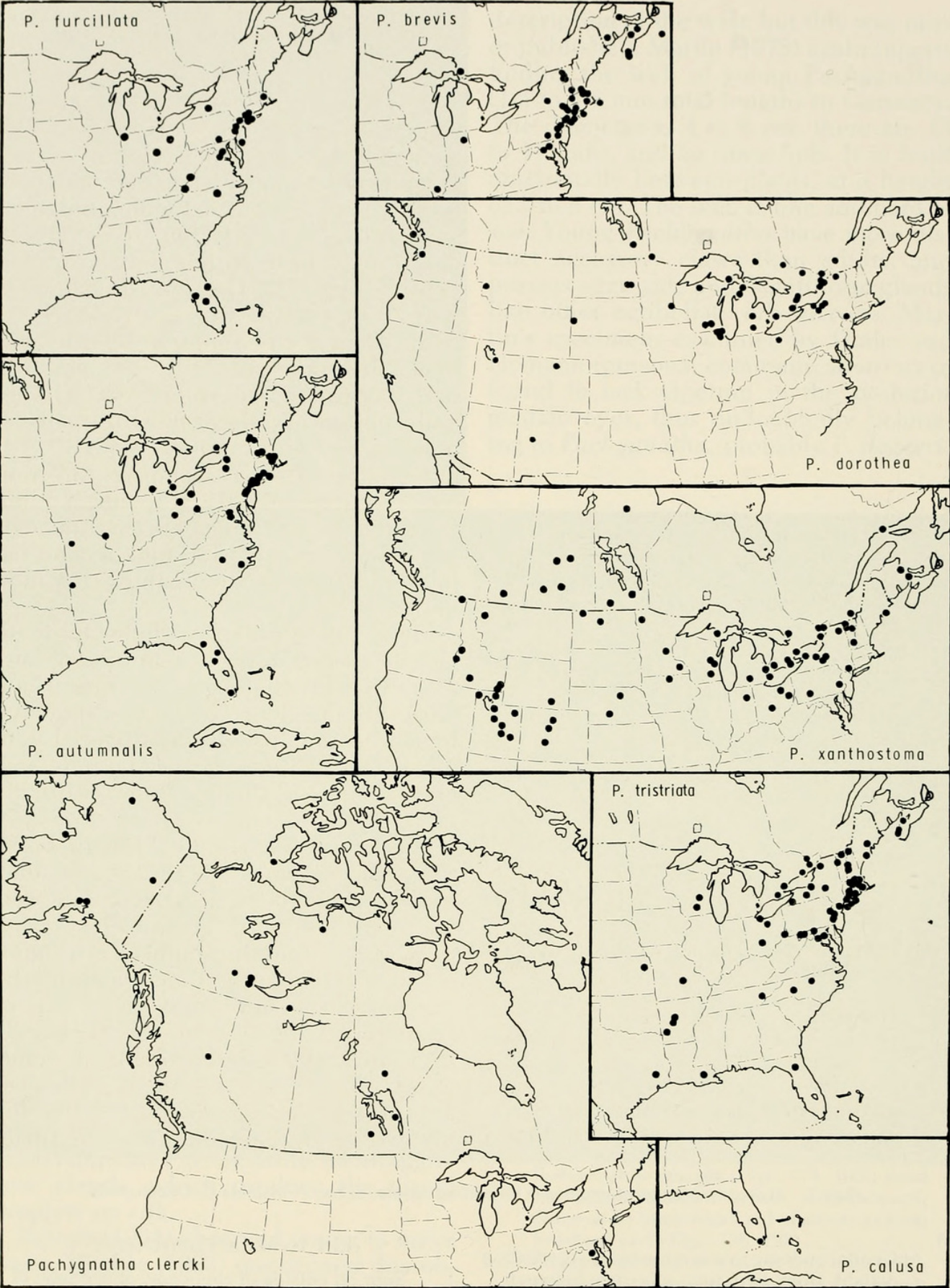


Plate 7. Above, *Pachygnatha autumnalis* Keyserling, female; below, *P. tristriata* C. I. Koch, male.

- Genital opening two or more times its width distant from two tiny sclerites between book-lung spiracles (Fig. 193); closer to spinnerets than to book-lungs (Fig. 193)----- *dorothea*

KEY TO MALE *PACHYGNATHA*

- | | | |
|----|---|---|
| 1. | Spur on outside of chelicerae above base of fang (Figs. 215, 227) ----- | 2 |
| - | Chelicerae without such spur (Figs. 166, 203, 239) ----- | 4 |



Map 7. Distribution of *Pachygnatha* species.

- 2(1). Embolus and conductor length 2 to 3 times length of spherical tegulum (Fig. 223) ----- *xanthostoma*
 - Embolus and conductor at most 1.5 times length of tegulum (Fig. 235) ----- 3
- 3(2). Duct in tegulum undulating (Fig. 235); paracymbium distally entire (Fig. 236); total length more than 4.0 mm; Alaska, Canada ----- *clercki*
 - Duct in tegulum straight (Fig. 252); paracymbium distally with a notch (Fig. 253); total length less than 2.0 mm; Florida ----- *calusa*
- 4(1). Posterior median eyes two to three times diameter of posterior laterals (Fig. 203); conductor pointed away from cymbium, notched at tip (Fig. 213); paracymbium straight and pointed (Fig. 212) -- *autumnalis*
 - Posterior median eyes one and one-half times diameter to subequal of posterior laterals (Fig. 215); conductor not notched at tip (Figs. 176, 189, 201); tip of paracymbium curved (Figs. 175, 188, 200) ----- 5
- 5(4). Conductor straight, embolus coiled behind tegulum; length of conductor and embolus two to three times length of spherical tegulum (Fig. 247); abdomen with 2 curved longitudinal lines not wavy behind (Fig. 244) ----- *tristriata*
 - Conductor lobed or twisted, embolus not coiled behind tegulum; length of conductor and embolus less than twice length of spherical tegulum (Figs. 187, 199); two broken lines on dorsum of abdomen waving toward posterior (Figs. 184, 196) ----- 6
- 6(5). Distal part of paracymbium without neck, tip pointed toward cymbium (Fig. 175); head with swelling on each side (Figs. 154, 163, 166) ----- *furcillata*
 - Distal part of paracymbium with narrow neck, tip pointed away from cymbium (Figs. 188, 200); head without swelling (Fig. 184, 196) ----- 7
- 7(6). In ventral view of palpus, base of conductor not visible above wide embolus (Fig. 189) ----- *brevis*
 - In ventral view of palpus, base of conductor visible above embolus (Fig. 201) -- *dorothea*

Pachygnatha furcillata Keyserling

Figures 154, 156, 157, 162–176; Map 7

Pachygnatha furcillata Keyserling, 1884, Verhändl. Zool. Bot. Ges. Wien, 32: 662, pl. 21, fig. 11, ♀. Female syntypes from Philadelphia in the Marx collection of the U.S. National Museum of Natural History, lost; one female in the Keyserling collection of the British Museum, Natural History, examined. McCook, 1894, American Spiders, 3: 271, pl. 28, fig. 3, ♀. Bryant, 1933, Bull. Mus.

Comp. Zool., 74: 177, pl. 4, figs. 38, 39, ♂. Kaston, 1948, Bull. Connecticut Geol. Natur. Hist. Surv., 70: 267, figs. 842, 858, ♀, ♂.

Description. Female. Carapace orange with darker lines. Head and eye area yellow. Chelicerae yellow-orange. Dorsum of folium with angular lobes posteriorly (Fig. 171). Head with a bulge on each side (Figs. 154, 162, 165, 171); in dorsal view, head outline not constricted behind (Fig. 171). The genital opening is narrow, a distance of about twice its width from the two muscle sclerites between the book-lungs (Fig. 168), closer to book-lungs than to spinnerets. Trichobothrium on middle of third metatarsus, none on fourth metatarsus (Fig. 173). Total length, 6.6 mm. Carapace, 3.2 mm long, 2.2 mm wide. First femur, 3.2 mm long; patella and tibia, 4.0 mm; metatarsus, 2.7 mm; tarsus, 1.4 mm. Second patella and tibia, 3.5 mm; third, 2.2 mm; fourth, 3.0 mm.

Male. Three posterior cheliceral teeth closely spaced, one close to base of fang (Fig. 167). Total length, 5.5 mm. Carapace, 2.7 mm long, 2.0 mm wide. First femur, 3.3 mm; patella and tibia, 4.1 mm; metatarsus, 2.7 mm; tarsus, 1.4 mm. Second patella and tibia, 3.7 mm; third, 2.2 mm; fourth, 3.2 mm.

Variation. Female total length, 5.2 to 6.2 mm; carapace, 2.4 to 2.9 mm long. Male total length, 4.6 to 5.9 mm; carapace, 2.3 to 2.9 mm long. The smallest specimens come from the southeastern states. Adult and juvenile females from the southeastern states may have a spur above the fang base on the chelicerae (Fig. 165); the fang is minute in some, absent in northern specimens. (The eyes appear larger in Fig. 165 than in Fig. 162 because of the size difference: the smaller southern specimen has relatively larger eyes.)

Diagnosis. Females of this species are readily identified by their light head with bulges on each side (Figs. 154, 162, 171). Females from the southeastern states may have a spur on the chelicerae

above the base of the fang (Fig. 165). Males are identified by the knobbed tip and lateral lobe on the tip of conductor (Figs. 174, 176) and by the tip of the paracymbium pointed toward the cymbium (Fig. 175).

Natural History. The species has been collected from a cedar bog in Ohio, a bog in Massachusetts, bottom land hardwood in North Carolina.

Distribution. New England west to Indiana, south to Florida (Map 7).

***Pachygnatha brevis* Keyserling**
Figures 178–189; Map 7

Pachygnatha tristriata:—Keyserling, 1882, Verhandl. Zool. Bot. Ges. Wien, 32: 209 (not *P. tristriata* C. L. Koch).

P. brevis Keyserling, 1883, Verhandl. Zool. Bot. Ges. Wien, 33: 658. New name for *P. tristriata*:—Keyserling, 1882, misidentified. Male specimen marked “Amer. N.” in the Muséum National d’Histoire Naturelle, Paris, examined and labeled lectotype. Emerton, 1884, Trans. Connecticut Acad. Sci., 6: 336, pl. 34, fig. 21, pl. 40, figs. 8, 10, ♀, ♂. ?McCook, 1894, American Spiders, 3: 267, pl. 26, figs. 9, 10a, pl. 28, fig. 2, ♀, ♂. Comstock, 1912, *The Spider Book*, p. 407, figs. 101, 418, ♂. Kaston, 1948, Bull. Connecticut Geol. Natur. Hist. Surv., 70: 267, figs. 841, 857, ♀, ♂.

Note. A collection labeled in pencil *Pachygnatha tristriata* C. L. Koch, Amer. N., no. 2942 was found within the collection of the Paris museum. In the vial was one shriveled *P. tristriata* female, two male *P. clercki*, and one pair of *P. brevis*. The male of the two was marked lectotype, the female, paralectotype.

Description. Female. Carapace with dark band enclosing median eyes (Fig. 184). Dorsum of folium lobed in posterior part (Fig. 184). Carapace has a constriction between head and thorax (Fig. 184)

in dorsal view. The genital opening is a distance about equal to its width or one and one-half times its width from the two sclerites between the book-lungs; it is equidistant or closer to sclerites than to spinnerets (Fig. 181). Third metatarsus has a trichobothrium one third distance from proximal end in slightly posterior position; the fourth lacks a trichobothrium (Fig. 186). Total length, 5.6 mm. Carapace, 2.7 mm long, 1.9 mm wide. First femur, 2.7 mm; patella and tibia, 3.5 mm; metatarsus, 2.3 mm; tarsus, 1.2 mm. Second patella and tibia, 3.2 mm; third, 1.9 mm; fourth, 2.7 mm.

Male. Posterior of the chelicerae with four teeth, the distal three almost equally spaced (Fig. 180). Total length, 5.5 mm. Carapace, 2.7 mm long, 2.0 mm wide. First femur, 2.8 mm; patella and tibia, 3.6 mm; metatarsus, 2.4 mm; tarsus, 1.2 mm. Second patella and tibia, 3.5 mm; third, 2.0 mm; fourth, 2.7 mm.

Variation. Female total length 4.6 to 5.5 mm; carapace 2.4 to 2.6 mm long. Male total length 4.5 to 5.6 mm; carapace 2.2 to 2.6 mm long.

Diagnosis. This species is easily confused with *P. dorothea*; females are difficult to separate. The females can be distinguished by the wide genital opening, equidistant from spinnerets and book-lungs or closer to book-lungs (Fig. 181). The male can be separated from *P. dorothea* by the heavy embolus (Fig. 189).

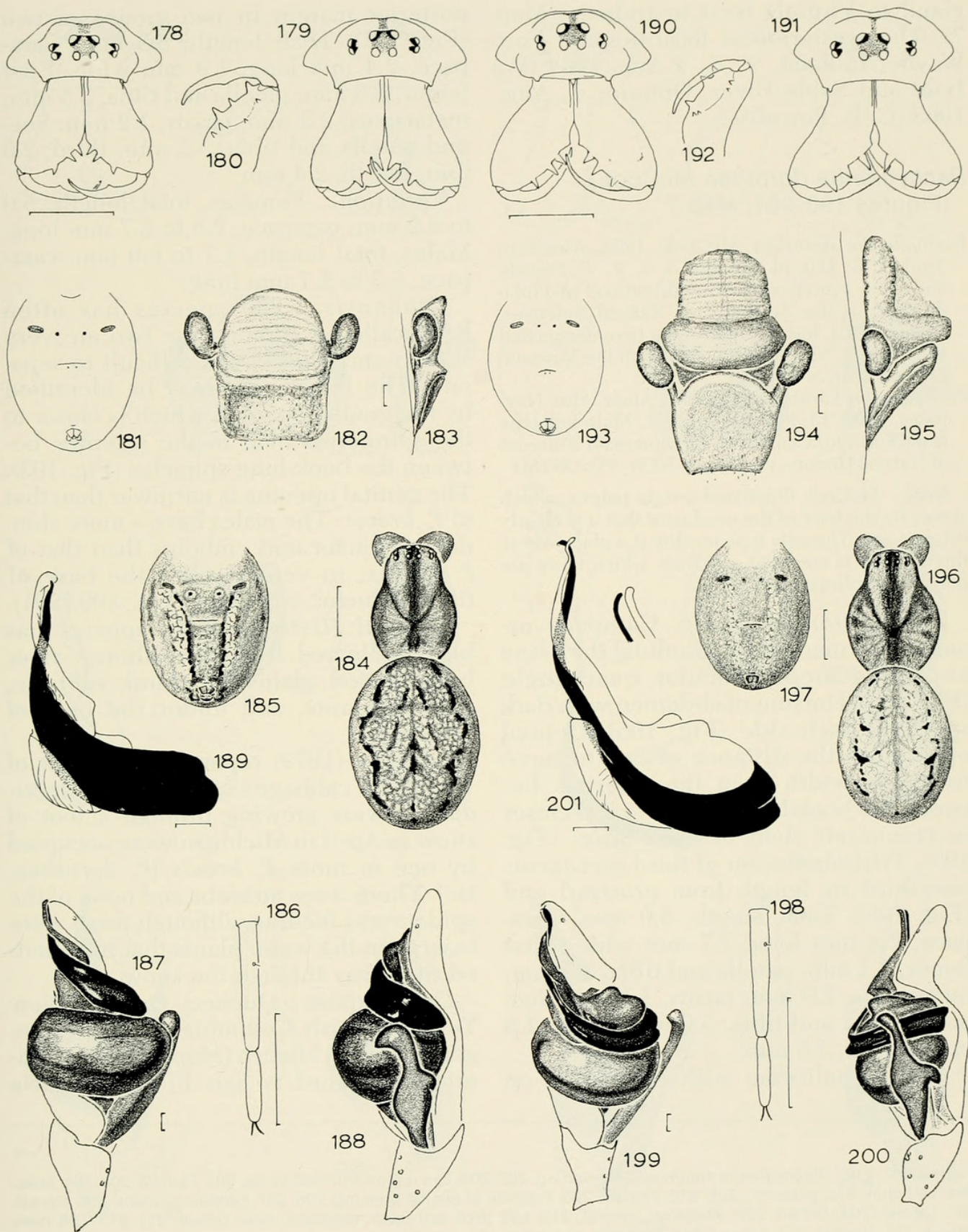
Natural History. Specimens have been collected from swamps in New England, salt marsh in Maryland, and in an asparagus bed in Massachusetts.

Distribution. Nova Scotia, New En-

Figures 178–189. *Pachygnatha brevis* Keyserling. 178–180. Eye region and chelicerae. 178. Female. 179, 180. Male. 180. Left chelicera, posterior. 181–186. Female. 181. Position of genital opening. 182, 183. Female genitalia. 182. Dorsal. 183. Lateral. 184. Dorsal. 185. Abdomen, ventral. 186. Third metatarsus and tarsus, dorsal. 187–189. Left male palpus. 187. Ventral. 188. Lateral. 189. Embolus and conductor, ventral (embolus black).

Figures 190–201. *P. dorothea* McCook. 190–192. Eye region and chelicerae. 190. Female. 191, 192. Male. 192. Left chelicera, posterior. 193–198. Female; 193. Position of genital opening. 194, 195. Female genitalia. 194. Dorsal. 195. Lateral. 196. Dorsal. 197. Abdomen, ventral. 198. Third metatarsus and tarsus, dorsal. 199–201. Male palpus. 199. Ventral. 200. Lateral. 201. Embolus and conductor, ventral.

Scale lines. 0.1 mm; Figures 178–181, 184–186, 190–193, 196–198, 1.0 mm.



gland to Virginia west to Indiana (Map 7). The westernmost localities are Fort Wayne, Indiana, ♀, ♂, 3 Aug. 1964 (W. Ivie) and Sable River, Ontario, ♂, Aug. 1963 (C. B. Powell).

***Pachygnatha dorothea* McCook**
Figures 190–201; Map 7

Pachygnatha dorothea McCook, 1893, American Spiders, 3: 270, pl. 26, figs. 3, 4, ♀, ♂. Female and male syntypes from neighborhood of Philadelphia in the Academy of Natural Sciences, Philadelphia, lost. Male neotype here designated from Ithaca, New York (N. Banks) in the Museum of Comparative Zoology.

Pachygnatha kuratai Levi, 1951, Amer. Mus. Novitates, 1501: 15, figs. 29–31, ♀, ♂. Male holotype from Toronto, Canada in the American Museum of Natural History, examined. NEW SYNONYMY

Note. McCook illustrated a right palpus, which shows by the base of the conductor that it is clearly this species. The new type locality is a place where this species is common and from which there are numerous collections.

Description. Female. Carapace orange with median longitudinal dark line enclosing median ocular quadrangle (Fig. 196). Dorsum of abdomen with dark spots on each side (Fig. 196). Genital opening is the distance of two to three times its width from the sclerites between the book-lung spiracles; it is closer to spinnerets than to book-lungs (Fig. 193). Trichobothrium of third metatarsus one third its length from proximal end (Fig. 198). Total length, 5.0 mm. Carapace, 2.4 mm long, 1.7 mm wide. First femur, 2.4 mm; patella and tibia, 3.2 mm; metatarsus, 2.0 mm; tarsus, 1.1 mm. Second patella and tibia, 3.0 mm; third, 1.8 mm; fourth, 2.6 mm.

Male. Chelicerae with four teeth on

posterior margin in two groups of two (Fig. 192). Total length, 5.5 mm. Carapace, 2.4 mm long, 1.9 mm wide. First femur, 2.6 mm; patella and tibia, 3.5 mm; metatarsus, 2.2 mm; tarsus, 1.2 mm. Second patella and tibia, 3.2 mm; third, 2.0 mm; fourth, 2.4 mm.

Variation. Females, total length, 5.0 to 6.2 mm; carapace, 2.5 to 2.7 mm long. Males, total length, 4.7 to 6.0 mm; carapace, 2.3 to 2.7 mm long.

Diagnosis. The species has often been called *P. brevis*; the two are very similar and females are difficult to separate. The female can best be identified by the genital opening which is closer to the spinnerets than to the sclerites between the book-lung spiracles (Fig. 193). The genital opening is narrower than that of *P. brevis*. The males have a more slender conductor and embolus than that of *P. brevis*; in ventral view the base of the conductor is visible (Fig. 199, 201).

Natural History. This species has been collected from lake shores, river banks, flood plains; in skunk cabbage, pitcher plants, and under the bark of trees.

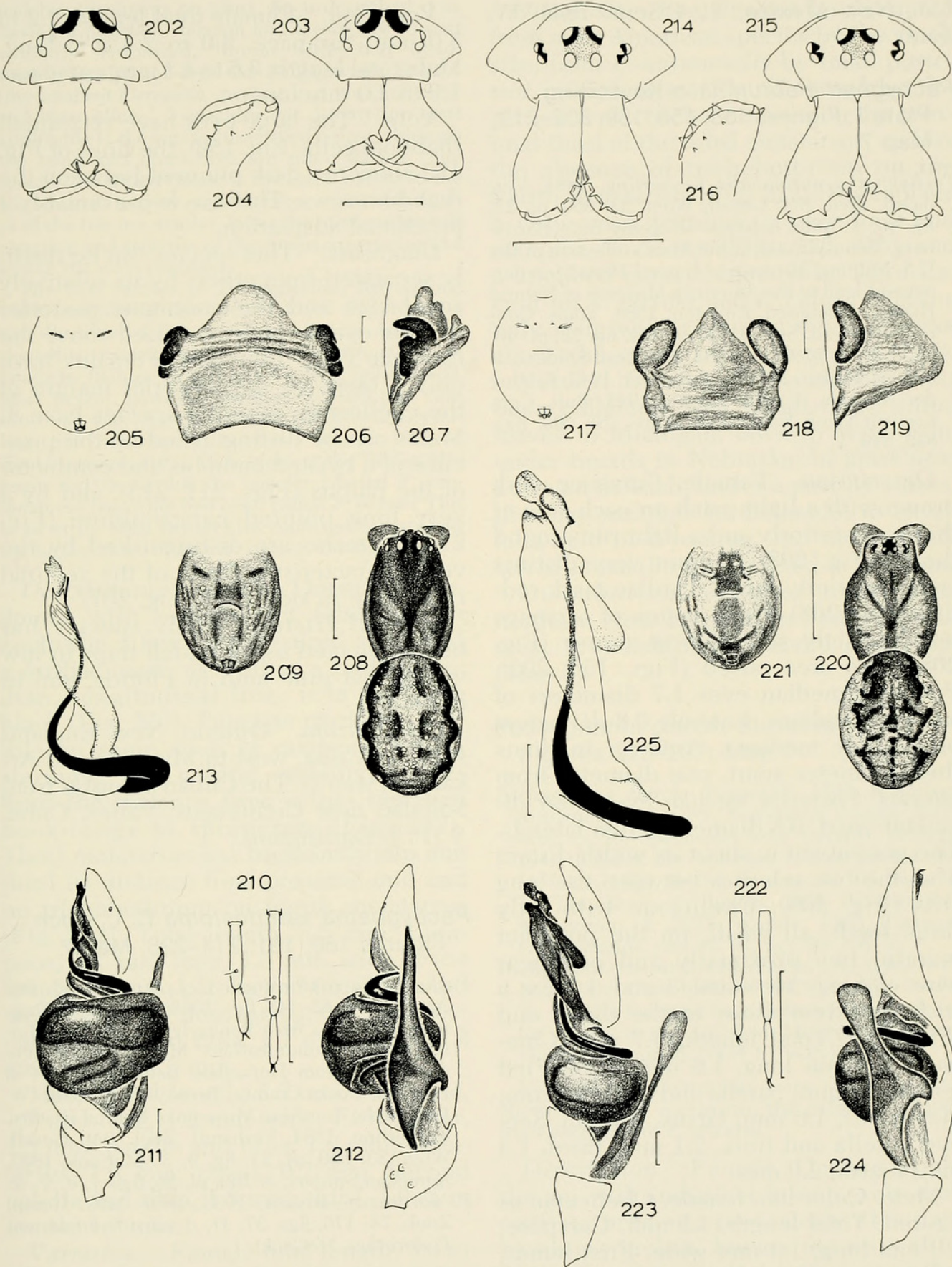
Knutson (1979) reports that 40 out of 150 skunk cabbage (*Symplocarpus foetidus*) flowers growing through a foot of snow in April in Michigan were occupied by one or more *P. brevis* [*P. dorothea*, sic]. There were no webs and none of the spiders was feeding, although there were insects on the warm plants that had melted their way through the snow.

Distribution. Quebec, Ontario, New York to British Columbia, south to Oregon and New Mexico (Map 7). The southernmost record is San Fidel, Valencia

Figures 202–213. *Pachygnatha autumnalis* Keyserling. 202–204. Eye region and chelicerae. 202. Female. 203, 204. Male. 204. Left chelicera, posterior. 205–210. Female. 205. Position of genital opening. 206, 207. Female genitalia. 206. Dorsal. 207. Lateral. 208. Dorsal. 209. Abdomen, ventral. 210. Left third and fourth metatarsi, tarsi, dorsal. 211–213. Left male palpus. 211. Ventral. 212. Lateral. 213. Embolus and conductor, ventral.

Figures 214–225. *P. xanthostoma* C. L. Koch. 214–216. Eye region and chelicerae. 214. Female. 215, 216. Male. 216. Chelicera, posterior. 217–222. Female. 217. Position of genital opening. 218, 219. Female genitalia. 218. Dorsal. 219. Lateral. 220. Dorsal. 221. Abdomen, ventral. 222. Third and fourth metatarsi and tarsi, posterodorsal. 223–225. Male palpus. 223. Ventral. 224. Lateral. 225. Embolus and conductor, ventral.

Scale lines. 0.1 mm; Figures 202–205, 208–210, 214–217, 220–222, 1.0 mm.



Co., New Mexico, ♀, 4 Sept. 1941 (W. Ivie).

***Pachygnatha autumnalis* Keyserling**

Plate 7; Figures 155, 158, 159, 202–213; Map 7

Pachygnatha autumnalis Keyserling, 1884, Verhandl. Zool. Bot. Gesell. Wien, 33: 660, pl. 21, fig. 10, ♂. Male holotype allegedly from Harrisburg, Pennsylvania in the Marx collection of the U.S. National Museum of Natural History on permanent loan to the American Museum of Natural History, examined. Emerton, 1884, Trans. Connecticut Acad. Sci., 6: 337, pl. 34, fig. 22, pl. 40, fig. 9, ♀, ♂. McCook, 1893, American Spiders, 3: 268, pl. 26, figs. 1, 2, ♀, ♂. Roewer, 1942, Katalog der Araneae, 1: 998. Kaston, 1948, Bull. Connecticut Geol. Natur. Hist. Surv., 70: 266, figs. 840, 849, ♀, ♂.

Description. Female. Carapace dark brown with a light patch on each side of thorax posteriorly and a light rim around thorax (Fig. 208). Folium very distinct and posteriorly lobed, cardiac mark reddish (Fig. 208). Head region of carapace not distinctly set off from thorax (Fig. 208). Eye area raised (Figs. 155, 202). Posterior median eyes 1.7 diameters of anterior medians. Laterals 0.8 diameters of anterior medians. Anterior medians their diameter apart, one diameter from laterals. Posterior median eyes their diameter apart, 0.8 diameters from laterals. The genital slit is about its width distant from the two sclerites between the lung slits (Fig. 205). Chelicerae with only three teeth, all small, on the posterior margin; two proximally and one near base of fang. Metatarsi 3 and 4 have a trichobothrium close to the distal end (Fig. 210). Total length, 4.7 mm. Carapace, 2.2 mm long, 1.6 mm wide. First femur, 2.0 mm; patella and tibia, 2.4 mm; metatarsus, 1.6 mm; tarsus, 1.0 mm. Second patella and tibia, 2.1 mm; third, 1.4 mm; fourth, 2.0 mm.

Male. Color like female. Chelicerae as figured. Total length, 4.3 mm. Carapace, 1.9 mm long, 1.3 mm wide. First femur, 1.9 mm; patella and tibia, 2.3 mm; metatarsus, 1.4 mm; tarsus, 0.8 mm. Second patella and tibia, 1.9 mm; third, 1.2 mm; fourth, 1.7 mm.

Variation. Female total length, 4.2 to 5.0 mm; carapace, 2.0 to 2.4 mm long. Male total length, 3.5 to 4.3 mm; carapace, 1.9 to 2.0 mm long.

Note. The large eyes have very small rhabdom cells (Fig. 159), the lines of Fig. 159 show the dark pigment between the rhabdom rows. The size is presumably a functional adaptation.

Diagnosis. This species can be readily separated from others by its relatively small size and the enormous posterior median eyes, which are raised above the carapace (Fig. 155, 208). Females have only 3 teeth on the posterior margin of the chelicerae; all other species have 4. Males can be distinguished by the presence of a twisted embolus and conductor of the palpus (Figs. 211, 213), and by a very long pointed paracymbium (Fig. 212). Females are distinguished by the very characteristic shape of the seminal receptacle in side view (Fig. 207).

Natural History. This species has been collected using pit-fall traps in low woods, flat pine land in Florida, and in old fields.

Distribution. Ontario, New England south to Cuba, west to Missouri and Arkansas (Map 7). The Cuban record is from Soledad near Cienfuegos, Valles, Cuba, ♀ (P. J. Darlington).

***Pachygnatha xanthostoma* C. L. Koch**

Figures 160, 161, 214–225; Map 7

Pachygnatha xanthostoma C. L. Koch, 1845, Die Arachniden, 12: 148, figs. 1068, 1069, ♀, ♂. Original specimens from Pennsylvania lost (M. Moritz, pers. communication). Male neotype here designated from Horseshoe Bend, northeast of Jamison, Bucks County, Pennsylvania, 1959 (W. Ivie) in the American Museum of Natural History. Keyserling, 1884, Verhandl. Zool. Bot. Gesell. Wien, 33: 659, pl. 21, fig. 9, ♂. McCook, 1893, American Spiders, 3: 269, pl. 26, figs. 7, 8, ♀, ♂. *P. dorothea*:—Bryant, 1933, Bull. Mus. Comp. Zool., 74: 176, figs. 37, 41, ♂ (misidentified, not *P. dorothea* McCook).

Note. The type of *P. xanthostoma* has been lost and there is no evidence that it ever was in the Berlin Museum (M. Moritz, letter). *Pachygnatha xanthostoma* came from Pennsylvania, was 2¼ lines long (4.8 mm, probably with chelicerae; Koch

had his specimens on pins). Koch described it as having a punctate sternum and a carapace in part similarly sculptured; "thorax wider than head, rounded, palpi and legs like *Pachygnatha degeeri* [the smallest European species], and the chelicerae and legs yellow." I consider this description most applicable to the species described below, although the head and chelicerae are often darker. The species described below is the most similar to the European *P. degeeri*, and the proportions of the palpi of the two are similar. It has the most sculptured carapace and sternum of the American species and is also the most common.

The first reviser of *Pachygnatha*, Keyserling, 1884, considered this species to be *xanthostoma* and illustrated the diagnostic chelicerae. In collections this species has been called *xanthostoma* on labels by Bishop, Crosby and Gertsch, before 1933. Miss Bryant, however, decided in 1933 that *xanthostoma* was an older name for *P. brevis* Keyserling. She indicated as evidence that in 1912 N. Banks examined the Koch types at the Berlin Museum and found that the species labeled *P. xanthostoma* was what had been called *P. brevis*. This is an error. Miss Bryant also confused two species under the name of *brevis*: *brevis* and *dorothea*.

Description. Female. Dorsum of abdomen with an indistinct, lobed folium enclosing a few white, paired spots and a cardiac mark, as well as a broken median, longitudinal line; it is dusky to black (Fig. 220). Punctate marks are visible on some areas of carapace and on sternum. The genital opening is one-third the distance from a line between book-lungs to spinnerets (Fig. 217). Third metatarsus has trichobothrium one third its distance from proximal end and no trichobothrium on fourth metatarsus (Fig. 222). Total length, 3.5 mm. Carapace, 1.7 mm long, 1.3 mm wide. First femur, 1.4 mm; patella and tibia, 1.9 mm; metatarsus, 1.3 mm; tarsus, 0.7 mm. Second patella and tibia, 1.7 mm; third, 1.2 mm; fourth, 1.6 mm.

Male. Total length, 3.3 mm. Carapace, 1.7 mm long, 1.2 mm wide. First femur, 1.5 mm; patella and tibia, 1.9 mm; metatarsus, 1.3 mm; tarsus, 0.7 mm. Second patella and tibia, 1.8 mm; third, 1.0 mm; fourth, 1.7 mm.

Variation. Female total length, 3.0 to 4.2 mm; carapace, 1.6 to 1.9 mm long. Male total length, 2.9 to 3.8 mm; carapace, 1.4 to 1.8 mm long.

Diagnosis. Females can be separated from most American species by the small size, from *P. autumnalis* by small posterior median eyes (Fig. 214) and by the presence of a trichobothrium on the proximal third of the third metatarsus, and by the absence of trichobothrium on the fourth metatarsus (Fig. 222). Males have a very small tegulum, a very long and complex conductor (Figs. 223, 225), and a knobbed paracymbium (Fig. 224). Except for *P. clercki* and *P. calusa* it is the only male with a spur on the chelicerae above the origin of the fang (Fig. 215).

Natural History. This species has been collected from pitfall traps, sifted leaves in Michigan, lawn in Wisconsin, under boards in Nebraska, in grass near a stream in Utah, under a post by a pond in a hay meadow in Colorado, in an alfalfa field in Wyoming, and in the stomach of a toad (*Bufo*) collected in Montana.

Distribution. Quebec to Alberta, northern New England to Pennsylvania, west to Washington, Idaho and Utah (Map 7).

Pachygnatha clercki Sundevall Figures 226–237; Map 7

Pachygnatha clercki Sundevall, 1823, Specimen Academicum Geneva, Araneidum Sueciae Exhibens, p. 16. Specimens from Sweden. Roewer, 1942, Katalog der Araneae, 1: 996. Locket and Millidge, 1953, British Spiders, 2: 106, figs. 71, 72, 73A, D, ♀, ♂. Bonnet, 1958, Bibliographia Araneorum, 2: 3277. Wiehle, 1963, Tierwelt Deutschlands, part 49: 61, figs. 99–106, ♀, ♂.

Pachygnatha sewardi Chamberlin and Ivie, 1947, Bull. Univ. Utah, biol. ser., 10(3): 64, figs. 76–78, ♀, ♂. Male holotype from Beluga Flats, Cook Inlet, Alaska in the American Museum of Natural History, examined. NEW SYNONYMY.

Note. The illustrations were all made from North American specimens, the palpi were made from paratypes of *P. sewardi*.

Description. Female. Dorsum of abdomen with indistinct folium, only dark outline present; posteriorly the dark bands are broken, but are not wavy (Fig. 232). The sternum lacks connection between coxae 1 and 2 to the narrow dorsal plate above. The genital slit is only one-

fourth the distance from a line between book-lungs to the spinnerets (Fig. 229). One trichobothrium on middle of metatarsus 3, and one two-thirds the distance from proximal end on metatarsus 4 (Fig. 234). Total length, 5.5 mm. Carapace, 2.6 mm long, 1.9 mm wide. First femur, 2.5 mm; patella and tibia, 3.2 mm; metatarsus, 2.0 mm; tarsus, 1.2 mm. Second patella and tibia, 2.9 mm; third, 1.9 mm; fourth, 2.6 mm.

Male. Coloration more distinct than female. Total length, 5.3 mm. Carapace, 2.4 mm wide, 1.8 mm long. First femur, 2.5 mm; patella and tibia, 3.3 mm; metatarsus, 2.0 mm; tarsus, 1.2 mm. Second patella and tibia, 3.1 mm; third, 1.9 mm; fourth, 2.6 mm.

Variation. One male from the north slope of Alaska had a relatively smaller tegulum and a longer conductor and embolus in the palpus. As a result of the smaller tegulum, the loops of the duct were shallower. The specimen belongs to the Florida State Collection of Arthropods.

Diagnosis. The female can be separated from most larger North American *Pachygnatha* by the presence of a trichobothrium on the fourth metatarsus (Fig. 234); from *P. tristriata* by lack of a sclerite on the genital area (Fig. 229) and by the posteriorly broken dorsal abdominal markings (Fig. 232). The male is the only large North American species with a spur above the fang attachment on the chelicerae (Fig. 227), with a coiled duct in the tegulum (Fig. 235), and with the shape illustrated in Figs. 235, 237 of the palpal

conductor. Half grown specimens have the trichobothrium on metatarsus 4.

Natural History. This species is found in wet areas (Wiehle, 1963). The egg-sac has been described by Wiehle (1963) and pictured by Nielsen (1932, fig. 358); it is attached to both bark and moss and is guarded. The young leave after only 2 weeks.

Distribution. Eurasia, Alaska to Manitoba (Map 7). One male from Washington, D.C. in the N. Banks collection may have been introduced.

Pachygnatha tristriata C. L. Koch
Plate 7; Figures 238–250; Map 7

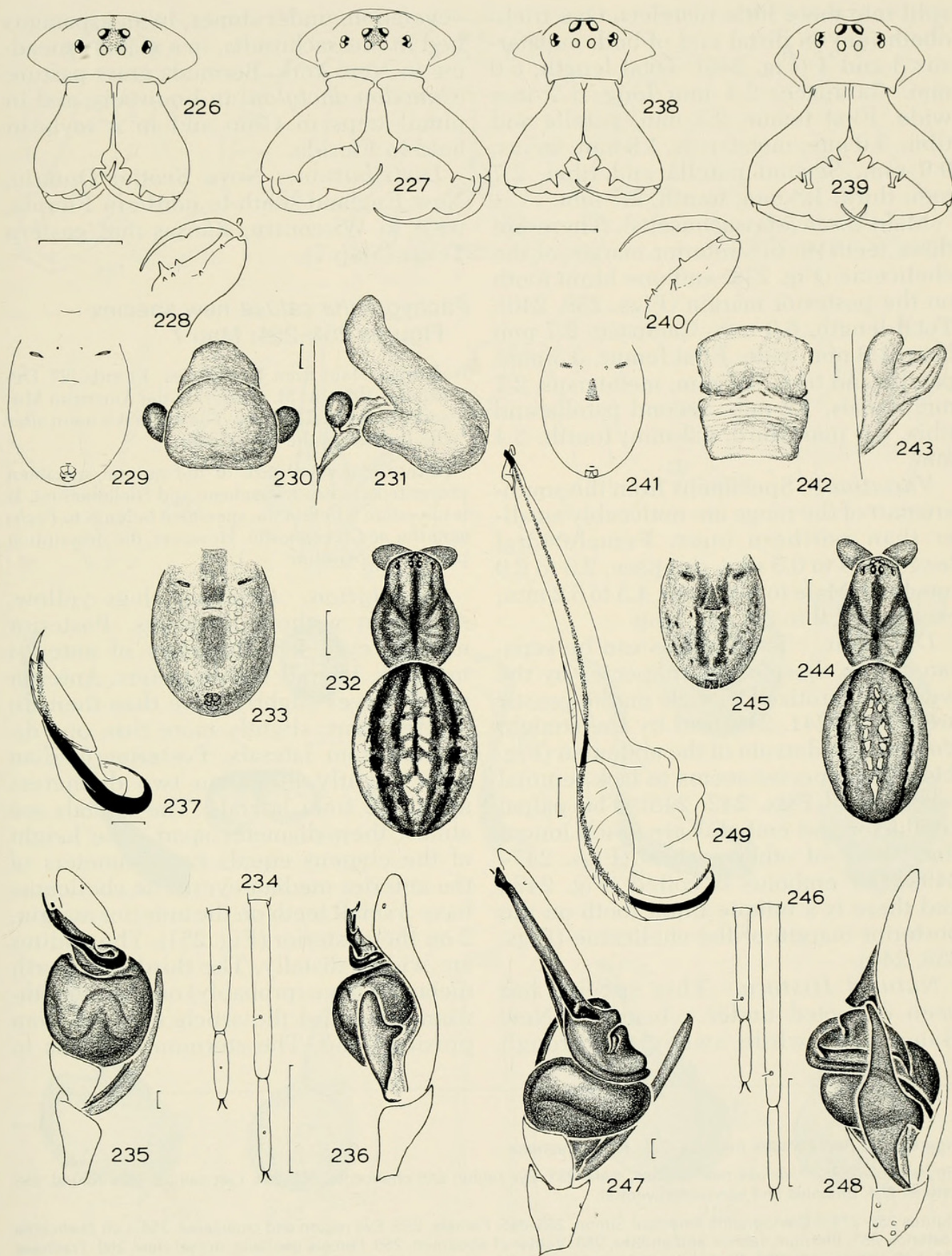
Pachygnatha tristriata C. L. Koch, 1845, *Arachniden*, 12: 145, fig. 1066, ♀. Female from Pennsylvania in the Museum of the Humboldt University, Berlin, lost. Keyserling, 1884, *Verhandl. Zool. Bot. Ges. Wien*, 33: 656, pl. 21, fig. 8, ♀, ♂. McCook, 1893, *American Spiders*, 3: 270, pl. 26, fig. 6, pl. 28, fig. 1, ♀, ♂. Emerton, 1909, *Trans. Connecticut Acad. Sci.*, 14: 202, pl. 5, fig. 6, ♀, ♂. Roewer, 1942, *Katalog der Araneae*, 1: 998. Kaston, 1948, *Bull. Connecticut Geol. Natur. Hist. Surv.*, 70: 266, figs. 838, 839, 847, 848, ♀, ♂.

Description. Female. Carapace orange with longitudinal dark stripes and a dark band from thoracic depression antero-laterally (Fig. 244). Chelicerae, sternum brown. Dorsum of abdomen with a gently curved black line on each side, farthest apart in middle (Fig. 244). Venter of abdomen above the genital area has a weakly sclerotized triangular patch, pointing anteriorly (Figs. 241, 245). The muscle impressions between the book-lung slits are barely visible and may be

Figures 226–237. *Pachygnatha clercki* Sundevall. 226–228. Eye region and chelicerae. 226. Female. 227, 228. Male. 228. Left male chelicera, posterior. 229–234. Female. 229. Position of genital opening. 230, 231. Female genitalia. 230. Dorsal. 231. Lateral. 232. Dorsal. 233. Abdomen, ventral. 234. Left third and fourth metatarsi and tarsi, dorsal. 235–237. Left male palpus. 235. Ventral. 236. Lateral. 237. Embolus and conductor, ventral.

Figures 238–249. *P. tristriata* C. L. Koch. 238–240. Eye region and chelicerae. 238. Female. 239, 240. Male. 240. Left male chelicera, posterior. 241–246. Female. 241. Position of genital opening. 242, 243. Female genitalia. 242. Dorsal. 243. Lateral. 244. Dorsal. 245. Abdomen, ventral. 246. Third and fourth metatarsi and tarsi, dorsal. 247–249. Male palpus. 247. Ventral. 248. Lateral. 249. Embolus and conductor, ventral.

Scale lines. 0.1 mm; except Figures 226–229, 232–234, 238–241, 244–246, 1.0 mm.



split into three little platelets. One trichobothrium on distal end of both metatarsus 3 and 4 (Fig. 246). Total length, 6.0 mm. Carapace, 2.4 mm long, 1.7 mm wide. First femur, 2.3 mm; patella and tibia, 3.0 mm; metatarsus, 1.9 mm; tarsus, 0.9 mm. Second patella and tibia, 2.7 mm; third, 1.8 mm; fourth, 2.7 mm.

Male (from Massachusetts). There are three teeth on the anterior margin of the chelicerae (Fig. 239) and one blunt tooth on the posterior margin (Figs. 239, 240). Total length, 6.0 mm. Carapace, 2.7 mm long, 1.9 mm wide. First femur, 3.3 mm; patella and tibia, 4.1 mm; metatarsus, 2.7 mm; tarsus, 1.2 mm. Second patella and tibia, 3.6 mm; third, 2.2 mm; fourth, 3.4 mm.

Variation. Specimens from the southern part of the range are noticeably smaller than northern ones. Female total length, 4.9 to 6.5 mm; carapace, 2.3 to 2.9 mm long. Male total length, 4.5 to 6.2 mm; carapace, 1.9 to 2.9 mm long.

Diagnosis. The females can be separated from those of other species by the weakly sclerotized triangle on the genital area (Figs. 241, 245) and by the straight lines on the dorsum of the abdomen (Fig. 244). This species seems to lack seminal receptacles (Figs. 242, 243). The palpal conductor and embolus are much longer than those of other species (Figs. 247–249). The embolus is coiled (Fig. 247), and there is a unique blunt tooth on the posterior margin of the chelicerae (Figs. 239, 240).

Natural History. This species has been collected under a board in New Hampshire, while sweeping through

vegetation, under stones, in an asparagus bed in Massachusetts, in a marshy meadow in New York, Bermuda grass pasture (*Cynodon dactylon*) in Louisiana, and in pitfall traps in Ohio and in a soybean field in Florida.

Distribution. Nova Scotia, Ontario, New England south to northern Florida, west to Wisconsin, Kansas and eastern Texas (Map 7).

Pachygnatha calusa new species Figures 251–254; Map 7

Holotype. Male from Everglades, Florida, 27 December 1950 (A. M. Nadler) in the American Museum of Natural History. The name is a noun after the Indians of the Everglades.

Note. The small size of the unique specimen prevented studies of tracheae and trichobothria. It is uncertain whether the specimen belongs to *Pachygnatha* or *Glenognatha*. However, the description permits recognition.

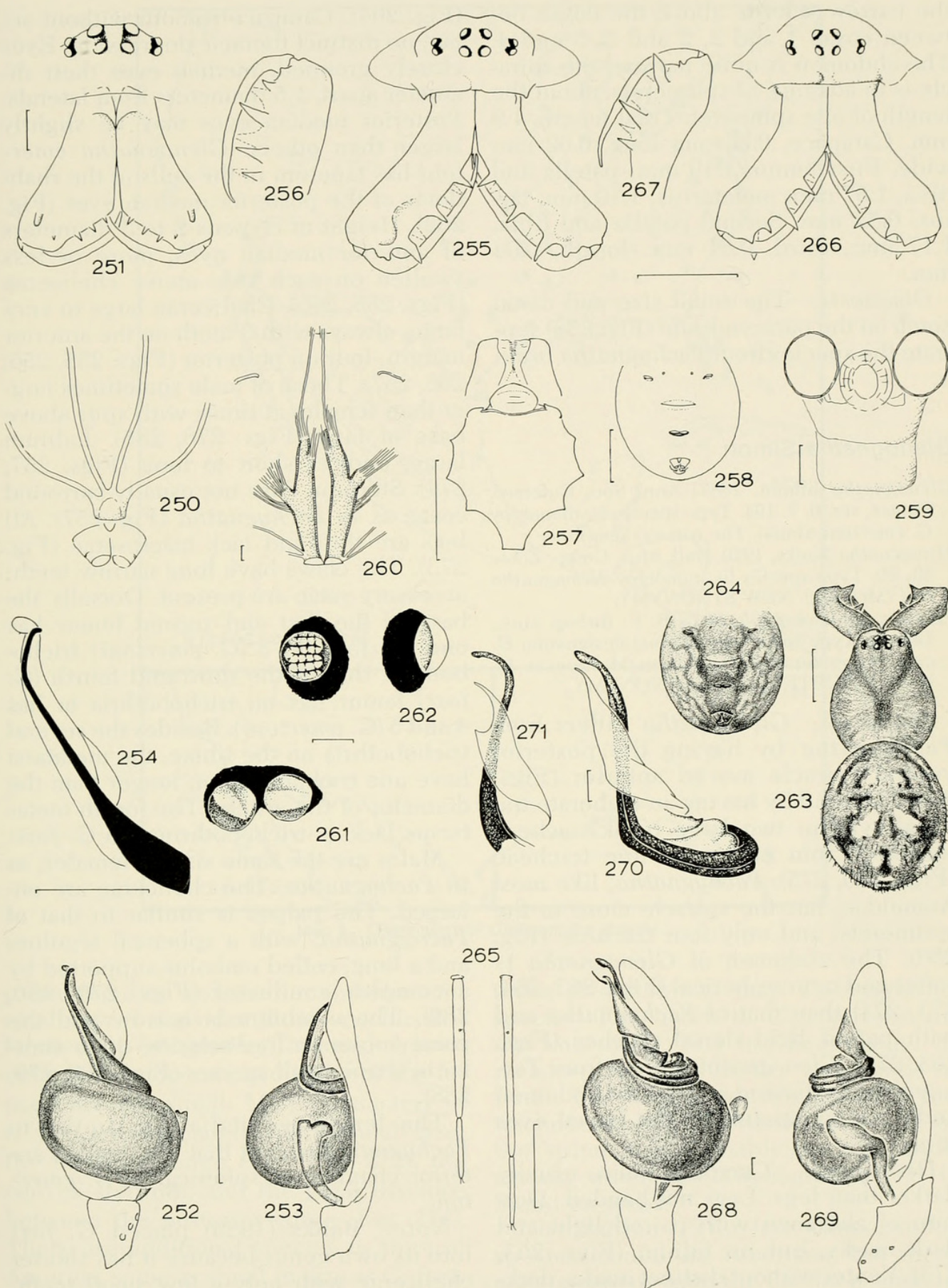
Description. Carapace, legs yellow. Abdomen without markings. Posterior median eyes 0.8 diameters of anterior medians, laterals 0.6 diameters. Anterior median eyes slightly more than their diameter apart, slightly more than one diameter from laterals. Posterior median eyes slightly less than two diameters apart, 1.5 from laterals. The laterals are almost their diameter apart. The height of the clypeus equals two diameters of the anterior median eyes. The chelicerae have 3 small teeth on the anterior margin, 2 on the posterior (Fig. 251). The endites are widest distally. The third and fourth metatarsi have (probably) one trichobothrium, one-third the article's length from proximal end. The sternum connects to

Figure 250. *Pachygnatha tristriata* C. L. Koch, tracheae.

Figures 251–254. *P. calusa* new species, male. 251. Eye region and chelicerae. 252–254. Left palpus. 252. Ventral. 253. Lateral. 254. Embolus and conductor, ventral.

Figures 255–271. *Glenognatha emertoni* Simon. 255–265. Female. 255. Eye region and chelicerae. 256. Left chelicerae, posterior. 257. Sternum, labium and endites. 258. Venter of abdomen. 259. Female genitalia, dorsal view. 260. Tracheae. 261. Left lateral eyes. 262. Posterior median eyes. 263. Dorsal. 264. Abdomen, ventral. 265. Left third and fourth metatarsus and tarsus. 266–271. Male. 266. Eye region and chelicerae. 267. Left chelicera, posterior. 268–271. Palpus. 268. Ventral. 269. Lateral. 270. Embolus and conductor, ventral. 271. Embolus and conductor tip, mesal.

Scale lines. 0.1 mm; Figures 255, 256–258, 263–267, 1.0 mm.



the narrow sclerite above the coxae between coxae 1 and 2, 2 and 3, 3 and 4. The abdomen is quite narrow; the spiracle is in advance of spinnerets, about the length of one spinneret. Total length, 1.9 mm. Carapace, 0.82 mm long, 0.62 mm wide. First femur, 1.19 mm; patella and tibia, 1.57 mm; metatarsus, 1.19 mm; tarsus, 0.52 mm. Second patella and tibia, 1.17 mm; third, 0.61 mm; fourth, 0.94 mm.

Diagnosis. The small size and distal notch on the paracymbium (Fig. 253) separate the species from *Pachygnatha brevis*.

Glenognatha Simon

Glenognatha Simon, 1887, Ann. Soc. Entomol. France, ser. 6, 7: 194. Type species by monotypy *G. emertoni* Simon. The name is feminine.

Mimognatha Banks, 1929, Bull. Mus. Comp. Zool., 69: 90. Type species by monotypy *Mimognatha foxi* (McCook). NEW SYNONYMY.

?*Hivaoa* Berland, 1935, Bull. B. P. Bishop Mus., 142: 50. Type species by original designation *H. argenteoguttata* Berland from Marquesas Islands. DOUBTFUL NEW SYNONYMY.

Diagnosis. *Glenognatha* differs from *Pachygnatha* by having the posterior ventral spiracle moved anterior (Figs. 258, 274), and by having an elaborate tracheal system: two large trunk tracheae that split into numerous fine tracheae (Figs. 260, 275). *Pachygnatha*, like most Araneidae, has the spiracle close to the spinnerets, and only four tracheae (Fig. 250). The abdomen of *Glenognatha* is softer and more spherical (Figs. 263, 264, 273, 274) than that of *Pachygnatha* and with paired light dorsal patches (Figs. 263, 273). *Glenognatha* differs from *Tetragnatha* by having a spherical abdomen and a canoe tapetum in the lateral eyes (Fig. 261).

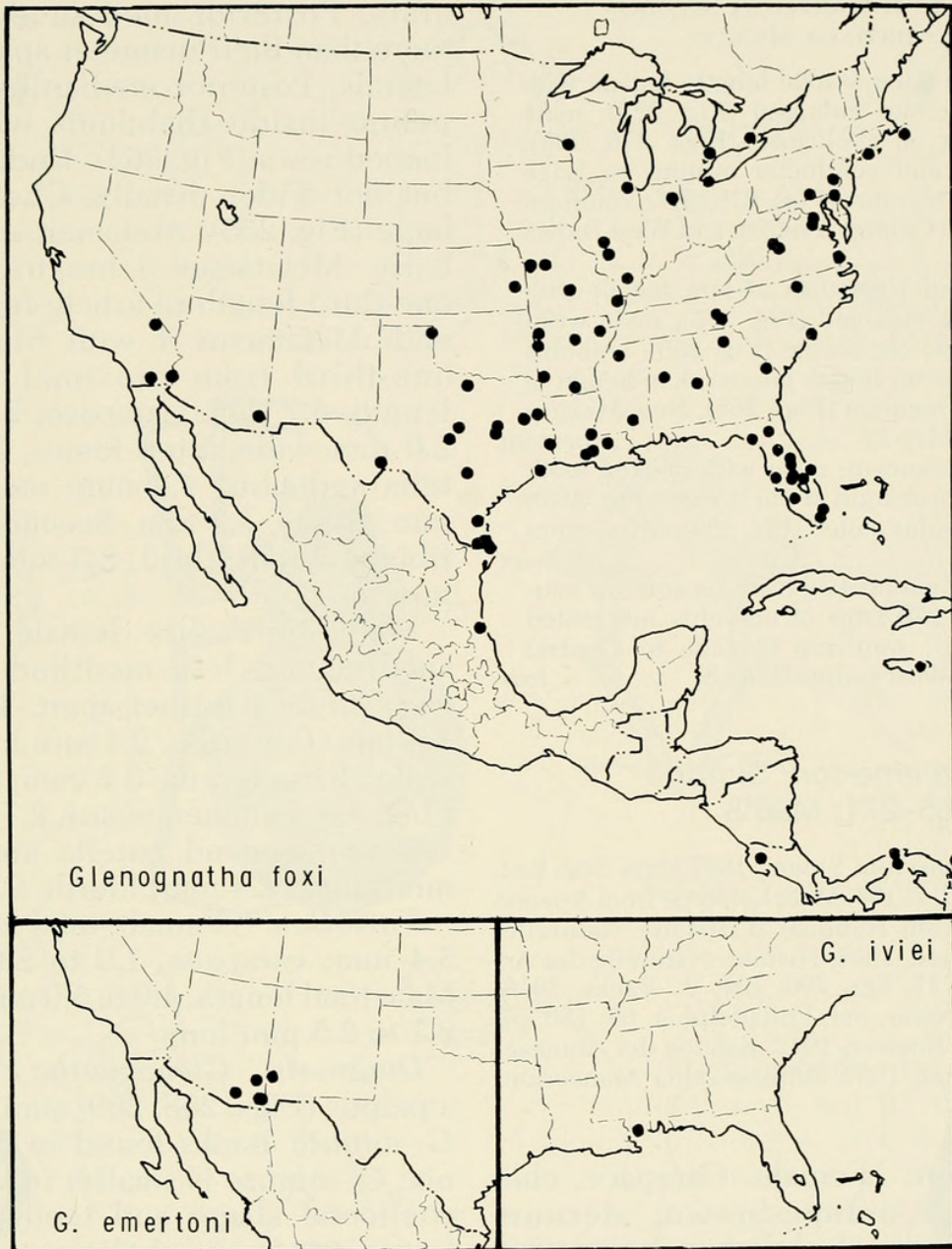
Description. Carapace plain, usually darker than legs. Legs not banded. Dorsum of abdomen with paired light and dark marks, but no folium (Figs. 263, 273). Venter without distinct marks, darker gray in a longitudinal band in center

(Fig. 264). Carapace smooth without setae, no distinct thoracic depression. Eyes closely grouped, median eyes their diameter apart, 1.5 diameters from laterals. Posterior median eyes may be slightly larger than others. *Glenognatha emertoni* has tapetum in the cells of the rhabdoms of the posterior median eyes (Fig. 262). Height of clypeus 2 to 3 diameters of anterior median eyes, more or less swollen on each side above chelicerae (Figs. 255, 266). Chelicerae large to very large, always with 3 teeth on the anterior margin, four on posterior (Figs. 255, 256, 266, 267). Those of male sometimes larger than female, at times with spur above base of fang (Figs. 276, 285). Labium large, endites short to long (Figs. 257, 274). Sternum does not usually surround coxae as in *Pachygnatha* (Fig. 257). All legs are thin and lack macrosetae (Fig. 273). The claws have long narrow teeth; accessory setae are present. Dorsally the base of the first and second femur has one (*G. foxi*) to 3 (*G. emertoni*) trichobothria, that of the third and fourth (*G. foxi*) femur has no trichobothria or has 4 and 5 (*G. emertoni*). Besides the several trichobothria on the tibiae, the metatarsi have one trichobothrium longer than the diameter of the article. The fourth metatarsus lacks a trichobothrium in *G. foxi*.

Males are the same size as females, as in *Pachygnatha*. The chelicerae are enlarged. The palpus is similar to that of *Pachygnatha*, with a spherical tegulum and a long, coiled embolus supported by a complex conductor (Figs. 270, 280, 289). The cymbium is narrow and the paracymbium a free sclerite, quite similar in shape in all species (Figs. 269, 279, 288).

The female genitalia are similar to *Pachygnatha* except that the median anterior chamber is spherical in *G. emertoni*.

Note. Banks (1929) placed *G. foxi* into its own genus because it has shorter chelicerae with only a few small teeth, and because of the very large spherical

Map 8. Distribution of *Glenognatha* species.

palpal tegulum and smaller embolus and conductor. I consider these specific differences. *Glenognatha foxi* males have enlarged chelicerae, and those of the female are not small. Many characters of *G. foxi* are associated with its small size: the relatively large eyes (Fig. 272), the convex sternum, and the great distance between the posterior coxae (Fig. 274). There are additional species in tropical America, some as small in size as *G. foxi*.

Natural History. The species live in

more arid habitats than *Pachygnatha* species. The habits of *G. emertoni* are not known; *G. foxi* has been found in meadows and on hot, dry wastelands in Ohio. The unusual development of the tracheae and the forward movement of the spiracle is probably an adaptation against water loss. *Glenognatha foxi* is found on webs.

Distribution. The few *Glenognatha* species named are American, but there are specimens from the Pacific Islands in American collections.

KEY TO *GLENOGNATHA* SPECIES
NORTH OF MEXICO

1. Less than 3.0 mm total length; female with chelicerae not enlarged (Fig. 272); male with spur on chelicerae (Figs. 276, 285); embolus and conductor minute on huge spherical tegulum (Figs. 278, 287); southern Canada to Central America and West Indies (Map 8) ----- 2
- Total length more than 3.5 mm; female with chelicerae enlarged (Fig. 255); male without spur on chelicerae (Fig. 266); embolus and conductor length greater than height of spherical tegulum (Figs. 268); New Mexico, Arizona (Map 8) ----- *emertoni*
- 2(1). Female unknown; male with hooked tooth on anterior margin of chelicerae (Fig. 285); tip of embolus coiled (Fig. 289); Mississippi (Map 8) ----- *iviei*
- Male without hooked tooth on anterior margin (Fig. 276); tip of embolus not coiled (Fig. 280); southern Canada to Central America, West Indies (Map 8) ----- *foxi*

Glenognatha emertoni Simon
Figures 255–271; Map 8

Glenognatha emertoni Simon, 1887, Ann. Soc. Ent. France, ser. 6, 7: 194. Male holotype from Arizona in the Muséum National d'Histoire Naturelle, Paris, examined. 1894, Histoire Naturelle des Araignées, 1: 717, figs. 790, 791, ♂. Banks, 1913, Proc. Acad. Natur. Sci. Philadelphia, 65: 180, pl. 2, fig. 22, ♂. Roewer, 1942, Katalog der Araneae, 2: 995. Bonnet, 1957, Bibliographia Araneorum, 2: 1994.

Description. Female. Carapace, chelicerae, legs orange-brown; sternum brown. Dorsum of abdomen has paired gray spots alternating with paired light areas consisting of tiny white spots (Fig. 263). Clypeus swollen with two bulges (Fig. 255). Eyes subequal in size. Anterior median eyes slightly more than their diameter apart, two diameters from lat-

erals. Posterior median eyes slightly more than their diameter apart, two from laterals. Posterior median eyes have tapetum inside rhabdoms which are in looped rows (Fig. 262). Endites are long but not wider distally. Chelicerae very large (Fig. 255). Abdomen spherical and hairy. Metatarsus 3 has trichobothrium one-third length of article from proximal end. Metatarsus 4 with trichobothrium one-third from proximal end. Total length, 4.7 mm. Carapace, 2.6 mm long, 2.0 mm wide. First femur, 3.3 mm; patella and tibia, 4.3 mm; metatarsus, 2.9 mm; tarsus, 1.4 mm. Second patella and tibia, 4.2 mm; third, 2.3 mm; fourth, 3.2 mm.

Male. Much like female. Chelicerae smaller and less modified (Fig. 266). Eyes slightly further apart. Total length, 4.0 mm. Carapace, 2.4 mm long, 1.9 mm wide. First femur, 3.2 mm; patella and tibia, 4.3 mm; metatarsus, 2.7 mm; tarsus, 1.5 mm. Second patella and tibia, 4.1 mm; third, 2.4 mm; fourth, 2.8 mm.

Variation. Female total length, 4.6 to 5.4 mm; carapace, 1.9 to 2.6 mm long. Male total length, 4.0 to 5.0 mm; carapace, 2.1 to 2.5 mm long.

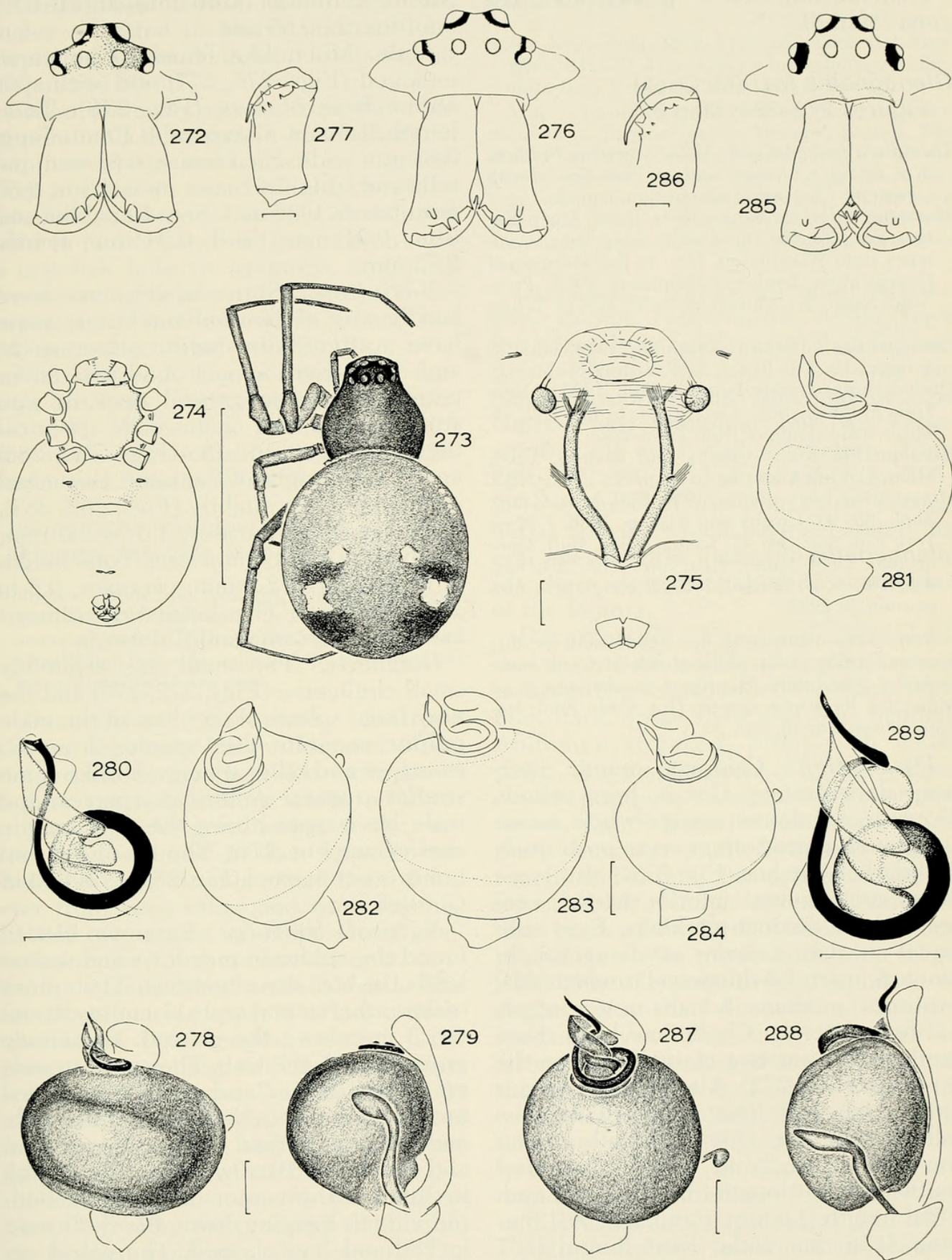
Diagnosis. *Glenognatha emertoni* has a palpus (Figs. 268, 269) similar to that of *G. minuta* Banks found in Baja California; *G. minuta* is smaller in size, and the chelicerel shape and teeth differ. The larger size, large chelicerae readily separate *G. emertoni* from *G. foxi*. The seminal receptacles are unusually thin-walled and difficult to see (Fig. 259).

Natural History. Specimens have been found under rocks near streams and under rocks in nearly dry stream bed.

Figures 272–284. *Glenognatha foxi* (McCook). 272–275. Female. 272. Eye region and chelicerae. 273. Female. 274. Sternum, coxae and venter of abdomen. 275. Female genitalia and tracheae, dorsal view. 276–284. Male. 276. Eye region and chelicerae. 277. Left chelicera, posterior. 278–281, 283, 284. Left palpus. 278, 281–284. Ventral. 279. Lateral. 280. Embolus and conductor, ventral. 278–280. (Pennsylvania). 281. (Jamaica). 282, 283. (Arkansas). 284. (Panama Canal Zone). 282, 283. Right and left palpus from same individual.

Figures 285–289. *G. iviei* new species. 285. Eye region and chelicerae. 286. Left chelicera, posterior. 287–289. Palpus. 287. Ventral. 288. Lateral. 289. Embolus and conductor, ventral.

Scale lines. 0.1 mm; Figures 273, 274, 1.0 mm.



Distribution. New Mexico and Arizona (Map 8).

***Glenognatha foxi* (McCook)**

Figures 272–284; Map 8

Theridium foxi McCook, 1893, American Spiders, 3, pl. 29, fig. 1. ? *Nomen nudum*. Plate legend with comment: "No verbal description is made."

Mysmena bulbifera Banks, 1896, Trans. Amer. Entom. Soc., 23: 66. Three male, three female syntypes from Washington, D.C. in the Museum of Comparative Zoology, examined. 1904, Proc. Acad. Natur. Sci. Philadelphia, 56: 127, pl. 7, figs. 12, 13, ♂.

Glenognatha bulbifera:—Barrows, 1919, Ohio J. Science, 19: 210, figs. 1, 2, ♂ (mating, web).

Diplocephalus crumbi Petrunkevitch, 1925, J. New York Entomol. Soc. 33: 171, pl. 8, fig. 1, 2, ♂. Three male syntypes from Tennessee.

Glenognatha foxi:—Crosby and Bishop, 1928, Mem. Cornell Univ. Agric. Exp. Sta., 101: 1055.

Mimognatha foxi:—Banks, 1929, Bull. Mus. Comp. Zool., 69: 90. Crosby and Bishop, 1936, J. New York Ent. Soc., 44: 47. Kaston, 1948, Bull. Connecticut Geol. Natur. Hist. Surv., 70: 264, figs. 834, 835, ♀, ♂. Bonnet, 1957, Bibliographia Araneorum, 3: 2922.

Note. The name *foxi* has been used for this species for fifty years, although the McCook name lacked a description. His figure is adequate as an indication for a new species (Int. Code Zool. Nomenclature, Art. 16, vii).

Description. Carapace orange, sternum dark orange. Coxae, legs yellow. Dorsum of abdomen orange-white, sometimes with paired silver spots posteriorly and darker patches (Fig. 273); also some silver spots around anterior margin; venter without distinct markings. Eyes subequal in size; anterior medians 1.3 diameters apart, 1.5 diameters from laterals; posterior medians 1.1 diameters apart, 1.2 from laterals. Chelicerae have three teeth on the anterior margin, four on the posterior (Fig. 272). A tooth on posterior side of fang. Endites are not wider distally than at base. One trichobothrium on the metatarsi 1, 2 and 3, about one-quarter the article's length from proximal end. Total length, 1.6 mm. Carapace, 0.61 mm long, 0.56 mm wide. First femur, 0.67 mm; patella and tibia, 0.75 mm; metatarsus, 0.57 mm; tarsus, 0.36 mm. Second

patella and tibia, 0.66 mm; third, 0.45 mm; fourth, 0.65 mm.

Male. Much like female. Chelicerae enlarged (Figs. 276, 277) and with spur above base of fang (Fig. 276). Total length, 1.8 mm. Carapace, 0.70 mm long, 0.63 mm wide. First femur, 0.81 mm; patella and tibia, 1.01 mm; metatarsus, 0.65 mm; tarsus, 0.36 mm. Second patella and tibia, 0.91 mm; third, 0.54 mm; fourth, 0.75 mm.

Variation. Some specimens have hardly any abdominal markings, some have scattered tiny white silver spots, and some have a pair of ventral silver patches between genital opening and spiracle. The size of the male spherical tegulum varies in size (Figs. 281–284) and left and right of the same individual may even differ slightly (Figs. 282, 283). Total length of females, 1.6 to 2.6 mm; carapace, 0.6 to 1.0 mm long. Total length of males, 1.4 to 2.2 mm; carapace, 0.6 to 1.0 mm long. The largest specimens came from Arizona and California.

Diagnosis. The small size, relatively small chelicerae (Figs. 272, 276) and the very large spherical tegulum of the male palpus separate this species from *G. emertoni* and other species. Unlike some similar tropical American species, the male has a spur above the fang on the chelicerae (Fig. 276). The tip of the embolus is not twisted (Fig. 280) as is that of *G. iviei*.

Natural History. Barrows (1919) found the spider in meadows and wastelands, in hot, dry situations. The spider makes a horizontal web 11 cm in diameter, 5 cm above the ground. Grass may grow through the web. The spiral strands are close together, and viscid silk is present. Spiders rest in the center of the web, and when disturbed drop to the ground and run away. Barrows observed mating in June in the center of the web, both individuals hanging down, the chelicerae locked and legs clasped. The palpal organs are inserted alternately every 5 minutes, copulation lasting 15 minutes.

Crosby and Bishop (1936) reported males collected in March and April by airplanes above Tallulah, Louisiana at 900 m and 60 m.

Other collections come from the edge of pond and saltmarsh in Massachusetts, from sweeping short grass in Virginia, from pitfall traps in a cornfield, sweet potato field, and a one-year-old abandoned field in North Carolina; from a web over a crawfish hole in Arkansas, a ground crevice in a dry lake in Missouri, and between stones on the bank of a stream "but did not notice an orb-web."

Distribution. The northernmost records are from Nantucket Island, Massachusetts, Wisconsin, Kansas, southern Arizona, southern California, south to Jamaica and Panama (Map 8).

Glenognatha iviei new species

Figures 285–289; Map 8

Holotype. Male from Gulfport, Mississippi, 28 August 1933 (W. Ivie, coll.) in the American Museum of Natural History. The species is named after Wilton Ivie, who collected the specimen and recognized that it was new.

Description. Carapace, sternum brown, legs light brown. Dorsum of abdomen mostly gray to black, with paired lighter patches lacking white or silver pigment. Venter gray, darkest in the center. Eyes subequal in size. Anterior median eyes slightly more than their diameter from each other and from laterals. Lateral eyes are on tubercles. One trichobothrium on third metatarsus only, one-third distance from proximal end. The fourth metatarsus appears to lack a trichobothrium. Total length, 1.4 mm. Carapace, 0.74 mm long, 0.65 mm wide. First femur, 0.78 mm; patella and tibia, 1.00 mm; metatarsus, 0.65 mm; tarsus, 0.41 mm. Second patella and tibia, 0.88 mm; third, 0.47 mm; fourth, 0.67 mm.

Diagnosis. *Glenognatha iviei* differs from *G. foxi* by the presence of an anterior hooked tooth on each chelicera (Fig. 285) and by the twisted tip of the embolus (Figs. 287, 289).

Azilia Keyserling

Azilia Keyserling, 1882, Verhandl. Zool. Bot. Ges. Wien, 31: 270. Type species by monotypy *A. formosa* from Peru. The name is feminine.

Note. According to Keyserling, the type specimens of *A. formosa* are in Warsaw, Poland. The staff of the Polish Academy of Sciences has not answered requests, thus the type may be lost. A neotype will have to be designated for *A. formosa* when the South American members of the genus are revised, since there is doubt on the identity of the species.

Diagnosis. Unlike all other Araneidae, except *Tetragnatha*, *Azilia* have the lateral eyes farther apart than the medians (Figs. 295, 300). The eyes are closely grouped and subequal in size. Unlike most Araneidae but like *Tetragnatha*, all eyes lack a tapetum (Figs. 299, 300). The oval abdomen (Figs. 295–297) separates *Azilia* from those *Tetragnatha* species which have separated lateral eyes. Unlike some other tetragnathids, there are no trichobothria on the base of the femora.

Description. Carapace streaked, darker on sides and head region; narrow in front. Eyes surrounded by black. Sternum dark, coxae light and legs banded. Abdomen streaked, often with white patch above spinnerets (Fig. 297). Eyes closely grouped, subequal in size, or posteriors slightly larger. Median eyes almost their diameter apart; anteriors almost touching laterals; posteriors about 1.5 from laterals; laterals about 2 diameters from each other. Eyes without tapetum, rhabdoms are in rows which loop (Figs. 299, 300). Clypeus height equal to or slightly less than diameter of anterior median eyes (Fig. 294). Chelicerae strong but not enlarged as in *Pachygnatha* or *Glenognatha*. Endites long, widest distally (Fig. 298); legs fairly long with macrosetae (Fig. 295). No trichobothria on base of femur. Abdomen ovoid, widest anteriorly (Fig. 295), often with a hump above spinnerets (Fig. 297).

Males slightly smaller than females with stronger macrosetae on legs.

Genitalia. There is an epigynum

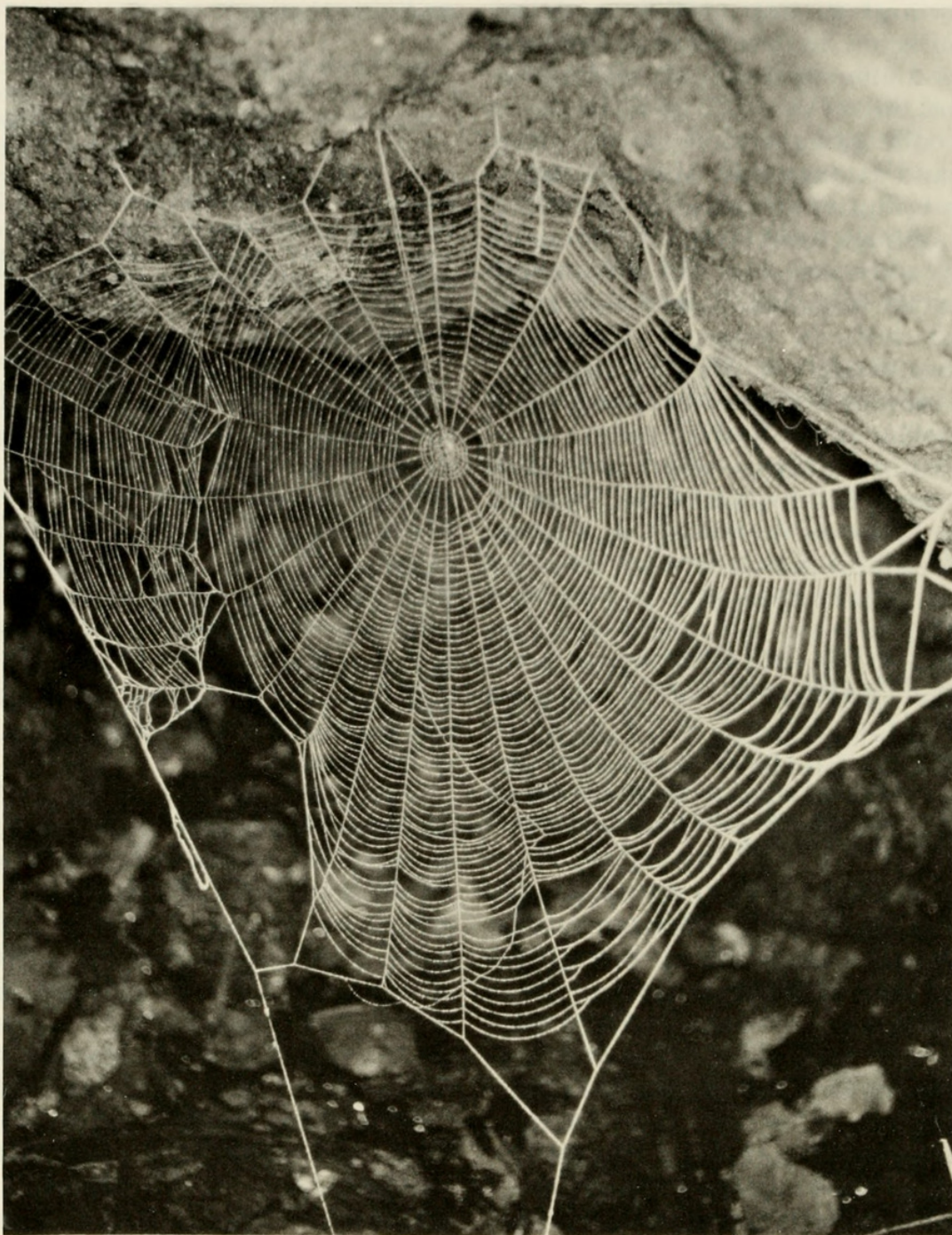


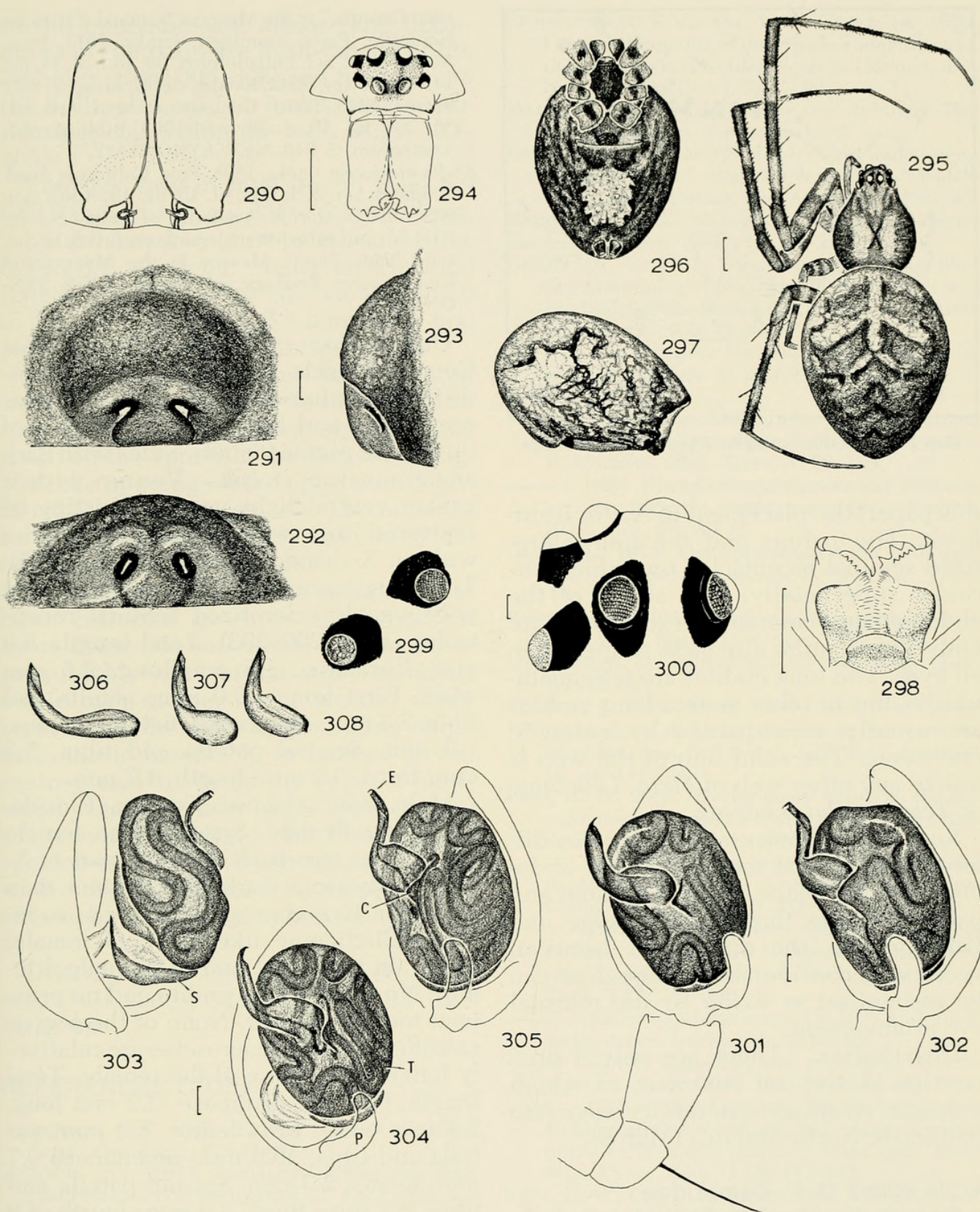
Plate 8. *Azilia affinis* O. P.-Cambridge. Web, diameter about 12 cm; note the closed hub (photo M. Stowe).

present (Figs. 291–293), but the openings face posterior as in *Meta*. The seminal receptacles (Fig. 290) are very thin-walled like those of *Leucauge*. The palpus is very simple (Figs. 301–305) with tegulum (T) and embolus (E), but it lacks a distinct conductor. The paracymbium (P in Fig. 304) is only little modified.

Natural History. All species are found in dark places and caves, like many

Meta. It is interesting that, despite the crepuscular habits, the eye of the spider lacks a tapetum. The web is vertical to horizontal and loose. The hub, unlike that of *Meta*, *Leucauge* and *Tetragnatha* webs, is closed (Plate 8). The spider hangs on the underside of the web and bounces when disturbed (S. Peck, personal communication).

Relationship. Like other genera in



Figures 290–308. *Azilia affinis* O. P.-Cambridge. 290–300. Female. 290. Female genitalia, dorsal view. 291–293. Epigynum. 291. Ventral. 292. Posterior. 293. Lateral. 294. Eye region and chelicerae. 295. Female. 296. Abdomen, ventral. 297. Abdomen, lateral. 298. Labium and endites. 299. Left lateral eyes. 300. Posterior median eyes and left laterals. 301–308. Left male palpus. 301. Ventral. 302. Lateral. 303–305. Expanded and cleared. 303. Mesal. 304. Ventral. 305. Lateral. 306–308. Embolus. 306. (Florida). 307. (Georgia). 308. (Southern Texas).

Scale lines. 0.1 mm; Figures 294–298, 1.0 mm.

Abbreviations. C, conductor; E, embolus; P, paracymbium; S, subtegulum; T, tegulum.



Map 9. Distribution of *Azilia affinis* O. P.-Cambridge.

this paper, the placement of *Azilia* is difficult. The palpus and the non-sclerotized seminal receptacles resemble *Leucauge* superficially. The shape of the abdomen and coloration resemble *Meta*. Only *Tetragnatha* also lacks a tapetum in all eyes. The long endites are tetragnathid-like, but in other genera long endites are usually accompanied by enlarged chelicerae. The solid hub of the web is unlike any other web of *Meta*, *Leucauge* or *Tetragnatha* relatives.

Species Differences. The species differ in the ventral marking of the abdomen, and the shape of the epigynum and palpus. Unlike those of *Leucauge* and *Pachygnatha*, the differences between species are considerable, although all can be recognized as *Azilia* by the unusual eye arrangement.

Distribution. There are only 4 or 5 species in tropical America, of which only one, *A. affinis*, extends its range into temperate North America (Map 9).

Azilia affinis O. P.-Cambridge

Plate 8; Figures 290–308; Map 9

Azilia affinis O. P.-Cambridge, 1893, *Biologia Centrali-Americana, Araneidea*, 1: 115, pl. 15, fig. 4, ♀. Female holotype from Teapa, Tabasco, Mexico in British Museum, Natural History, examined.
Azilia vagepicta Simon, 1895, *Ann. Soc. Entomol. France*, 64: 153. Female specimens from "Amer.

sept, Georgia," in the Muséum National d'Histoire Naturelle, Paris, examined. Banks, 1913, *Proc. Acad. Natur. Sci. Philadelphia*, 65: 180, pl. 11, fig. 14, ♀. Roewer, 1942, *Katalog der Araneae*, 1: 923. Bryant, 1945, *Trans. Connecticut Acad. Arts Sci.* 36: 208, fig. 10, ♂. Bonnet, 1955, *Bibliographia Araneorum*, 2: 840. NEW SYNONYMY.

Azilia mexicana Banks, 1898, *Proc. California Acad. Sciences*, ser. 3, 1: 258, pl. 15, fig. 19. Adult syntypes in California Academy of Sciences, destroyed, one subadult male and one juvenile syntype from Tepic, Mexico in the Museum of Comparative Zoology, examined. NEW SYNONYMY.

Description. Female from Alachua County, Florida. Dorsum of abdomen indistinctly patterned with dark chevrons posteriorly and light areas consisting of tiny white pigment spots. Sides with dark anastomosing streaks. Venter with a square central light patch consisting of scattered tiny white pigment. Thorax with an X-shaped depression (Fig. 295). The epigynum has two openings and very weakly sclerotized seminal receptacles (Figs. 290–293). Total length, 8.9 mm. Carapace, 3.5 mm long, 2.5 mm wide. First femur, 6.0 mm; patella and tibia, 7.3 mm; metatarsus, 6.4 mm; tarsus, 1.9 mm. Second patella and tibia, 5.3 mm; third, 3.2 mm; fourth, 4.7 mm.

Male from Alachua County, Florida. Color like female. Smaller than female but similar structure. Anterior part of X-shaped thoracic mark less distinct than posterior. Eye sizes and spacing as in female. Chelicerae like those of female. Tooth on the distal end of the palpal femur. No tooth on the endite and no proximal tooth on femur. None of the legs is modified, but the macrosetae are relatively longer than those of the female. Total length, 6.8 mm. Carapace, 3.2 mm long, 2.4 mm wide. First femur, 8.0 mm; patella and tibia, 10.0 mm; metatarsus, 9.7 mm; tarsus, 2.3 mm. Second patella and tibia, 6.7 mm; third, 3.0 mm; fourth, 4.9 mm.

Variation. The posterior hump is more distinct in some specimens (Fig. 297) than others, almost absent in specimens from Florida. No two populations have similar genitalia, but the differences

in the epigynum are minor. The differences of the palpi are in the shape of the embolus (Figs. 306–308) and the width of the bulb; also, no two males have a similar duct coil within the bulb (Figs. 303–305).

Females vary in total length from 6.9 to 9.9 mm; carapace, 2.9 to 3.8 mm long, 2.1 to 2.8 mm wide; first patella and tibia, 6.3 to 8.1 mm long. Males vary in total length from 5.2 to 6.9 mm; carapace, 2.6 to 3.9 mm long, 1.9 to 2.4 mm wide; first patella and tibia, 6.3 to 9.4 mm long.

Diagnosis. *Azilia* can be separated from other Central and South American species by its prominent square, light patch on the venter of the abdomen (Fig. 296), the openings of the epigynum (Figs. 291–293), and its large size. The males of related species are mostly unknown; one has a long filiform embolus.

Natural History. *Azilia vagepicta* has been collected in caves and wood rat nests (*Neotoma micropus*) and in other presumably dark situations, including mesic lush ravine; mesic woods, shady recesses on the sides of a building structure, mesic hammock, in bottom of wet ravine, and in dried-up cypress-hardwood swamp. Many were collected at night with flashlight. In Florida, the species occurs in twilight zones of caves, where the spiders feed on fungus gnats. Orb-webs are vertical to horizontal (Plate 8).

Distribution. Georgia, northern Florida, Gulf states, Mexico to Costa Rica (Map 9).

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