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Intraspecific morphological variation of *Scutovertex sculptus* Michael (Acari: Oribatida: Scutoverticidae) and description of its juvenile stages

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Abstract

This paper provides a detailed redescription of the adult and the first morphological description of all juvenile stages of *Scutovertex sculptus*. Specimens from four European countries, Austria, Germany, France and Spain were investigated. The species specific characters are the broadened posterior notogastral setae (*lp*, h_1–h_3), the slightly broadened anterior notogastral seta (*dm*), the gastronotic cuticle with irregularly distributed foveae and a thick layer of secretion forming blocs with color dispersive qualities on the posterior half of notogastral region. Minor differences in the shape of notogastral setae and in the thickness of the secreted layer on the posterior gastronotic region were found in specimens from different countries. The investigation of the juveniles of *S. sculptus* showed that the larva and nymphs can be easily distinguished from those of *S. minutus*; the lateral setae on tibia I are leaf-shaped in *S. sculptus* and knife-shaped in *S. minutus*.

Key words: taxonomy, morphology, development, *Provertex*

Introduction

Scutovertex sculptus Michael, 1879 is a member of the family Scutoverticidae, which belongs, within higher Oribatida, to the subgroup of "Circumdehiscentiae with wrinkled nymphs and adults without pteromorphae" (Grandjean 1953). Woas (2002) supposed this family to be an "archeopterogasterine" group. Since Michael´s description of this species (Michael 1879), several diagnoses in keys (Ghilarov & Krivolutsky 1975, Pérez-Iñigo 1993, Sellnick 1960 and Strenzke 1943) and one redescription of adults (Woas 1998) were published. All of them do not accord in certain characters, such as in the shape of some notogastral setae or the length of cuspides. Furthermore, the knowledge of juvenile Scutoverticidae is still very poor. Scattered and fragmentary information is available for the juveniles of *Scutovertex* sp. (Grandjean 1949), *Provertex delamarei* Travé, 1962, and *Argentinovertex coineaui* Fernandez & Cleva, 2002. Comprehensive data on all stages are published only for *S. minutus* (Schäffer & Krisper 2007). The aim of this paper is to provide a detailed redescription of *S. sculptus* and to prove the morphological variation in this species from different European locations as well as to perform the description of all juvenile stages.

Materials and methods

Mite collection

Specimens of *S. sculptus* were extracted from moss samples using Berlese-Tullgren funnels. The samples were collected from rocky habitats of Styria, North Tyrol and Lower Austria, as well as from pannonian soils of eastern Austria (Burgenland), from habitats of southern France and from Spain. Additional material from

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Germany was obtained from the collection of Moritz, Museum für Naturkunde of the Humbold-University in Berlin.

Collection sites. (1) Ruine Gösting near Graz; 4.11.2004 (G. Krisper leg.). (2) W lake Oberer Stinker near Illmitz; 16.9.2005. (3) Shore of lake Zicklacke near Illmitz; 16.9.2005. (4) Landeck, Fliess; 6.6.2007 (H. Schatz and B. M. Fischer leg.). (5) Ernstbrunn, "Toter Hengst" (E. Ebermann leg.); 29.3.2005**.** (6) Near the coast of Seignosse—Les Bourdaines (France) (J. Knapp leg.); 14.6.2007. (7) Olympic stadium (moss in eaves gutter) Barcelona (J. Knapp leg.); 17.10.2007.

Rearing

Breeding experiments to obtain all juvenile stages for morphological investigation were performed with adults from Austria and France. Cylindrical polystyrol-containers supplied with plaster of Paris were used as rearing boxes and the animals were fed with collected substrate, e.g. small pieces of lichens and mosses or thin layers of coccal green algae.

Preparation

Juvenile specimens from the offspring and adults from the breeding boxes were preserved in ethanol (70%). For investigation in transmitted light, the material was embedded in SWAN-medium (gum-arabic, distilled water, chloral hydrate, glucose, pure acetic acid) or in HOYER's medium. Observations and drawings were made with a differential interference contrast microscope (Olympus BH-2) equipped with a camera lucida. For SEM-investigations the samples were dehydrated in ascending ethanol concentrations, dried on air and mounted on aluminium-stubs with double sided sticky tape, and then the specimens were sputter-coated with gold. The SEM-micrographs were taken at the Research Institute for Electron Microscopy and Fine Structure Research, Graz, University of Technology, with a Zeiss Leo Gemini DSM 982. Figures of the specimens not originating from Austria are indicated in the figure captions separately.

Results

Diagnosis. Diagnostic characters for *S. sculptus* are well developed cusps, ridges between lamellae reaching translamella, gastronotic cuticle with irregular distributed foveae, thick layer of color dispersing secretion forming V-shaped structure and blocs on posterior half of gastronotic region, strongly broadened and spinose posterior notogastral setae (*lp*, h_1-h_3), slightly broadened anterior notogastral seta (*dm*).

Redescription of adults

Specimens from Austria (fig.1). Length (N=41): 521-671 µm (mean 566 µm)

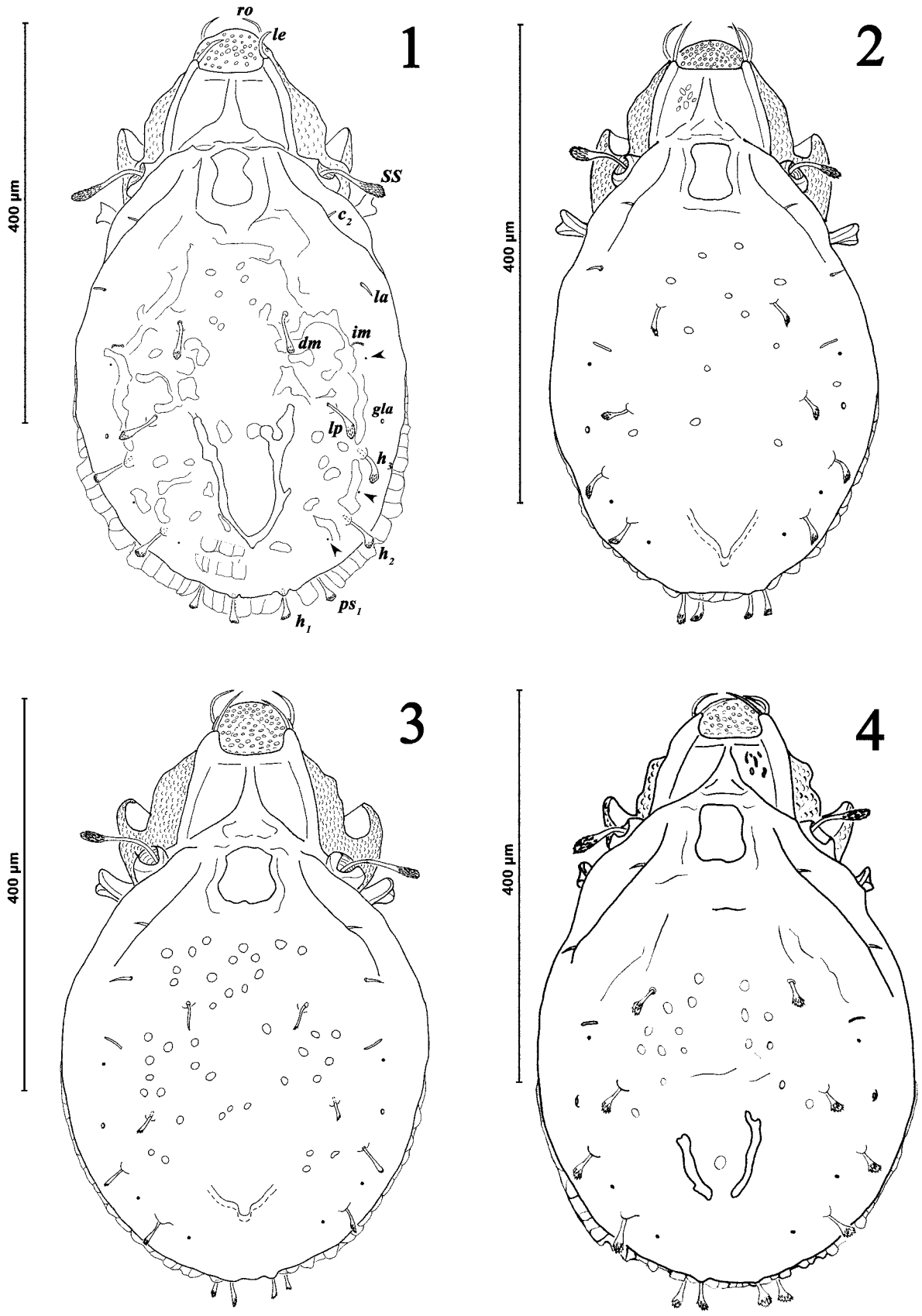
Specimens from Germany (fig. 2). Length (N=1): 518 µm

Specimens from France (fig. 3). Length (N=5): 601-671 µm (mean 628 µm)

Specimens from Spain (fig. 4). Length (N = 1): 595 µm

Integument. Color of body coffee brown to dark brown

Prodorsum. Cuticle alveolate. Sensillus club-shaped and spinose. Cup-like projecting bothridia. No exobothridial and interlamellar setae. Lamellae well developed, slightly converging and connected by translamella. Cusps longish, well developed; length to a minor extend variable. Long acuminate lamellar setae, slightly pectinate and bent to median axis. A pair of ridges between lamellae converging to median axis from proximal end of lamellae to translamella. Rostral setae long, robust and bent strongly to median axis. Setae *le* and *ro* of approximately same length. V-shaped ridge situated anterior to pedotectum I in position of tutorium.



FIGURES 1–4. *Scutovertex sculptus* dorsal view of adult. **1,** specimen from Austria (male), arrowheads point to sacculi; **2,** specimen from Germany (male); **3,** specimen from France (female); **4,** specimen from Spain (female).

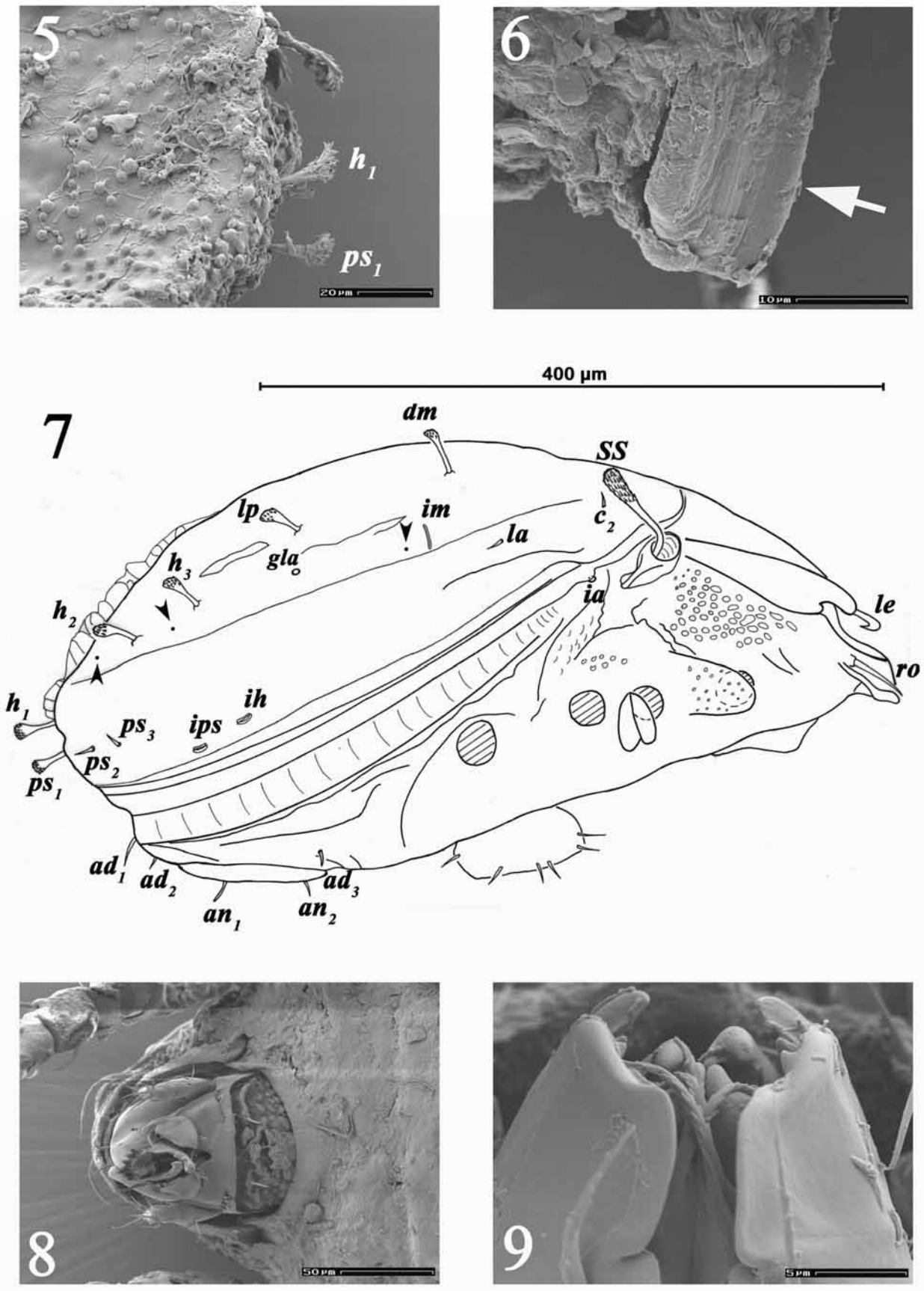
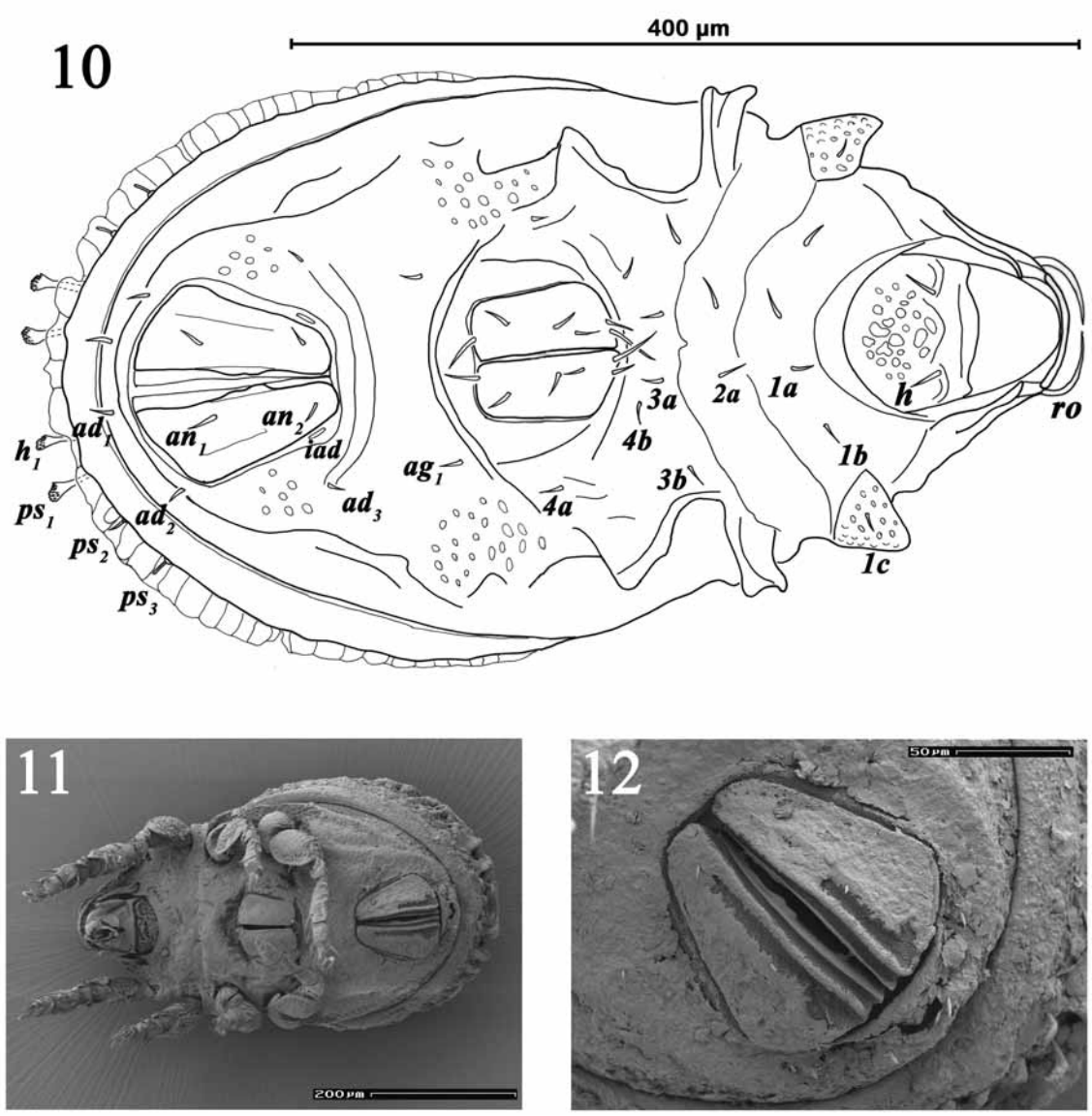


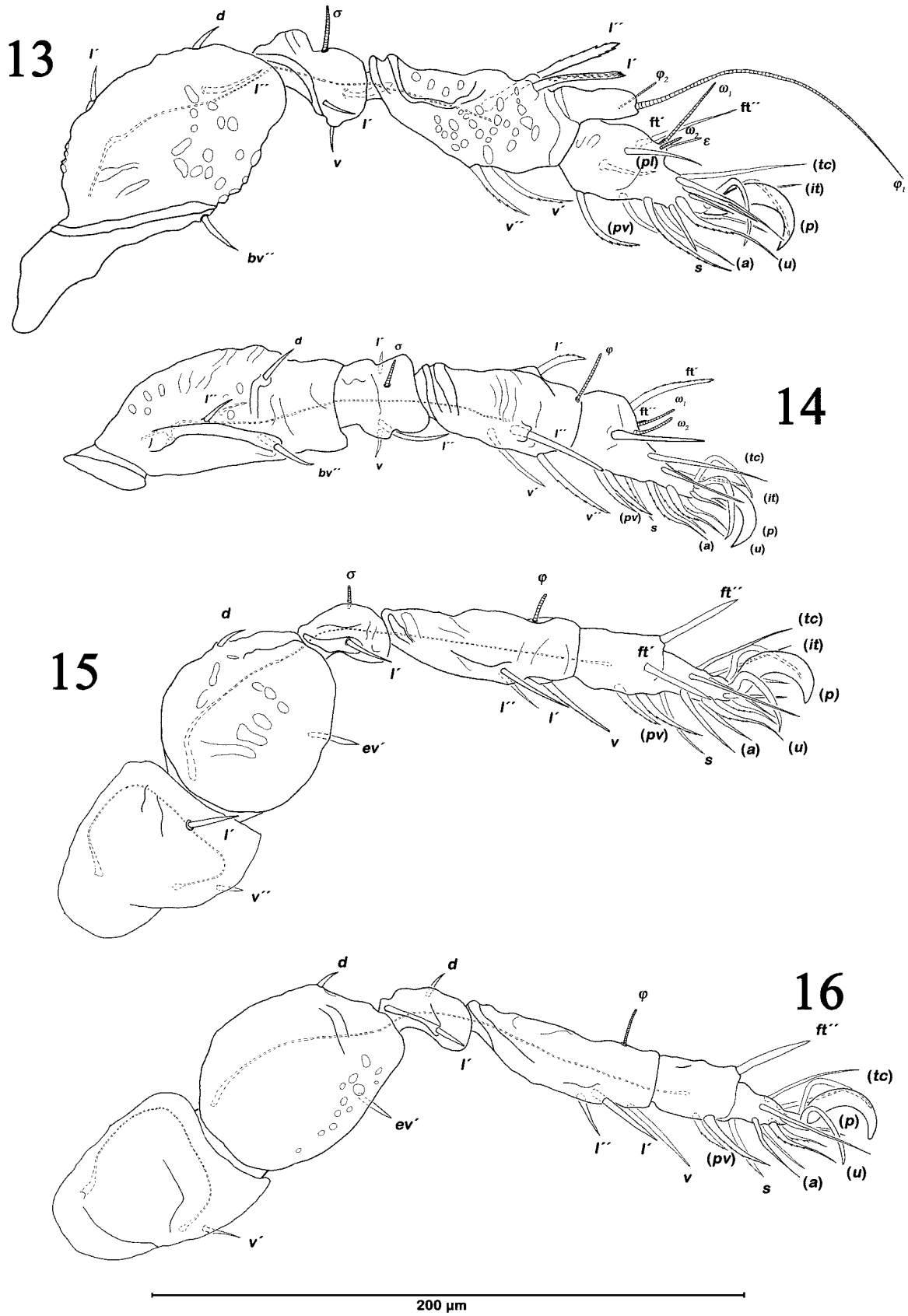
FIGURE 5–9. *S. sculptus* adult. **5,** notogastral setae h_1, ps_1; **6,** secreted block (arrow) on posterior border of gastronotic region; **7,** *S. sculptus* female adult, lateral view, arrowheads point to sacculi; **8,** *S. sculptus* adult, subcapitulum, ventral view; **9,** *S. sculptus* adult, rutella, ventral view.



FIGURES 10–12. *S. sculptus* male adult. **10, 11,** ventral view; **12.** *S. sculptus* adult, anal region.

Notogaster (fig. 1). Lenticulus well discernable, lateral borders concave, width variable. Ten pairs of notogastral setae. Setae c_2, *la*, ps_2, ps_3 normal, pointed at tip; others brush-like shaped, robust, broadened distally and inserting on little tubercles (fig. 5). Specimens from France with notogastral setae lesser broadened, especially *dm*. Cuticle alveolate; cuticular foveae with indistinct margin distributed irregularly over gastronotic region. Thick secretion with color dispersive properties forming V-shaped structure and conspicuous blocs on posterior half of notogaster (except for freshly molted adults) (fig. 6). Specimens from Germany and France throughout with such blocs well developed but smaller than in Austrian specimens and V-shaped structure on posterior half of notogaster scarcely visible. Five pairs of lyrifissures present; *ia* located laterally on a small projection at level of sejugal furrow, hidden beneath well developed humeral angle. Lyrifissure *im* broad, situated between setae *la* and *lp*; *ih* and *ips* (fig. 7) located laterally on a level near posterior lateral border of notogaster anterior to seta ps_3. Lyrifissure *ip* in posterior part of notogaster situated between setae h_1 and ps_2. Three pairs of sacculi. Orifice of opisthonotal gland lateral to seta *lp*.

Subcapitulum and camerostome (fig. 8). Rostral border showing two distinguishable structures: an apical lobe-like projection originating below the rostral setae and a lateral triangular longish lamella originating from the posterolateral corner of camerostome. Both structures do not represent margin of camerostome



FIGURES 13–16. *S. sculptus* adult. **13,** right leg I, antiaxial view; **14,** left leg II, paraxial view; **15,** left leg III, antiaxial view; **16,** left leg IV, antiaxial view. Leg I and II trochanters omitted.

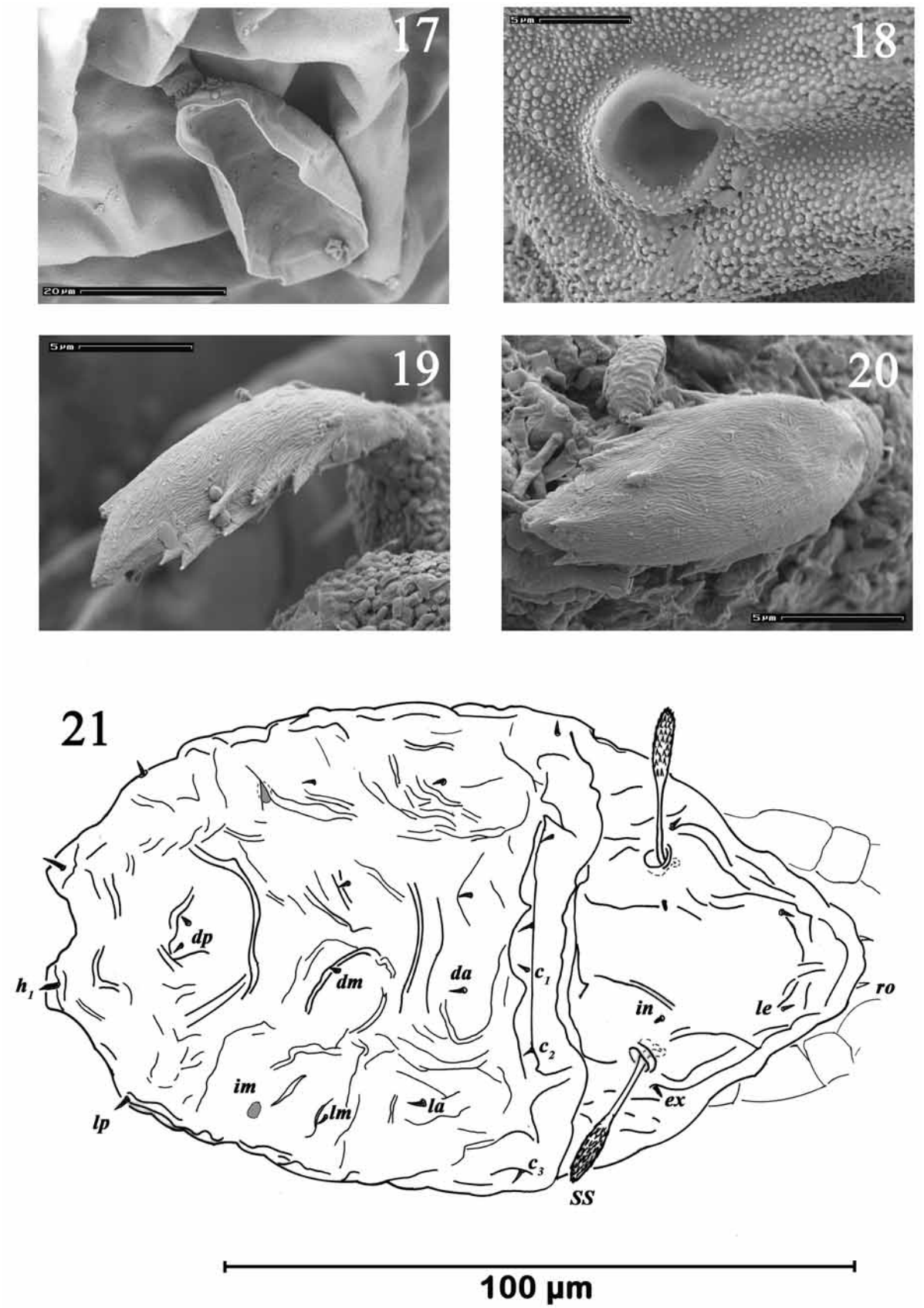


FIGURE 17–21. *S. sculptus*. **17,** tritonymphal exuvia internal view, collapsed reservoir of opisthonotal gland; **18,** tritonymph, detailed view of orifice of opisthonotal gland; **19,** tritonymph, lateral seta *l´* of tibia I; **20,** tritonymph, seta *l´´* of tibia I; **21,** larva, dorsal view.

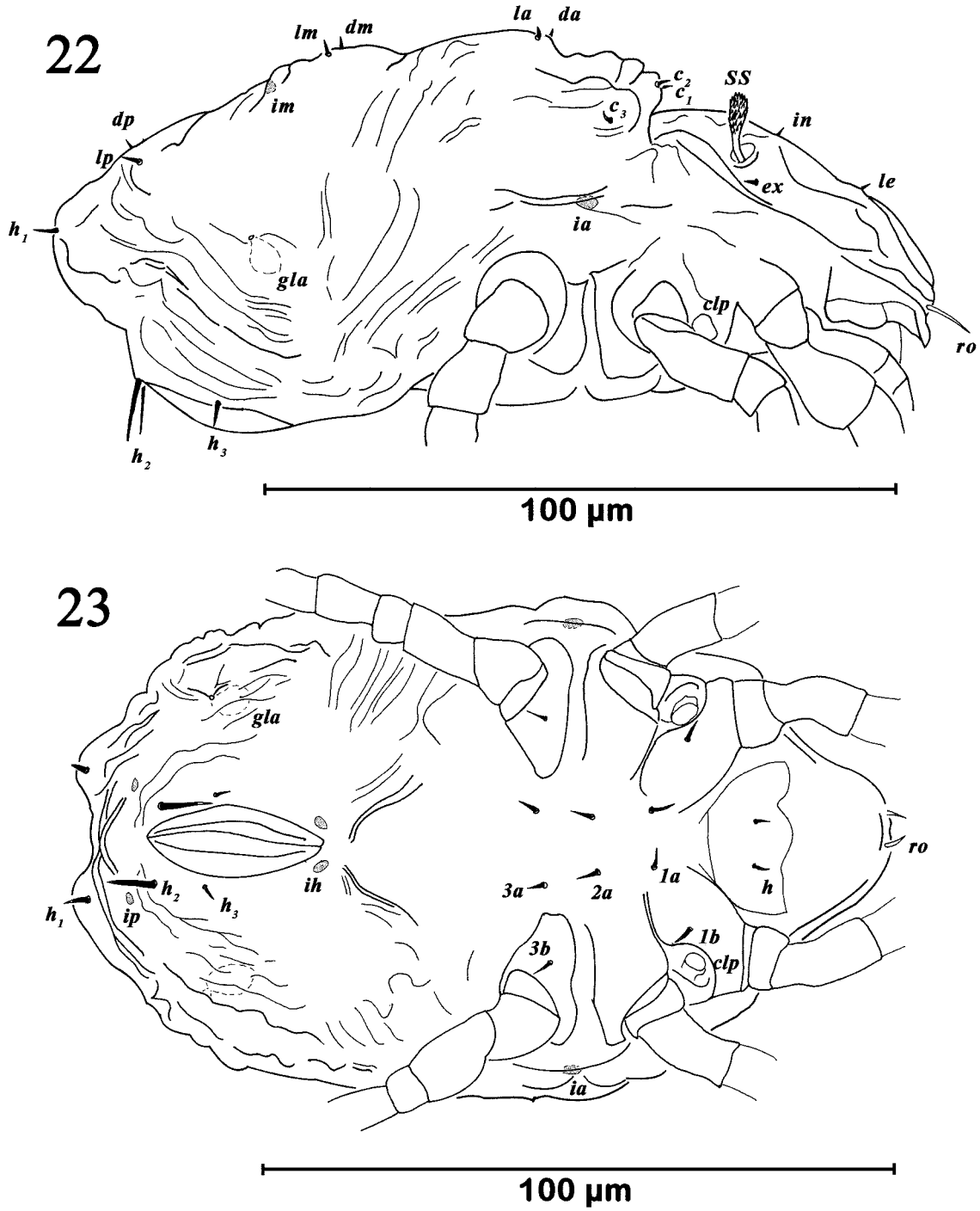
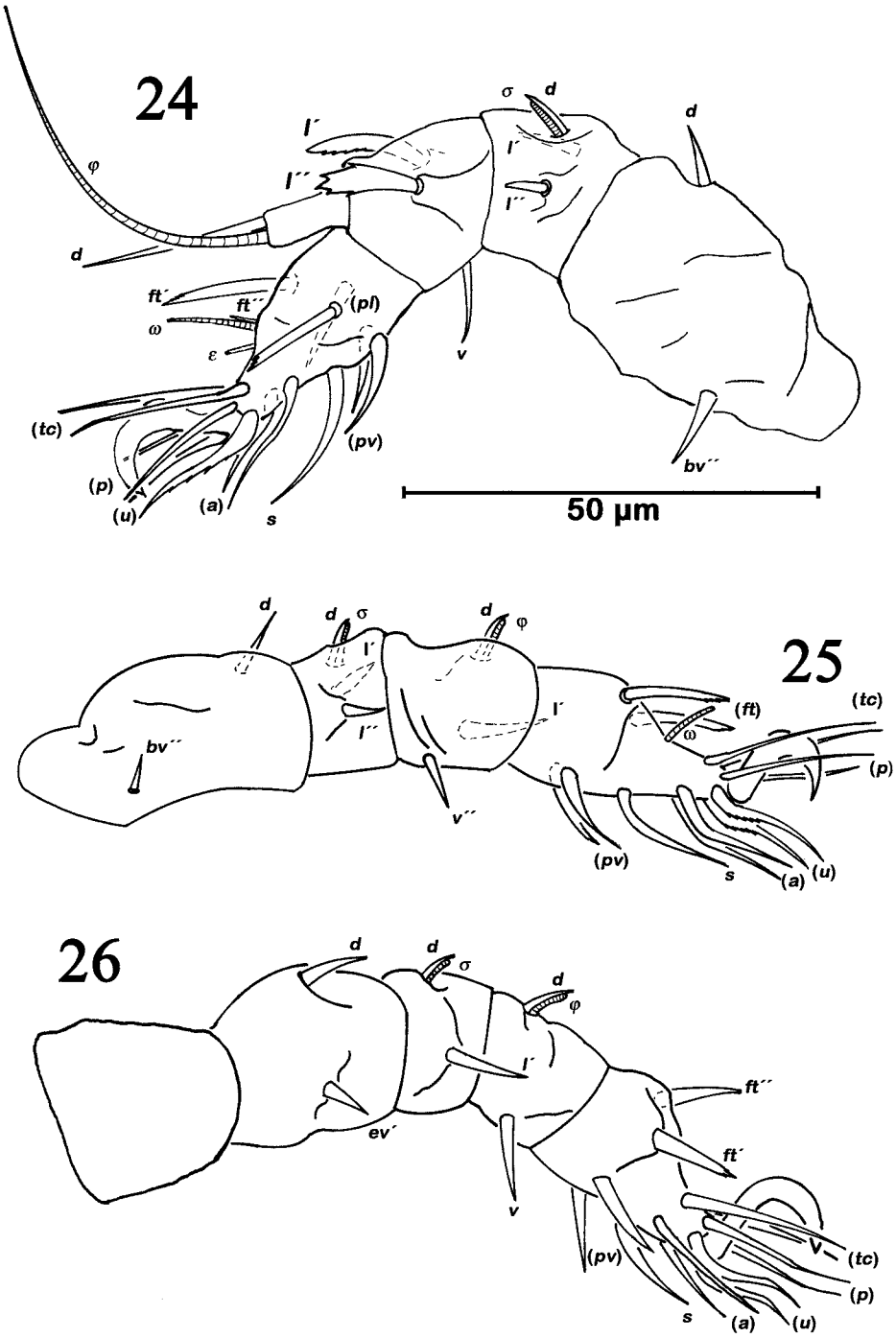


FIGURE 22–23. *S. sculptus* larva. **22,** lateral view; **23,** ventral view (genae, rutella and palps not drawn).

exclusively, rostrophragma running continuously around camerostome reaching articulation of subcapitulum. Cuticle strongly alveolate. Transverse ridge on mentum interrupted forming three parts, two lateral straight ones and a median inverted V shaped one. Robust setae *h* inserting median on lateral parts of transverse ridge. Genae with robust and slightly pectinate setae *a* and *m*. Three teeth present on rutellum, first one twice as large as the others (fig. 9). Two small ones do not project anterior margin of rutellum. Axillary saccule opens adaxial to insertion of pedipalp. Pedipalp pentamerous; setation: 0-2-1-3-9; solenidion recumbent, distal end touching basis of eupathidium *acm*. Träghardh´s organ paraxial on chelicerae. Each digit of the chelicerae with four strong teeth, two foremost interlocking.



FIGURES 24–26. *S. sculptus* larva. **24,** left leg I; **25,** right leg II; **26,** left leg III (all antiaxial view; trochanters I and II not drawn).

Ventral region of idiosoma (figs. 10-11). Epimeral setation (I-IV): 3-1-2-2. Pedotectum I large, hiding completely acetabulum I, pedotectum II well developed. Borders of epimera I and II reaching median axis, epimeron III small and margin of epimeron IV absent. Cuticle in posterior ventral part of idiosoma strongly alveolate. Genital valves broadened anteriorly. Genital setation 6+6 (asymmetric variation 5+6 observed in one individual), first two pairs of genital setae located next to each other whereas first pair of setae as twice as long as all other genital setae. Setae 3-5 arranged in a row, last pair located next to median axis. Cuticular grooves surrounding genital valves. The anterior one arcuated rostrad, the posterior one bent caudad and

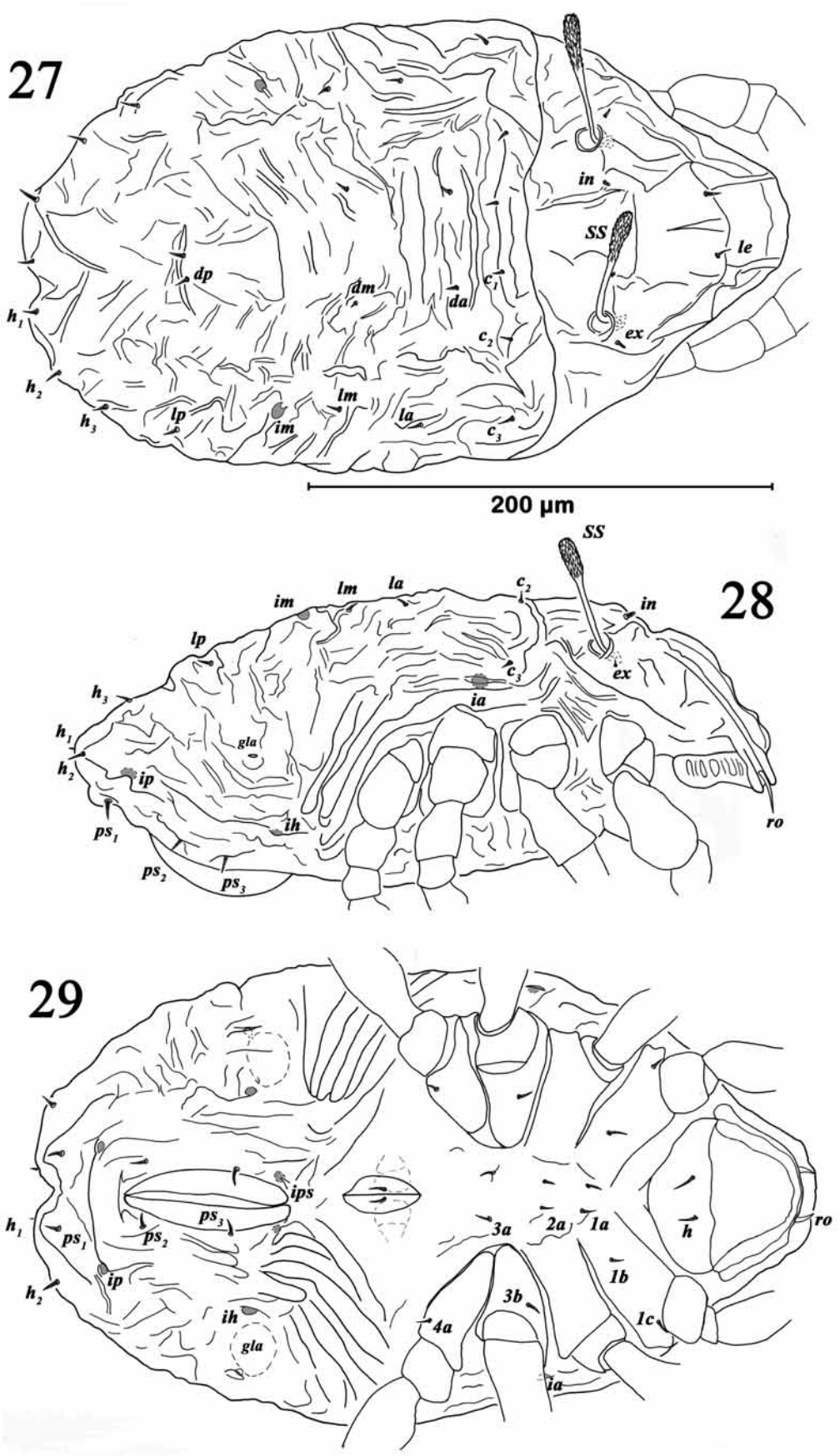
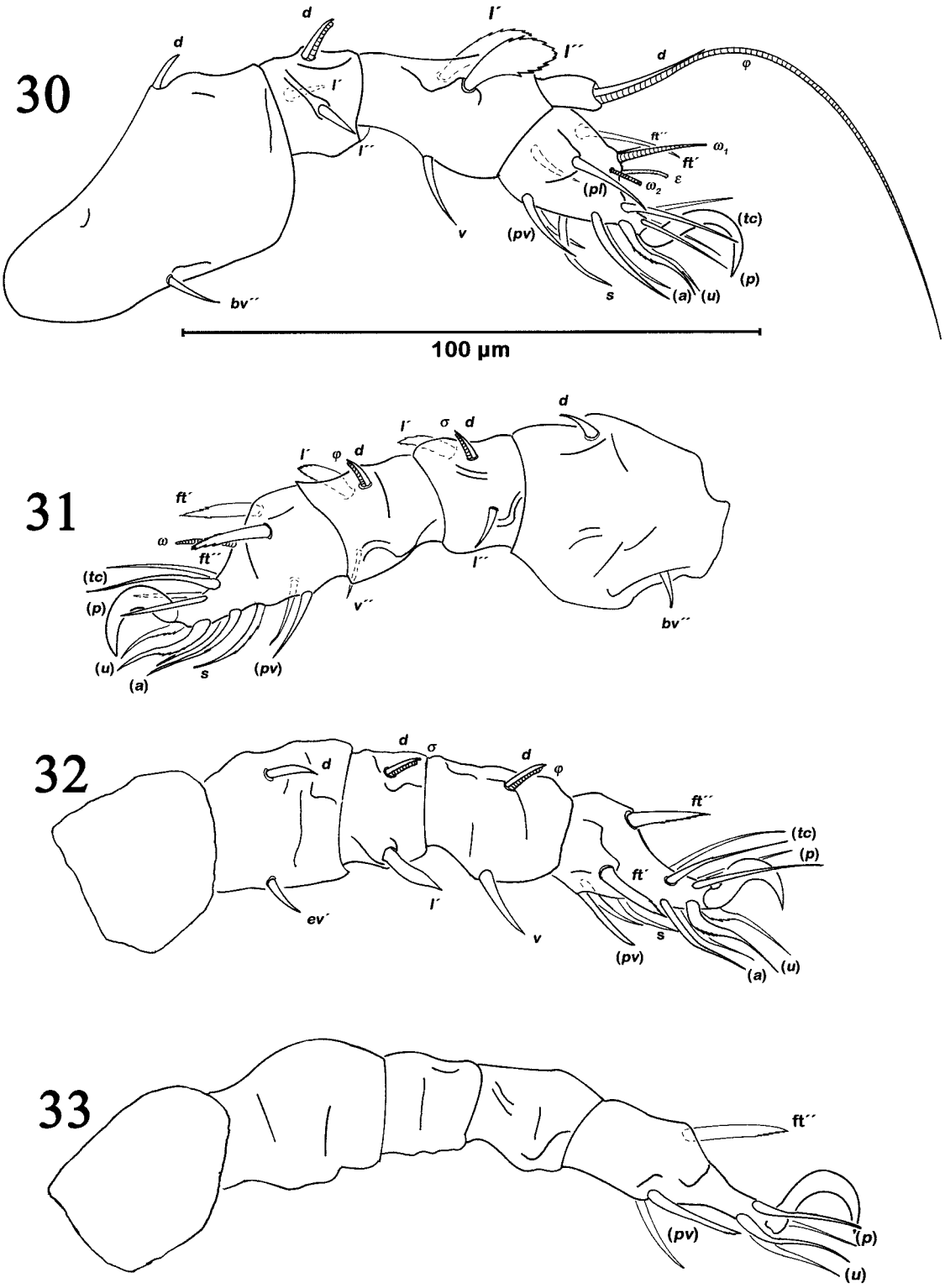


FIGURE 27–29. *S. sculptus* protonymph. **27,** dorsal view; **28,** lateral view; **29,** ventral view (subcapitulum omitted except mentum).



FIGURES 30–33. *S. sculptus* protonymph. **30,** right leg I; **31,** left leg II; **32,** left leg III; **33,** left leg IV (all antiaxial view).

longer, reaching lateral to the line of seta *4a*. Lateral grooves ranging from anterior margin of epimeron IV, drifting slightly laterally, to posterior furrow. One pair of aggenital setae located laterally and posterior of genital aperture. Anal valves broadened posteriorly. A ridge running along medial border of the valves, between those a groove. A shallow groove laterally of this ridge; anal setation 2+2 (fig. 12). Lyrifissure *iad* located lat-

erally of anterior border of anal opening. Adanal setae 3+3, ad_1 and ad_2 next to posterior border, ad_3 lateral and next to anterior border of anal valves. Preanal organ cup like.

Legs (figs. 13-16). Tridactyl, heterodactyl; all claws dorsally slightly dentate, lateral claws thinner. Solenidia and chaetome of legs I-IV listed in table 1. Cuticle alveolate with ribs on femur and genu. Genu smallest leg segment. Ventral setae on tibia and tarsus serrate. Lateral setae on tibia I large, robust and serrate; large apophysis bearing solenidia φ_1 and φ_2. All legs equipped with tracheae originating on axial dorsolateral side of femur. On leg I and II trachea divided into two branches, long one reaching distal part of tibia and short one reaching proximal area of femur. In leg III and IV only one branch runs from stigma into proximal part of the tarsus. In trochanter III and IV one trachea curves along their inner wall.

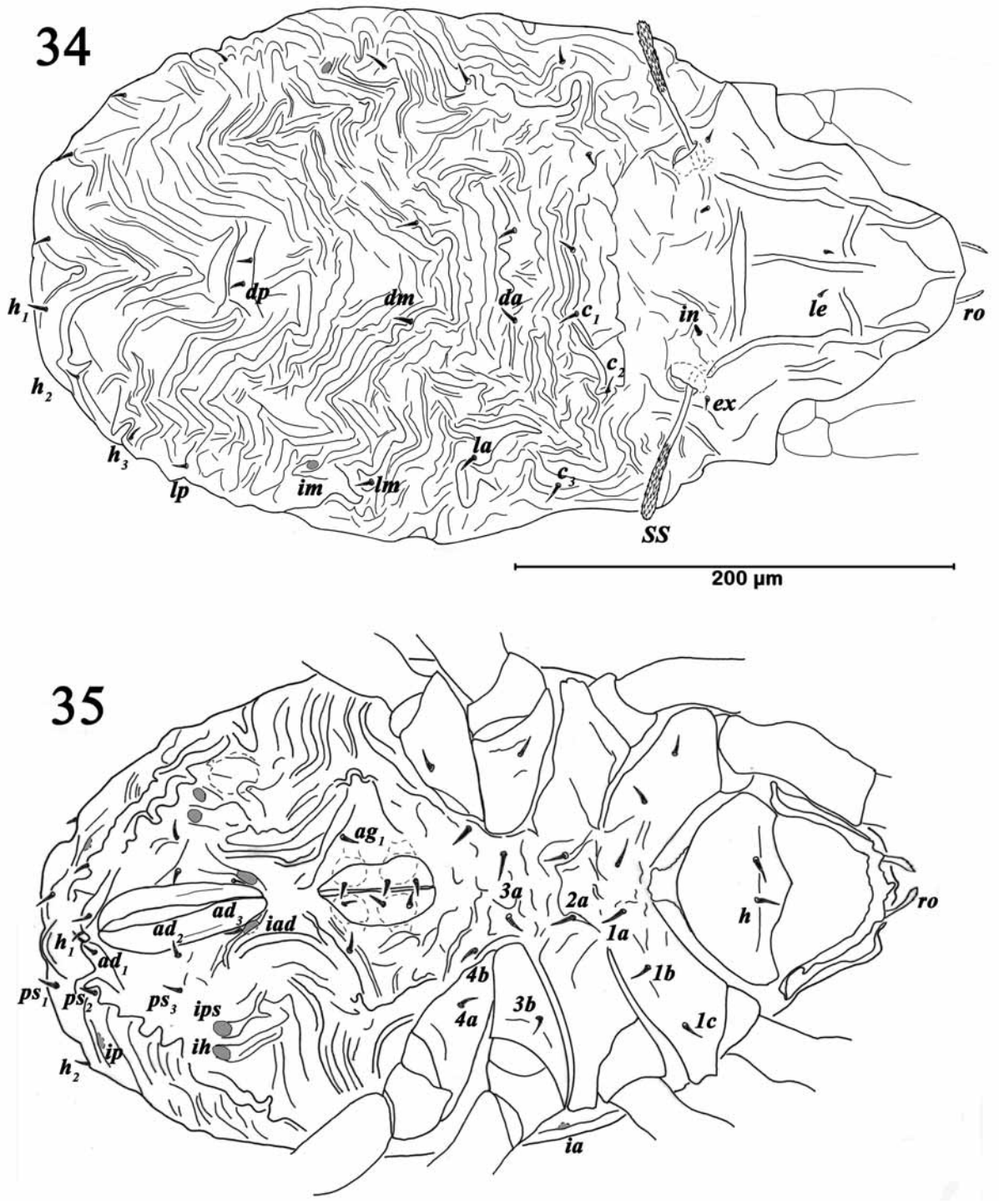
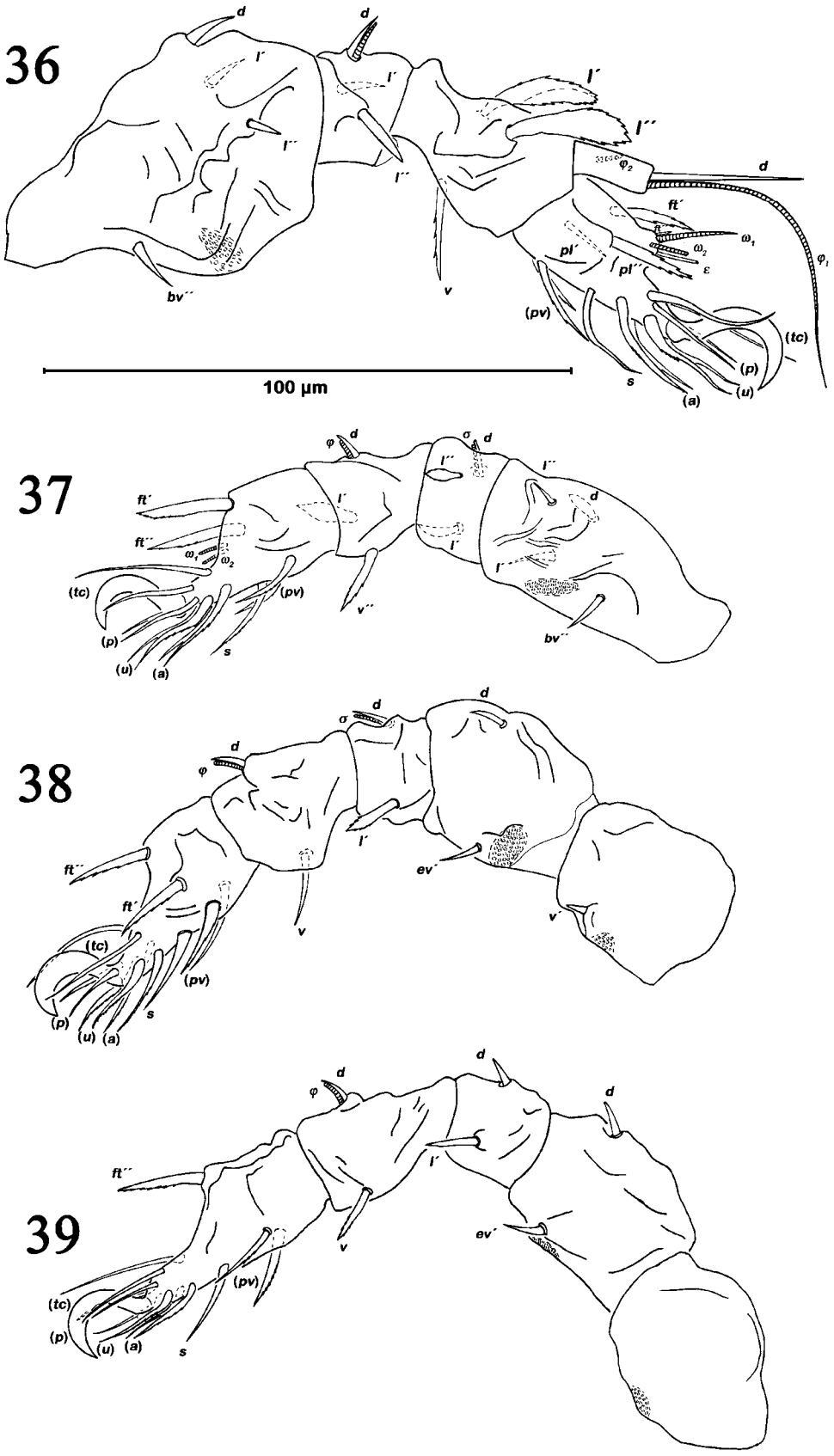


FIGURE 34–35. *S. sculptus* deutonymph. **34,** dorsal view; **35,** *S. sculptus* deutonymph, ventral view.



FIGURES 36–39. *S. sculptus* deutonymph. **36,** right leg I; **37,** left leg II; **38,** right leg III; **39,** right leg IV (all antiaxial view).

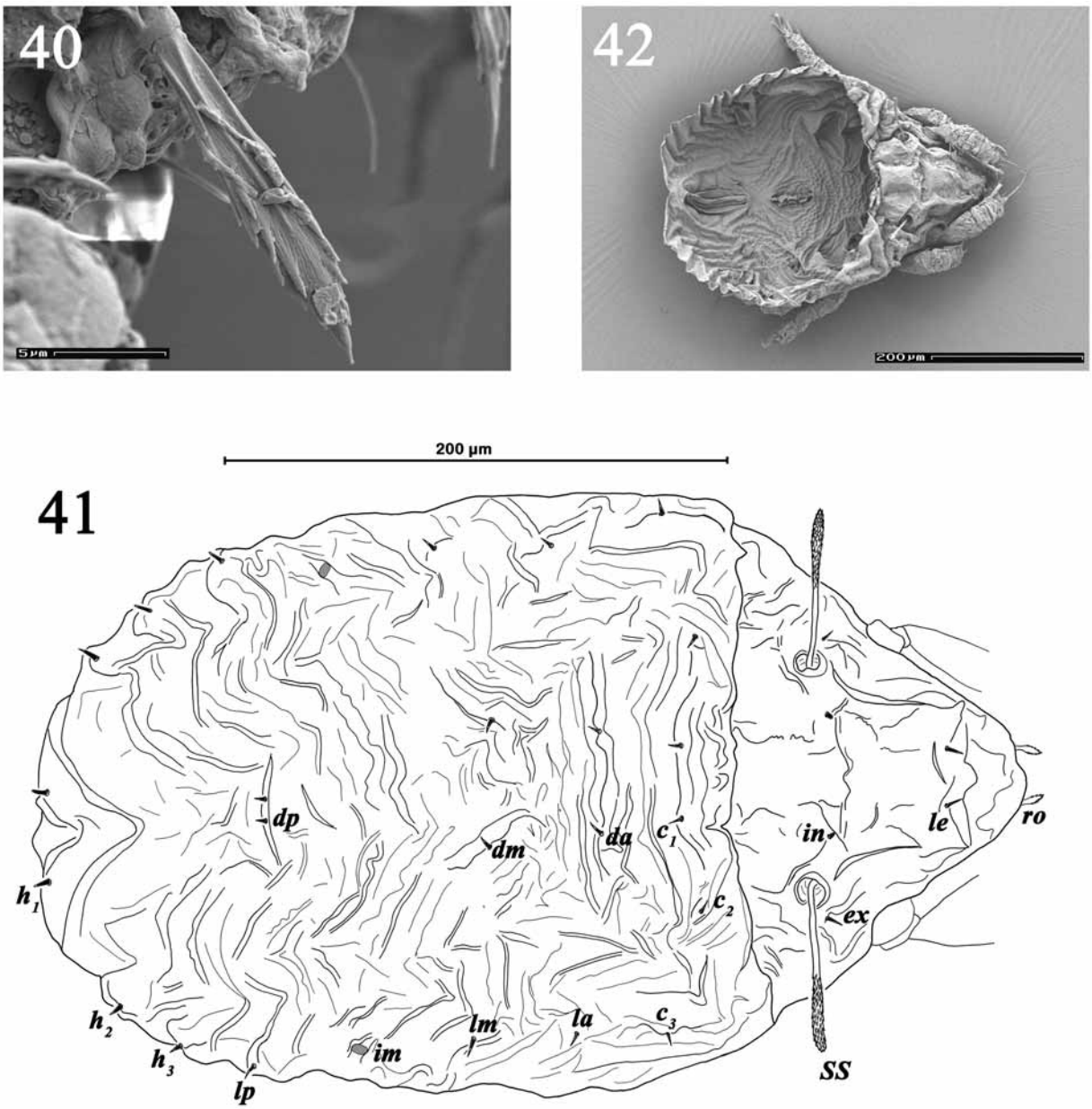


FIGURE 40–42. *S. sculptus* tritonymph. **40,** rostral seta; **41,** dorsal view; **42,** exuvia (without "notogaster").

Description of the juvenile instars

Common features in all juvenile stages of *Scutovertex sculptus*

Habitus. Gastronotic cuticle plicate and color ranges from yellowish white to brown. Prodorsum and legs more strongly sclerotized than gastronotic region and consequently a bit darker colored. Most setae with a cerotegumental collar around their base.

Prodorsum. Interlamellar setae (*in*) short, acute, located between bothridia. Exobothridial setae (*ex*) very short. Lamellar setae (*le*) short with usual appearance inserted on anterior third of prodorsum. Sensillus (*ss*) spinose distally thickened. Border of bothridium spiral-like, laterally open.

Gastronotic region. In every stage well visible opisthonotal gland reservoirs (fig. 17) filled with a reddish secretion. Orifice of opisthonotal gland lateral to seta *lp* (fig. 18). Notogastral setae short and acute.

Subcapitulum. Diarthric, atelebasic dentate rutella, first rutellar-tooth longest one.

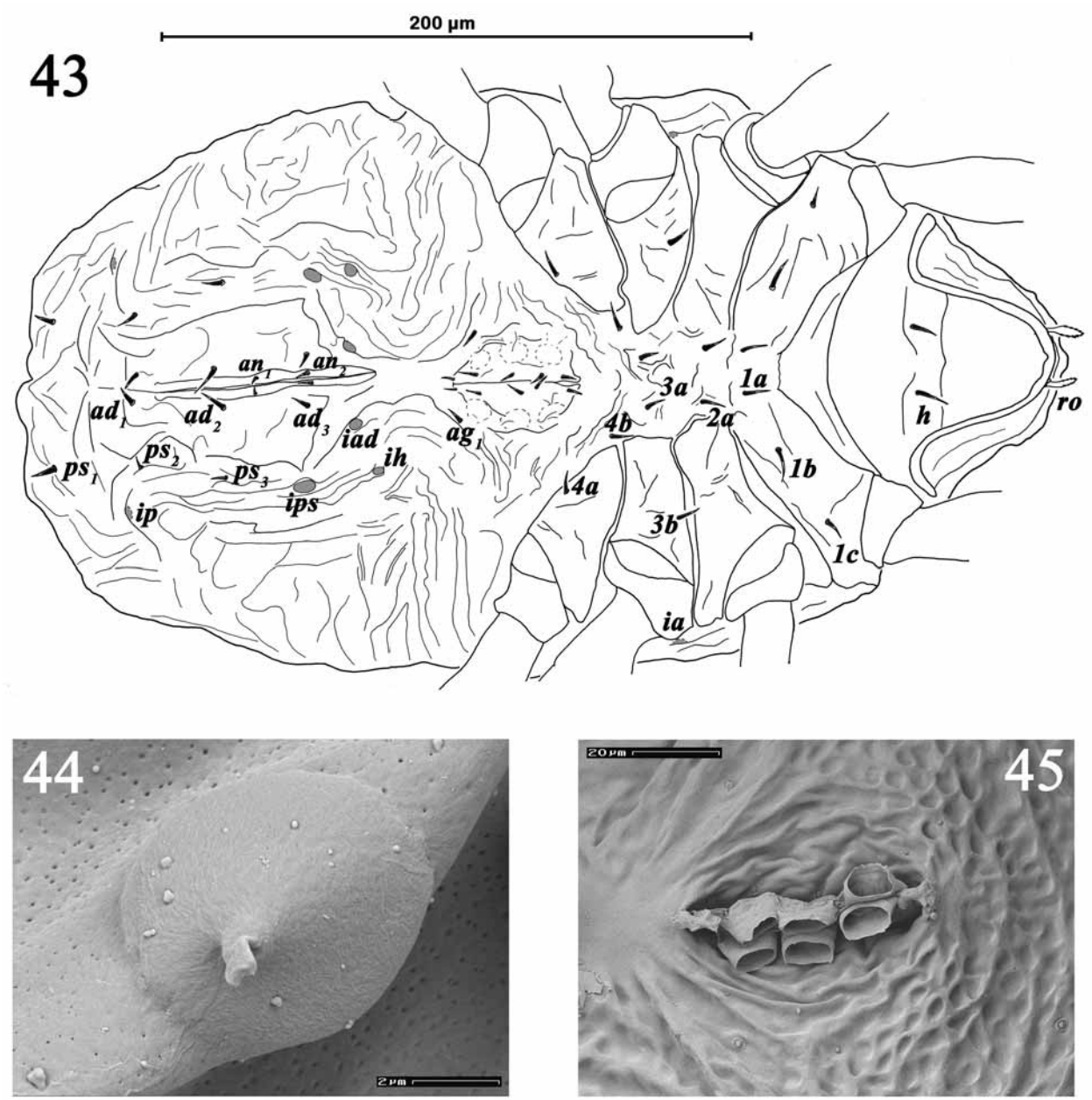


FIGURE 43–45. *S. sculptus* tritonymph. **43,** ventral view; **44,** exuvia, cupula *iad* internal view; **45,** exuvia, genital papillae internal view.

Legs. Lateral setae *l´* and *l"* on tibia I leaf-shaped with microtrichae in all stages (figs. 19-20). Starting from protonymphal stage all other lateral setae on the legs slightly broadened and serrate, whereas modification is increased in following stages. Dorsal setae *d* on genu and tibia always associated to solenidia (if already developed).

Morphology of larva

Idiosoma. Length (N=21): 203-312 µm (mean 248 µm)

Gastronotic region (fig. 21). 12 pairs of short notogastral setae, c_1, c_2, c_3, *da*, *dm*, *dp*, *la*, *lm*, *lp*. Cupula *im* situated between seta *lm* and *lp*. Cupula *ia* (fig. 22) lateral on a level with sejugal furrow.

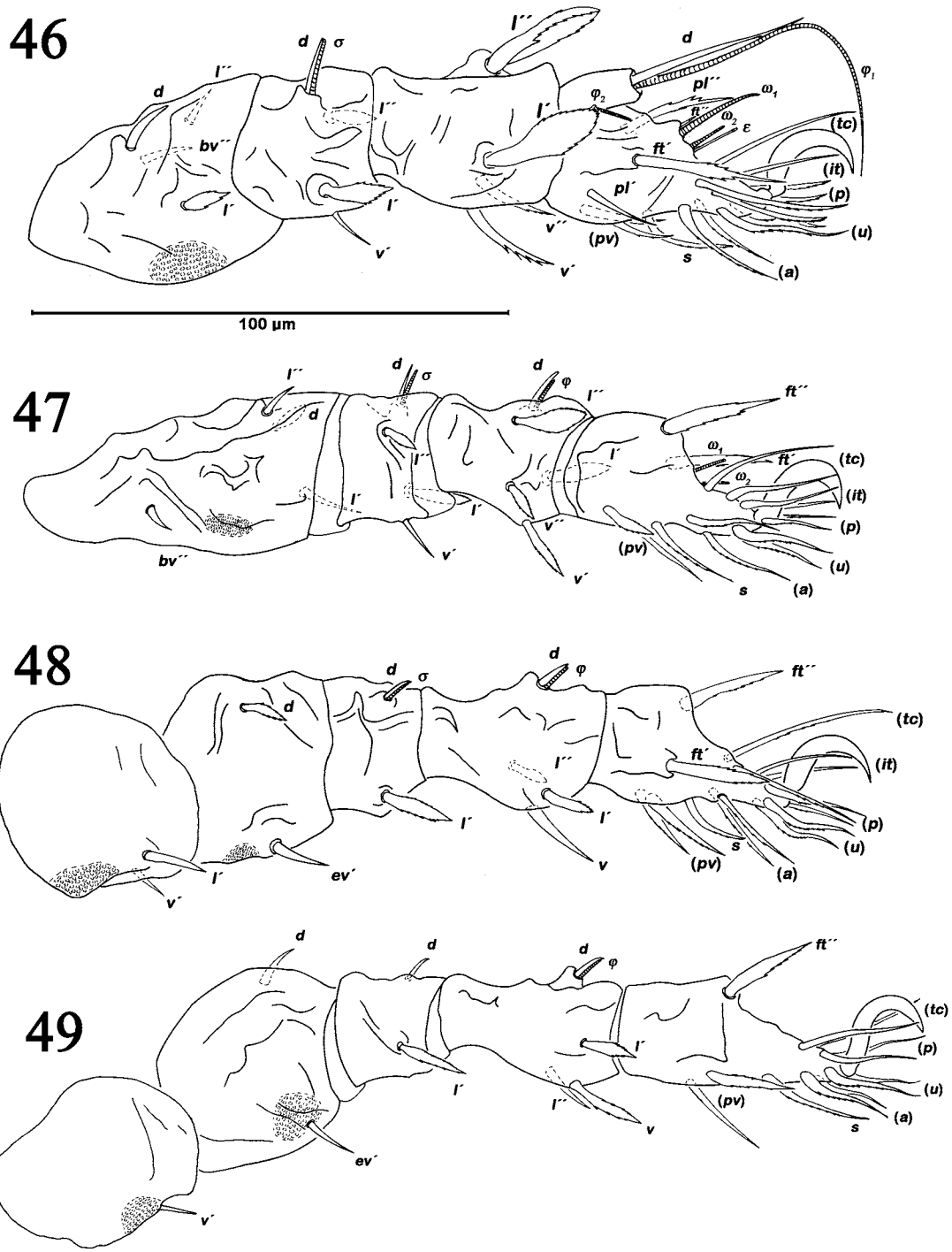
Ventral region of the idiosoma (fig. 23). Cupula *ih* located anterior to anal aperture. Setae h_3 and h_1 inconspicuous. Seta h_2 remarkable long and thick. Cupula *ip* situated laterally between setae h_2 and h_1. For-

mula of epimeral setae (I-III): 2-1-2. Setae *1a*, *2a*, *3a* arranged in two median rows. Seta *1b* situated on a level with Claparède organ on epimeron I. Seta *3b* located in the middle of epimeral plate III. Porose areas on apodemes 2, sejugal and apodeme 3.

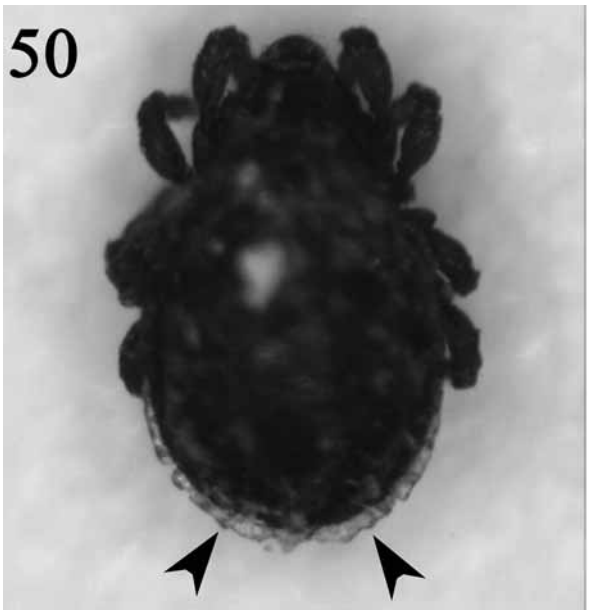
Legs (figs. 24–26). setation see table 1.

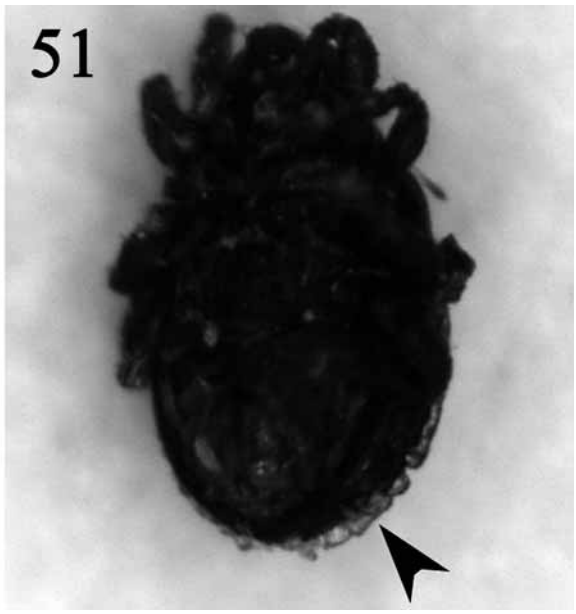
Morphology of protonymph

Idiosoma. Length (N=21): 277-343 µm (mean 303 µm)



FIGURES 46–49. *S. sculptus* tritonymph. **46,** left leg I paraxial view; **47,** right leg II antiaxial view; **48,** left leg III; **49,** left leg IV antiaxial view.





FIGURES 50–51. *S. sculptus* adult (stereomicroscope), color dispersive blocs (arrows). **50,** dorsal view; **51,** lateroventral view.

TABLE 1. *Scutovertex sculptus*; leg setation of all stages. First development of setae characterized by letters; ( ) = pair of setae; - = no change with regard to the preceding stage.

	Instars	Trochanter	Femur	Genu	Tibia	Tarsus
Leg I	Larva		*d, bv´´*	(*l*), *d*, s	(*l*), *v, d,* j_1	(*ft*), (*tc*), (*p*), (*u*), *s*, (*a*), (*pv*), (*pl*), *e,* w_1
	Protonymph		-	-	-	w_2
	Deutonymph		(*l*)	-	j_2	-
	Tritonymph	v´´	-	v´	v´	(*it*)
	Adult	-	-	*d* lost	*d* lost	-
Leg II	Larva		*d, bv´´*	(*l*), *d*, s	*l´, v´´, d, j*	(*ft*), (*tc*), (*p*), (*u*), *s*, (*a*), (*pv*), w_1
	Protonymph		-	-	-	-
	Deutonymph		(*l*)	-	-	w_2
	Tritonymph	v´´	-	v´	*l´´, v´*	(*it*)
	Adult	-	-	*d* lost	*d* lost	-
Leg III	Larva		*d, ev´*	*l´, d*, s	*v, d, j*	(*ft*), (*tc*), (*p*), (*u*), *s*, (*a*), (*pv*)
	Protonymph		-	-	-	-
	Deutonymph	v´	-	-	-	-
	Tritonymph	l´	-	-	(*l*)	(*it*)
	Adult	-	-	*d* lost	*d* lost	-
Leg IV	Protonymph					*ft´´*, (*p*), (*u*), (*pv*)
	Deutonymph		*d, ev´*	*l´, d*	*v, d, j*	(*tc*), *s*, (*a*)
	Tritonymph	v´	-	-	(*l*)	-
	Adult	-	-	-	*d* lost	-

continued.

	Instars	Formula of setae	Formula of solenidia
Leg I	Larva	0-2-3-4-16	1-1-1
	Protonymph	0-2-3-4-16	1-1-2
	Deutonymph	0-4-3-4-16	1-2-2
	Tritonymph	1-4-4-5-18	1-2-2
	Adult	1-4-3-4-18	1-2-2
Leg II	Larva	0-2-3-3-13	1-1-1
	Protonymph	0-2-3-3-13	1-1-1
	Deutonymph	0-4-3-3-13	1-1-2
	Tritonymph	1-4-4-5-15	1-1-2
	Adult	1-4-3-4-15	1-1-2
Leg III	Larva	0-2-2-2-13	1-1-0
	Protonymph	0-2-2-2-13	1-1-0
	Deutonymph	1-2-2-2-13	1-1-0
	Tritonymph	2-2-2-4-15	1-1-0
	Adult	2-2-1-3-15	1-1-0
Leg IV	Protonymph	0-0-0-0-7	0-0-0
	Deutonymph	0-2-2-2-12	0-1-0
	Tritonymph	1-2-2-4-12	0-1-0
	Adult	1-2-2-3-12	0-1-0

Gastronotic region (figs. 27-28). 15 pairs of notogastral setae present. Setae ps_1, ps_2 and ps_3 added in this stage.

Ventral region of idiosoma (fig.29). Cupula *ips* located anterior to anal aperture (same place as *ih* in larval stage). Setae ps_3 and ps_2 flanking anal opening. Seta ps_1 situated posterior near setae h_2 and h_1. Cupula *ih* now located laterally on a level with opening of opisthonotal gland *gla*. One pair of genital setae present in the middle of genital valves. Epimeral setation (I-IV): 3-1-2-1. Seta *1c* on epimeral plate I close to trochanter. Seta *4a* situated close to posterior margin of epimeral plate IV near by trochanter.

Legs (figs. 30-33). Setation see table 1. Porose areas on ventral paraxial side of femur I-IV.

Morphology of deutonymph

Idiosoma. Length (N=26): 316-459 µm (mean 369 µm).

Prodorsum. Rostral seta *ro* lanceolate-serrate.

Gastronotic region (fig. 34). 15 pairs of notogastral setae, no difference to protonymph.

Ventral region of idiosoma (fig. 35). Anal valves surrounded by adanal setae; seta ad_3 adjacent to anterior part of anal valves, ad_2 lateral and ad_1 right behind anal aperture. Cupula *iad* flanking anal aperture anteriorly and located next to seta ad_3 (same place as *ips* in protonymph). Cupulae *ih* and *ips* close to each other. Three pairs of genital setae on genital valves (no variation). One pair of aggenital setae lateral to posterior half of genital opening. Formula of epimeral setation (I-IV): 3-1-2-2.

Legs (figs. 36-39). Setation see table 1. Concave porose area on ventral side of femur I-IV.

Morphology of tritonymph

Idiosoma. Length (N=12): 434-521 µm (mean 476 µm)

Prodorsum. Rostral setae *ro* clearly lanceolate-serrate (fig. 40).

Gastronotic region (figs. 41-42). 15 pairs of notogastral setae.

Ventral region of idiosoma (fig. 43). Two pairs of anal setae appear on anal valves. Cupula *iad* same position as in deutonymph (fig. 44). Seta an_2 next to ad_3 and seta an_1 in the middle of distance ad_3-ad_2. Five pairs of genital setae on genital valves (constant) (fig. 45). Epimeral setation (I-IV): 3-1-2-2.

Legs (figs. 46-49). Solenidia and chaetome see table 1. Porose area on femur I-IV more invaginated, building cavities.

Discussion

Adult morphology. Some former descriptions and illustrations of the adult of *S. sculptus* differ in various aspects from each other. Woas (1998) depicted this species with a smooth sensillus, deeply incised bothridial borders, a rectangular lenticulus and acuminated setae *dm* (whereas he sketched the same seta broadened in the lateral view). In all other known descriptions (Ghilarov & Krivolutsky 1975; Michael 1884; Pérez-Iñigo 1993 and Strenzke 1943) the sensillus is spinose, the lenticulus is laterally slightly concave and seta *dm* is more or less broadened. Concerning the notogastral setae, Ghilarov and Krivolutsky (1975) sketched a specimen with broadened setae *la*, but this is not described elsewhere. On the other hand the V-shaped structure on the posterior half of the gastronotic region was only depicted by these two authors; Woas (1998) sketched a structure that could not be clearly identified to be the same. The color dispersive bloc-like structures were not mentioned by any of the authors. At last there is only poor information on the leg setation in all descriptions.

The investigated specimens from Austria, France, Germany and Spain show some morphological differences. The German and Spanish individuals correspond completely with the Austrian specimens, except for a smaller gastronotic layer of secretion that forms the V-shaped structure and blocs. The French specimens have the least developed brush-like notogastral setae and the thinnest secreted layer among these representatives. The variation of habitus in figures 1-4 relate to the natural variation found in this species, whereas the different sizes of the cusps are caused by a different inclination angle of the preparations. According to Strenzke (1943), only a gradation of thickness of the notogastral setae *la*, *dm*, *lp*, h_{1-3} and ps_1 is observable in *S. sculptus*, whereas posterior setae are thicker than anterior ones. The well visible blocs on the posterior half of the notogastral region are unique for this species up to now and can be actually identified by means of a stereomicroscope (figs. 50-51), thus being a character very useful for in vivo determination. Weigmann (2006) stated that *Scutovertex* species are variable in species specific characters and that some individuals can not be assigned properly to *S. minutus* or *S. sculptus*. We agree with Strenzke (1943) who stated that the distinction between *S. sculptus* and *S. minutus* is clear because *S. minutus* never possesses notogastral cuticular foveae. The differences in former descriptions of *S. sculptus* exceed the degree of variation found in the present study; therefore, doubts persist whether all of the published figures refer to this species.

Developmental characteristics. In the course of postembryonic development *Scutovertex sculptus* shows different structural modifications of setae. On the one hand these phenomena are regressive events; but on the other hand they are changes in form and dimension. A simple regression concerns the interlamellar setae which are very short and edgeless in all juvenile stages. In the adult stage these setae are completely reduced. The loss of interlamellar setae in the adult stage is a widespread phenomenon, but the reason for this change is not known. The dorsal "companion setae" *d* (coupled with solenidia; Grandjean 1935) on tibia and genu I-IV are developed in all immatures, but they are also completely reduced in adults. The function of the companion setae of solenidia is supposed to be tactile and protective. Different variations of these "binary groups" exist in the Oribatida and the reduction of seta *d* occurs in different stages (Grandjean 1935). The culmination is the

lack of these setae in all stages, a condition found in many poronotic Brachypylina (Norton 1977). The lateral setae on tibia I of larva and all nymphs are broad leaf-shaped with microtrichae, but in the adult stage these setae have lost their specific form. This transformation of the conspicuous lateral setae on tibia I of the juveniles to more or less normal shape in the adult stage could be an example for a so-called "despecialisation" in ontogeny (Grandjean 1956). Seta h_2 is extraordinary long and thickened in the larval stage but in the other stages it is reduced to a typical simple setal form; this phenomenon was also observed in *S. minutus* (Schäffer & Krisper 2007) and in the crotonoid mite *Trhypochthonius tectorum* (Berlese, 1896) (Seniczak 1992).

In juveniles of *S. sculptus*, the formation of respiratory organs can be observed very well. Already in the larva porose areas appear on the apodemes 2, 3 and on the sejugal apodeme. From stage to stage these areas become more distinctive and are well visible in the deuto- and tritonymphs. On the femur of all legs slightly invaginated porose areas can be observed from the protonymphal stage. In the tritonymph these porose areas are strongly emarginated. In the adult stage of *S. sculptus* all the porose organs mentioned above become tracheae, as Grandjean (1940) assumed for all members of *Scutovertex*, therefore this feature represents a good diagnostic character for this genus. Furthermore he considered these porose areas and the tracheae of adults to be homologous. Such tracheae in legs are developed only in few other oribatid taxa, e.g. in the ameronothroid genus *Aquanothrus* (Norton et al. 1997).

The comparison of juveniles of *S. sculptus* with those of *S. minutus*, a close relative, shows morphological conformities in most characters. Their habitus is very similar and at first sight almost identical. Each of them show very short interlamellar setae, conspicuous larval setae h_2, solenidia σ and φ coupled with setae *d*, all lacking in the adult stage and specific shaped lateral setae on tibia I. But the last character is just that morphological feature, which allows us to distinguish the juveniles of both species easily. The lateral setae on tibia I of *S. sculptus* are broad and leaf-like shaped, the same setae of *S. minutus* show a knife-like form. There are barely any differences in the solenidia and the setation of the legs, only the deutonymph of *S. minutus* shows variable setation on tibia I and III (Schäffer & Krisper 2007).

The tritonymph of *Provertex delamarei* described by Travé (1962) shows a similar habitus as that of *Scutovertex*. But *Provertex delamarei* exhibits one seta more on tibia II and III in the deutonymph and the lateral setae on tibia I do not show a specific shape in any stage. The sensillus of *Scutovertex* is much longer and flat and the lamellae on the prodorsum differ from that of *P. delamarei*. Juveniles of *P. delamarei* have femoral porose areas similar to that of *Scutovertex* but in the adult stage these areas of *Provertex* become brachytracheae. Concerning the larval seta h_2 Travé (1962) gives no information about a conspicuous shape of this seta.

A comparison of the juveniles of *S. sculptus* and *Argentinovertex coineaui* is difficult due to the fact that only the tritonymph of *A. coineaui* is known (Fernandez & Cleva 2002). Nevertheless the number of epimeral, genital and notogastral setae is the same. But the sensilli are very short and shaped leaf-like without microtrichae and the prodorsal lamellae are distinct structures. The lateral notogastral setae of *A. coineaui* are very long and the median ones very short. There is no information about femoral porose areas or special modifications of certain setae.

Conclusions. The comparison of *S. sculptus* and *S. minutus* showed that only the shape of the lateral setae of tibia I allows us to distinguish the juveniles of these two species clearly. Based on today's state of knowledge the juveniles of *P. delamarei* show more conformities with *Scutovertex* than *A. coineaui* does and therefore seem to be closer related. For a more detailed comparison it would be necessary to get more information about the juveniles of all members of the Scutoverticidae. The current investigation showed at least, that there are characters that are unique for the juveniles of a certain species. Such attributes represent useful additional features in phylogenetic analyses.

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