

## Polskie Pismo Entomologiczne

Studies on morphology of nymphs of selected *Amblycera* and  
*Ischnocera* (*Mallophaga*)

Badania nad morfologią nimf wybranych *Amblycera* i *Ischnocera*  
(*Mallophaga*)

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ABSTRACT. A comparative analysis of three nymphal instars of *Amyrsidea perdicis megalosoma*, *Uchida phasiani*, *Goniocotes chrysocephalus*, *Zlotorzycella colchici*, *Lipeurus maculosus maculosus*, *Reticulipeurus mesopelios colchicus*, and *Lagopoecus colchicus* is given. The diagnostic criteria to *Mallophaga* of subfamilies *Somaphantinae*, *Menoponinae*, *Menacanthinae*, and families *Goniodidae*, *Lipeuridae*, and *Degeeriellidae* have also been estimated.

## INTRODUCTION

The systematic and faunistic studies on mallophagans are generally based on the knowledge of adult forms. Developmental stages, i. e. nymphs called larvae by several authors, however, are difficult to differentiate, particularly within one or between related genera. Also, it is not easy to determine properly one of three developmental stages within the mallophagan species. The respective data are inadequate and incomparable in general. The present work is supposed to determine the diagnostic characters in nymphs. Mallophagans from pheasant (*Phasianus colchicus* L.) were chosen as a pattern because material collected from this host was very rich and varied. We have examined nymphs of 7 species representing the following families: *Somaphantidae*, *Menoponidae*, *Goniodidae*, *Lipeuridae*, and *Degeeriellidae* and we studied a comparative collection (Coll. ZŁOTORZYCKA) and literature dealing with nymphs of mallophagans from cock (WILSON, 1939; CONCI, 1956; ARORA and GOPRA, 1959). After this we tried to determine criteria useful in

separating species, developmental stages, and also in determining a comparative degree. The works of the authors mentioned above are only descriptions of nymphs of representatives of the family *Lepidoptera* (WILSON and ARORA & CHOPRA) and *Goniodidae* (CONCI). At the same time, there is no description of *Somaphantidae* and *Menoponidae* and the data on morphology of *Degeeriellidae* nymphs (CLAY, 1938) are based only on one genus *Kelerinirmus* which is relatively distant in systematics from mallophagans of the genus *Lagopoecus* we are now studying. After this, our personal investigations correspond only with the literature on the subject.

#### MATERIAL AND METHODS

Nymphs and adults of the following species were the subject of our studies:

- *Amyrsidea perdicis megalosoma* (OVERGAARD, 1943) — 125 N<sub>I</sub>, 140 N<sub>II</sub>, 354 adults
- *Uchida phasiani* MODRZEJEWSKA and ZŁOTORZYCKA, 1957 — 25 N<sub>I</sub>, 56 N<sub>II</sub>, 55 N<sub>III</sub>, 149 adults
- *Goniocotes chrysocephalus* GIEBEL, 1874 — 7 N<sub>I</sub>, 60 N<sub>II</sub>, 83 adults
- *Zlotorzycella colchici* (DENNY, 1842) — 137 N<sub>I</sub>, 340 N<sub>II</sub>, 532 adults
- *Lipeurus maculosus maculosus* CLAY, 1938 — 32 N<sub>I</sub>, 49 N<sub>II</sub>, 167 adults
- *Reticulipeurus mesopelios colchicus* (CLAY, 1938) — 69 N<sub>I</sub>, 137 N<sub>II</sub>, 191 adults
- *Lagopoecus colchicus* EMERSON, 1949 — 18 N<sub>I</sub>, 48 N<sub>II</sub>, 146 adults.

The material was fixed in 70% ethanol. Next, the slides of specimens have been made after maceration in 5–10% NaOH solution in alcoholic sequence, overexposure in xylene, and then in canadian balsam.

Schematic draftings were made basing on microscopic view at magnification and also on photos of selected specimens.

#### RESULTS

The following diagnostic characters were determined for nymphs of *Somaphantinae*, *Menoponinae*, *Menacanthinae* (*Amblycera*): g

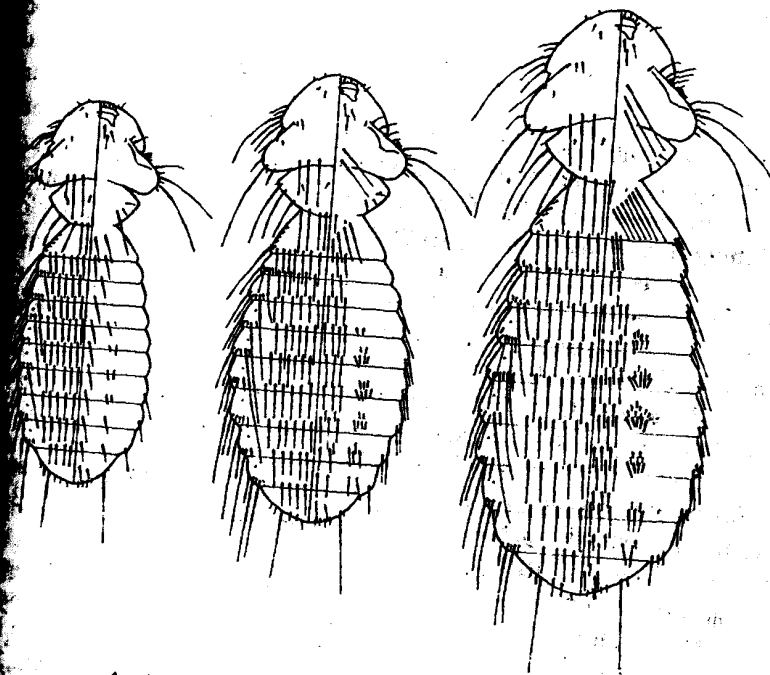
\*N<sub>I</sub>, N<sub>II</sub>, N<sub>III</sub> — nymphs of the first, second and third instars.

short setae on the sides of ventral part of segments III–V and setae appearing on gular plate sides; and for nymphs of *Goniodidae*, *Lipeuridae*, *Degeeriellidae* (*Ischnocera*) — number of setae on hind margin of prothorax. The detailed chaetotaxy in nymphs is presented in figs. 1–7.

#### DESCRIPTIONS OF NYMPHAL STAGES

##### *Amyrsidea perdicis megalosoma* (Overgaard)

N<sub>I</sub>: Body length 0.80–1.24 mm. Head rather wide with clypeus rounded anteriorly. No setae on gular plate. Numerous head setae of various lengths. Thorax three-segmented; segments separated by sutures. Prothoracic angles lacking setae. Abdomen oval, a little broader than head, with visible, straight intersegmental bounds. On segments III–IV always a pair of short setae apart from sternocentral setae. Last abdominal segment rounded posteriorly. On its dorsal side 12 setae: two long, remaining ones short, and on ventral side two pairs of sternocentral setae. Hind margin with 8 short setae and a pair of long setae with short setae on the sides.



1. *Amyrsidea perdicis megalosoma* — N<sub>I</sub>, N<sub>II</sub>, N<sub>III</sub>

that in  $N_1$  only in presence of an additional seta at antennal fossa. On sides of gular plate there appear two pairs of setae. Lateral prothoracic angles with single setae. Number of short setae on abdominal II grows to 5-7. Terminal segment chaetotaxy as in  $N_1$ .

$N_{III}$ : Body length: 1,41-1,89 mm. Dorsal head chaetotaxy unchanged. Three pairs of setae on sides of gular plate. Number and arrangement of setae on prothorax and on dorsal side of mesothorax the same as in  $N_1$ . Each fascicle on abdominal III-V numbers 9-13 setae. It is almost impossible to differentiate sex basing on chaetotaxy. Female nymphs have wreath of short setae (25-30) at the end of abdomen; it is absent in male nymphs. Apart from that, female nymphs have only 4 sternocentral setae whereas male nymphs have 8-9 of them (fig. 8).

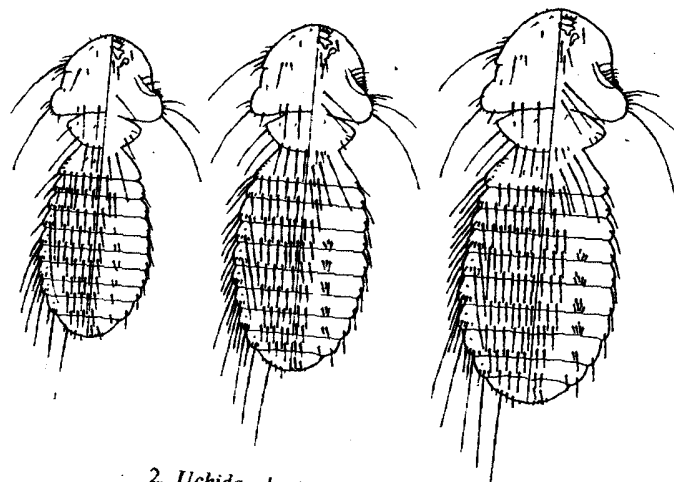
Setae on dorsal side of head in adults are like in  $N_{III}$ . However number of setae at margins of antennal fossa on ventral side of head in adults arises to 20-22, and number of setae on gular plate sides to 4 pairs. Setae on ventral side of mesothorax and abdomen become enriched. In adults, chaetotaxy of terminal abdominal segment is different than in nymphs. Terminal abdominal sternum in females has an anal wreath of setae. Numerous setae in males are situated in the middle of terminal segment.

#### *Uchida phasiani* Modrz. and Zlot.

$N_1$ : Body length: 0,71-0,89 mm. Head rather wide, rounded frontally. Facial wedges comma-shaped, sharply ended. Numerous setae of various lengths on the head. Gular plate with one seta on each side. Characters describing thorax are the same as in *Amyrsidea p. megalosoma*. Abdomen oval, almost as wide as the head, with distinctly marked intersegmental incisions on the sides. On segments III-V there is always observed wreath of short setae apart from sternocentral ones. Terminal abdominal segment rounded posteriorly with 12 setae (two of them long) on dorsal side, and with 4 sternocentral (of medium length) and 8 short setae on the margin; both situated ventrally.

$N_{II}$ : Body length: 0,90-1,08 mm. Dorsal head chaetotaxy different from  $N_1$  only in presence of an additional seta near antennal fossa. The same pair appears on sides of gular plate. Each of segments III-V with wreath of short setae apart from sternocentrals.

$N_{III}$ : Body length: 1,01-1,34 mm. Dorsal head chaetotaxy unchanged. There are already 3 pairs of setae on gular plate sides. Small setae at prothoracic angle is sometimes duplicated. Number of these setae is constant even in adult forms, where oscillates between 2 and 3.

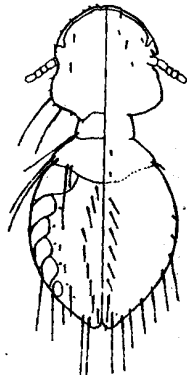
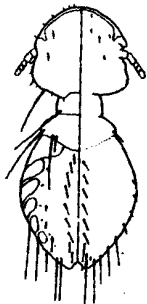
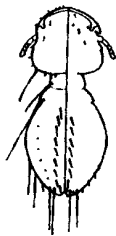


2. *Uchida phasiani* -  $N_1$ ,  $N_{II}$ ,  $N_{III}$

On segments III-V number of short setae is 5-6 per one fascicle. Like in *Amyrsidea p. megalosoma*, it is possible to determine sex basing on chaetotaxy. Only in female nymphs, there are 4-6 additional setae on the lateral margin of terminal abdominal segment. Also, on ventral side of this segment in female nymphs there are 6 long and 3-4 short setae. In adults the described chaetotaxy is developed as in *Amyrsidea p. megalosoma*.

#### *Goniocotes chrysocephalus* Giebel.

$N_1$ : Body length: 0,59 mm. Head rather big, much wider and longer than thorax. All the head setae very short, except one pair arising from the lateral margin of temples. Prothorax considerably narrower than mesothorax. Abdomen dumpy, a little wider than head, gradually contracting posterad. It has 9 pairs of medium long tergocentrals, 8 pairs of sternocentrals, and on terminal abdominal segments short or rarely long pleural setae. Nymphs I of *Goniocotes chrysocephalus* share the following characters with nymphs of other species of *Ischnocera* described: prothorax distinctly separated from pterothorax; suture between prothorax and abdomen being effaced; not marked intersegmental lines on abdomen; lack of pigmented plates which appear in  $N_{II}$ ; single seta present at lateral angles of hind margin of prothorax and mesothorax; number and arrangement of prothoracic and head setae in nymphs the same as in other nymphal instars and adult forms (only some of them are being elongated during the succeeding moultings); a shallow depression at the end of abdomen in  $N_1$ ,  $N_{II}$ , and  $N_{III}$ .



3. *Goniocotes chrysocephalus* - N<sub>II</sub>, N<sub>III</sub>, N<sub>IV</sub>

N<sub>II</sub>: Body length: 0,66-0,77 mm. Paired setae, one of them long, the other short appear at hind margin of pterothorax on both sides. On abdomen we can already see 3 pairs of tergotaterals and 3 pairs of pleural setae.

N<sub>III</sub>: Body length: 0,72-0,99 mm. Number of setae at hind margin of pterothorax increases to 4 on each side. On abdomen, number of tergotaterals is the same as in N<sub>II</sub>, and only some pleural setae being elongated.

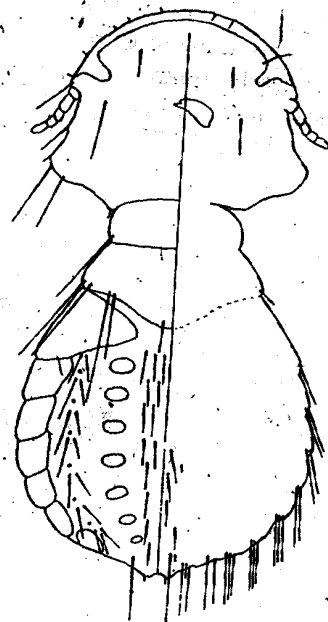
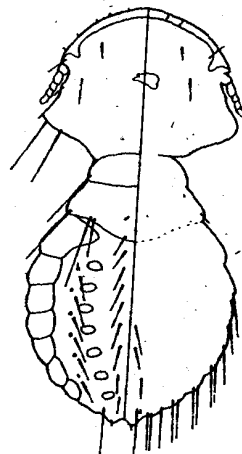
In adults, thoracic and head chaetotaxy is like in N<sub>III</sub>, the abdominal chaetotaxy, however, is different. In females, there are 3 pairs of tergotaterals on abdomen, like in N<sub>III</sub> (however being elongate) whereas in males the number increases to 6 pairs. Tergocentral setae in females appear on 6 segments, in males only on the first five. First visible abdominal segment in nymphs has two pairs of tergotaterals and three pairs of pleural setae. In adults also, pleural setae grow in number beginning with abdominal III.

### *Zlotorzycella colchici* (Denny)

N<sub>I</sub>: Body length: 0,87-1,08 mm. Head rather big, considerably longer than thorax. From all the setae on head the longest ones arising from lateral margins of temples, like in *G. chrysocephalus*. On lateral margins of pterothorax there are two short setae apart from the long ones. Thorax dumpy, a little wider than head, contracting posteriorly. Abdomen with 5 pairs of tergotaterals, 8 pairs of tergotaterals, 8 pairs of sternocentrals, and pleural setae occurring individually or in pairs.

N<sub>II</sub>: Body length: 1,08-1,50 mm. Two long setae appear between the two existing previously at hind margin of pterothorax on both sides.

Body. Abdomen more dumpy, with next pair of tergotaterals and two pairs of sternocentrals. Pleural plates, mostly rectangular in shape, gradually diminish posterad. They are stronger sclerotized than the tergal and oval tergal ones.



4. *Zlotorzycella colchici* - N<sub>II</sub>, N<sub>III</sub>, N<sub>IV</sub>

N<sub>III</sub>: Body length: 1,49-2,14 mm. One more long seta appears at hind margin of pterothorax. Abdominal chaetotaxy is considerably changed.

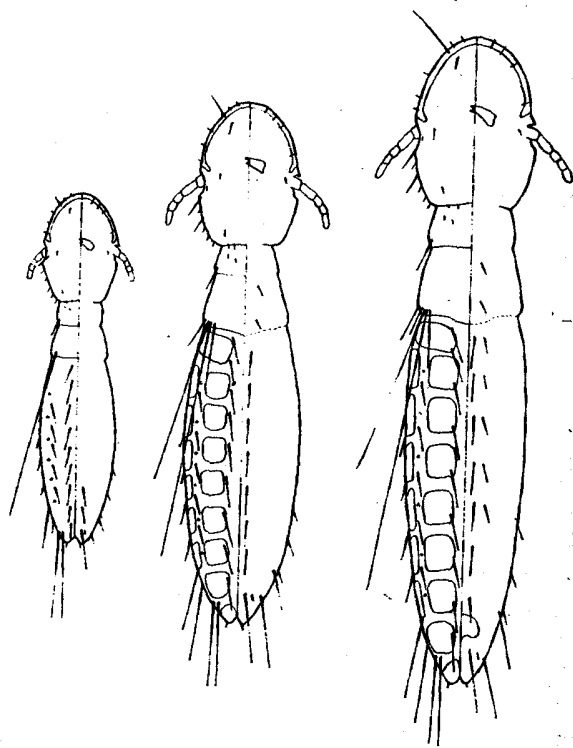
Adult forms show a distinct sexual dimorphism, but no differences between sexes have been observed in nymphs. Shape of head and antennae is different in males and females, but all the nymphs have a similar type of head. It refers also to the thread-like antennae. Number of tergotaterals and tergotateral setae increases to 5 on the first abdominal segment in adults. Females have 4-8 tergotaterals on separate segments of abdomen, the males have only two.

### *Lipeurus maculosus maculosus* Clay.

N<sub>I</sub>: Body length: 0,99-1,17 mm. Head elongate with parabolically rounded clypeus and with temporal part moderately contracting posteriorly. All the head setae short. Thorax consisting of small prothorax and considerably bigger pterothorax. Abdomen slim, nearly as wide as

head, with 5 pairs of tergo-laterals, 9 pairs of tergo-centrals, 3 pairs of sternocentral setae and generally short pleural ones.

$N_{II}$ : Body length: 1,29–1,49 mm. Number of setae arises to 4 on body surface at both sides of pterothorax. First visible abdominal segment with two big, flat pleural plates; on the successive six, they are narrow and almost rectangular and accompanied by appearing plates nearly square. On segment VIII only tergal plates visible. Chaetotaxy of setae on dorsal side of abdomen the same as in  $N_I$ . Anterior surface of abdomen with sternocentrals.



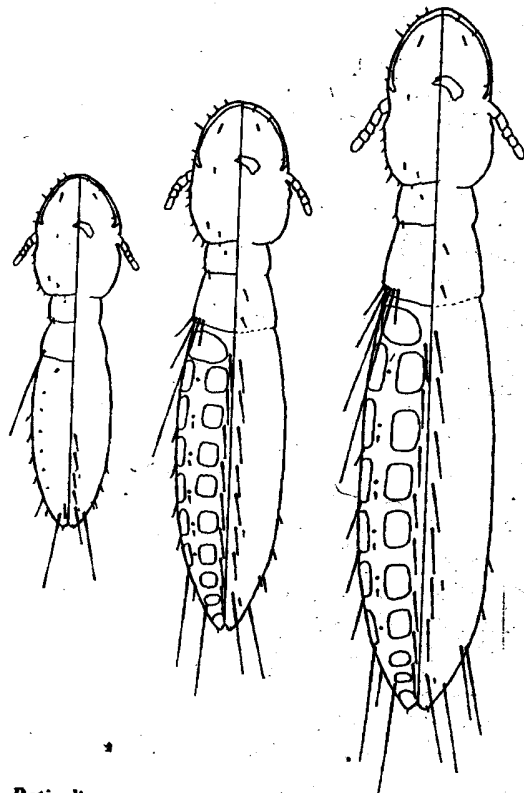
5. *Lipeurus maculosus maculosus* –  $N_I$ ,  $N_{II}$ ,  $N_{III}$

$N_{III}$ : Body length: 1,58–1,95 mm. Hind margins of pterothorax with one seta more. At last, five different setae occur on both sides of pterothorax from medium to very long ones. The same number of setae is characteristic also of adult forms. Dorsal abdominal chaetotaxy is unchanged whereas first five pairs of tergo-centrals are doubled on each side. In  $N_{III}$  we can already observe sexual dimorphism which is expressed in differences in structure of antennae and plate on abdominal sternite.

Antennae in male nymphs are more massive than in female, particularly the first article is strongly incrassate (fig. 9). Sternal plate in male nymph is different and less regular in outline at its posterior part than that in female nymphs. Adult forms do not possess such plates. Antennae in males are considerably different from those in females. Proportions of articles are different and males have a big, finger-like appendix (ZLOTORZYCKA, 1980, fig. 45). Also head is shaped in different way in both sexes (ZLOTORZYCKA, 1980, fig. 42, 43) and chaetotaxy is also varied. Differences in chaetotaxy are also marked in pterothorax (males have two setae near central body line; in females these setae are absent).

*Reticulipeurus mesopelios colchicus* (Clay)

$N_I$ : Body length: 0,81–1,18 mm. Head elongate like in *Lipeurus maculosus* but temples are more rounded, with numerous short setae. Pterothorax a little narrower and shorter than pterothorax. Abdomen slim,



6. *Reticulipeurus mesopelios colchicus* –  $N_I$ ,  $N_{II}$ ,  $N_{III}$

$N_{II}$ : Body length: 1,30–1,58 mm. On dorsal side of pterothorax, at hind and lateral margins two next setae appear and surround that long observed previously. Pleural and tergal plates similar to those of *Lipeurus m. maculosus*. Abdominal chaetotaxy becomes considerably enriched: pairs of tergo-centrals appear on first seven segments, and pairs of sternocentrals on the first three. Single short tergo-lateral setae appear also on segments III–VI.

$N_{III}$ : Body length: 1,64–2,02 mm. On dorsal side of pterothorax at hind margin, the number of setae arises to 5 on each side and remains unchanged in adults.

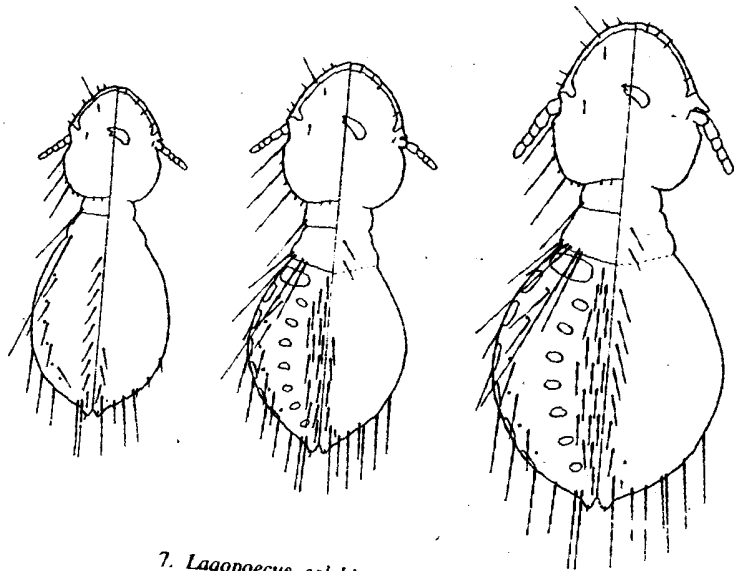
In  $N_{III}$  sexual dimorphism may already be noticed and appears in differences in structure of antenna, like in *Lipeurus m. maculosus*. Nymphs of both sexes have ventral margin of clypeus frame arcuate, whereas in adults it is irregularly folded. Nymphs also lack transverse furrow on dorsal side of clypeus which is observed in adults. In adults also, setae on dorsal side of abdomen are strongly elongate. Number and arrangement of setae on ventral side of abdomen in males is generally the same as in  $N_{III}$ ; additional setae appear only in genital region (ZLOTORZYCKA, 1963, fig. 72). Females have 6 sternocentrals on abdominal VI and males have only 4 as nymphs. Numerous setae appear on margins of genital lobe.

#### *Lagopoecus colchicus* Emerson.

$N_I$ : Body length: 0,77–0,95 mm. Head slightly elongate, temples arcuately protruded sideways. Head setae generally short; the longest are an ocular one and two at lateral margin of temples. Abdomen wider than head and thorax; it has 5 pairs of tergo-laterals, 9 pairs of tergo-centrals, 4 pairs of sternocentrals, and some pleural setae of various lengths situated individually or rarely in twos.

$N_{II}$ : Body length: 0,98–1,15 mm. Number of setae on dorsal side of pterothorax arises to 4 on each side. Abdomen is a little broader than in  $N_I$ . Majority of tergo-centrals are getting double and number of sternocentrals grows to 5 pairs. First visible abdominal segment with two big rectangular pleural plates. Successive segments with narrow and long pleural plates and small and oval tergal ones. Venter of segment with pair of tergal plates.

$N_{III}$ : Body length: 1,13–1,48 mm. Hind margin of pterothorax with one seta more on each side. Abdomen gains next tergo-centrals (number arises to 6 on several segments) and sternocentrals – on the first three segments. All the nymphs have filiform antennae as observed in adults.



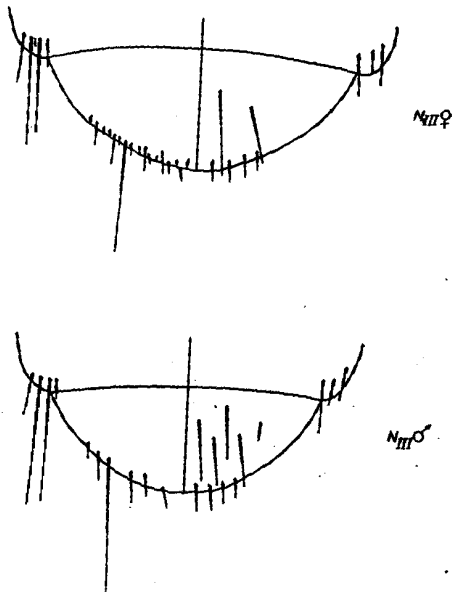
7. *Lagopoecus colchicus* –  $N_I$ ,  $N_{II}$ ,  $N_{III}$

Number of tergo-centrals on abdominal I–VII in adults arises usually to 6 in one row, but we can also observe 7 to 8 of them. Abdominal VIII in adults with one pair of tergo-centrals and one pair of sternocentrals less. In females, hind margin of genital lobe with a row of short setae. In males, hind margin of last abdominal segment with numerous setae, which are not observed in females.

#### DISCUSSION AND CONCLUSIONS.

Nymphs as well as adults of paucimorphically developing *Lagopoecus colchicus* are constituted in a similar way. Three nymphal instars differ not only in length of the body (KESSEL, 1942; EICHLER, 1963) and in proportions between dimensions of individual parts of the body. The last instar was described in detail by KÉLER (1952). He showed different stages of growth of size of head as well as dimensions of the whole body during the developmental period of *Pseudomenopon rovanae* KÉL. (Pseudomenoponidae). EICHLER (1963) pointed that only the most derived groups of mallophagans do not change during their developmental period. Nymphs of more specialized groups however, where adults are characterized by a peculiar modification of setae, have only gradual modifications or they are not observed at all. As an example of such highly specialized representatives of *Amblycera*, EICHLER (op. cit.)

introduced *Eulaemobothrion cubense* (KELL.) (*Laemobothridae*) successive instars of that species, number of setae transformed into linear thorns on osculum successively grows to create definitively adult. Also the representatives of *Ischnocera* — *Columbicola c. columbae* (L.) (*Esthiopteridae*) developed two clypeal setae of linear shape only not before adult.  $N_I$  dose not possess those setae while they are present in  $N_{II}$  (MARTIN, 1934). Also CLAY (1958) described gradual appearance of new setae in nymphs of the tribe *Degeeriellini* (*Degeeriellidae*).

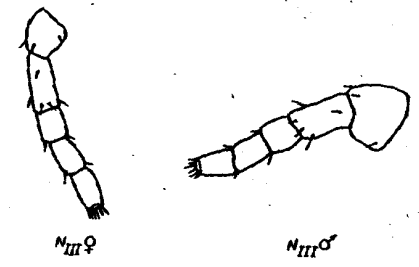


8. *Amyrsidea perdicis megalosoma* — chaetotaxy of the terminal segment on the third nymphal instar in female  $N_{III}$

Making a diagnosis of individual nymphal instars based on the progression of chaetotaxy, as it was performed by CLAY in reference to mallophagans of the genus *Kelerinirmus*, appeared to be suitable for our investigations of nymphs of the genus *Lagopoecus* (also *Degeeriidae*) as well as the representatives of related families *Lipeuridae*, *Goniodidae*, included by EICHLER (1963) in the separate suborder *Goniodoidea*.

We saw however, that changes in chaetotaxy during the developmental period of mallophagans may perform a main diagnostic criterion for nymphs of *Amblycera*: *Somaphantidae* and *Menoponidae*, which are the most derived groups within the suborder. The developmental characters based on chaetotaxy do not stand alone in derived

*Goniodidae*, *Lipeuridae*, and *Degeeriellidae*). Adults of *Ischnocera* have darkened sclerites of plate shape on different parts of body, particularly on abdomen. EICHLER (1948) said, and our observations support it, that the appearance of abdominal plates was a valuable diagnostic criterion in nymphs which are less pigmented in principle. It is a rule in all *Ischnocera* although in adults of *Ardeicola bulbosus* EICHL. (*Esthiopteridae*) almost all the body surface is colourless while in nymphs we can see numerous pigmented sclerites (EICHLER, 1948). Several species show sexual dimorphism in structure of antennae in adults. EICHLER (1963) states, that those nymphs which develop into males with complicated structure of antennae have at least basal article of antenna slightly incrassate beginning with the first instar already, as for example *Goniodes pavonis* (L.). Results of our study confirm that idea but only in part. It turned out that not always sexual dimorphism in structure of antennae in adults occurs together with initial dimorphism in antennae in nymphs. For example, antennae in nymphs of *Zlotorzycella colchici* do not differ between both sexes, however this species resembles *Goniodes pavonis* in sexual dimorphism. Also CONCI (1952, 1956) states that it is not possible to determine sex of nymphs of *Cuclotogaster heterographus* (WITZSCH) (*Lipeuridae*) and nymphs of *Columbicola c. columbae* (*Esthiopteridae*) after the shape of antennae. We were successful in observing sexual dimorphism manifested in incrassation of first article of antenna in males, but at least in third instar, of *Lipeurus m. maculosus* and *Amblycera m. colchicus*. It is also possible to differentiate males from females among nymphs of third instar in *Amblycera*. Chaetotaxy of the terminal part of abdomen is the distinctive criterion there, what has already been noticed by KÉLER (1951) in reference to the genus *Pseudomenopon*. *Somaphantidae* and *Menoponidae* we have been studied also showed differences between sexes in  $N_{III}$  instar manifested in different number and arrangement of setae in the terminal part of abdomen (fig. 8). Sometimes several morphological characters occur only in nymphs. To present such character, KÉLER (1951) pointed at presence of paired



9. *Lipeurus maculosus maculosus* — antennae in male and female  $N_{III}$

facial wedges in nymphs of *Pseudomenopon* which were absent in adults. We noticed some dark coloured plates on abdomen in  $N_{III}$  of *Lipewurms maculosus* which are not observed in adults. Size and shape of these plates depends on sex.

Variability or progression does not refer to all characters in nymphs and adults of investigated *Ischnocera*. CONCI (1952, 1956) showed that head and prothoracic chaetotaxy in nymphs of *Cuclotogaster heptanotus* (*Lipeuridae*) and *Stenocrotaphus gigas* (*Goniodidae*) is the same in nymphs and adults. Our studies confirmed those observations also in some other species of those families and in *Lagopoecus colchicus* (*Degeeriellidae*). The only constant character in studied mallophagans of *Amblycera* appears to be the dorsal head chaetotaxy except one seta near antennae which may be observed not before  $N_{II}$ . This is also observed in *Pseudomenopon rowanae* (*Pseudomenoponidae*) which has been examined by KÉLER (1951).

The described categories of characters may be arranged as follows:

1. Constant characters, independent from developmental stages, in head and prothoracic chaetotaxy in studied *Ischnocera*.
2. Characters gradually changing (nymphal) during postembryonic period, as abdominal chaetotaxy in examined *Ischnocera*.
3. Characters referring only to preimaginal stages (larval), as chitinous plate occurring on ventral side of abdomen in  $N_{III}$  of *Lipewurms m. maculosus*.
4. Characters present only in adults (imaginal), as folds on lateral margin of clypeus frame in *Reticulipeurus m. colchicus*.

All the above categories of characters may be useful in the designation of nymphs; differentiation of individual instars within species is possible but only basing on nymphal and larval characters. Similarities in progression of nymphal characters in examined *Amblycera* basing on head and abdominal chaetotaxy, and in *Ischnocera* on head chaetotaxy and development of sclerites point at two generic communities: (a) *Somaphantidae* and *Menoponidae* and (b) *Goniodidae*, *Lipeuridae* and at any rate partly *Degeeriellidae*. The conclusion seems to be particularly valuable in reference to phylogenesis of *Goniodidae* and *Lipeuridae*. The imaginal characters in both groups have reached a high level of development that it is not possible to characterize them unequivocally taxa of a comparative degree.

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