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The morphology of the juvenile stages of moss mites of the family *Scheloribatidae* GRANDJEAN, 1953 (*Acari, Oribatei*) I

[With 9 text-figures]

Morfologia stadiów młodocianych mechowców z rodziny *Scheloribatidae* GRANDJEAN, 1953 (*Acari, Oribatei*) I

Abstract: The author describes the morphology of all juvenile stages of *Scheloribates latipes* and, on the example of the tritonymph, the most significant diagnostic characters of immature individuals of *S. laevigatus*. The two species mainly differ in the shape of seate on notogaster.

INTRODUCTION

To the family *Scheloribatidae* belong medium sized mites (350—690 μm) grouped in 6 genera (SHALDYBINA 1975). They are fairly uniform as regards morphological structure, but differentiated in respect of ecological requirements. Most members of the family in question live essentially in soil. Generally these mites have low requirements as regards relative air humidity and food quality (they live on almost untransformed litter fall), they are fairly mobile and therefore populate the surface layers of soil. They may, especially in the adult stage, leave the soil for some time and live on trees, shrubs or herbaceous plants. A few species have adapted to aerial climate and live on plants, and only occasionally can be found in soil.

In the soils of the northern and central Poland the most common of the family in question are three moss mite species: *Scheloribates laevigatus* (C. L. KOCH), *S. latipes* (C. L. KOCH) and *Hemileius initialis* (BERLESE). The first species occurs mainly in meadow soils (FRENZEL 1936, STRENZKE 1952, RAJSKI 1961, ŻYROMSKA-RUDZKA 1976). RAJSKI (1961) found that in meadow soil at Sypniewo near Poznań (plant community *Arrhenatheretum elatioris*) *Scheloribates laevigatus* reached a fairly high abundance 2.4 thou. ind./1 m^1) and dominance index (D = 8.4), in spite of the fact that the author identified only adult individuals of that species.

Close investigations carried out in forest soils and taking into account all development stages of species of the family *Scheloribatidae* have demon-

strated that their juvenile individuals are generally 2—3 times as numerous as adults. The most numerous was generally *Hemileius initialis*, and in the mucky soil in the reserve "Las Piwnicki" (plant community *Tilio Carpinetum typicum*) it was found to reach an average density of 9.4 thou. ind./1 m^2 and a dominance index D = 6.0.

Moss mites of the family *Scheloribatidae* have attracted particular interest of naturalists, agriculturists and foresters for many years, for along with a positive part in transforming organic matter they play a negative part as intermediate hosts of dangerous tapeworms of the suborder *Anoplocephalata*, which attack domestic and forest animals (POTIOMKINA 1951, SHALDYBINA 1953, RAJSKI 1959). For that reason the mites in question have been often raised under laboratory conditions, and their development cycle and association with parasitic tapeworms are comparatively well known. The most frequent subject of study has been *Scheloribates laevigatus*, commonly occurring in meadows.

Some of the papers discussing the biology of *S. laevigatus* (WOODRING and COOK 1962, SUBBOTINA 1967a) and of *S. latipes* (SUBBOTINA 1967b) contain some marginal information on the morphology of juvenile stages of these species. The descriptions, however, are too general, and the drawings too schematic to be used in identifying material collected in the field. Likewise, the drawings of tritonymphs of *S. laevigatus* and *S. confundatus* SELLNICK = *Hemileius initialis* (BERLESE) given by V. D. HAMMEN (1952) do not seem to show enough details. GRANDJEAN (1958), on the other hand, analyzed only the structure of the ventral region and the setation of palpi in larvae of *S. laevigatus*, concentrating on characters indicative of the distinctness of the families *Scheloribatidae* and *Oribatulidae*.

According to my own observations, juvenile individuals of some of the species of the family *Scheloribatidae* look strikingly alike, so that for a correct identification of species a close chaetotaxonomic analysis is indispensable. That is why I will start the series of papers on the morphology of juvenile stages of *Scheloribatidae* with a description of the morphology of larvae and succesive nymphs of a species typical of the genus *Scheloribates* — *S. latipes* (C. L. KOCH). Considering the fact that the particular species of this genus undergosimilar morphological changes in the process of ontogenesis, I will then describe the morphology of tritonymps of other species, as the significant diagnostic specific characters are best seen at this development stage.

THE MORPHOLOGY OF JUVENILE STAGES OF *SCHELORIBATES LATIPES* (C. L. KOCH) AND *S. LAEVIGATUS* (C. L. KOCH)

1. *Scheloribates latipes* (C. L. KOCH)

Larva (Figs. 1, 2). Dimensions: length 212 μm, width 95 μm (the average of 10 specimens).

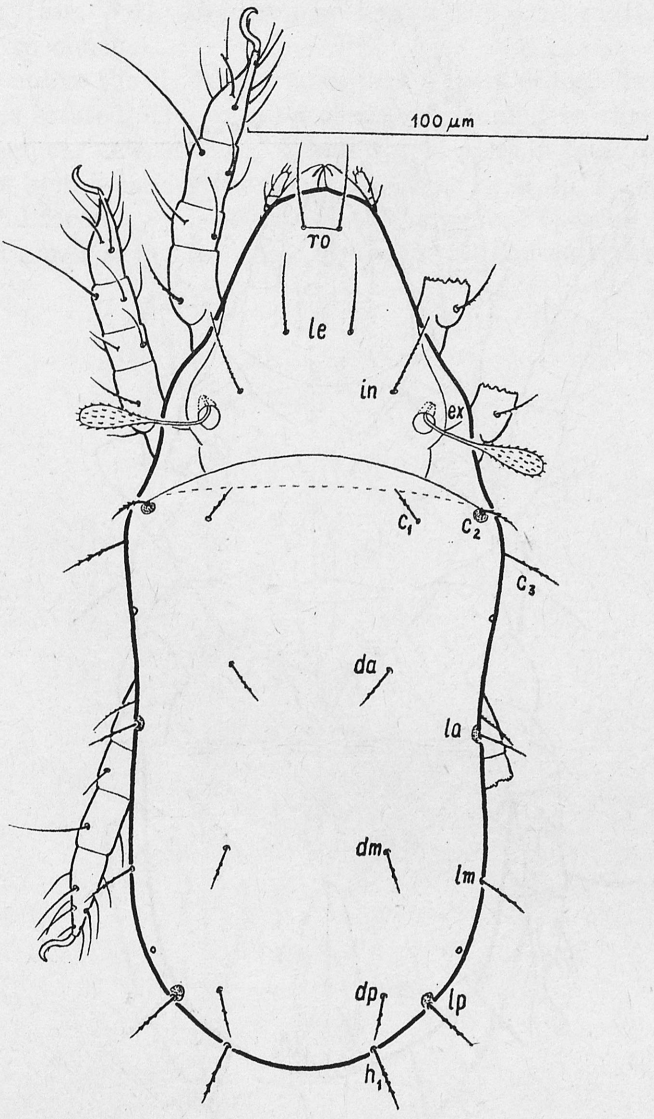

Fig. 1. *Scheloribates latipes* (C. L. Koch), larva, dorsal view

Dorsal side. Aspis is trapezoidal in shape, rostrum is rounded. On aspis are roundish bothridia with sensillus and 4 pairs of setae. The head of sensillus is usually club-shaped, the swelling being covered by fine thorns. In the anterior part of aspis grow rostral setae (*ro*), and in the central part — lamellar (*le*) and interlamellar (*in*) setae. All these setae are straight, rigid, pointed and covered by fine thorns, and they are much longer than the exobothridial setae situated on the outside of bothridia.

On notogaster there are 10 pairs of setae. They are straight, rigid, pointed and covered with fine thorns, and they are definitely shorter than setae *ro*,

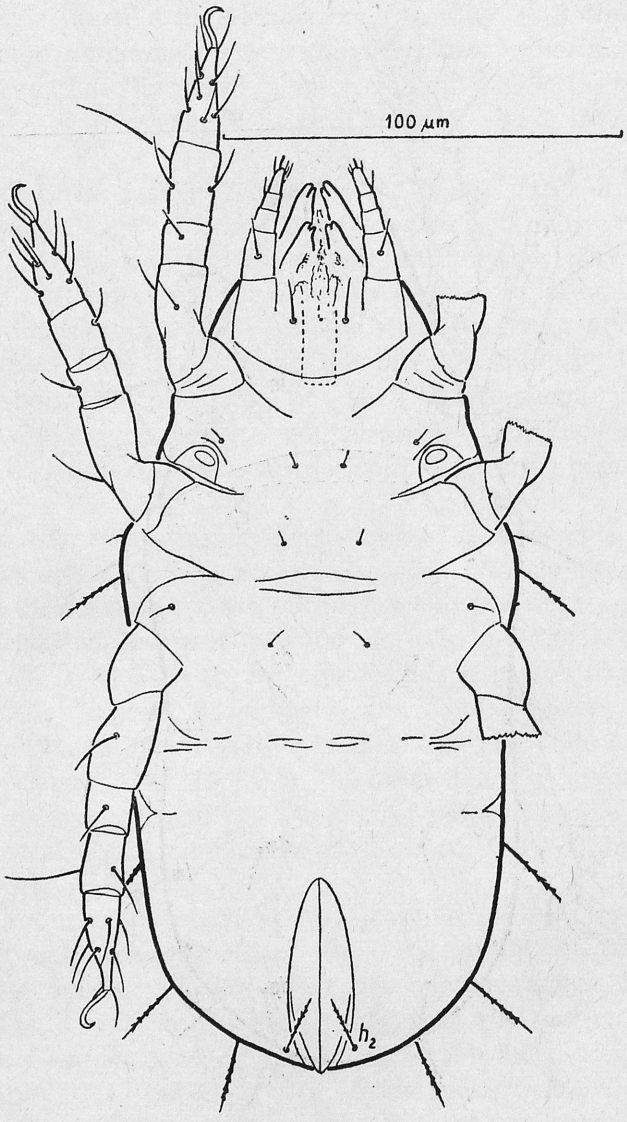

Fig. 2. *Scheloribates latipes* (C. L. KOCH), larva, ventral view

le and *in*. Among the setae covering the notogaster the longest are setae c_3, and the shortest setae c_2. At the base of setae c_2, *la* and *lp* lie roundish porous areas.

Ventral side. Hypostomal setae (*h*) are ordinary and definitely longer than the epimeral setae. The epimeral formula is 2—1—2. On epimerae I lie elliptic CLAPARÈDE's organs. On both sides of the posterior part of the anal opening grow a pair of posterior setae (h_2), somewhat shorter than setae h_1, but similar in shape.

Protonymph (Fig. 3A). Dimensions: length 278 μm, width 120 μm (the average of 10 specimens).

This stage, unlike the six-legged larva, has 4 pairs of legs. In the forth pair only the foot is setated. The setation of aspis is similar to that in larva, but on notogaster appear new setae (h_2, h_3 and p_1), 13 pairs in total number. Porous areas are found at the base of the following setae: c_2, *la*, *lp*, h_2, h_3 and p_1.

The epimeral formula is 3—1—2—1. At the genital opening there is a pair of papillae and a pair of genital setae. The epimeral and genital setae are small

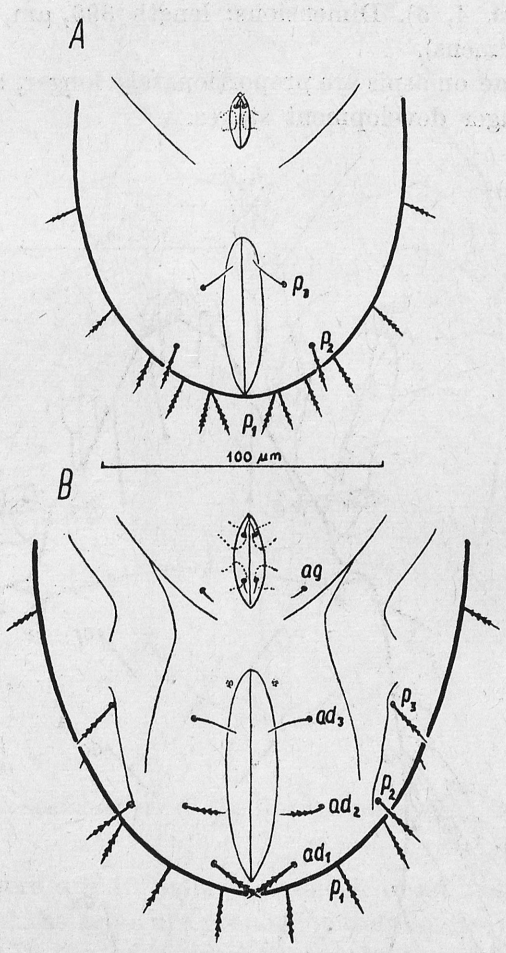

Fig. 3. *Scheloribates latipes* (C. L. Koch), ventral plate: A — protonymph, B — deutonymph

and ordinary. At the anal opening grow 2 pairs of pseudoanal setae (p_2 and p_3), p_2 being straight and rigid, like the notogastral setae, while p_3 are finer, less rigid, but also covered with fine thorns.

Deutonymph (Fig. 3B). Dimensions: length 330 μm, width 142 μm (the average of 10 specimens).

In this stage, except the trochanter, other joints of IV pair of legs are setated. The epimeral formula is: 3—1—2—2. At the genital opening there are two pairs of papillae and two pairs of genital setae. By the sides of the posterior part of the genital area grow a pair of small postgenital setae (*ag*). At the anal opening are three pairs of adanal setae (ad_1 ad_2 and ad_3), the thickest of which are setae ad_1, and the thinest setae ad_3. The latter are smooth, while setae ad_1 and ad_2 are covered with fine thorns.

Tritonymph (Figs. 4, 5). Dimensions: length 390, μm, width 184 μm (the average of 10 specimens).

Dorsal side. Setae on aspis are proportionately longer, and sensillus is slenderer than in younger development stages.

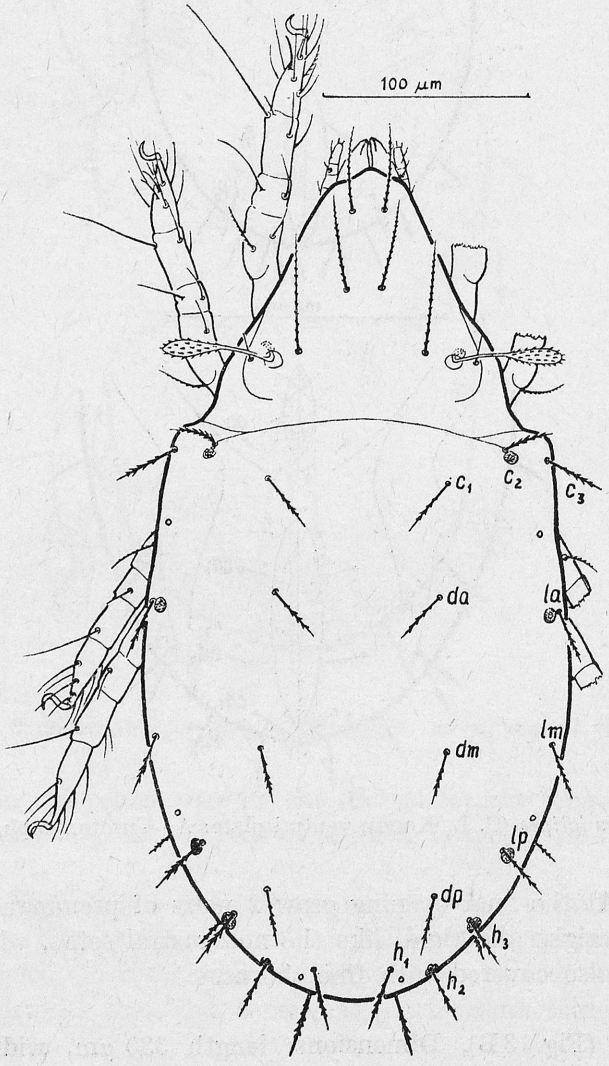

Fig. 4. *Scheloribates latipes* (C. L. Koch), tritonymph, dorsal view

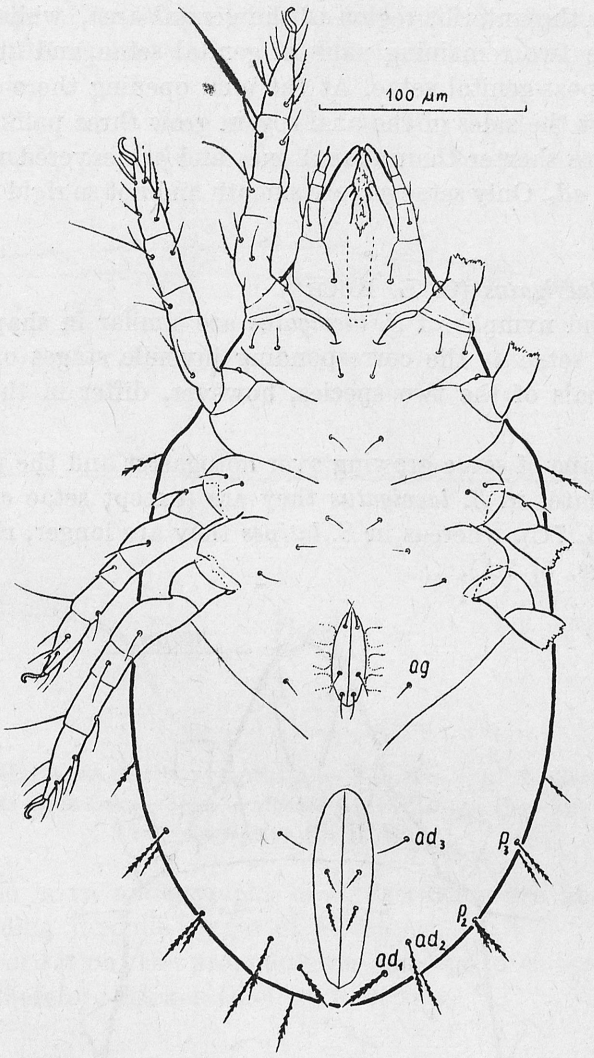

Fig. 5. *Scheloribates latipes* (C. L. Koch), tritonymph, ventral view

On notogaster there are 13 pairs of setae, i. e. as many as in the proto- and deutonymph, and the setae are proportionately longer than in the younger development stages. In the tritonymph it can be seen most clearly that the setae growing over the notogaster are covered with thorns in a rather characteristic way: the basal portion of the setae is free, the central region is covered with smaller, and the distal region with larger thorns (Fig. 7A). Porous areas lie at the base of the following setae: c_2, *la*, *lp*, h_2, h_3 and p_1. Near setae *lp* lie sebaseous glands.

Ventral side. The hypostomal setae are ordinary and similar in size to the epimeral setae. The epimeral formula is: 3—1—3—2. At the genital opening there are three pairs of papillae and three pairs of genital setae. One pair of

these setae lies in the anterior region of the genital area, while in its posterior portion grow the two remaining pairs of genital setae, and at the sides there is yet a pair of post-genital setae. At the anal opening there are two pairs of anal setae, and at the sides of the anal region grow three pairs of adanal setae. The anal setae are shorter than adanal ones and are covered with fine thorns, like setae ad_2 and ad_3. Only setae ad_1 are smooth and not so rigid as the remaining adanal setae.

2. *Scheloribates laevigatus* (C. L. KOCH)

The larvae and nymphs of *S. laevigatus* are similar in shape and have the same number of setae as the corresponding juvenile stages of *S. latipes*. The juvenile individuals of the two species, however, differ in the following characters:

— length and shape of setae growing over notogaster and the posterior portion of the ventral plate; in *S. laevigatus* they are (except setae c_3) short, flexible and bare (Figs. 6, 7C), whereas in *S. latipes* they are longer, rigid and covered with thorns (Figs. 5, 7A),

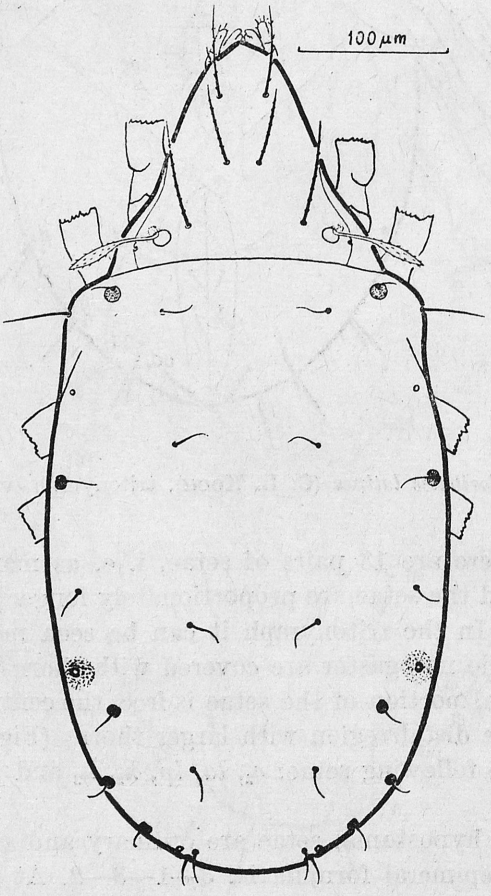

Fig. 6. *Scheloribates laevigatus* (C. L. KOCH), tritonymph, dorsal view

— length and shape of exobothridial setae (*ex*): in *S. laevigatus* they are small, bent and hard to distinguish, whereas in *S. latipes* they are straight, protruding and clearly visible,
— shape of sensillus; in *S. laevigatus* the sensillus head is slenderer than in *S. latipes* and generally pointed at the end, while in *S. latipes* it is usually rounded,

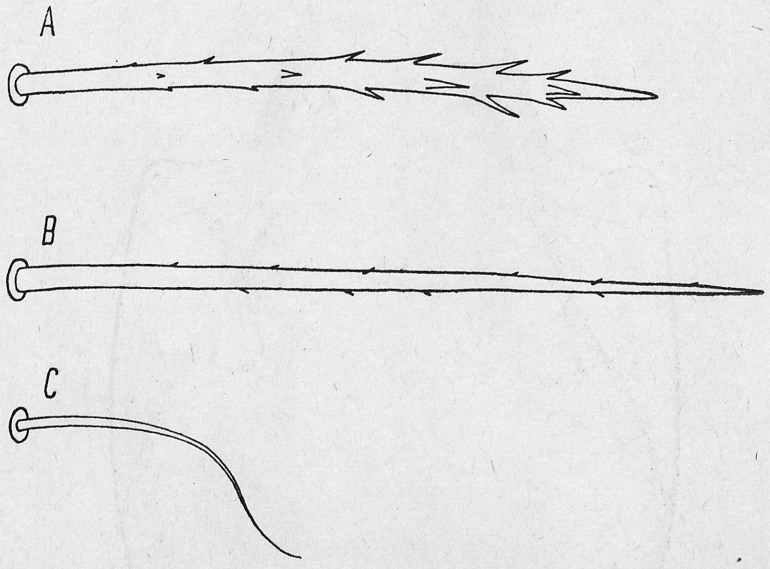

Fig. 7. The notogastral setae of tritonymphs: A — The seta c_2 of *Scheloribates latipes* (C. L. Koch), B — The seta c_2 of *Scheloribates laevigatus* (C. L. Koch), C — The seta c_1 of *Scheloribates laevigatus* (C. L. Koch)

— body size; the larva and nymphs of *S. laevigatus* are about 1.4 the size of the corresponding juvenile stages of *S. latipes*,
— degree of sclerotization, the propodosoma and legs in *S. laevigatus* are more sclerotized and therefore darker than in *S. latipes*.

DEVELOPMENT OF SETATION

In the course of development the number of setae on aspis remains the same, only their length changes. Starting from the stage of larva up to the tritonymph, the setae become proportionately longer, but in adult individuals they increase in length very considerably, especially setae *le* and *in* (Figs. 8, 9).

The number of setae on notogaster, on the ventral side of the body and on the legs changes in the process of ontogeny. In the larva there are 10 pairs of setae on the notogaster, whole in the nymphs there are 13. In the course of development from the larva to the tritonymph the notogastral setae become proportionately longer, whereas in the adult individual they are considerably reduced or even disappear altogether. In the species in question setae c_1, c_3, *da*, *dm* and *dp* disappear, so that only 10 pairs of setae remain.

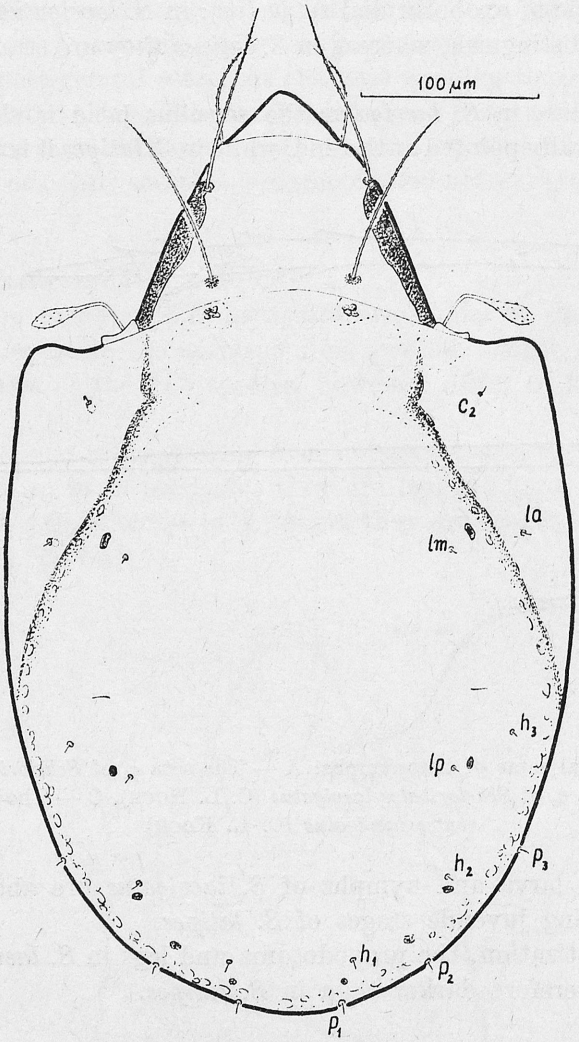

Fig. 8. *Scheloribates latipes* (C. L. Koch), adult, dorsal view

In consecutive juvenile stages the number of epimeral setae increases according to the formulae: larva — 2—1—2, protonymph — 3—1—2—1, deutonymph — 3—1—2—2 and tritonymph — 3—1—3—2. The genital setae increase in number in agreement with the formula: 1—2—3—4. As new segments appear in successive juvenile stages, the setae round the anal opening also increase in number. The number of setae and solenidia on the legs increases according to the formulae presented in Table I.

SYSTEMATIC REMARKS

Adult individuals of *Scheloribates latipes* and of *S. laevigatus* show much resemblance at first sight, so that their identification, especially in vast material used in ecological studies, is not at all easy. Although Sellnick (1929),

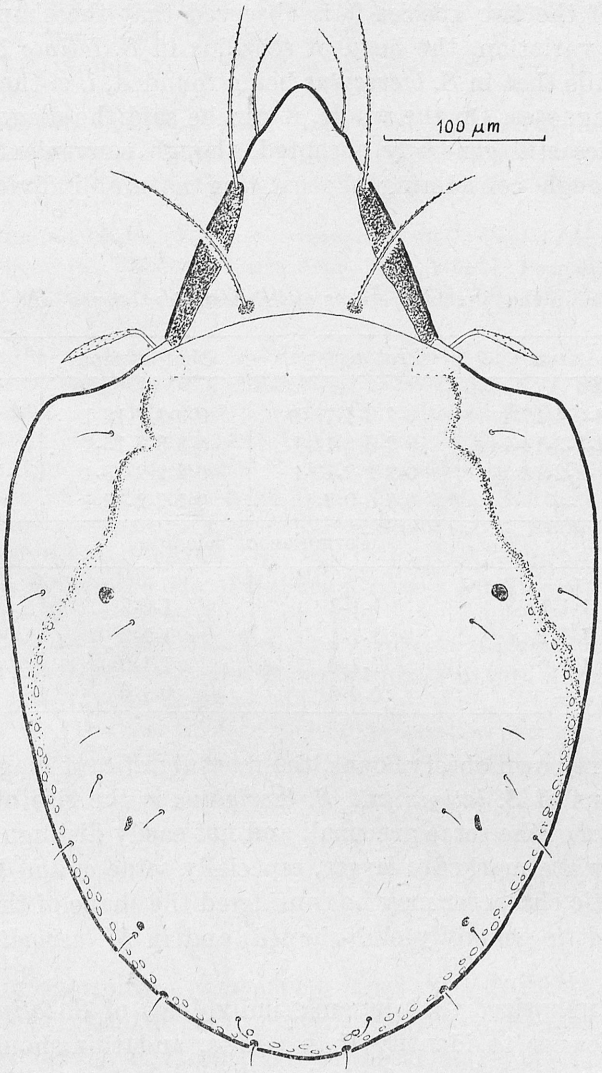

Fig. 9. *Scheloribates laevigatus* (C. L. Koch), adult, dorsal view

Willmann (1931) or Shaldybina (1975) in their keys give characters distinguishing the two species in question (shape of sensillus, colour and size of body), these characters are known to show a certain amount of variability within the species, which reduces their value as diagnostic characters. The least reliable specific characters are: the colour of the body, which changed with age (young individuals are lighter, older ones are darker) and the size of the body, which shows a considerable range of variation. According to data reported by Perez-Inigo (1974, 1976), the length of *S. latipes* varies from 415 µm to 520 µm, whereas that of *S. laevigatus* from 450 µm to 630 µm, which means that the lenght ranges of these two species overlap. In examining large numbers

of populations of the two species it is observed that the shape of sensillus is subject to some variation, the head of sensillus in *S. latipes* being sometimes even pointed, while that in *S. laevigatus* being rounded, i. e. the reverse of what is claimed by diagnoses. On the whole, it can be said the diagnostic characters of the two species still generally accepted, though convenient in use, do not seem precise enough considering the existing natural individual variability.

Table I

Setation formulae in the juvenile stages of *Scheloribates latipes* and *S. laevigatus*

Legs	Larva	Protonymph	Deutonymph	Tritonymph
I	0-2-3-4-17-1	0-2-3-4-18-1	0-3-3-5-18-1	1-4-3-6-20-1
II	0-2-3-3-14-1	0-2-3-3-14-1	0-3-3-3-15-1	1-4-3-4-17-1
III	0-2-2-2-13-1	0-2-2-2-13-1	0-2-2-2-13-1	1-2-2-2-15-1
IV	---	0-0-0-0-7-1	0-2-2-2-12-1	0-2-2-3-12-1
	Formulae of solenidia			
I	1-1-1	1-1-2	1-2-2	1-2-2
II	1-1-1	1-1-1	1-1-2	1-1-2
III	1-1-0	1-1-0	1-1-0	0-1-0
IV	---	0-0-0	0-1-0	0-1-0

According to my own observations, the most significant diagnostic character of adult specimens of *S. latipes* and *S. laevigatus* is the size of setae on notogaster. In the former the setae are small and not easily distinguishable, whereas in the latter they are markedly larger, especially setae c_2 and *la*. As a complementary diagnostic character may be considered the shape of the sensillus head, for in *S. latipes* it is generally club-shaped, and in *S. laevigatus* it is spindle-shaped.

It must be emphasized that juvenile individuals of *S. latipes* and *S. laevigatus* are much easier to identify than adults, and this should be made use of in analysing material for ecological studies.

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STRESZCZENIE

Autor opisuje morfologię wszystkich stadiów młodocianych *Scheloribates latipes* oraz, na przykładzie tritonimfy, najważniejsze cechy diagnostyczne osobników młodocianych *S. laevigatus*. Wspomniane gatunki różnią się głównie kształtem włosów na notogaster.

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