

**On the spinning apparatus of spiders of the genus *Atypus*
(Araneae, Atypidae)**

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RIASSUNTO

E' studiata la struttura dell'apparato di tessitura della tela dei ragni del genere *Atypus* Latreille, 1804.

Lo studio è stato condotto sugli stadi ninfali I e II. Solo in questi due stadi, che vivono in tubi materni comuni, le filifere antero-laterali sono capaci di produrre seta.

Le ghiandole, collegate con un fusolo su ciascuna filiera antero-laterale, potrebbero avere la stessa funzione delle ghiandole ampollacee delle filiere antero-laterali del sottordine Labidognatha.

Parole chiave: Tessitura della tela, Filiera, Stati ninfali.

SUMMARY

The structure of spinning organs in the spiders genus *Atypus* (Latreille, 1804) is studied.

The study was above all intended on nymphal stages of I and II instar. Only at these two stages living in common maternal tube are anterior lateral spinnerets capable of producing silk.

The glands connected with one spigot on each anterior lateral spinneret might have the same purpose as glandulae ampullaceae of the anterior lateral spinnerets of suborder *Labidognatha*.

Key words: Spinning activity, Spinnerets, Nymphal stages.

Introduction

Among animals, there is no group, except spiders, in which spinning activity represents such an imposing phenomenon.

The spinning organ consists of spinnerets and spinning glands attached to them. Spinnerets represent external spinning organs. KAUTZCH (1910) found that in the spiders respiratory organs have developed extermities on the bases of the 8th and 9th body segments, and external spinning organs on the 10th and 11th segments.

YOSHICURA (1954-1955) confirmed Kautzch's conclusions in his study of the spider *Heptathela kimurai* Kishida (*Mesothelae*). *Mesothelae* are the most archetypal recent spiders known. The spiders of the genus *Liphistius* have four pairs of spinnerets: two pairs of multisegmented lateral and two pairs of monosegmented median ones. With an excepting of *Mesothelae*, four pairs of spinnerets are never formed, since an anterior median pair is not developed. The cribellate spiders of the suborder *Labidognatha* have a cribellum in place of the anterior median pair of spinnerets; the cribellate have a colulus. Cribellum as well as colulus are considered to be homologous to the anterior median spinnerets.

For the sake of simplification the spinnerets are called "anterior" (= anterior lateral of *Liphistius*), "median" (= posterior lateral) and "posterior" (= posterior lateral of *Liphistius*).

A characteristic feature of spiders, which belong to the third suborder *Orthognatha*, is a tendency for the reduction of the number of spinnerets and there has not been yet an organ described that could be definitely considered a colulus. However, this is not to say that no work describing the whole ontogenetic development of spinning apparatus of some species that belong to this suborder has been published.

LOTHAR GLATZ (1973) dealt with the spinning apparatus of spiders of the family *Atypidae* and in his precise morphological, anatomical and histological study he also set the basic classification of spinning glands of spiders of the genus *Atypus*.

Material and methods

The focus of the study was mainly on the comparison of the first youngest nymphal stages in which the spinning apparatus is able to spin, e.g. the nymphal stages of I and II instar (further on only N.I and N.II).

Material examined:

1. *Atypus affinis* (EICHWALD, 1830), (12 nymphs of I. instar and 20 nymphs of II. instar).
2. *Atypus piceus* (SULZER, 1776), (16 nymphs of II. instar).
3. *Atypus muralis* (BERTKAU, 1890), (9 nymphs of I. instar).

The first two species were found in the Central Bohemian Highlands. *Atypus muralis* material comes from the Prokopske valley near Prague. Nymphal stages of nymphs I-II of all three species live in a common maternal tube. I dealt only with the structure and mutual comparison of anterior spinnerets of the adult spiders, since their spinning organ was already described by GLATZ in 1973. My study was based on the methodology described in some previous works (see for inst. HAJER, 1989). All spiders were fixed with Bouin fixation liquid. For staining the "Azan" method or the combination of the haematoxylin-eosin method was usually used.

For the study of the external morphology a SEM TESLA 500 and light microscope JENAMED was used.

Results

1. The spinning apparatus of the nymphal stage of the first instar. (Fig. 1)

The nymphs of the first instar represent the first complete stage with a fully functions spinning organ. The length of the cephalothorax is 0.4-0.6 mm. The nymphs are whitish, slightly pigmented and almost immobile. They move inside the egg-sac or on its surface. The spinning apparatus consists of three pairs of spinnerets: anterior lateral (ALS), posterior median (PMS) and posterior lateral spinnerets (PLS).

1a) Anterior lateral spinnerets (ALS).

They are monosegmented, cylindrical and with a fine grained structure of cuticule. The ALS are situated laterally before the PMS. On the top of each spinneret there is always one large spigot with a strong basal part and a thin sharp apical part in a cavity. A large gland producing acidophilic secretion is connected to the spigot. This gland is reminiscent of ampullaceous glands of spiders of the suborder *Labidognatha*.

1b) *Posterior median spinnerets (PMS).*

Each of these median spinnerets consist of one segment with a conically narrowed top. On the top there is the only large spigot connected to a gland which produces an acidophilic secretion.

1c) *Posterior lateral spinnerets (PLS).*

Developing nymphs of the first instar have trisegmented PLS but the margins of the segments are barely distinguishable. On the top of each PLS there are three large spigots connected to glands which contain epithelium with acidophilic secretion. One of this spigots is situated on an inner elevation of the middle segment and the other two are situated at the end of an apical segment.

The spinning apparatus of the first nymphal stage of the spiders *Atypus affinis* and *Atypus muralis* don't differ.

2. *Spinning apparatus of the nymphal stages of the second instar.*
(Fig. 2)

Nymphs of this complete stage are grey-black and their body is thickly covered with hairs. The length of cephalothorax is 0.9-1.1 mm.

Young spiders of genus *Atypus* can hibernate in this stage (SCHWENDINGER, 1990) and later leave the maternal tube-like web. Nymphs of the II instar reared separately under laboratory conditions built pipe-like retreats and successfully caught insects of fruit pomace fly size (*Drosophila melanogaster*).

2a) *Anterior lateral spinnerets (ALS).*

Both spinnerets are covered with long hairs that have sharp outgrowths on their surface. The terminal part of each monosegmented spinneret consists of a cavity with one immersed spigot on either inner side, that has been described for the former stage. In contrast to Glatz, I have not found neither on *Atypus affinis* nor on *Atypus piceus* any other spigots on the ALS; despite the spinnerets were studied very carefully in detail by means of scanning electron microscopy (Fig. 3).

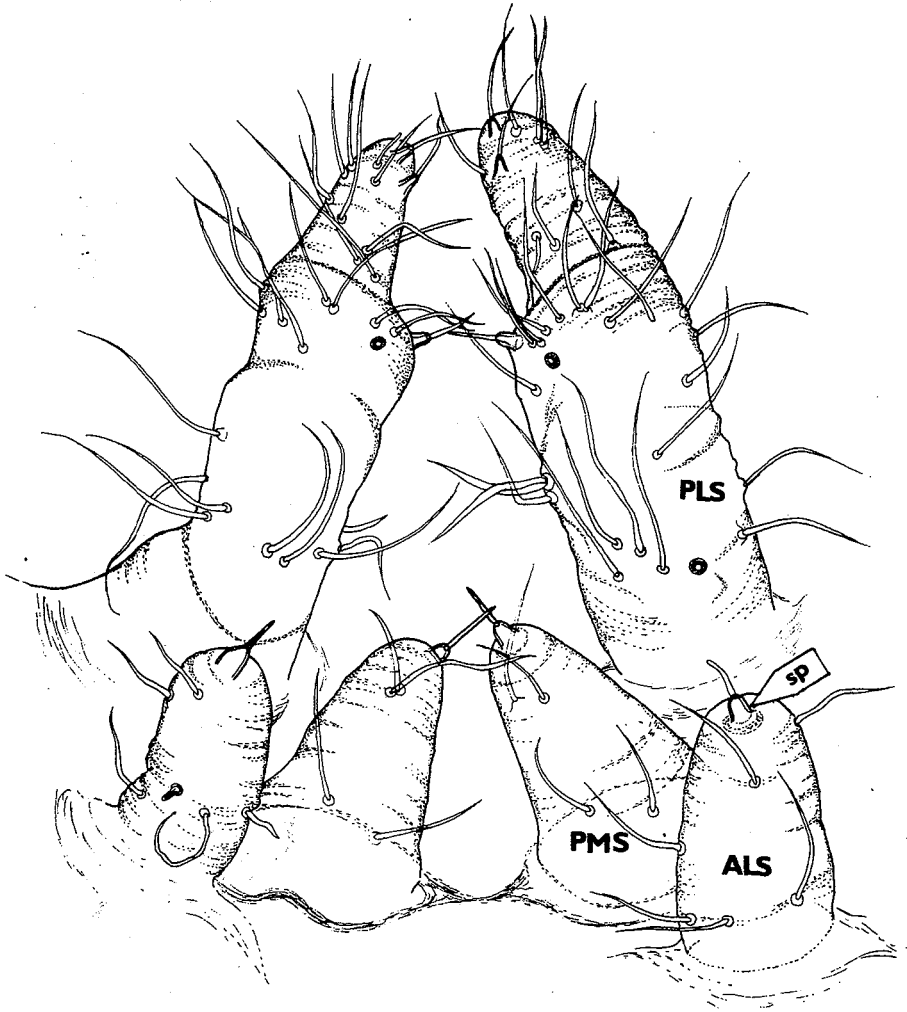


Fig. 1 - *Atypus muralis*, the spinning apparatus of the first nymphal stage. ALS-anterior lateral spinneret, PMS-posterior median spinneret, PLS-posterior lateral spinneret, sp-spigot.

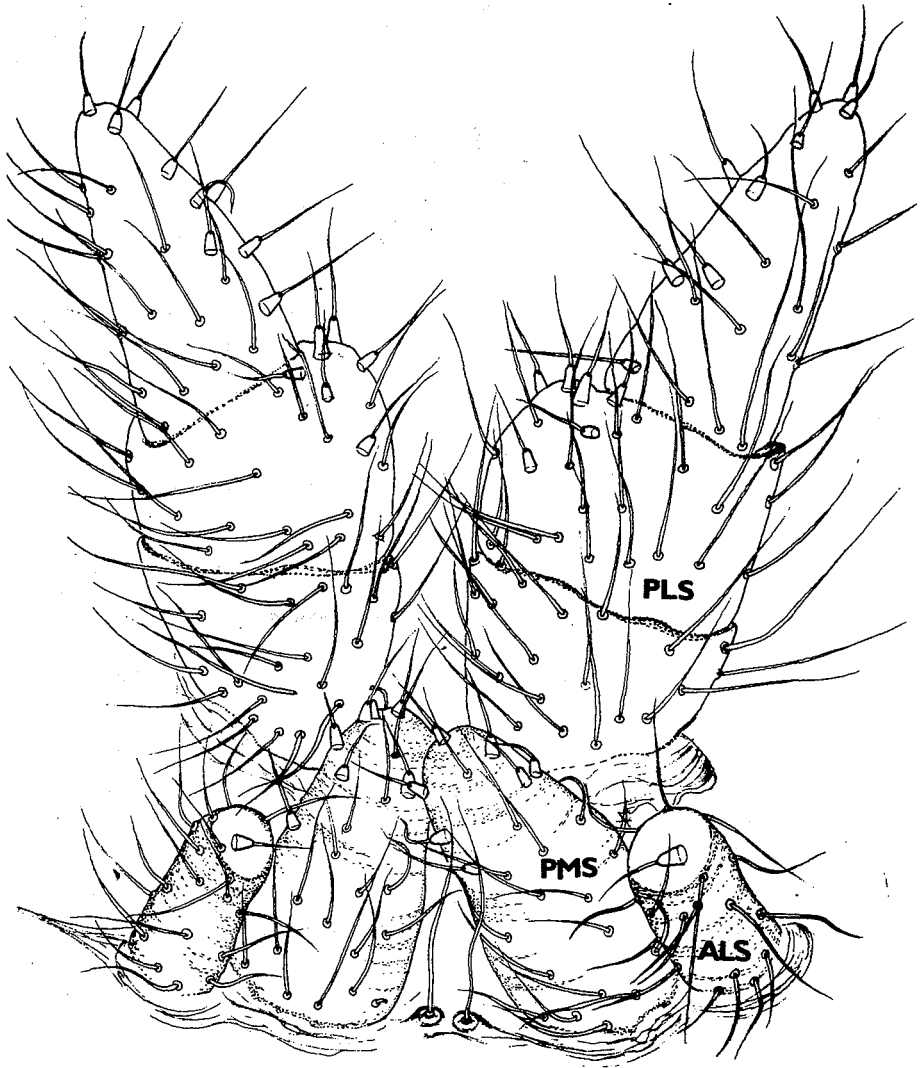


Fig. 2 - *Atypus piceus*, the spinning apparatus of the second nymphal stage.



Fig. 3 - A) *Atypus affinis*, the anterior lateral spinneret of the second nymphal stage, sp-spigot. Magnification 1150 x. Scale line 10 micrometres.
B) *Atypus affinis*, ALS. The detail of the alone spigot. Magnification 2500 x. Scale line 10 micrometres.

2b) *Posterior median spinnerets (PMS).*

PMS are monosegmented cylindrical and they lean against each other so that they touch with their tops. On the surface of their upper part there are 7-9 large spigots connected to glands producing an acidophilic secretion. On their back part near the base of the spinneret, there are 7-8 glandular hairs described by GLATZ (1973) also in adult females. The small spigots with bipartial glands, which were also described by GLATZ on adult spiders of genus *Atypus*, are not yet developed on the N.II stage.

Among individuals of the nymphal stage of the second instar of *A. affinis* and *A. piceus* there were no differences in the structure of the spinning apparatus.

Attention should be paid to a pair of long hairs on a slight protuberance before the PMS slightly reminiscent of a colulus.

2c) *Posterior lateral spinnerets (PLS).*

These spinnerets are distinctly trisegmented and thickly covered with long hairs. The basal segment does not carry any spigots but on its back part there are 13-21 glandular hairs. The number of these hairs differs among various individuals of the same species and can also be different on the right and left spinneret of one individual. The median segment is bulky and on the convex inner side carries 6 large spigots connected to glands with an acidophilic secretion. On the back side of this segment there are 26-34 glandular hairs. The apical segment carries 9 large spigots which also produce acidophilic secretion. There are no glandular hairs on this segment. The main difference between the spinning apparatus of this nymphal stage and that of the adult spiders described by GLATZ (1973) is the absence of a large number of small spigots connected with bipartial glands (that produce both an acidophilic and a basophilic secretion).

Spigots of these bipartial glands occur on adult spiders in a large number both on the median and apical segment of the PLS.

Discussion

A special feature of the structure of the spinning apparatus of spiders of the suborder *Orthognatha* is a tendency towards the reduction in number of spinnerets. For these spiders no colulus has been described

and anterior lateral spinnerets (if developed at all) are considerably reduced, too. Spiders of the family *Atypidae* have monosegmented ALS equipped with only one spigot with one gland.

This stage is compared to spiders of suborder *Labidognatha*. These spiders have bi-or trisegmented ALS always equipped with two types of spigots on which end are both large bipartial glandulae ampullaceae and small bipartial glandulae piriformes. While glandulae ampullaceae provide material for the creation of drag-lines, the glandulae piriformes provide secretion for the attachment discs, by means of which the drag-lines are fixed to the substratum.

Atypidae have no piriform glands. The glands connected with one spigot on each anterior lateral spinneret might have the same function as glandulae ampullaceae for spiders of suborder *Labidognatha*.

Atypidae have a significant geographical spread (SCHWENDINGER, 1990).

They also have the ability to settle in such biotopes that cannot be reached except by aerial dispersal in their early instars.

I suppose that threads on which the young overcome long distances are produced by the anterior lateral spinnerets and their glands.

Adult spiders of the genus *Atypus* have functionless ALS and their spigots as well as glands connected to them, are reduced.

REFERENCES

GLATZ L., 1973 - *Der Spinnapparat der Orthognatha (Arachnida, Araneae)*. Z. Morph. Tiere 75: 1-50.

HAJER J., 1989 - *Spinning apparatus of the spider Filistata insidiatrix (Araneae: Filistatidae)*. Acta Entomol. Bohemoslov. 86: 401-413.

KAUTZCH G., 1910 - *Über die Entwicklung von Agelena labyrinthica, Clark*. Zool. Jhb. Abt. Anat.: 28-30.

SCHWENDINGER P.J., 1990 - *A synopsis of the genus Atypus (Araneae, Atypidae)*. Zoologica Scripta, Vol. 19, No. 3: 353-386.

YOSHICURA M., 1954-1955 - *Embryological Studies on the Liphistiid spider Heptathela kimurai*. Kumamoto J. Sci. B 2/3: 73-86.