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NESTING HABITS OF THE AMERICAN PURSEWEB SPIDER.[1]

BY REV. HENRY C. MCCOOK D. D.

Genus **ATYPUS.**

Atypus Abbotii (Walck).

1792. *Purse Web Spider* Abbot. Mss. drawings of Georgia Insects, Vol. xiv, Pl. 8, No. 36, Zool. Lib. Brit. Mus. Nat. Hist.

1837. *Sphodros Abbotii* Walk. His. Nat. des Ins. Apt. Vol. i, p. 247.

1842. *Atypus niger* Hentz. Jour. Bost. Soc. Nat. Hist. Vol. iv, p. 224, p. 2, viii.

1875. *Atypus niger* Hentz. Spid. of the U. S. p. 19, Pl. ii, fig. 1.

During a visit to Florida in April 1886, I had the pleasure of observing in natural site for the first time the nests of Abbot's Atypus, an aranead heretofore known as the black Atypus, or *Atypus niger* of Hentz. I had possessed for a number of years specimens of the long tubes in which this creature dwells [2] concerning which I only knew that they were reported as being spun along the outside of the trunks of trees.

I. GEOGRAPHICAL DISTRIBUTION.

The field of observation was on the plantation of Dr. William Wittfeld,[3] at the lower part of Merrit's Island, which is situated between the Indian and Banana Rivers, a few miles south of Cape Canaveral. A large number of specimens were collected, some of which are submitted for inspection. The species is distributed widely throughout the state of Florida, is found in Georgia, and probably in the Southern Atlantic States.

The female of this Atypus has not heretofore been described, although it has recently come to light that it was known and figured nearly a century ago by Mr. John Abbot, an Englishman settled in Savannah, Georgia, during the latter part of the last century [4]

[1] The substance of this paper was given as a verbal communication before the last meeting (1887) of the British Association for the Advancement of Science, at Manchester, England.

[2] I had Floridian examples of the nest from Professor Riley the Entomologist of the Agriculture Bureau; and also from Dr. George Marx of Washington.

[3] Fairyland, Georgiana, Brevard Co. Fla.

[4] See the author's paper in Proc. Acad. Nat. Sci. Phila. 1888, p. 74, on Necessity for Revising the Nomenclature of American Orbweaving Spiders.

Among Mr. Abbot's figures is one of this Atypus which he quite happily describes as "the purse web spider", (a popular name which I cordially adopt), and makes a brief and correct note of its habits. "This singular species," he says, "makes a web like a money purse to the roots of large trees in the hammocks or swamps, five or six inches out of the ground, fastened to the tree, and the other end in the ground about the same depth or deeper. To the bottom of that part in the ground the spider retreats. I imagine they come out and seek their food by night as I never observed one out of its web. In November their young ones in vast numbers cover the abdomen of the female and the abdomen then appears very much shrunk. The male is the smallest, but has the longest nippers. Taken in March and is not common."[1]

The description of Hentz[2] was made from a single specimen, a male, found in June on newly turned soil at Northampton, Mass. Mr. William Holden reports it as collected in Ohio.[3] The spider ought therefore to be found in the Middle and Atlantic States of America, but I have never been so fortunate as to see it therein, and have never heard of any one who happened upon it. It probably is not abundant, or its nesting habits must be greatly modified by change of latitude; otherwise one would suppose that its very conspicuous nest would not have escaped notice. Or, may we suppose that it is disappearing, perhaps has disappeared before the progress of human civilization?

Fig. 1. Atypus Abbotii.

II. DESCRIPTION OF THE NESTS.

The Florida nests are silken tubes of various lengths and sizes, ranging from ten inches long and three-fourths inch in diameter, to minute silken pipes a few inches long, and about one-eighth inch in diameter. Externally most of them present a dark, weather beaten appearance and are covered with more or less sand. Inside, the silk is white and clean. The texture of the material of which the nest is spun is quite close, resembling a rough-finished bit of silk cloth.

[1] Manuscript Drawings of the insects of Georgia in America by John Abbot of Savannah. Vol. xiv, 1792. Zoological Library of the British Museum of Natural History.

[2] Spiders of the United States, p. 19. Plate ii., fig. 1. Hentz knew nothing of the habits of his species.

[3] Id. Emerson's note.

These tubes are found attached to the trunks of trees, along which they extend upwards for various distances according to their size; the size being evidently determined by the age of the occupant. The young spiders have very small tubes. The adults occupy large tubes. The nests are fastened to the bark of the trees at several points by white threads. They are often open at the top, that is, there is no designed closure like a lid or door; but for the most part the top edge of the tube drops in or folds over, making an accidental closure. Beneath the surface of the ground the tubes extend into the sandy soil around the root of the tree for various distances, sometimes equalling the length above the surface, and in one or two cases even exceeding it.

Fig. 2. Purseweb Spider's Nest with under-surface part exposed by removing the sand.

The spider seems to have no preference for any special tree against which to spin its tubes. The palmetto was frequently chosen, and I counted as many as thirteen tubes, great and small, long and short, extending around a large portion of the base of one palmetto trunk. Some of these may have been the nests of a brood the individuals of which had established themselves in close neighborhood. Very frequently these tubes were found attached to small trees or bushes. When the trunks of the saplings have a slanting position, as occasionally happens by reason of external pressure of some kind, the tube generally drops straight down to the ground, forming an angle with the point of attachment instead of hugging the bark of the plant. Most of the tubes which I followed beneath the surface terminated in a point or had a club-shaped terminus; but in one case at least the tube broadened out into an irregular chamber with two short branches constructed like the main stem.

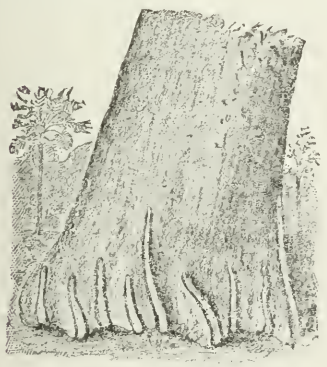

Fig. 3. Colony of Purseweb spider's nest on a palmetto tree.

III. USE AND MANNER OF SPINNING THE TUBULAR NEST.

Immense numbers of these nests were found throughout the woods on the grounds of Dr. Wittfeld. Spiders when found within the tubes were usually clinging to the inside, a short distance from the top, or were found in the same position underneath the soil. The most persistent observation at various hours, night and day, failed to uncover any of the spider's habits as to capture of prey, the mode of building the tube, or the uses of the tube in the life economy of the creature. I have no doubt, however, that in the uses of its peculiar web the Purseweb spider will be found to resemble closely her British congener, *Atypus piceus*. According to Mr. Fredrick Enock,[1] this aranead captures the insects that crawl upon the outer surface of her tube by striking them through the silk from the inside, and when they are thus secured cutting a vent in the tissue large enough to drag the prey through into the tube. This is a most curious and interesting habit, the existence of which was established with tolerable certainty by Mr Enock by various observations and experiments. I may venture to repeat the substance of one of these.

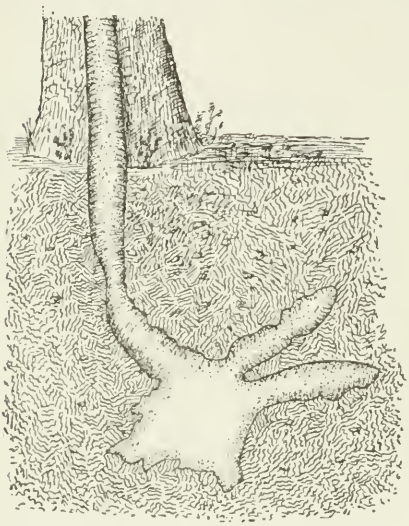

FIG. 4. An underground terminus or den, with branches.

A large blow fly was held by its wings and permitted to crawl upon a bank until it walked upon one of the tubes of Atypus. The spider ascended a little distance and returned. The head of the fly was then rubbed against the tube a number of times, the tube meanwhile becoming imperceptably distended, indicating the spider's approach. After a moment's pause the fangs were thrust through the fly, followed by a crunching sound as the spider closed and almost crossed the top fangs around its prey. The observer released his hold upon the fly, and immediately the left hand fang was withdrawn just into the tube which was torn, and the fang refixed into the fly. The right fang was then withdrawn and quickly seized the

[1] The Life History of Atypus piceus Sulz., by Fredc. Enock. The Transactions of the Entomological Society of London, 1885, p. 389.

fly through the opening, and after several tugs the insect was pulled within the tube, and the spider backed downward holding its prey fast in its falces, leaving a rent a quarter inch long by three-sixteenth inch wide. After an interval of three minutes the spider cautiously reascended the tube to the opening, and taking hold of the ragged edges of the rent, drew them towards each other until they almost touched. She then backed a little and turned her abdomen so that the spinners approximated the united edges. Then by a number of zigzag movements with the spinners across the juncture, she completely closed the rent, and when it was neatly repaired returned apparently to feed upon her prey. The next morning the rent was covered with sand so carefully that Mr. Enock could scarcely detect where it had been. When the spider was satisfied with food, it would draw in the tube in a determined manner, and would retain her hold in this position sometimes for several hours.

1. *A time-measure of the spinning-work.*—Being foiled by the persistent secretiveness of this spider in natural sites, I captured several specimens and placed them within glass jars in order to observe their behavior under these artificial conditions. Some important facts resulted, particularly as to the mode of constructing the tubular nests. The bottom of each jar was filled with sand, and a stick inserted within, in order to give a natural position for the establishment of a nest if the spider should be inclined to weave one. One individual, after long continued exploration of its quarters, at last established itself at the foot of the standing stick and began to burrow a little hole. I was compelled to leave at this point, and did not return to my room until evening, after twelve hours absence. During this time a vertical tube of white silk one and one-fourth inch long and about the thickness of the spider had been spun along the side of the stick. The outside of the tube was sparsely covered over with particles of sand which of course had been brought from below.

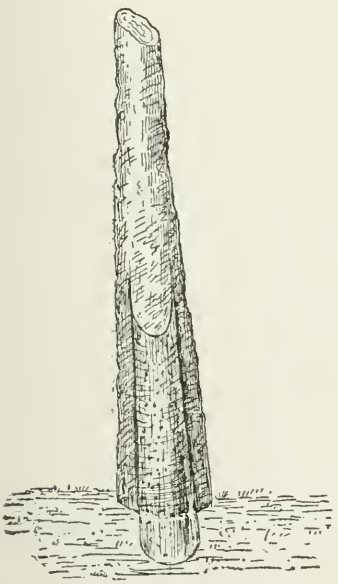

Fig. 5. First section of Purseweb spider's tubular nest.

A unit for measuring the time required to construct a tube was also obtained. The inch and a

quarter tubing was built within twelve hours, although of course it cannot be determined how much of this time was actually consumed in spinning work, probably not more than two hours. It is at least evident that a length of two inches or more a day is quite within the spinning capacity of Atypus.

2. *The Foundation Frame and mode of Spinning the Exterior Tube.*—Another specimen gave a very satisfactory clew to the entire mode of constructing a tube. It first took its position at the foot of the stick in the centre of the jar and wove a small lateral tube extending partly around the base. (See fig. 7.) At 9 o'clock in the evening this tube was pierced at the top, and the creature began to erect a vertical tube along the surface of the stick. The mode of proceeding was substantially as follows: Single threads were attached to the stick about two inches above the surface. These threads were stretched downward and over a lateral space about the width of the tube to be spun, extending to the little opening which had been made in the tube at the base of the stick. The lines were repeated and over laid until at last they acquired considerable consistency of texture. At the top terminus they were attached to the stick or to one another. At the bottom the point of attachment was a little distance from the surface of the stick so that most of the lines had a slanting position. Their appearance might be compared to that of a number of poles leaned against a tree. The structure thus gradually assumed a skeleton tubular form which was increased by the pressure of the spider against the lines as it moved back and forward within them upon the surface of the stick. When the scaffolding was completely overspun the section appeared as a close silken tube.

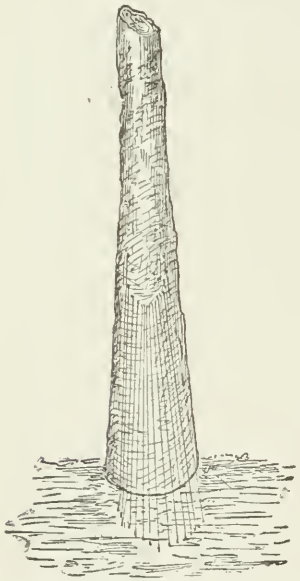

Fig. 6. Purseweb Spider. Foundation lines of frame for a tube.

3. *Mode of Spinning under ground.*—A third specimen enabled me to determine the manner in which this rough frame was completed so as to give it the close texture of the tubes found in Nature. This specimen had excavated a tunnel against the inner surface of the

glass jar. Its movements were thus entirely open to observation.

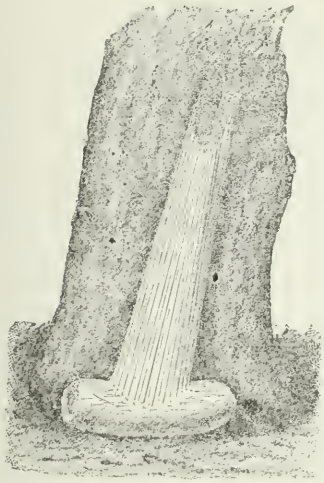

Fig. 7. Purseweb Spider's tube. Section after frame is overspun.

Along this subterranean way or tunnel the spider strung fine threads covering the bottom, the side and the top, forming a frame quite resembling the foundation scaffolding used in spinning the vertical tube. (See fig. 6). It then proceeded to thicken these lines in the following manner. The bottom parts were overspun by emitting from the long inferior spinnerets numerous fine threads which were beaten down against the surface by dropping the spinnerets, and were spread around by a lateral movement of the abdomen, which of course carried with it the spinnerets and the threads issuing thereform. The animal's motion reminded one of a plasterer using his trowel to spread mortar rather than a weaver spinning cloth. The space covered by these movements having been sufficiently thickened, the spider proceeded to another spot and went through the same process. When it came to thickening the upper portion of its tube it turned its abdomen upward resting its body upon the dorsum of the cephalothorax. In other words the creature laid upon its back. Its abdomen was well turned over so that in this position the spider was almost in the form of a semicircle. The pressure of the abdomen upwards forced the lines at the point of impact into a little bay, the concavity of which was thickened over with threads spun from the spinnerets which were managed in the way already described. That is, the spinnerets were moved back and forward, and the out spun threads were beaten upwards into the lines already formed.

This procedure very closely resembles the manner of spinning which I have often observed in *Mygale Hentzii* the large tarantula of our southwestern States. This mode of thickening over the foundation lines of the tube also closely resembles the behavior of orb-weaving and other spiders when constructing the thick padding which surrounds their eggs, forming their eggsacs or cocoons. I have seen it notably in the case of Lycosa. It is without doubt the way in which the trap-door spider of California (*Cteniza Californica,*)

spins the silken lining of her well known and much admired trap-door nest.

4. *The Nesting Tube Spun in Sections.*—It was further determined with reasonable certainty that the spider builds its tube in sections. A letter from Miss Anna Wittfeld, after I returned from Florida, informed me that the spiders had spun complete tubes within the jars which I had left under her care. The question was at once raised, were these tubes completed by adding to the section which had already been observed? From correspondence with Miss Wittfeld the information was obtained that the tubes had been finished as I had conjectured, by adding to the portions previously formed. We may, therefore conclude first, (1) that the mode of constructing these tubes is for the first time fully determined; second, (2) that the original section, of greater or less length as the case may be, is spun in the manner now determined and described; and third, (3) that additional sections, of probably about the same length, are added thereto according to the fancy or necessity of the builder, and constructed in the same manner as the preceeding one. It is thus within the power of Atypus to lengthen out her tube and extend along the trunk to any desirable height, the web surface available as a snare for taking food. Thus, also, as she ascends along her arboreal hunting ground she carries with her the protecting walls of her tubular home, which is truly her castle.

A large number of tubes was collected, and these I cut open with the view of determining whether any trace of this mode of spinning by sections had been left in the form of seams or joints; but nothing of the sort was found. The points of juncture were so skilfully covered over that they differed in no respect from the texture of other portions of the tube. The silk on the inside, however, was of beautiful smooth white color, decidedly in contrast with the appearance of the outside. In many specimens examined the upper extremity of the tube was made of perfectly white silk which apparently had been quite recently spun, showing an addition to the tube either for the purpose of repairing and strengthening, or else of extending the old nest. This observation upon the nests spun in natural site quite harmonizes with the conclusion reached from the action of Atypus in confinement.[1]

[1] For an account of the English *Atypus piceus* making a new nest as observed by Rev. O. Pickard-Cambridge, See Annals and Mag. of Natural History, Vol. viii., p. 241, 1876.

5. *Doors.*—An examination of the numerous nests shows that openings are usually but not always left at the top of the tube. These openings are placed indifferently beneath, at the side and above. When the spider is not near the upper portion of its tube, the silk naturally collapses, and the opening is not apparent. However, it must be remembered that a very slight stroke of the mandibles would open the tube at any part and give the spider egress. So also a few movements of the spinnerets would close the aperture. Moreover, if we accept the conclusion that the mode of capturing prey is the same as that of *Atypus piceus* (as above described) there appears to be no special need for a door for the main necessity of life, since the spider has little or no occasion ever to go outside her own tower or cave.

IV. SANDING THE OUTSIDE OF THE TUBE.

It has been stated that one of the individuals put under observation, after having spun her snare, covered it more or less thickly with grains of sand. It was thus indicated that the sanded condition of the tubes found in natural positions is the result of purpose on the part of the builder. What purpose does it serve? Many spiders of various families are in the habit of protecting their cocoons or eggsacs by covering them with mud, with particles of soil, with bits of decayed wood and bark scraped or broken off, with various minute chippage, and even with the debris of insects' wings, heads, legs etc., captured for food. In this behavior the purpose is obviously to protect the enclosed eggs from hurtful weather changes and various enemies, cheifly the parasitizing ichneumon-fly, *Pezomachus*.

The use of the sand deliberately placed upon the outside of the nest of Atypus is not so obvious, although it perhaps serves to toughen it, and possibly protects its inmate from the assaults of certain enemies as yet unknown. In natural site the sand and weathering give the tubes almost the exact appearance of the outside of the tree along which it is placed. In a large proportion of my specimens the sand was intermingled with brown wood-dust from decayed bark and the dark colored vegetable mold which was heaped around the base of the trunk, and into which the spiders had excavated.

It has been conjectured that this is an example of so called mimicry. Some observations made by Mr. Frederick Enock on the habits of *Atypus piceus*, the British congener of our Florida species, raise a doubt upon this supposition, at least indicate another

solution. The mode of constructing the tube as observed by Mr. Enock is substantially that which I have above described as practiced by our Purseweb Atypus. After the completion of her tube Piceus was seen to take a load of sand between its falces, every grain of which it deftly guided with its fangs, literally pushing the grains through the side of the tube. Having exhausted its supply it reversed its position, returned to the bottom, and repeated the action of gathering and distributing the sand. At the end of an hour and a half it had completely covered the silken tube with sand, every grain of which it had brought up from the surface of the ground, thrust it through the silken tube from the inside, and afterwards, as the occasion required, smoothed over the rent with newly extruded silk. The next morning a small quantity of sand had been forced out at the top of the tube, showing that the industrious creature had continued its labor during the night; and this, indeed, was prolonged during the greater part of the day. The following night it had lengthened the aerial portion of the tube and covered it with sand.[1] We may perhaps, conclude from these facts that the spider had apparently simply endeavored to save itself the labor of carrying sand to the top of its tube, by pushing it through the rent sides, a method which would be naturally suggested by its custom of opening the tube to take in its prey.

Mr. Moggridge attributed this sanding of the exterior to a protective purpose, and alludes to the fact that while tubes of *Atypus piceus* found on sandy banks were covered with sand, a nest taken at Troyes, France, in a mossy site, had moss and plant fibres woven upon it.[2] But as the spider in such environment would be compelled to clear away particles of moss, root fibres etc., in extending the nest over the surface and through the close standing stems, there appears to be no reason why it might not treat this chippage precisely as it did the sand in Mr. Enock's examples. No doubt these spiders, as well as our Purseweb, while in the act of deporting the sand excavated from beneath, frequently leave grains attached to the inside of the tube. Indeed, it would be difficult to prevent this, as the sand readily entangles with the silken fibres; but as such a rough coating would be unpleasant to the creature in its frequent passing to and fro, it would overspin all these inside droppings. Indeed, in this very fact we may see a sufficient reason for the

[1] The Life-History of Atypus piceus, page 397.

[2] Harvesting Ants and Trap-Door Spider. Supplement. p. 188.

habit of getting the sand out at a point nearer the ground than the top of the tube. On the contrary the particles dumped from the top or through slits in the side, and which also readily entangle within the silk strands as they fall, are permitted to remain inasmuch as they are not inconvenient. The idea of a protective purpose cannot, however, be wholly excluded; for it is found that in repairing the rents made in the tube in order to draw in the stricken prey, the new material spun over the rent is quite invariably sanded. This indicates a deliberate intention.

On the whole, in view of the above facts, and reasoning from them by analogy it appears that (1) much of the sand and bark-dust which covers the outside of the nests of Atypus is an incidental result of the act of excavation; (2) that, however, the spider does at times deliberately add to this coating; (3) that the purpose of this act is probably protective at least in the way of strengthening the tube; (4) that there is no positive proof that protective mimicry has any part in the habit; yet (5) as a matter of fact this exterior coating does better adapt the tube as a snare both to decoy insects to a light and enable them to travel upon it.

V. MATERNITY HABITS.

Much remains to be determined of the life-history of the Purseweb spider, but we may venture the prediction that in many points it will be found to differ little from the habits of its British congener as described by various observers. We know from Abbot's note above cited that the young, like the offspring of Lycosids, domicile upon the back of the mother after they are hatched. The cocoon containing the eggs is of course retained within the purseweb, and probably in that portion which is beneath the surface of the ground. *Atypus piceus* suspends her egg-cocoon in a pretty hammock of silk an inch long, attached to the top and bottom of the pouch.[1] The number of eggs within the cocoon of Piceus is from one hundred to one hundred and fifty. They are deposited in midsummer, July or early August, and the young issue from the cocoon about the latter part of September. They remain with their mother in the maternal nest during the winter, and Mr. Enock found the female and her young together March 31st, and again as late as April 5th. About

[1] See Mr. Enock's paper, p. 392. See also a good figure representing the same habit in Mr. Simon's paper, Annals Entomological Society of France, 5th Series, tom. 3, 1874, plate 4; also "Spiders of Dorset", Rev. O. P. Cambridge, page xxxiii, Introduction.

the last named dates the younglings make their exode, and after being dispersed in the manner usual to spiderlings, proceed to make tiny tubes which are miniatures of the parent nest. As the development of spider life in Great Britain is later than in the United States the tubelets of the young of Abbot's Atypus may be looked for in the early autumn. Some of the Florida specimens which I collected in April within their tubes, I judge to be members of the preceding autumn broods.

VI. ORIGIN AND RELATIONS OF THE TUBEWEAVING HABIT.

The tube-making faculty appears to be, as far as secondary causes are concerned, the natural result of the instinct of self-protection. It is perhaps most natural that the lower animals should seek to protect themselves within barriers formed by their body secretions, as is the case among the larvæ of many insects. The restless movements of the body characteristic of these creatures, conjoined with the instinct to cover themselves up, to protect themselves from unfavorable weather changes and from the approach of enemies, may be a sufficient natural explanation of the origin of the tube-making habit. Thus the silk moth larva while secreting silk from the glands which open on the under lip, moves backward and forward continually distributing its secretions, and at the same time by the motion of its body limits them to the borders of the space around which it moves. In the same way the social caterpillars have learned to shut themselves within their well known tent, which presents so largely the appearance of a designed structure, but which, in its origin, at least, may have been quite as much the result of accident, the silken secretion simply hardening around the limits of the space through which the restless creatures move, and which by their motions they keep free from threads. In like manner the larva of the ant, at the moment when Nature brings upon it the sense of the great change from its larval to its pupal estate, moves backward and forward within a narrow space secreting its delicate silk, which by its movements is pushed from direct contact with its body, and hardens into the little case or pouch in which itself at last is encompassed. Thus, in an entirely natural way, we may suppose that the Great Over-Force while planning and directing, preserving and governing all creatures and all their actions, has developed the interesting habit of spinning tubes or cylinders as a protection to the body.

Among the spider fauna this habit is particularly prominent. It does not exist as with insects in a larval estate, but in the perfect animal, the only one, with possibly one exception,[1] of which we have knowledge, the tube-making instinct of insects being confined to the larval period. This habit, which characterizes the larvæ of insects is carried forward to the perfect animal among the Araneæ. The habit of protecting themselves by tubular spinning work in one form or another exists among some species of every section or tribe of the spiders.

Among the Orbweavers we have such examples as *Epeira strix*, which spins a tough silken cylinder, open at one end. Within this she makes her home, and holds a connection with her round snare by means of a thread. This tube is spun within cavities of various sorts, and often within a curled leaf. The habit is again illustrated among the Orbweavers by the beautiful silken domes or tents with or without a leafy covering, such as are formed by the Insular spider, *Epeira insularis* or the Shamrock spider, *Epeira trifolium*.

Among the Retitelariæ or Lineweavers we have such examples as the pretty tubular tent of *Theridium zelotyppum* which I have found swinging among pine leaves in the Adirondack forests containing the mother and young. The Saltigrades or Vaulting spiders spin thick silken tubes within which they shelter themselves during summer and winter, and in which also they bestow their egg-sacs. The Laterigrades I have found sheltered underneath a little tubular tent, guarding their cocoons, although the tube making habit seems to be least decided among these of all the aranead families. The Tubeweavers, of course, as their name implies, have a strong tendency in this direction. Indeed, some remarkable examples of tubular nests may be found among them, as in the case of our Medicinal spider (*Tegenaria medicinalis*), and the funnel-shaped snare of the Speckled tubeweaver (*Agalena nævia*), which is one of the most common spiders of America.

The nest of this Agalena is a tube, oftentimes of considerable length, which broadens out from the top-opening into a sheeted snare that is spread over surrounding surfaces, and is usually guyed or supported by lines reaching upward. It may be seen extending within little cavities and openings, insect burrows, gopher holes and the like, and in some cases I have thought that I have seen indica-

[1] Psocus. See my "Note on a Web-spinning Neuropterous Insect, Psocus sexpunctatus." Proceed. Acad. Nat. Sci. of Philadelphia 1883, pp. 278–9.

tions that the occupant had assisted in accommodating her spinning work to her usurped quarters by widening and deepening the hole. At all events, the snare when seen in such sites presents a very striking appearance of having been a work of design, both in the burrow and in the inter-spun tube, precisely as in the case of the Tunnelweavers. *Agalena* has one remarkable physical characteristic in common with Atypus and other Theraphosids, namely, the long jointed spinnerets which are used so actively in spinning her characteristic tube.

When we come to the two remaining tribes, the Lycosids and Tunnelweavers, (Territelariæ) we see this habit possessing special developments, and here also we see it associated with the burrowing habit which is such a marked characteristic of many of the higher animals and even of man himself.

The nest of *Cyrtauchenius elongatus* as described by M. Eugene Simon closely resembles that of *Agalena nævia* in the character of the tube alone; but this tube is enclosed within a deep cylindrical burrow, and is prolonged upward for about three inches above the surface of the ground, and enlarged into a funnel-shape, so that it becomes from two to three inches across at the orifice. This aerial portion is snow white, and at once attracts the eye even from a considerable distance; the nests, rising up amid sparse grass which serves to support but not conceal them, present the appearance of scattered white fungi. *Cyrtauchenius* belongs to the Territelariæ, and appears to be nearly related to *Atypus* and *Nemesia*. Mr. Moggridge classifies its nest among those of the trap-door spiders, characterizing it as the funnel-shaped nest.[1]

The nest of Cyrtauchenius even more closely resembles that of certain Lycosids found in the United States; for example, *Lycosa tigrina*[2] is quite abundant in the Atlantic States of America. It constructs a nest which answers closely to Simon's description of Cytauchenius, the only exception being that the portion of the nest above ground quite invariably forms an oblique angle with the tunnel within the ground, and the burrow is not lined with spinning work below the mouth. The aerial portion of this spider's nest is sometimes formed into a beautiful vestibule above the mouth of the burrow, and as the winter season advances is occasionally shielded

[1] Harvesting Ants and Trap-Door Spiders, Supplement p. 190. Mr. Moggridge gives a diagramatic figure of this Spider's nest from the description of M. Simon. See pl. 13, p. 183.

[2] Tarentula tigrina McCook. Proceed. Am. Entom. Soc. 1879, p. xi.

with a sort of swinging door. Hentz says that one winter he found a burrow of a *Lycosa* (species not named) supplied with a lid, and he thinks it probable that all Lycosids close the orifice of their holes for hibernation.[1] I may say here that probably all burrowing Lycosids close the openings of their nests as the cold season approaches, and it is possible that the same habit will be found to prevail as a protection against heavy rains even in the summer and autumn. Mrs. Mary Treat says that certain Lycosids thus shut themselves in just before moulting, and remain so until quite recovered from the after debility[2].

Another interesting Lycosid tubemaker is the turret spider.[3] This creature constructs above the surface of the ground to the height of one or two inches a little tower which is in form an irregular pentagon, and is composed of bits of straw, stalks of grass etc. It is quite like the old fashioned mud-chimneys which I have often seen attached to the gables of log cabins in the far west.[4] Unlike the surface nest of Tigrina, the tower of Arenicola is invariably built in the line of the burrow, the whole forming a straight perpendicular tube. We have thus established, through the nest of *Cyrtauchenius*, a very close connection between the nesting habits of the Lycosids and that of the Territelariæ.

In the case of *Atypus sulzeri*, as it is seen in England and described by its first observer, Mr. Joshua Brown, the nest assumes the shape of a pendant inflated tube, covered with particles of sand, closed at the top, extending nine inches more or less above the silk-lined burrow of like depth, and attached to surrounding foliage. In this form it cannot differ largely from that of our Purseweb spider except that the former is stayed among the grass-stalks and the latter is fastened to the tree trunks. It would be interesting and perhaps highly suggestive were Abbot's Atypus to be domiciled in a grassy site away from trees, to note its behavior. Would it make a nest quite like that of the English Atypus?[5]

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[1] Spiders U. S. p. 25.

[2] "My Garden Pets," p. 82.

[3] *Lycosa arenicola*, Scudder. Psyche. Vol. II, p. 2, 1887.

[4] McCook, "Tenants of an Old Farm," figs. 44, 45, p. 131–5.

[5] Efforts to pursue my studies of the Purseweb spider were prevented by the loss of the living specimens sent me by Miss Wittfeld from Florida. We exhausted our ingenuity in providing protection for packages sent through the mail, but not a spider lived. Evidently the species is more sensitive to such confinement than many others. I regret to record that since writing this note, the young lady here mentioned has died. Her keen and intelligent interest in insect life are well known and were highly appreciated not only by myself but by others entomologists.

The nests of the same spider[1] according to other observers have the projecting part trailed along the ground or surface growth of grass or moss. Thus the tube differs from that of the Purseweb Atypus simply in that it is spun horizontally along the surface instead of being attached in a perpendicular position to a tree. M. Eugene Simon says that *Atypus piceus* conceals herself in dry localities, partly underground; sometimes in woods, principally the plantations of evergreens. Its retreat is altogether hidden, sometimes by the stones, at other times by the moss, so that it is necessary to search with care and over large spaces in order to discover it. This Atypus burrows obliquely a deep tunnel of 15 to 20 centimetres of the size of its body. It constructs part of its tube quite straight and of a tissue very thick, of which the upper part is longer than that within the subterranean gallery. It is continued horizontally upon the soil and terminates in a tapering closed point. Near its lower extremity, the tube presents a large expansion where it dilates into the form of a chamber quite spacious, within which the spider dwells. It is at the entrance of the contraction that it suspends by a few threads the cocoon containing its eggs. Simon presents a drawing in site of the nest of Atypus,[2] and a good figure of a collected specimen is given by Moggridge.[3]

These comparative results suggest a very interesting analogy between the spinning industry of the two aranead tribes, the Citigradæ and Territelariæ, which I venture to present in diagrammatic outlines at Fig. 8 and 9. The first figure in the cut (Fig. 8, 1) represents the simple burrow of the Mygalidæ, which, in many species and especially our own American tarantula, is a tubular hole in the ground without any silken tube or lining. This quite corresponds with the unlined tubular burrow which is the typical nest of the Citigrades as represented by most of the Lycosids (Fig. 9, 1.) The second figure of the series (Fig. 8) shows the silken tubular nest of the Atypinæ, as represented by the American and European species considered in this paper. Here we have the ground burrow

[1] Note on Atypus sulzeri, Mr. Edward Newman, Linnean Society. See also Zoologist, Vol. xiv., 1856. p. 5021. See also Moggridge, Trap-Door Spiders, p. 185.

[2] Annals Entomological Soc. of France, 5th Series, Tome 3, 1873, Plate 4.

[3] Harvesting Ants and Trap Door Spiders, Supplement, p. 183, Pl. xiii.

of Mygale with the addition of a silken lining[1] which also is carried above the surface and attached to trees (*a*) or to the adjacent herbage either in a straight tube (*b*) or a curved one (*c*).

Fig. 8. Nesting Industry of the Territelariæ.
1. Mygale. 2. Atypus a, A. Abbotii, b, c, A. piceus. 3. Cyrtauchenius. Cteniza and Nemesia.

Fig. 9. Nesting Industry of the Citigradæ.
1. Lycosa. 2. L. arenicola. 3, 4. L. tigrina.

Turning to the corresponding number in the Citigrade series (Fig. 9, 2) we see the burrow slightly silk lined at the mouth, and carried upward above the surface where it is supported by a rude turret. The silken tube is, however, open and is rudimentary as compared with that of Atypus.

The third members of the two series show a yet closer likeness in in the nest forms viz., that of *Cyrtauchenius* (Fig. 8, 3) and that of *Lycosa tigrina* (Fig. 9, 3). The last named spider by that form of surface nest described above (Fig. 9, 4), shows us a rude suggestion of the trap-door spider's nest which, whether spun within a ground burrow (Fig. 8, 4, *a*), or within the ridges of bark upon a tree (4, *b*) as with certain Mexican species, has attracted the admiration not only of naturalists but of all observers. It is curious to note, by the way, the tendency of these accomplished nest builders to domicile upon a tree like their American tribal associates, the Purseweb spiders.

[1] Some of the large creatures known generally as the Mygalidæ or tarantulas I have no doubt silk line their burrows. We might therefore add to this series another and intermediate form of nest between Mygale (1) and Atypus (2) as here given.

From this comparison these conclusions and inferences appear: First, (1) Tunnelweavers and Citigrades have several well marked common characteristics in their nesting industry that suggest a close relation in spinning economy. Second, (2) the two tribes furnish examples of nests that may be arranged in series of advanced industrial skill, from a simple burrow to the highly specialized nest of the Trap-door spider on one side and, on the other, to the rude door or lid of Tigrina's silk-lined vestibule. Third (3), the most perfect manifestation of nesting industry is found with the Tunnelweavers, who are more dependent upon spinning-work for sustenance (and probably protection) than the Citigrades. Fourth (4), there appears to be some, although no very marked relation between the animal organization and the quality of the spinning work of the two tribes. The greatest development in size, as well as in spinning function, has been reached among the Tunnelweavers; but most araneologists would consider the Lycosids the more highly organized spiders. Moreover, the Tunnelweavers are provided with long, jointed superior spinners (lacking in Lycosids) specially adapted for weaving their more perfect nests.

Finally, as the result of a comparative study of the nesting industry of all the spider fauna, we may conclude that there is one germinal or typical form of nest among all the tribes, which form is the tube. Around this common and rudimentary form, which has been shown to be the one most natural to all animals possessing the spinning function, the greatly varied and widely divergent nests of spiders,—whether known as domiciles, dens, tents, tunnels, or caves, —may be grouped in series of more or less modified forms.