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# Morphology of protonymph of *Bathyphantes eumenis* (L. Koch, 1879) (Araneae: Linyphiidae)

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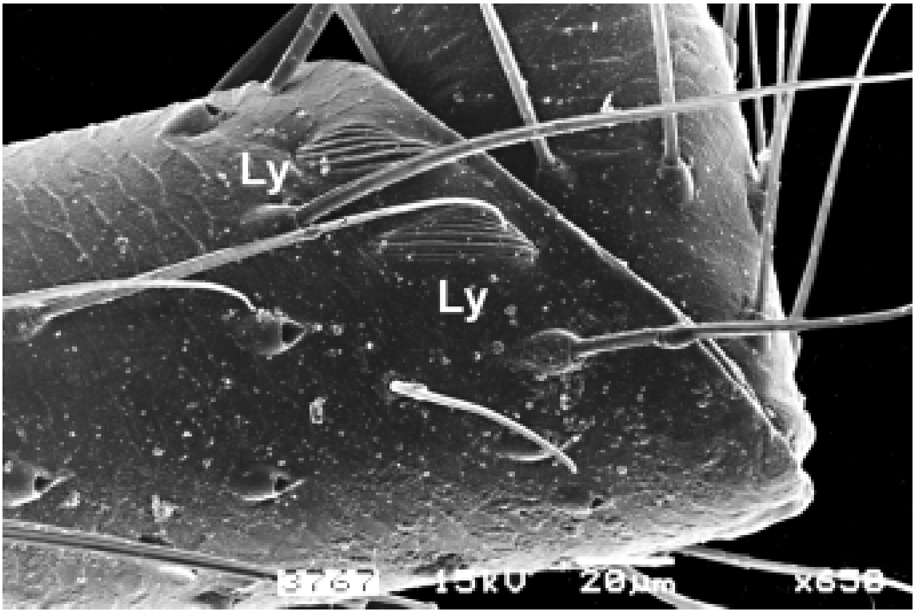
Abstract. The protonymph of *Bathyphantes eumenis* (L. Koch, 1879) is described and illustrated. The description, including all morphological and sensory structures of juveniles, is the one of this kind for Araneae. Nomenclature of setae and other morphological and sensory structures is proposed.

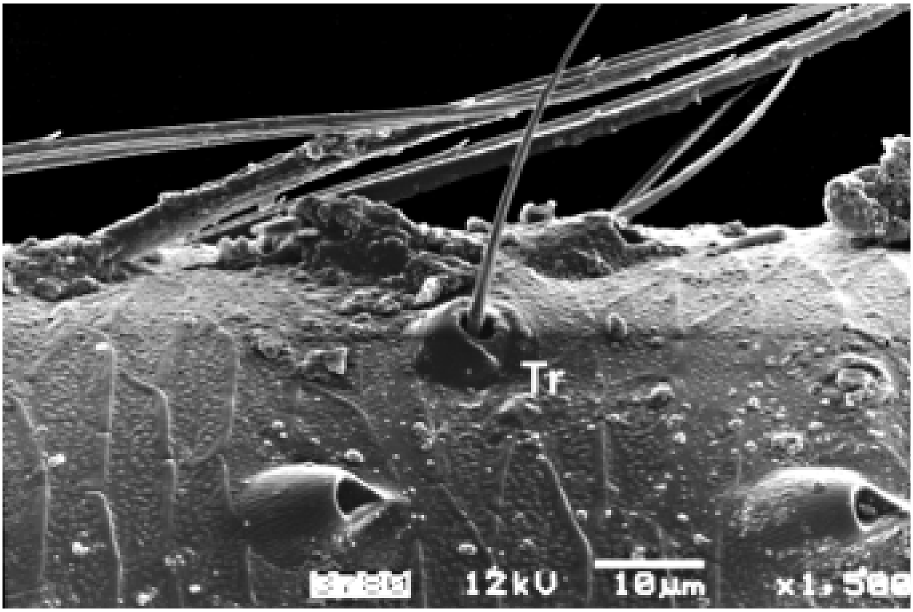
Key words: arachnology, morphology, Linyphiidae, protonymph, nomenclature.

## 1. INTRODUCTION

Most studies on spider postembryonic development has focused on the number of juvenile stages and on descriptions of general morphology of various families (Holm 1940, Meier 1967, Vachon 1967, Canard 1986, Downes 1988, Hallas 1988, Galiano 1991, Canard & Stockman, 1993, Galiano & Goloboff 1996). A majority of authors concentrated on the nomenclature of particular development stages (Holm 1940, Vachon 1957, Canard 1987, Downes 1987). Some papers have dealt with the function of sensory and morphological structures in consecutive phases of development (Wurdak & Ramousse 1984, Vachon & Hubert 1971, Galiano 1991). Development and physiology of some sensory structures, e.g. tactile hairs (Höger & Seyfarth 1995) have been analysed. Other papers pertaine to identification and phylogeny reconstruction, based on the number and arrangement of trichobothria in nymphs (trichobothriotaxy, e.g. Vachon & Hubert 1971) and adults (e.g. Lehtinen 1980, Sciosca 1992).



1. Typical setae (T) and lyriform organ (Ly) of protonymph



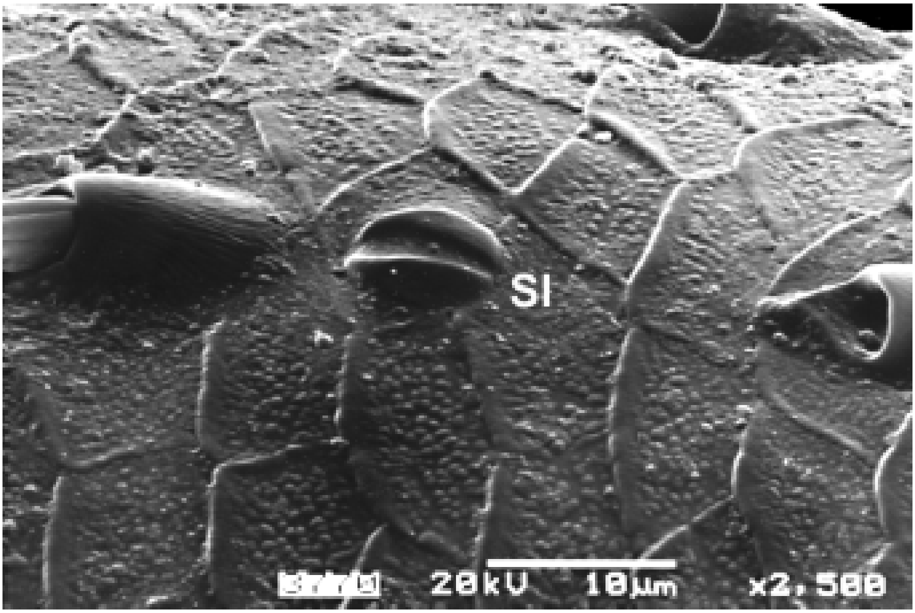
2. Trichobothria and chaetopore of protonymph typical setae (T)

However, all the papers cited above are of preliminary character, since the arrangement of all sensory and morphological structures in juveniles (larval chaetotaxy) have never been analysed.

The nomenclature of consecutive larval stages of Araneae is still under debate. Some authors interpret the embryo inversion as the beginning of postembryonic phase (VACHON 1957, 1958, LEGENDRE 1958). Others adopt hatching as the beginning of postembryonic phase (CANARD 1984, DOWNES 1987). In this paper we follow VACHON'S (1957) nomenclature of postembryonic stages. Our study focuses on the protonymph stage ("première nymphe"), in which all the chaetotactic structures present in adults are already well-developed. The stage appears just before leaving the cocoon and corresponds to:

- V instar according to GALIANO (1991),
- complete instar according to HOLM (1940),
- juvénile (J2) according to CANARD (1987).

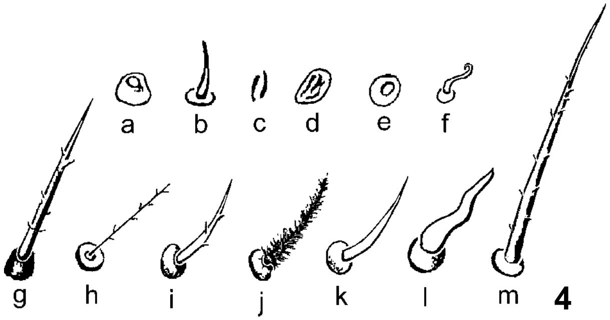
The main purpose of this paper is to present a complete description of chaetotaxy and other sensory structures which are present in the protonymph of *Bathyphantes eumenis* (L. KOCH, 1879), a member of Linyphiidae. Another objective is to propose a universal classification and nomenclature of chaetotactic structures, which could be applied also to other representatives of Araneae.



3. Slit sensilla (Sl) and micro-sculpture of protonymph cuticule

## 2. MATERIAL AND METHODS

The protonymph is a very active and mobile stage. All of its organs and structures, except copulatory apparatus, are well-developed. Its cuticle is pigmented, the tarsal organ, numerous liryform organs and rich chaetotaxy, which includes various kinds of setae and trichobotria. The chelicerae bear distal claws and poison canals, the maxillae are serrulated. The spinnerets are functional. The protonymphs is able to forage and feed.



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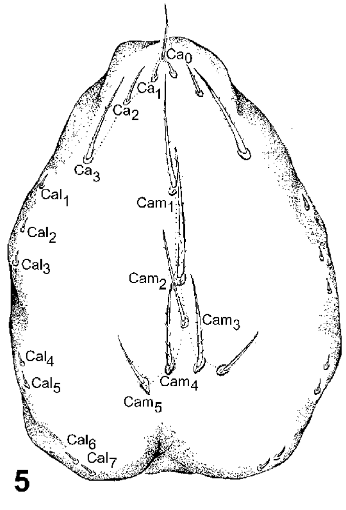

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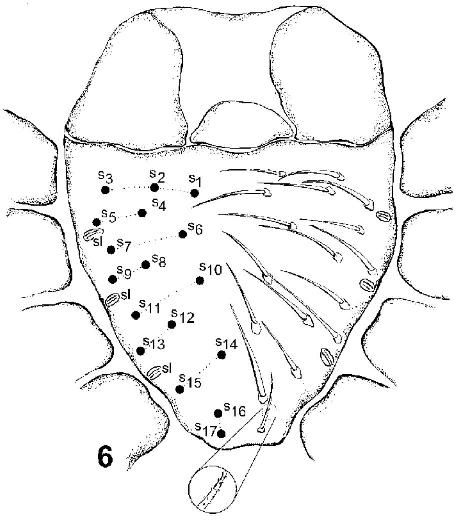

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4. Chetotactic structures and other morphological structures of protonymph of *B. eumenis*: a – typical chetopore, b – spine (S), c – slit sensilla (Sl), d – lyriform organ (Ly), e – tarsal organ (Ta), f – contact chaemoreceptors (C), g – spiniform ciiri-bearing setae (t), h – trichobothria (Tr), i – cirri-bearing typical setae ($\underline{T}$), j – spiny typical setae ($T_K$), k – smooth typical setae (*T*), l – thicker setae occuring only on palp tarsus (Mi), m – cirri-bearing macrochetae (Ŧ); 5-6. Cephalothorax: 5 – dorsal side, 6 – ventral side

Fertilised females or well-developed cocoons were collected during 2 years (in spring and summer 2000-2002), in deep sandstone crevices in a stone labyrinth “Błędne Skały” (Góry Stołowe mountains, Sudetes). Eggs collected in the field and laid in the laboratory were placed in incubators with adequate development conditions: high humidity (90-100%) and sterility, since the eggs are very sensitive to drought and fungal infections. Once infected by the mould, they died immediately. To ascertaing the degree of development of the juveniles, and to determine the date of hatching and first moult, the incubators were checked daily.

The specimens at the stage of protonymph were preserved in 75% ethanol, and mounted on microscope slides. For this purpose the material was boiled in 75% ethanol and transferred to 10% KOH. Then the specimens were cleared in chloramphenol and mounted in Swan medium. All the specimens were examined under phase contrast microscope NIKON Eclipse E 600, with drawing attachment. SEM photos were taken with JEOL JSM-5800 LV.

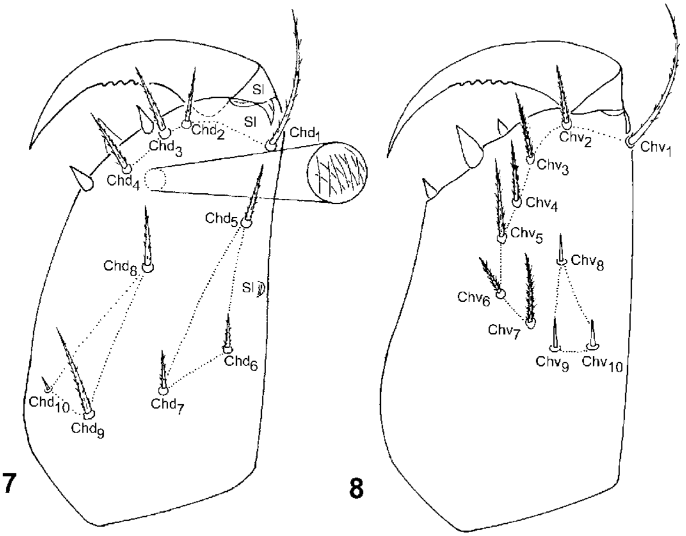
The material included 34 protonymphs.

## 3. RESULTS

### 3.1 Sensory and morphological structures in the portonymph of *B. eumenis* – a general description

#### 3.1.1 Mechanoreceptors

**Tactile hairs** (T): all types of the setae are triply innervated. They serve purely mechanical tasks (Fig. 1). The large leg spines are also triply innervated



7-8. Chelicerae: 7 – dorsal side, 8 – ventral side

(Foelix & Chu-Wang 1973a). However, these spines are haemolymph pressure receptors rather than tactile receptors. The regular tactile hairs consist of a long, exocuticular hair shaft which is suspended in a slipper-shaped socket in which it can move. These types of setae possess a round chaetopore, usually larger than the diameter of the seta measured at its basis (Figs. 1 and 2). The edges of chaetopore have epicuticular glassy grains (Foelix 1996).

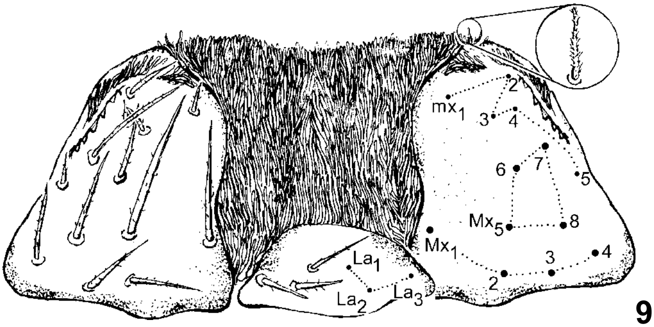
The classification of tactile hairs according to shape, sculpture and size was used here follows the classification applied in acarology ( Massoud & Ellis 1977).

3.1.1.1 Shape

**Typical setae** (T) – setae broadened at the base and gradually narrowing toward the top. They have simple, round chaetopores. They may have cirri on their surface. The ratio of maximum width to length exceeds 1/10.

**Spiniform setae** (t) – the maximum width: length ratio ranges from 1/4 to 1/10.

**Spine** (S) – the maximum width:length ratio is at most 1/4.



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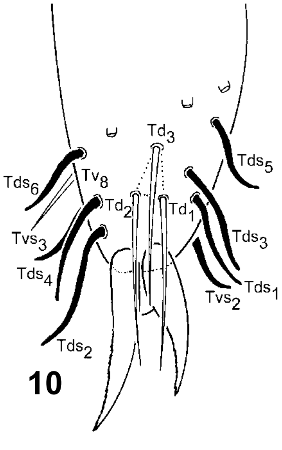

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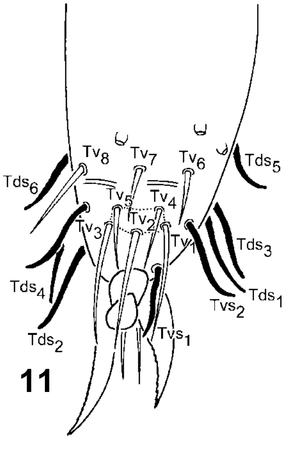

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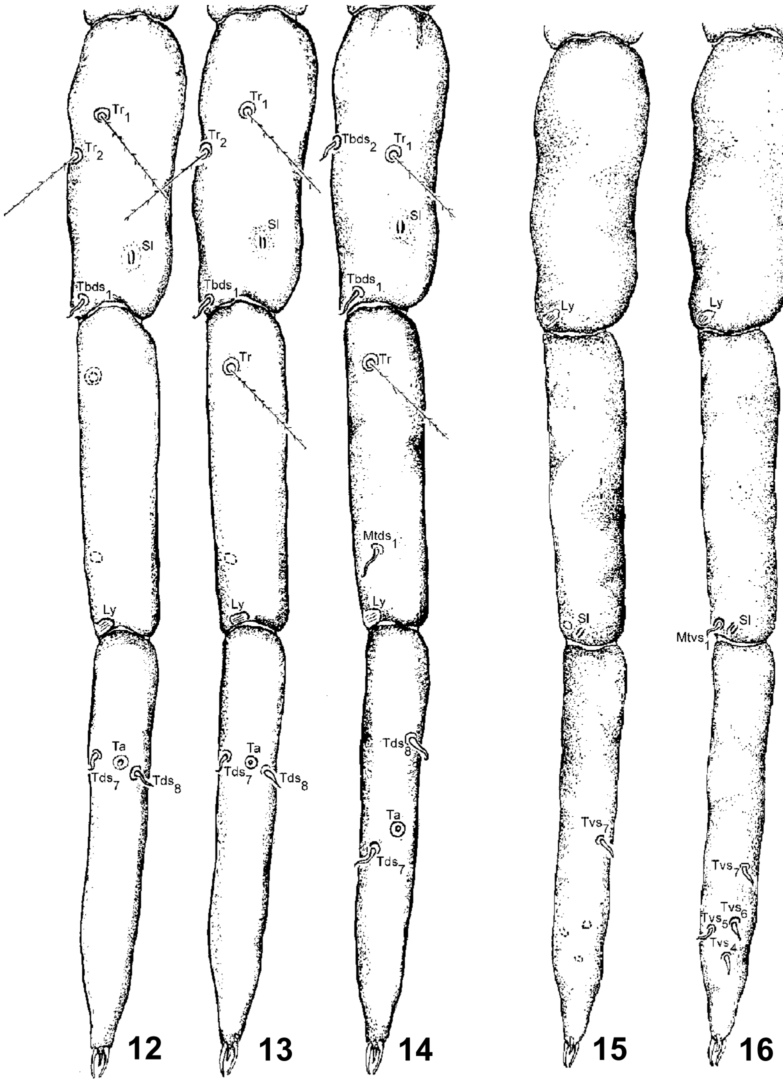
9. Maxillae and labium of protonymph; 10-11. Sensory and morphological organisation of tarsus legs: 10 – dorsal side, 11 – ventral side

3.1.1.2 Sculpture

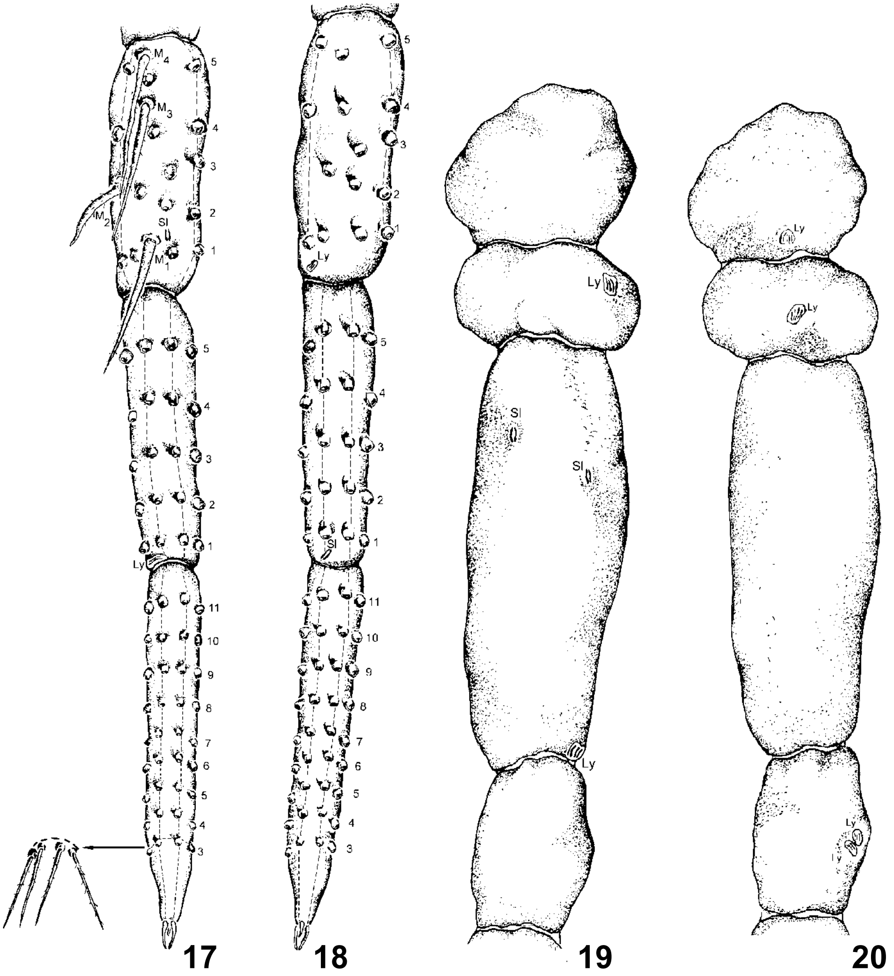
**Smooth setae** *T* – serration or micro-sculpture, if present, is not visible in optic microscope; possibly it can be observed in electron microscope.

**Cirri-bearing setae** $\underline{\mathrm{T}}$ – their surface is covered by short cirri, their length does not exceed the seta width measured in its middle. The cirri may cover one or



12-16. Sensory and morphological organisation of legs (tibia, metatarsus and distal part of tarsus): 12 – dorsal side of I and II pair of legs, 13 – dorsal side of III pair of legs, 14 – dorsal side of IV pair of legs, 15 – ventral side of I and II pair of legs, 16 – ventral side of III and IV pair of legs both sides of the seta; their arrangement is regular or irregular and they may be densely or sparsely arranged. They are often slightly bent.

**Spiny setae** T – their surface is covered with small cirri, which are longer than the width of seta measured in its middle. The cirri may cover one or both sides, their arrangement is regular or irregular, dense or sparse. Setae with extremely long cirri are called pinnate setae.



17-18. Chaetotaxy of legs (tibia, metatarsus and tarsus): 18 – dorsal side, 19 – ventral side; 19-20. Sensory and morphological organisation of legs (coxa, trochanter, femur and patella): 19 – dorsal side, 20 – ventral side

3.1.1.3 Size

When the length difference between setae exceeds 1/5 length of the longest seta, three types of setae can be distinguished:

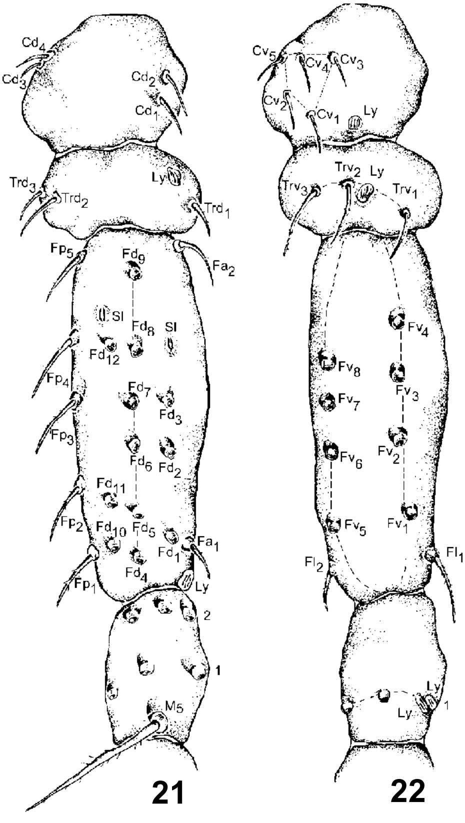
**Macrochetae** Ŧ – the longest setae (assuming its relative length as 1).

**Mesochetae** – medium setae, of a length ranging from 0.3 to 0.8 of the longest setae.

**Microchetae** Ŧ - small setae, of a length not exceeding 0.3 of the longest setae.

3.2 Trichobothria (Tr)

The filiform hairs or trichobothria (Fig. 2) are extremely fine hairs with widened bases in the form of special sockets. They are extremely sensitive. They have long slender hair shafts in a very thin cuticular membrane. Normal stimuli for the trichobothria are air currents and low-frequency air vibrations (sound). The air vibrations produced by insect wings are sufficient to trigger a directed capture response from the spider. In web spiders the trichobothria are believed to play a part in locating prey or enemies (Foelix 1996). Trichobothria in the protonymph of *B. eumenis* are sensory structures of the lasotrichial type (classification according to Massoud & Ellis 1977) – they are smooth, without incisions and proturberances, representing false lasotrichia called pseudolasotrichia – they have distinct bases and narrow shafts, similar to the shaft of typical setae.



21-22. Chaetotaxy of legs (coxa, trochanter, femur and patella): 21 – dorsal side, 22 – ventral side

3.3 Lyriform organs (Ly) and slit sense organs (Sl)

Lyriform organs are mechanoreceptors embedded in the exoskeleton, most numerous on the legs, particularly near the joints. Their function is to register and transmit mechanical tension or distortion in the surrounding cuticle, caused by substrate vibrations, gravity or spider's own movements (Seyfath &

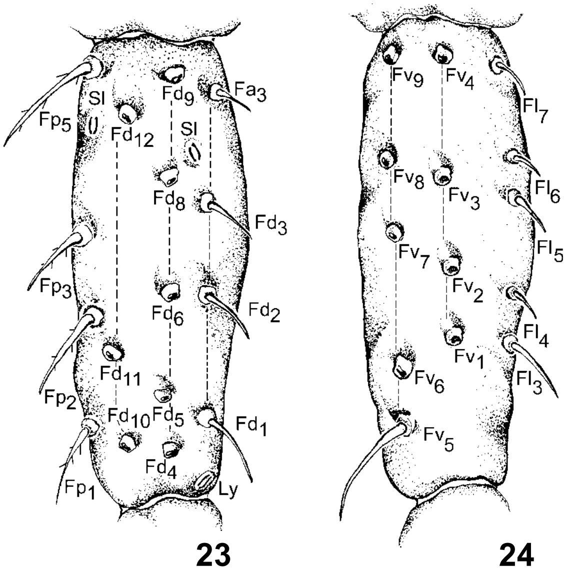
Barth 1972). Slit sense organs may occur singly (Sl) or in groups (Fig. 3). The most conspicuous are groups in which the slits run exactly parallel (Fig. 1). They are called lyriform organs (Ly), because their shape resembles a lyre. There design of a single slit sensilla and of a lyriform organ is basically the same (Barth 1971). Each slit is only 1-2 µm wide, but may be 8-200 µm long. A cuticular lip on either side borders the slit and a thin cuticular membrane spans the gap between these ridges. Each slit sensillum has two dendrites.

### 3.4 Proprioreceptors

Hair plates (Hp) have been recently discovered in several spider species (Seyfath 1985, Seyfath at all 1990). They have not been included in the tables because reliable identification of these structures is difficult. They are often short or long tactile hairs, which are numerous and occupy a small area of the coxa of each leg; the are located close to the joint and bend when the leg is flexed (Seyfath 1985). During locomotion the overlying pleural membrane presses them down. They control the body posture and also act as gravity receptors (Markl 1962).

### 3.5 Chemoreceptors

Tarsal organs (Ta): small pits on the dorsal side of each tarsus. They are multiply innervated (by about 20 neurones) and communicate with the external environment through seven small pores. They are hygroreceptors. The tarsal



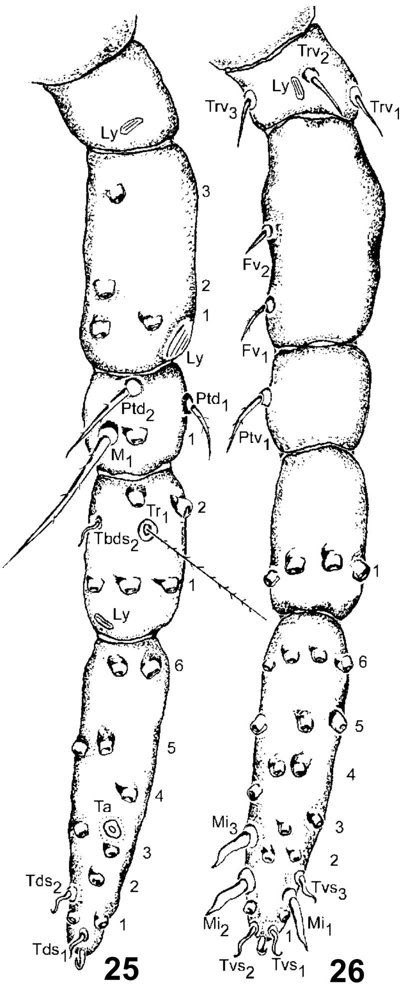
23-24. Chaetotaxy of femur IV pair of leg: 23 – dorsal side, 24 – ventral side organ also responds to certain intense smells, such as acetic acid or ammonia vapour (Foelix & Chu-Wang 1973b).

Contact chemoreceptors or taste hairs (C) are found on the distal segments of legs and palps, particularly on tarsus. They arise from the leg surface at a sharp angle (about 70°C). The hair shafts are S-shaped, and the hair tip is open to the outside. 21 sensory cells usually innervate each taste hair. Some chemosensitive hairs occur also on the mouthparts (on the maxillae and labium). More or less bent, colourless hairs resemble typical tactile hairs and often are misidenificated. The main differences are blunt tip and always smooth surface, the position may also help in identification (Foelix 1996, Foelix & Chu-Wang 1973b). Taste hairs of *B. eumenis* have a typical appearance (Fig. 5).

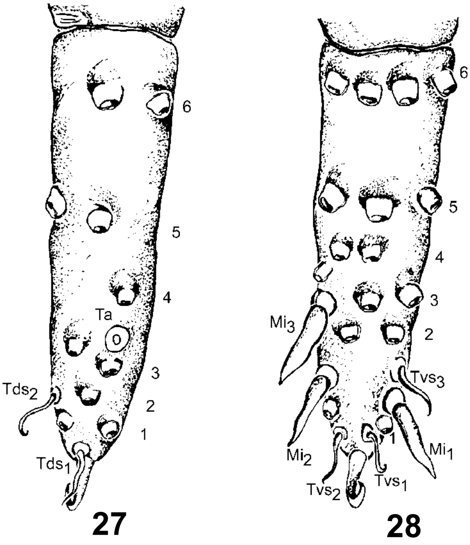
### 3.6 Micro-sculpture of the body

The cuticle forms polygonal structures with numerous swellings (Fig. 3).

### 3.7 Abbreviations and symbols of chaetotactic and other morphological structures (all types of morphological and chaetotactic structures in the protonymph are shown in Fig. 4)



25-26. Palps: 25 – dorsal side, 26 – ventral side



27-28. Palp tarsus: 27 – dorsal side, 28 – ventral side

Table 1. Morphology of cephalothorax, abdomen, chelicerae, maxillae and labium of protonymph

| Part of body | Chaetotactic and morphological structures |
|---|---|
| **Cephalothorax** (carapax Ca + sternum S) (Figs. 5-6) and **abdomen**, A | **Cephalothorax** – symmetrical chaetotaxy.<br>Dorsal side, complex Ca:<br>- 1 periapical setae (Ca$_0$ – $\underline{\text{Ŧ}}$ type, Ca$_1$ – *S* type, Ca$_2$ – $\underline{\text{t}}$ type, Ca$_3$ – $\underline{\text{Ŧ}}$ type),<br>- 3 medial setae $\underline{\text{Ŧ}}$ (Cam$_1$, Cam$_2$, Cam$_3$,) and 2+2 $\underline{\text{Ŧ}}$ type (Cam$_4$, Cam$_5$),<br>- lateral, 7 setae *S* type: (Cal$_1$, Cal$_2$ , Cal$_3$ , Cal$_{4,}$ Cal$_5$, Cal$_6$, Cal$_7$).<br>Ventral side: complex s:<br>- 17+17 setae $\underline{\text{T}}$ type (s$_1$...s$_{17}$),<br>- lateral 3+3 Sl.<br>**Abdomen** – whole surface covered by $\underline{\text{T}}$ type setae with atypical chaetopores. Spinnerets well developed.<br>**Sculpture** – cuticle creased with numerous swellings. |
| **Eyes** | Protuberant and differentiated. |
| **Chelicerae** Ch (Figs. 7-8) | Serrated poison fang and cuticular dents (3) well developed, opening of poison gland present, differentiated sensory structures present on basal segment.<br>**Dorsal side:** 2 cuticular dents,<br>- apical complex Ch$_{\text{DA}}$ (Chd$_1$ – $\underline{\text{Ŧ}}$ type, Chd$_2$, Chd$_3$, Chd$_4$ – $\underline{\text{t}}$ type),<br>- I medial triangle Ch$_{\text{DM I}}$ (Chd$_5$ – $\underline{\text{t}}$ type, Chd$_6$, Chd$_7$ – $\underline{\text{S}}$ type),<br>- II medial triangle Ch$_{\text{DM II}}$ (Chd$_8$, Chd$_9$ – type $\underline{\text{t}}$, Chd$_{10}$ – *S* type),<br>+ 3 Sl (two apical and lateral one in medial part).<br>**Ventral side:** 1 cuticular dent,<br>- apically – medial complex Ch$_{\text{VAM}}$ (Chv$_1$ – $\underline{\text{Ŧ}}$ type, Chv$_2$, Chv$_3$, Chv$_4$, Chv$_5$, Chv$_6$, Chv$_7$ – t$_{\text{K}}$ type),<br>- medial triangle (*S* type: Chv$_8$, Chv$_9$, Chv$_{10}$).<br>**Sculpture** – cuticle creased with numerous swellings. |
| **Maxillae** Mx (Fig. 9) | Serrulae present. Each maxilla with complex of 13 setae: 5 $\underline{\text{t}}$ type (mx$_1$-mx$_5$) and 8 $\underline{\text{T}}$ type (Mx$_1$-Mx$_8$). Distal parts of maxilla with apical tuft of setae $\underline{\text{T}}$ type. |
| **Labium** La (Fig. 9) | Distal part: tuft setae of T type. Proximal part: 3+3 setae $\underline{\text{t}}$ type La (La$_1$-La$_3$). |

Table 2. Morphology of legs and palps of protonymph

| **Leg segment** | **Fore legs - I and II pair** | **Hind legs - III pair** | **Hind legs– IV pair** | **Palps** |
|---|---|---|---|---|
| **Tarsus,** T:<br>**(Figs. 10-18. and 25-28.)** | Distal part **(Figs. 10-11.)**:<br>Dorsal side: triangle T$_D$ (setae Ŧ type: Td$_1$, Td$_2$, Td$_3$),<br>I sensory complex (C type) T$_{DS\,I}$: (Tds$_1$- Tds$_2$, Tds$_3$- Tds$_4$, Tds$_5$- Tds$_6$).<br>Ventral side: apical complex T$_{VA}$(Tv$_1$, Tv$_2$, Tv$_3$-Ŧ type, Tv$_4$, Tv$_5$-*t* type), 2 Sl, periapical complex T$_{VP}$ (Tv$_6$, Tv$_7$, Tv$_8$- *t* type). Sensory complex (C) T$_{VS\,I}$ (Tvs$_1$, Tvs$_2$- Tvs$_3$).<br>Further arrangement:<br>- dorsal side **(Fig. 12.)**:<br>medially tarsal organ (Ta), II sensory complex (C):T$_{DS\,II}$ (Tds$_7$, Tds$_8$)<br>- ventral side **(Fig. 15.)**:<br>II sensory complex (C): T$_{VS\,II}$ (Tvs$_4$,Tvs$_5$,Tvs$_6$,Tvs$_7$). Sometimes **lack of Tvs$_5$**.<br>Typical setae ($\underline{T}$) in circles **(Figs. 17-18.)**: 1 ok. = 8 (4 +4). Number of all circles = 9 (± 1) + 2 irregular circles in distal part.<br>Total: 11 ± 1. | Arrangement of distal part like I and II pairs of legs **(Figs. 10-11.)**.<br>Further arrangement:<br>- dorsal side **(Fig. 13.)**:<br>Translocation of **Ta** in proximal direction compared to I and II pairs. Translocation of T$_{DS\,II}$ (Tds$_7$ in proximal direction, Tds$_8$ in distal direction).<br>- ventral side **(Fig. 16.)**:<br>T$_{VS\,II}$ **(lack of Tvs$_4$, Tvs$_5$, Tvs$_6$,** Tvs$_7$ probably present but shifted in distally).<br>Typical setae ($\underline{T}$) in circles **(Figs. 17-18.)**:<br>Number of circles = 9 ± 1 (11 ± 1).<br>1 circle. = 8 $\underline{T}$ (4 + 4). | Arrangement of distal part ((**Figs. 10-11.)** similar to I, II and III pairs. Exception: T$_{VP}$ **(lack of Tv$_6$, Tv$_7$,** present but slightly shortenedTv$_8$ present but slightly shortened).<br>Further arrangement like III pair of legs **(Figs. 14,16.)**.<br>Typical setae ($\underline{T}$) in circles **(Figs. 17-18.)**:<br>Total = 9 ± 1 (11 ± 1).<br>1 circle = 8 $\underline{T}$(4 + 4). | Arrangement of distal part **(Figs. 25-26.)**:<br>Dorsal side (equivalents of leg sensillae not found): sensory complex of C type: T$_{DSI}$ (Tds$_1$,Tds$_2$).<br>Ventral side: sensory complex of C type T$_{VS\,I}$ (Tvs$_1$.Tvs$_2$,Tvs$_3$), 3 thicker setae (Mi$_1$, Mi$_2$, Mi$_3$).<br>Further arrangement **(Figs. 27-28.)**:<br>- dorsal: 1Ta.<br>- ventral: lack of structures.<br>Typical setae ($\underline{T}$) in circles:<br>Number of irregular circles: 6, max. 6 setae $\underline{T}$ in 1 circle. |

Table 2. Continuation

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| **Metatarsus,** Mt:<br>**(Figs. 12-18.)** | Dorsal side: 1Ly, distal sensilla (C) $Mtds_1$, proximal trichobothria Tr<br>Ventral side: distal sensilla (C) $Mtvs_1$, 1Sl.<br>Total number of circles $\underline{T}$ =5.<br>1circle= 8 (4+4). | Dorsal side: 1Ly, 1Tr, **lack of $Mtds_1$**<br>Ventral side: 1 Sl, **lack of $Mtvs_1$**<br>Number of circles $\underline{T}$ = 5.<br>1 circle = 8 (4 + 4). | Dorsal side: 1Ly, **lack of Tr and $Mtds_1$**,<br>Ventral side: 1Sl, **lack of $Mtvs_1$**.<br>Number of circles $\underline{T}$ = 5.<br>1 circle = 8 (4 +4). | |
| **Tibia**, Tb:<br>**(Figs. 12-18, 25-26.)** | Dorsal side: 2 sensillae (C) $Tb_{DS}$ (distal $Tbds_1$, medial $Tbds_2$) perimedial 1 Sl, medial $Tr_1$.<br>Setae of $\underline{Ŧ}$-type: distal $M_1$, laterally shorter $M_2$, proximal $M_3$, $M_4$.<br>Ventral side:<br>proximal 1Ly.<br>Number of circles $\underline{T}$ = 4 ± 2,<br>1circle from 8 to 7. | Dorsal side: $Tb_{DS}$: $Tbds_1$, **lack of $Tbds_2$**., 1Sl, $Tr_1$ slightly shifted anteriorly, $Tr_2$ present. $M_1$, $M_3$, **lack of $M_2$, $M_4$**.<br>Ventral side and number of circles: no change | Like III pair of legs. | Dorsal side: distal 1Ly, lateral $Tbds_2$ and proximal $Tr_1$.<br>Ventral side: lack of structures.<br>Number of circles = 2. Number of setae $\underline{T}$ in circle inconstant:<br>1 circle = 7 setae (3 + 4), 2 circle = 2-3 setae (2 on dorsal side). |
| **Patella**, Pt:<br>**(Figs. 19-22., 25-26)**: | Dorsal: distal 1setae $M_5$ of $\underline{Ŧ}$ type,<br>6 setae $\underline{T}$ type in 2 rows (2 x 3).<br>Ventral side: 2 Ly, 2 setae $\underline{T}$. | Like I and II pair of legs. | Like I and II pair of legs. | Dorsal side: 1setae $M_1$of $\underline{Ŧ}$ type, 1 setae $\underline{T}$ type + 2 setae $Pt_D$ of $\underline{t}$ type: $Ptd_1$, $Ptd_2$<br>Ventral side: lateral setae of $\underline{t}$ type: $Ptv_1$, |

1. Two well-developed claws and a third shorter claw presented on all legs. Only one well-developed claw present on palp.
2. Sensory structures of I and II leg pairs show no differences. Only on tibia (Tb) of leg I slight differences have been observed, there are no lateral cirri-bearing spiniform setae. Medial complex of 4 spiniform setae on coxa (Cx) of leg II has also one additional smooth spine.
3. No individual variation in number and appearance of sensory and morphological structures has been observed.
4. The proposed nomenclature of morphological and chaetotactic structures will require certain changes in the future, considering the present scarcity of larval chaetotaxy descriptions in other families of Araneae.

Table 2. Continuation

| | | | | |
|---|---|---|---|---|
| **Femur**, Fm:<br>**(Figs. 19-26.)**: | Dorsal side: distally 1Ly.<br>Seate of T type form 3 perpendicular rows: 1 row of $F_{DI}$ ($Fd_1$, $Fd_2$, $Fd_3$) + 1Sl, 2 row of $F_{D\,II}$ ($Fd_4$, $Fd_5$, $Fd_6$, $Fd_7$, $Fd_8$, $Fd_9$), 3 row of $F_{D\,III}$ ($Fd_{10}$, $Fd_{11}$, $Fd_{12}$- **sometimes lack**) + 1Sl.<br>Laterally 2 rows: anterolaterally: $F_A$ (setae of $\underline{t}$ type - $Fa_1$, $Fa_2$),<br>Posterolaterally Fp (setae of t type - $Fp_1$, $Fp_2$, $Fp_3$, $Fp_4$, $Fp_5$).<br>Ventral side: setae $\underline{T}$ form complex $F_V$: 4 parallel rows: 1 row of $F_{VI}$ ($Fv_1$,$Fv_2$, $Fv_3$ $Fev_4$), 2 row of $F_{VII}$ $Fv_5$-$Fv_6$, $Fv_7$-$Fv_8$) + laterally 2 setae $F_L$ of $\underline{t}$ type: $Fl_1$,$Fl_2$. | Dorsal side: 1Ly, $F_{D\,I}$ ($Fd_1$, $Fd_2$, $Fd_3$) + 1Sl, $F_{D\,II}$ ($Fd_4$, $Fd_5$, $Fd_6$, $Fd_7$, $Fd_8$, $Fd_9$),<br>$F_{D\,III}$ **(lack of $Fd_{10}$**, $Fd_{11}$, $Fd_{12}$) + 1S. Complex of $F_A$ ($Fa_1$, **lack of $Fa_2$**), $F_P$ ($Fp_1$, $Fp_2$, $Fp_3$, $Fp_5$, **lack of $Fp_4$**).<br>Ventral side: like I and II pair. | Dorsal side: 1Ly, $F_{DI}$ of *t* type ($Fd_1$, $Fd_2$, $Fd_3$)+ 1Sl, $F_{D\,II}$ of $\underline{T}$ type ($Fd_4$, $Fd_5$, $Fd_6$, **lack of $Fd_7$**,$Fd_8$, $Fd_9$), $F_{D\,III}$ of $\underline{T}$ type ($Fd_{10}$, $Fd_{11}$, $Fd_{12}$) +1Sl. Complex of $F_A$ **(lack of $Fa_1$, $Fa_2$)**, **new setae of *S* type $Fa_3$** , complex of $F_P$ ($Fp_1$, $Fp_2$, $Fp_3$, $Fp_5$, **lack of $Fp_4$**).<br>Ventral side: $F_V$: perpendicular arrangement remains, but 1 row of $F_{VI}$ shifted relative to 2 row $F_{VII}$. In 2 row:**$Fv_5$ of $\underline{t}$ type**.+ **new seta $Fv_9$ of $\underline{T}$ type.** $F_L$: **5 setae *S* type**: $F_L$: **lack of $Fl_1$,$Fl_2$**, posterolaterally **5 additional setae of *S* and *t* type**: **$Fl_3$, $Fl_4$, $Fl_5$, $Fl_6$, $Fl_7$**. | Dorsal side: distally 1Ly.<br>Ventral side: laterally: 2 setae of $\underline{S}$ type $F_V$ ($Fv_1$,$Fv_2$).<br>Number of setae $\underline{T}$ variable:<br>1row = 2- 3 (2 on dorsal side)<br>2 row = 1 on dorsal side<br>3 row = 1 on dorsal side |
| **Trochanter**, Tr:<br>**(Figs. 19-22., 25-26.)**: | Number of setae inconstant.<br>Dorsal side: proximally 1Ly + three setae of $\underline{t}$ type: $Tr_D$ ($Trd_1$,$Trd_2$,$Trd_3$).<br>Ventral side: medially 1Ly + three setae of $\underline{t}$ type: $Tr_V$ ($Trv_1$, $Trv_2$, $Trv_3$). | Dorsal side: sometimes lack of one of 3 setae.<br>Ventral side: like I and II pairs. | Like III pair | Dorsal side: distally 1Ly<br>Ventral side: distally 1Ly + 3 setae $Tr_V$ of *S* type: $Trv_1$, $Trv_2$,$Trv_3$. |
| **Coxa** , Cx:<br>**(Figs. 19-22.)**: | Dorsal side: anterolaterlly<br>2 setae of *t* type: $C_D$ ($Cd_1$, $Cd_2$+ posterolaterally<br>2 setae of *t* type: $Cd_3$,$Cd_4$.<br>Ventarl side: distally 1Ly, medially complex $C_V$ of 5 setae of *t* type $Cv$-$Cv_5$. | Like I and II pairs. | Like I and II pairs. | - |

- typical setae – capital letter T; - spiniform setae – small letter t; - spine – capital letter S; - smooth setae – *italic*: *T*; - cirri setae – underlined, e.g. T; - spiny setae – k in subscript, e.g. $_k$, - macrochetae – ~~crossed out~~ e.g. ~~T~~ ; - trichobotria – Tr; - slit sensilla, lyriform organ – Sl, Ly ; - tarsal organ – Ta; - contact chemoreceptor - C.

## 4. Model description of protonymph morphology
(Tables 1, 2 and 3, Figs. 5-28)

Table 3. Trichobothriotaxy of protonymph *B. eumenis*

| | tarsus | metatarsus | tibia |
|---|---|---|---|
| pedipalp | (0) | - | (1) |
| leg I, II | (0) | (1) | (1) |
| leg III | (0) | (1) | (2) |
| leg IV | (0) | (0) | (2) |

## 5. DISCUSSION

At present, the structure of the reproductive system and copulatory organs (bulbus and epigyne) is analysed for identification purposes. Such a procedure cannot be applied to juveniles. Sensory and morphological structures, chaetotaxy in particular, are the only useful characters for identification of juveniles. Our study showed that the arrangement of these structures was constant in all the examined specimens. It may be supposed that these structures will prove to be good diagnostic characters at the generic and species levels.

A precise morphological description is a good means of establishing the species identity of arthropod juveniles. Moreover, comparing morphology of corresponding developmental stages of different species, genera and families may provide useful characters for phylogeny reconstruction and ascertaining taxonomic placement of doubtful taxa. This kind of approach is popular among students of Collembola and Coleoptera (NAYROLLES & BETSCH 1993, POMORSKI 1996, KILIAN 1998). Its results have proved especially useful for phylogenetic considerations, and consequently led to the revision of taxonomic status of some taxa.

Preliminary studies on juvenile chaetotaxy of *B. eumenis*, and comparing it with other members of Araneae (Lycosidae; TOMASIEWICZ & RYBAK unpublished data) have already provided interesting observations and conclusions.

## LITERATURE

BARTH, F. G., 1971. Der sensorische Apparat der Spaltsinnerorgane (*Cupiennius salei* KEYS., Araneae). Z. zellforsch.mikrosk. Anat., **112**: 212-246.

CANARD, A., 1984. Contribution à la connasaince du développement, de l'écologie et de l'écophysiologie des aranéides des Landes Armoricaines. Thesis Univ. Rennes I: 389 pp.

—, 1986. Données sur le développement, le croissance, le cycle biologique et l'évolution démographique de la Mygale (*Atypus affinis* Eichwald 1830) (Atypidae, Mygalomorpha). Mém. Soc. roy. belge ent., **33**: 47-56.

—, 1987. Analyse nouvelle du développement postembryonnaire des araignées. Rev. Arachnol., **7**: 91-128.

Canard, A., Stockman R., 1993. Comparative postembryonic development of Arachnids. Mem. Queensl. Mus., **33**: 461-468.

Downes, M. F., 1987. A proposal for standardization of the therms used to describe the early development of spiders, based on study of *Theridion rufipes* Lucas (Araneae: Theridiidae). Bull. Br. arachnol. Soc., **7**: 187-193.

—, 1988. Hatching and early postembryonic development in three spiders at four temperatures. Bull. Br. arachnol. Soc., **7**: 204-208.

Foelix, R. F., 1996. Biology of spiders. Oxford University Press. Inc., New York: 306 pp.

Foelix, R. F., Chu-Wang, I.-W., 1973a. The morphology of the spider sensilla. I. Mechanoreceptors. Tissue Cell, **5**: 451-478.

—, 1973b. The morphology of the spider sensilla. II. Chemoreceptors. Tissue Cell, **5**: 451-478.

Galiano, M. E., 1991. Postembryonic development in ten species of neotropical Salticidae (Araneae). Bull. Br. arachnol. Soc., **8**: 209-218.

—, 1996. Postembryonic development of *Actinopus* cf. *insignis* and *Diplura paraguayensis* (Araneae, Mygalomorphae). Bull. Br. arachnol. Soc., **10**: 121-126.

Hallas, S. E. A., 1988. Hatching and early postembryonic development in the Salticidae. Bull. Br. arachnol. Soc., **7**: 231-236.

Holm, Ĺ., 1940. Studien über die Entwicklung und Entwicklungsbiologie der Spinnen. Zool. Bid. (Uppsala), **19**: 1-214.

Höger, U., Seyfarth, E. A., 1995. Just in the nick of time: postembryonic development of tactile hairs and tactile behavior in spiders. Zoology, **99**: 49-57

Kilian, A., 1998. Morphology and phylogeny of the larval stages of the tribe Agathidiini (Coleoptera: Leiodidae: Leiodinae). Annal. Zool., **48**: 125-220.

Legendre, R., 1958. Contributions à l'étude du développement embryonnaire des araignées. Bull. Soc. zool. Fr., **83**: 60-75.

Lehtinen, P. T., 1980. Trichobothrial patterns in high-level taxonomy of spiders. Proc. 8th Int. Arachnol. Congr. 1980, Vienna: 466 pp.

Markl, H., 1962. Borstenfelder an den Gelenken als Schweresinnesorgane bei Ameisen und anderen Hymenopteren. Z. vergl. Physiol., **45**: 475-569.

Massoud, Z., Ellis, W., 1977. Proposition pour une classification et une nomencalature cohérente des phanéres des Collemboles européens. Rev. Écol. Biol. Sol., **14**: 163-179.

Nayrolles, P., Betsch, J.-M., 1993. Pour une théorie de la description chétotaxique chez les Collemboles. Ann. Soc. Entomol. Fr. (N. S.), **29**: 5-15.

Pomorski, R. J., 1996. The first instar larvae of Onychiurinae – a systematic study (Collembola: Onychiuridae). Genus, **7**: 1-102.

Sciosca, C. L., 1992. Evolution de la trichobotriotaxia durante el desarrolllo de tres Salticidae neotropicales (Araneae). Eos, **68**: 193-200.

Seyfath, E.-A., Barth, F. G., 1972. Compound slit sense organs on the spider leg: mechanoreceptors involved in kinesthetic orientation. J. comp. Physiol., **78**: 176-191.

Seyfath, E.-A., 1985. Spider proprioreception: receptors, reflexes, and control of locomotion. In: Barth F. G., ed: Neurobiology of Arachnids. Springer Verlag, Berlin: 230 pp.

Seyfath, E.-A., Gnatzy W., Hammer K., 1990. Coxal hair plates in spiders: physiology, fine structure, and specific central projections. J. Comp. Physiol., A, **166**: 633-642.

Vachon, M., 1957. Contribution à l'étude du développement postembryonnaire des araignées. Premiére note. Généralités et nomenclature des stades. Bull. Soc. zool. Fr., **82**: 337-354.

—, 1958. Contribution à l'étude du développement postembryonnaire des araignées. Deuxième note. Ortognathes. Bull. Soc. zool. Fr., **83**: 429-461.

—, 1967. Contribution à l'étude du développement postembryonnaire des Araignées. Troisième note. *Pholcus phalangioides* (FUSSL.) (Pholcidae). Bull. Soc. zool. Fr., **90**: 607-620.

VACHON, M., HUBERT, M., 1971. Contribution à l'étude du développement postembryonnaire des Araignées. Quatrième note. *Tegenaria saeva* BL., *Coelotes terrestris* (WID.) et *Coelotes atropos* (WLK.) (Agelenidae). Bull. Mus. Hist. nat. Paris, **3**: 613-624.

WURDAK, E., RAMOUSSE R., 1984. Organization sensorielle de la larve et de la première nymphe chez l'araignée *Araneus suspicax* (O. PICKARD- CAMBRIDGE). Rev. Arachnol., **5**: 287-299.