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Contributions to a Revision of the Genus *Schwiebea* (Acari: Acaridae). I. Redescription of *Schwiebea talpa* and *Schwiebea nesbitti*

By Eberhard Wurst and Brigitte Frank, Stuttgart

With 91 figures and 1 table

Summary

All developmental stages of *Schwiebea talpa* Oudemans, 1916 and *S. nesbitti* Türk & Türk, 1957 are redescribed by using the original materials of the Oudemans collection (Leiden), the Türk collection (Karlsruhe) and new field collections. All instars of both mites are presented as drawings as well as light and electron micrographs. Their geographic distribution is shown.

Zusammenfassung

Unter Benutzung des Original-Materials der Oudemans-Sammlung (Leiden) und der Türk-Sammlung (Karlsruhe) sowie neuer Aufsammlungen werden alle Entwicklungsstadien von *Schwiebea talpa* Oudemans, 1916 und *S. nesbitti* Türk & Türk, 1957 wiederbeschrieben. Alle Stadien beider Milben werden in Zeichnungen sowie licht- und elektronenmikroskopisch abgebildet. Ihre geographische Verbreitung wird dargestellt.

Contents

1. Introduction

Species of the genus *Schwiebea* belong to the most abundant free-living mites. Under conditions of sufficient humidity they can be found in enormous numbers in plant litter, especially in and under the bark. Yet, contrary to its ubiquitous occurrence, the knowledge of this important edaphic group of mites is extremely scanty. Previous research mainly focused on the description of newly found "forms" as new species (e.g. FAIN 1977, 1982; FAIN & WAUTHY 1979) without any information from, for example, rearing experiments, if these "forms" were life stages of already known species or not. A first step towards autecological investigations was done by WALTER & KAPLAN (1990) with their work on the feeding behaviour of a *Schwiebea* and a *Histiostoma* species.

This research aimed at a revision of the central European species of the genera *Schwiebea, Michaelopus,* and *Thyreophagus,* including the elucidation of complete life cycles through rearing experiments, and thus at the elimination of the present taxonomic chaos in these genera. In this way it is hoped to create a solid taxonomic basis for further investigations of these mites.

This paper is the first of a series of publications on the results of our investigations.

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[1]) The reasons for printing these words in normal types (not in italics) are mentioned in chapters 3. and 6.2.

2. Materials, Methods and Acknowledgements

2.1. Materials

Large efforts were undertaken to obtain the specimens which had actually or at least with a high probability been the base for the original descriptions of the above mentioned species. We also tried to obtain all existing documents (drawings, notes) produced by the authors in connection with their work on the respective mites and to include them in this revision. Thus, we used mite preparations from the OUDEMANS collection (National Museum of Natural History, Leiden, Netherlands, formerly Rijksmuseum van Natuurlijke Historie) and from the TÜRK collection (Staatliches Museum für Naturkunde Karlsruhe, Germany).

Furthermore we collected mites from moist, decomposed plant material (fallen leaves, rotten branches and wood from old tree stumps) from various localities (see below). The plant material was put into plastic bags and kept moist and cool till investigation. Also, numerous arthropods found at the localities of plant material collections were inspected for deutonymphs.

Localities where mites were taken are the following (the numbers refer to the numbers in Fig. 1).

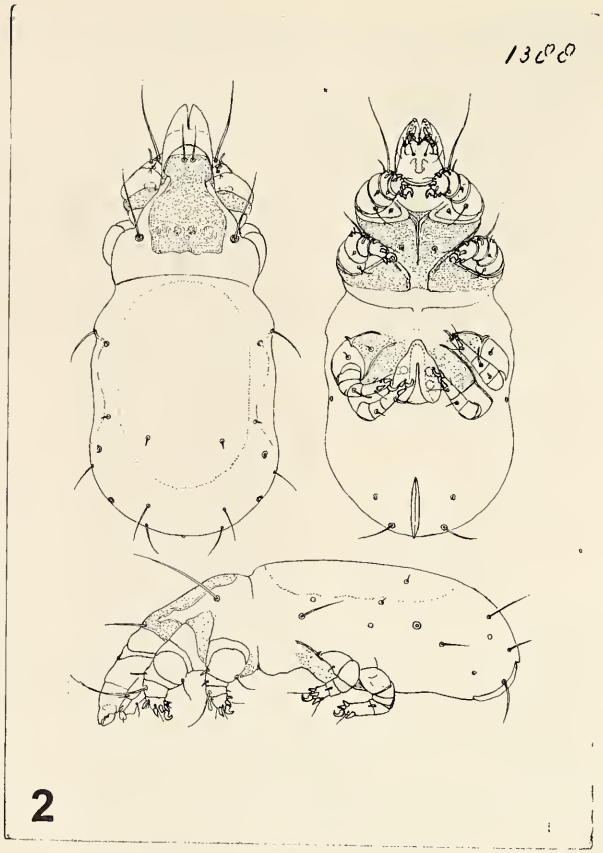
Germany – No. 1: a) 22.05.92, 07.09.96, 22.08.97. Aitern near Schönau (Black Forest), Geläubwald (at 1250 m altitude); in rotten wood, leg. E. WURST; b) 24.08.97. Utzenfeld near Schönau (Black Forest); in rotten stump, leg. E. WURST; c) 27.08.97. Near Todtnau (Black Forest); in rotten tree stump, leg. E. WURST. – **No. 2:** 22.05.92. Oberbränd near Titisee (Black Forest); in nest of *Camponotus herculeanus* (Insecta: Hymenoptera: Formicidae), leg. E. WURST. – **No. 3:** 24.05.97. Ödsbach near Oberkirch (Black Forest), Vordere Allmend; under moist bark, leg. H. LÖFFLER. – **No. 4:** 24.09.92. Near Enzklösterle (Black Forest); in nest of tit (*Parus* sp.) and Garden Dormouse *(Eliomys quercinus)* (1 deutonymph only), leg. E. WURST. – **No. 5:** a) 21.08.89. Schwieberdingen (near Ludwigsburg), alluvial forest of the River Glems; in mouldy tree stump, leg. E. WURST; b) 27.09.92. Schwieberdingen (near Ludwigsburg), alluvial forest of the River Glems; in rotten wood, leg. E. WURST; c) 22.03.90. Hemmingen (near Ludwigsburg), Bonholz Forest; under bark, leg. E. WURST; d) 28.03.91. Hemmingen (near Ludwigsburg), Eulenberg Forest; in rotten tree stump, leg. E. WURST; e) 30.08.89, 22.02.90, 28.03.91. Hemmingen (near Ludwigsburg), Eulenberg Forest; in fallen leaves and under bark, leg. E. WURST; f) 18.09.91. Weissach (near Ludwigsburg), "Weissacher Tal"; in rotten tree stump, leg. E. WURST; g) 13.10.96. Weissach (near Ludwigsburg), "Weissacher Tal"; under bark, leg. E. WURST. – **No. 6:** 26.04.97. Forest between Bad Waldsee and Bad Wurzach, at country road (L 300) near Haidgau; under moist bark, leg. E. WURST. – **No. 7:** 02.09.97. Grasdorf near Salzgitter, below Mieckenberg at Federal Highway No. B 444; under moist bark, leg. G. & U. WURST. – **No. 8:** 11.09.97. Schafstedt near the town of Heide, small forest near Schafstedterfeld; under moist bark, leg. G. & U. WURST.

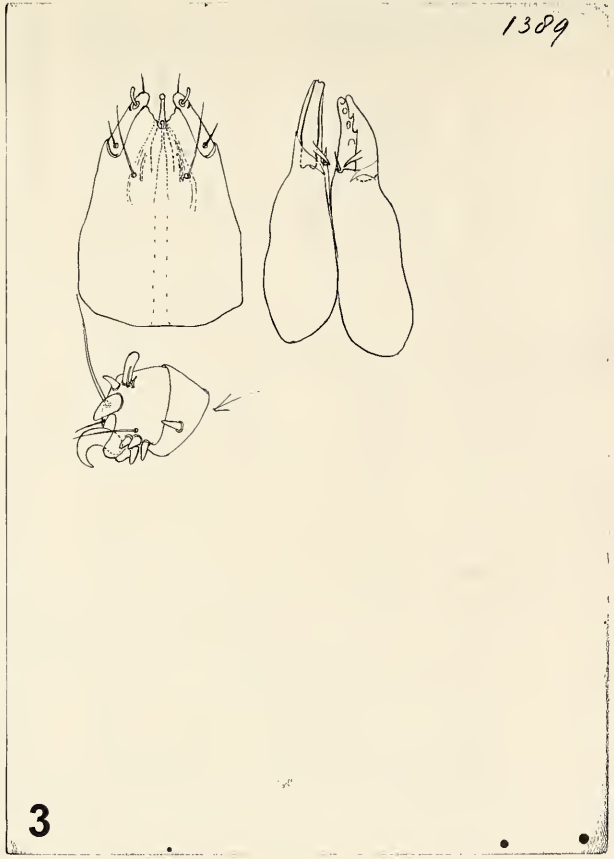
Austria – No. 9: 27.04.98. Dornbirn (Vorarlberg); under moist bark, leg. B. BILGER & A. DINKEL. – **No. 10:** 28.08.88. Floitengrund near Mayrhofen (Zillertal, Tyrol) (at 1200 m altitude); as deutonymph on a beetle, leg. E. WURST. – **No. 11:** 19.07.89. Kals at Grossglockner Mountain, at Kalserbach (at 1500 m altitude); on *Serviformica fusca* (Insecta: Hymenoptera: Formicidae) (deutonymphs only), leg. E. WURST. – **No. 12:** 26.02.98. Vienna, Wienerwald between Leopoldsberg and Kahlenberg (Josefinenhütte); under moist bark, leg. E. WURST.

Slovakia – No. 13: 18.05.97. Magurka southeast of Ružomberok; under moist bark, leg. E. WENDT. – **No. 14:** 20.05.97. Near Dobšiná, pasture at road No. 533 below Nad Javorom (at 1025 m altitude); under moist bark, leg. E. WENDT.

Poland – No 15: a) 13.08.96. Near Karpacz, "Strzecha Akademicka" (Giant Mountains) (at 1250 m altitude); under moist bark, leg. G. WURST; b) 14.08.96. Przełęcz Okraj (Giant Mountains), at road No. 368 at border crossing (at 1050 m altitude); under moist bark, leg. G. WURST; c) 15.08.96. Przełęcz Karkonoska (Giant Mountains) (at 1200 m altitude); under moist bark, leg. G. WURST. – **No. 16:** a) 16.09.96. Kędzierzyn-Koźle, Kuzniczka, forest at road to Cisowa; under moist bark, leg. E. POGODZIK; b) 03.04.97. Jemielnica-Szczepanek north east of Strzelce Opolskie; under moist bark, leg. E. POGODZIK. – **No. 17:** 14.01.98. Poznań, Park

Fig. 1. Map showing the geographic distribution of *Schwiebea talpa* and S. nesbitti. Data from collections and data from the literature are combined. The *numbers* refer to the localities and habitat given in the chapters 2.1., 5.3. and 6.3.





Figs. 2–3. *Schwiebea talpa*, female. Original drawings made by OUDEMANS 48 % of original size). – 2. *Top left:* dorsal view; *top right:* ventral view; *bottom:* lateral view; – 3. *top left:* gnathosoma, ventral view; *top right:* chelicerae; *bottom:* leg I, tibia and tarsus.

"Malta" *(Pinus, Quercus, Fagus);* under moist bark, leg. Z. Olzsanowski. – **No. 18:** 06.97. Road between Zambrów and Konopki-Jałbrzyków; under moist bark, leg. T. Stahl.

Spain – 03.10.87. Tenerife, Anaga, El Bailadero, El Pijaral; in fallen laurel leaves, leg. E. Wurst.

2.2. Methods

The plant material was observed by means of a stereo microscope (magnifications 16× and 40×), removing the bark carefully from the branches and drawing apart leaves and the rotten wood.

From all localities, maximally 50 specimens of each species were prepared for the light microscope in order to be able to estimate the local morphological variability within the respective population. Mites in moulting torpor were separated and prepared for the light microscope just before hatching to find out which instars belong to the same species. Eggs in different phases of development (after formation of the prelarva and after formation of the larva, but before hatching) were equally dealt with.

In samples from two populations of *S. talpa* (No. 1a and No. 16a) we tried to induce the formation of deutonymphs by gradually reducing the moisture of the natural substrate.

For light microscopy, the mites were mounted in Hoyer's fluid. Drawings were made with a Zeiss drawing apparatus. Light micrographs were done by using the Zeiss photomicroscope "Axiophot". For scanning electron microscope (SEM) investigations the mites were killed by freezing and were washed with a tenside. Further preparation was performed after Bock (1987): fixation by a modified Carnoy (acetic acid : chloroforme : ethanol = 1:1:3) (at least 4 hrs), ethanol (5–10 min), hexamethyldisilazane (5 min), air-drying. Sputtering with gold. SEM DSM 940 (Zeiss).

The nomenclature of idiosomal chaetotaxy follows Griffiths et alii (1990), nomenclature of leg chaetotaxy Griffiths (1964) and Fain (1967).

2.3. Acknowledgements

This project was supported by funds from the Deutsche Forschungsgemeinschaft (grant No. FR 276/12-1).

For their most generous help we sincerely thank the following persons: Dr. P. J. van Helsdingen (Leiden, Netherlands) made available slide preparations and documents of the Oudemans collection. Prof. Dr. L. Beck (Karlsruhe) provided access to the relevant preparations of the Türk collection. Numerous persons brought us plant material samples; without their help it would not have been possible to elucidate the distribution of the *Schwiebea* species within a rather extended geographical area. These are: B. Bilger (Stuttgart), A. Dinkel (Stuttgart), Dr. K.-H. Körtje (Adelsdorf), H. Löffler (Schwieberdingen), Dr. Z. Olzsanowski (Poznań, Poland), E. Pogodzik (Stuttgart), Dr. T. Romig (Stuttgart), Dr. N. Schäffer (Sandy, England), T. Stahl (Hersbruck), E. Wendt (Asperg), G. Wurst (Schwieberdingen), U. Wurst (Schwieberdingen).

We owe important informations concerning authors of the former Soviet Union to Dr. S. Mirónov (St. Petersburg, Russia), especially with regard to possibly still existing mite material of A. A. Zachvatkin. Dr. F. Türk (Bayreuth) and S. A. Bugrov (Moscow, Russia) readily gave us supplementary informations on their own investigations. P. Hesse (Leipzig) of the university archive helped us to find more biographical data about J. J. Schwiebe. B. Curth (Stuttgart) assisted in everything concerning SEM. M. Verhaagh (Karlsruhe) and D. Veile (Obersulm) determinated the ants.

W. Jansen (Stuttgart) critically read the manuscript and gave valuable comments. We are thankful to B. Schreiber (Ostfildern, Mairs Geographischer Verlag) for the permission of free use of a map for demonstrating the geographical distribution of the mites.

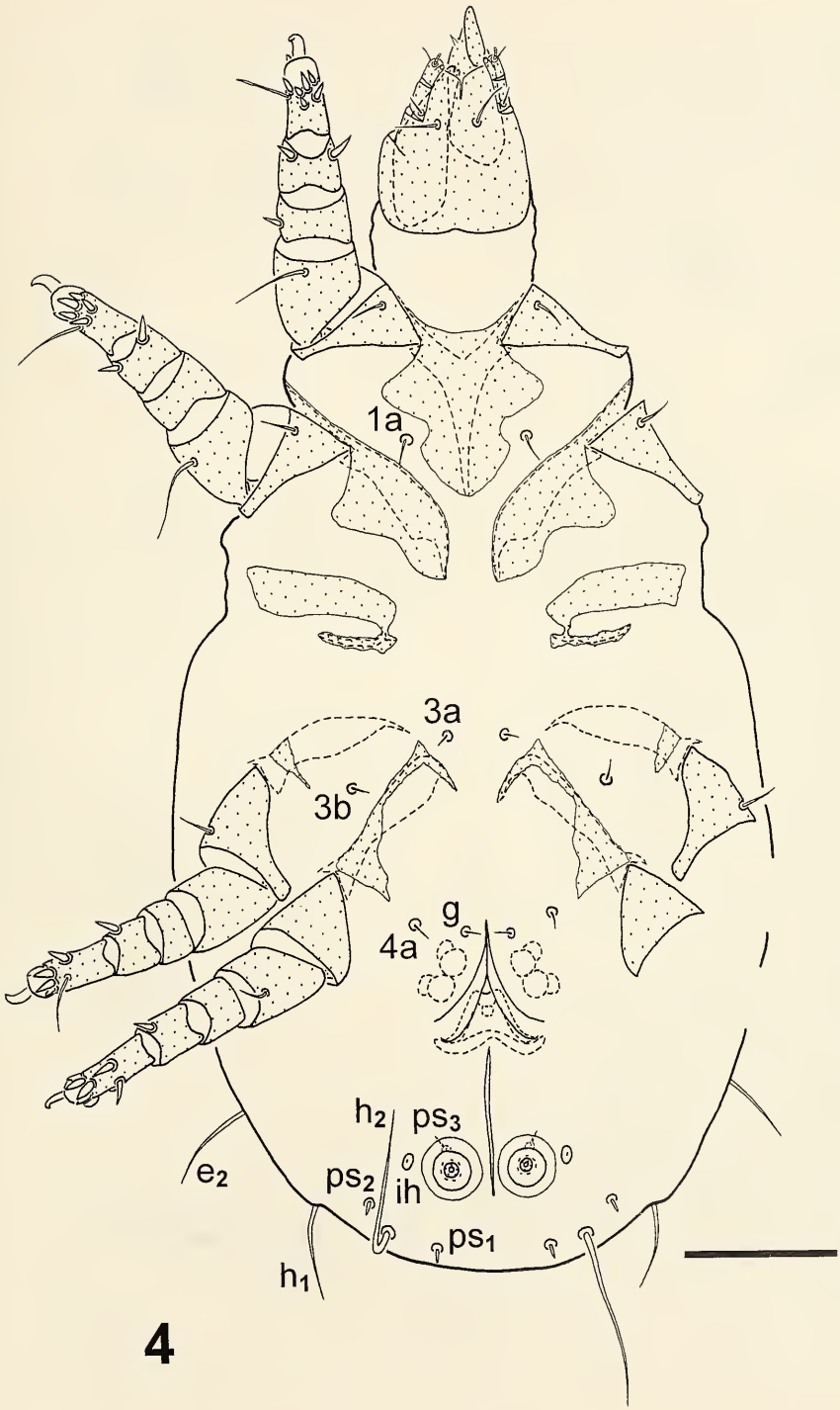
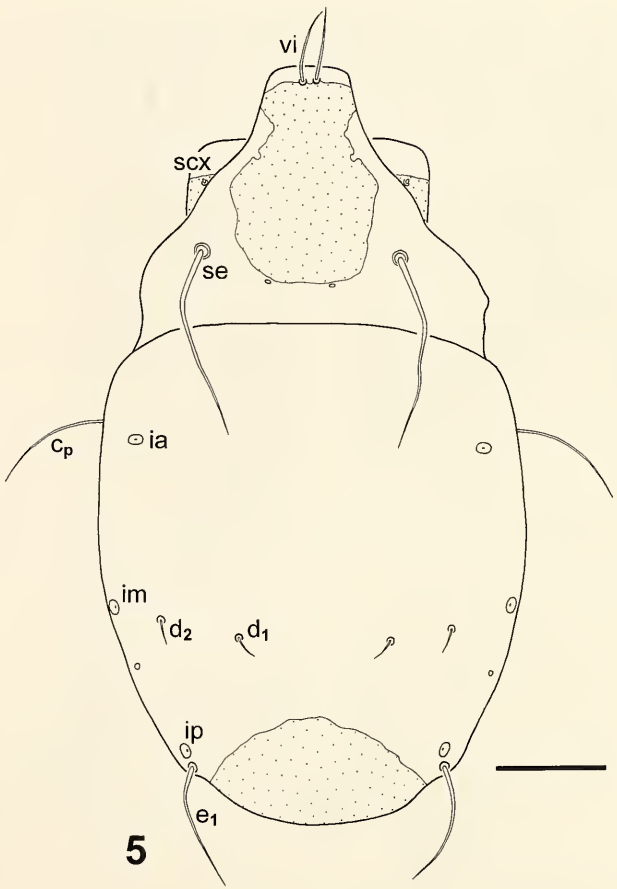
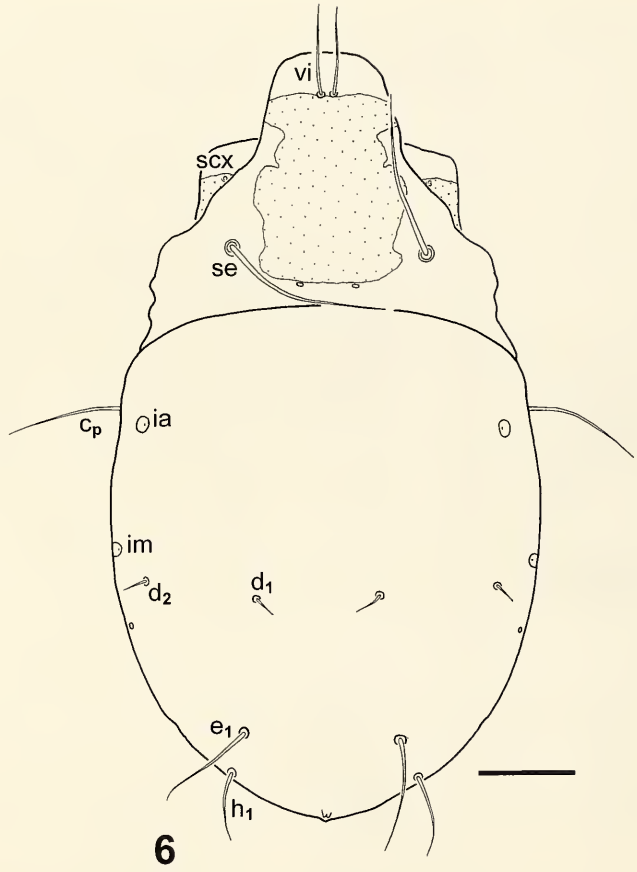
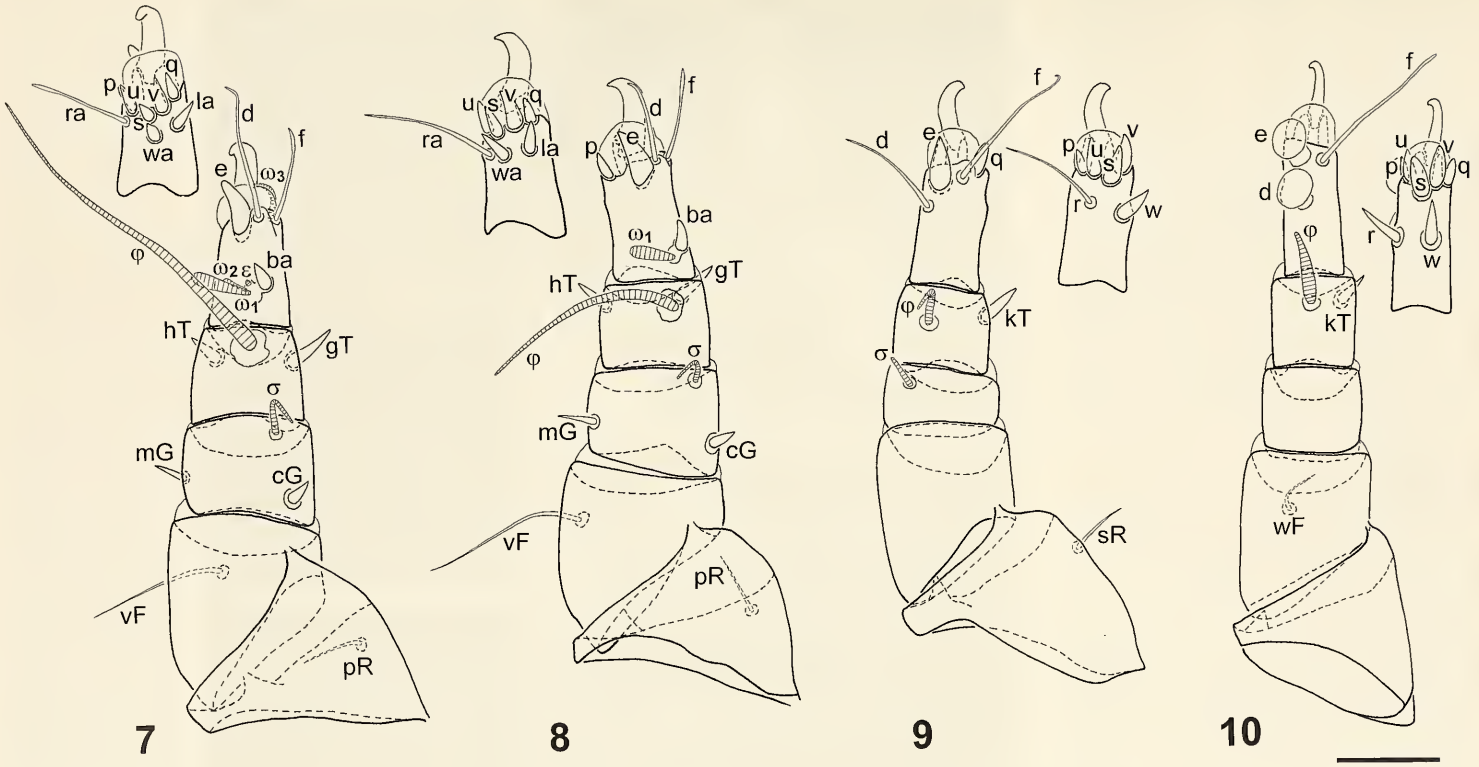


Fig. 4. *Schwiebea talpa,* male; ventral view, left legs partly omitted. – Scale bar: 40 µm.





Figs. 5–6. *Schwiebea talpa.* – 5. Male; idiosoma, dorsal view (scale bar: 40 µm); – 6. female; idiosoma, dorsal view (scale bar: 40 µm).



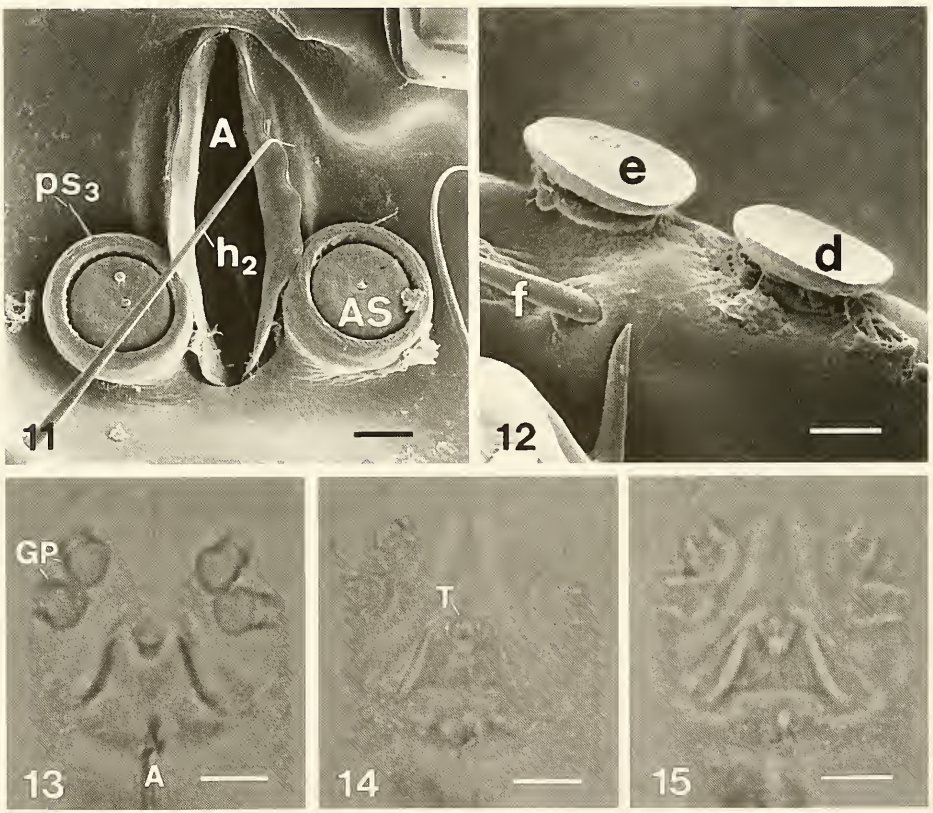
Figs. 7–10. *Schwiebea talpa*, male. – 7. Leg I; – 8. leg II; – 9. leg III; – 10. leg IV. – Legs are shown in dorsal view. In addition, the insert shows the tarsus from the opposite side. – Scale bar: 15 µm.

3. Species Concept and the Use of the Term "Phenon"

The ongoing discussion on the meaning of the word "species" and the present use of alternative species concepts requires a working definition of "species" in the present study. We understand the term "species" exclusively in the way MAYR (1963) used it in his "biological species concept".

For mite populations in which until now no males have been found, we will use the term "group of phena". The term "phenon" was introduced by MAYR (1969) when he described the working methods of taxonomists:

"The first step in classification is the separation of reasonably uniform samples and their assortment into taxa at the species level. There is no generally accepted technical term for a phenotypically reasonably uniform sample, but it may be designated as a **phenon,** a term introduced by CAMP & GILLY (1943) for phenotypically homogeneous samples at the species level. Males and females often belong to different phena, while in the case of sibling species it is possible that several species belong to a single phenon." (p. 5).



Figs. 11–15. *Schwiebea talpa,* male. – 11. Anal slit *(A)* flanked by the adanal copulatory suckers *(AS).* Further *explications*: h_2, ps_3: setae (scale bar: 5 µm). – 12. Right leg IV with copulatory setae d *(d)* and e *(e).* Further *explication*: *f*: seta (scale bar: 2 µm). – 13.–15. Optical sections (light micrographs) of different focal planes taken through retracted aedeagus: 13. Superficial plane; *A* = anus, *GP* = genital papillae; – 14. middle plane; *T* = tip of aedeagus; – 15. deepest plane (scale bars Figs. 13–15: 10 µm).

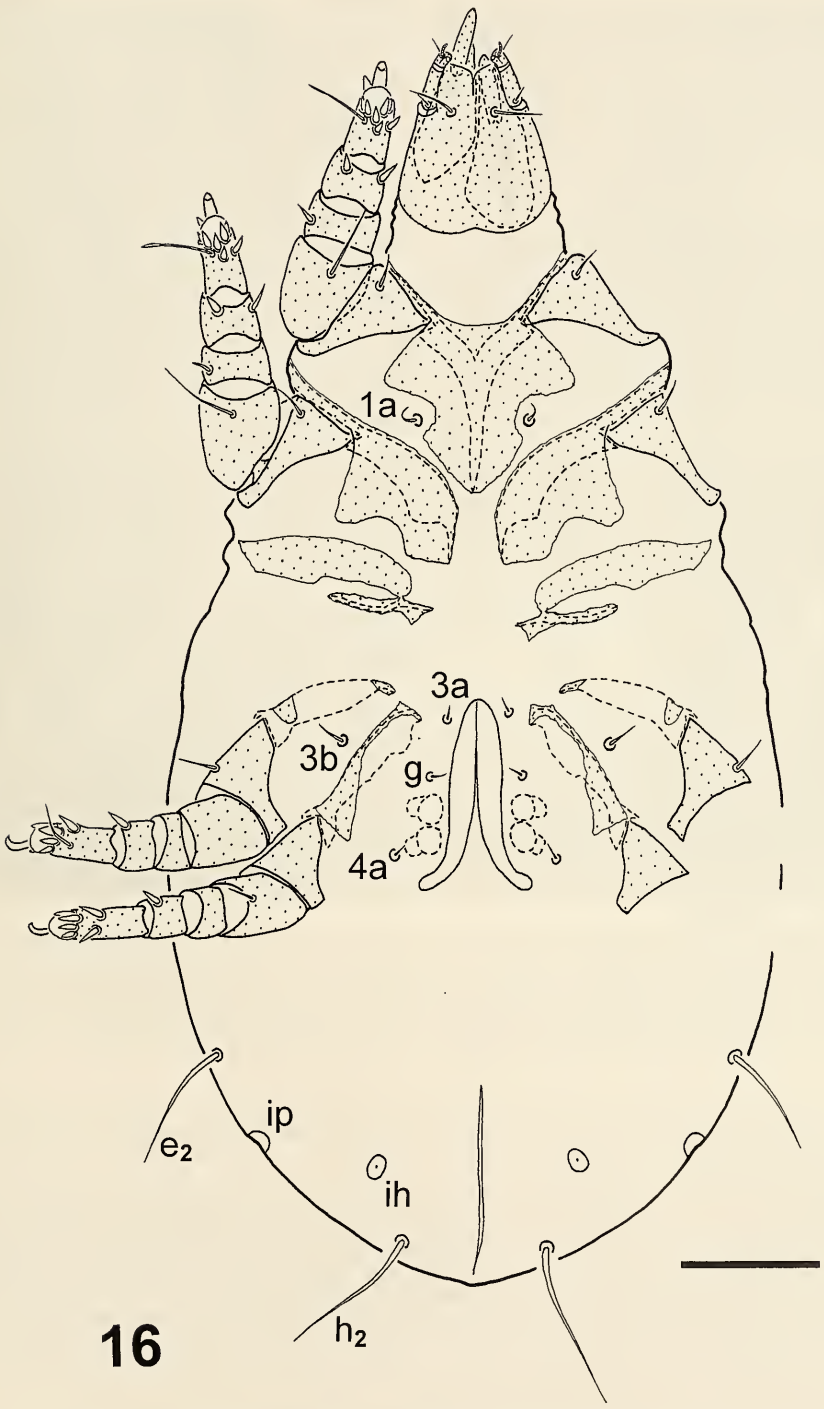


Fig. 16. *Schwiebea talpa*, female; ventral view, left legs partly omitted. – Scale bar: 40 µm.

"The systematist's first task is to sort that portion of the diversity of individuals which he encounters into easily recognizable and internally homogeneous groups, and to find constant differences between such groups. Each such aggregate is a **phenon.** A phenon is not necessarily a population in the biological sense but may also be either a biased sample from a population (males, juveniles, morphs, etc.) or else (in the case of sibling species) a mixture of several populations, and finally, in the case of geographically heterogeneous material, possibly a mixture of several subspecies." (p. 10).

We decided on the above usage of terminology in view of the present situation of a not yet finished discussion on species concepts and a deplorable lack of knowledge of the reproduction biology of mites. We do not follow one of the variants of the "evolutionary species concept" (Simpson 1961, Cracraft 1983, Ax 1995). In our opinion, the vagueness of this concept[2] does not guarantee the intersubjectivity and semantic unequivocal meaning which are prerequisites for a meaningful scientific discourse.

Our restriction to the assemblage and the description of a group of ontogenetically consecutive phena leaves room for individual interpretations: The "optimist" may assume that males might be found in future and may infer a "biospecies" sensu Mayr (1963); the advocate of an "evolutionary species concept" may, for his or her own sake, transform the "group of phena" into a "species".

4. Genus *Schwiebea* Oudemans, 1916

Schwiebea Oudemans (1916): Entomologische Berichten 4 (88): 264–265.
Type species: *Schwiebea talpa* Oudemans, 1916.
Megninietta Jacot (1936): Annals of the Entomological Society of America 29: 631.

Oudemans (1916b) described an acarid mite species based on one female found by him in 1901 near Bonn (Germany) in rotten leaves. For this he created the new genus "*Schwiebea*". The new species was named *S. talpa.* In addition to a genus diagnosis, Oudemans (1916b) presents a short description of the new species, but provides no drawings.

The genus diagnosis by Oudemans (1916b) is, in our translation, as follows:

"*Schwiebea* nov. gen. belongs to the Tyroglyphinae, it looks indeed like a *Tyroglyphus,* but has a dorsal shield like *Suidasia* Oudms. and *Hericia* Can. It differs from these two genera by the short, thick legs und possesses only two setae on the posterior half of the propodosoma. Also, the trochanters I are strongly chitinized on their dorsal side."

Oudemans named the genus after Johann Jacob Schwiebe[3] who, in 1722, submitted a doctoral thesis on scabies (Dissertatio inauguralis de pruritu exanthematum ab acaris; Lipsiae).

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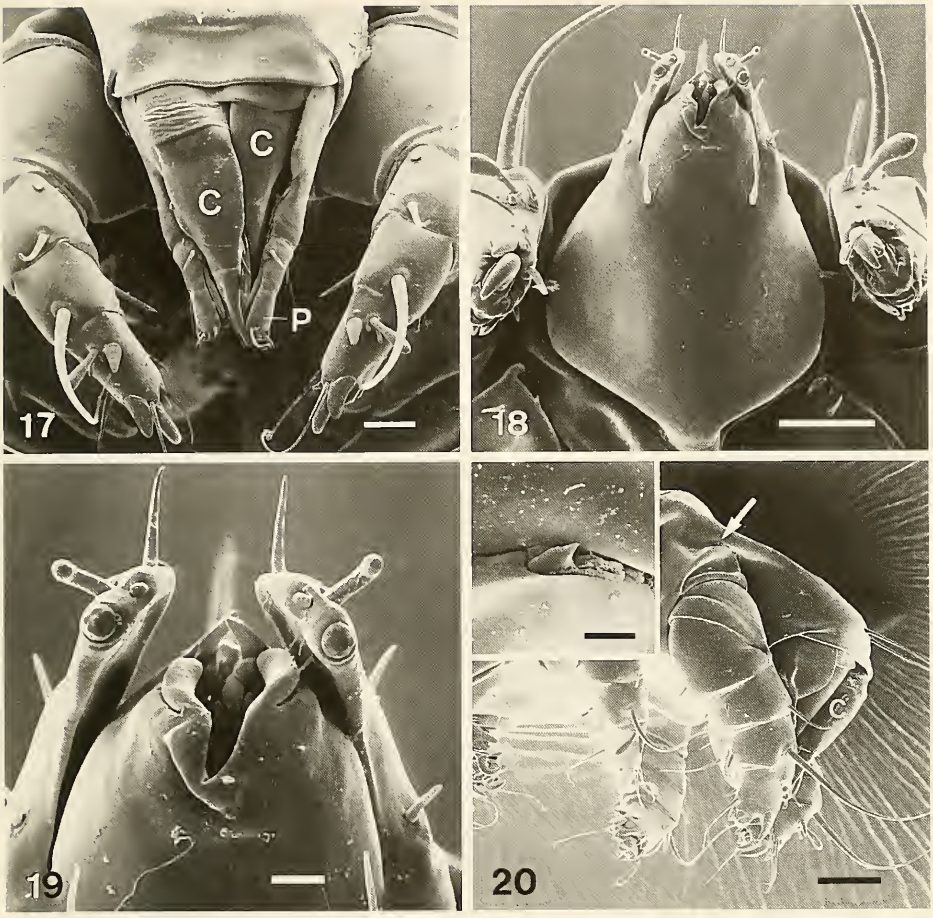
[2] All definitions of the term "species" based on an "evolutionary species concept" contain one or more criteria which allow a large latitude of interpretations: "a lineage evolving separately from others and with *its own unitary evolutionary role and tendencies*" (Simpson 1961: 153), "*the smallest diagnosable cluster* of individual organisms" (Cracraft 1983: 170), "objects sharing *certain characteristics*" [Ax 1995: 14; this criterion, initially accounted for as the "natural kind" by Ax (1995), equally, i.e. as a consequence of the modus ponens, applies to the term "species"].

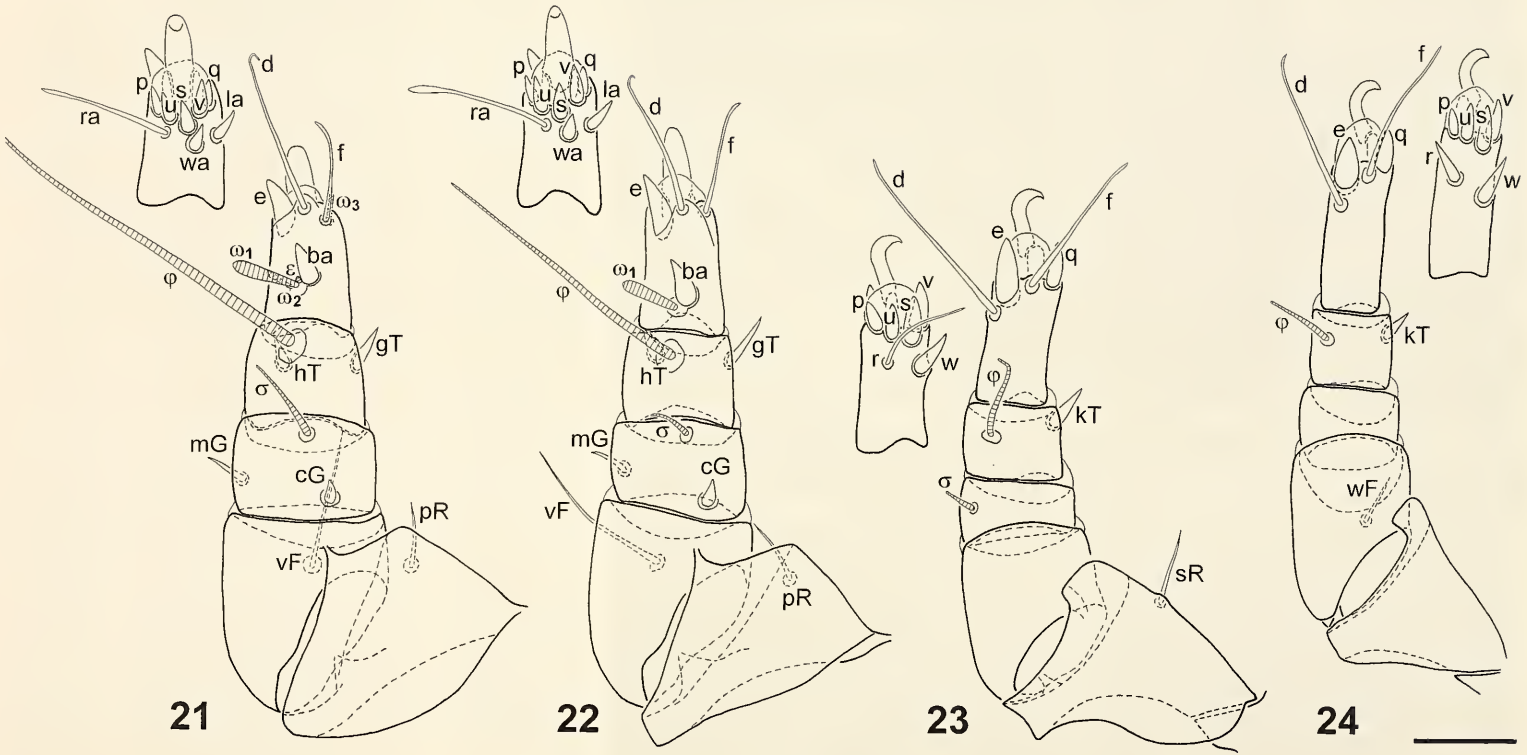
[3] J. J. Schwiebe, most probably born in Breslau, matriculated in the winter term of 1718 at the university of Leipzig. Since students in that time generally were eighteen when starting their studies he may have been born in the year 1700. He applied for a "Doctorate in Medicine" at June 27th 1722 (Erler 1909). We do not have any further biographical data.



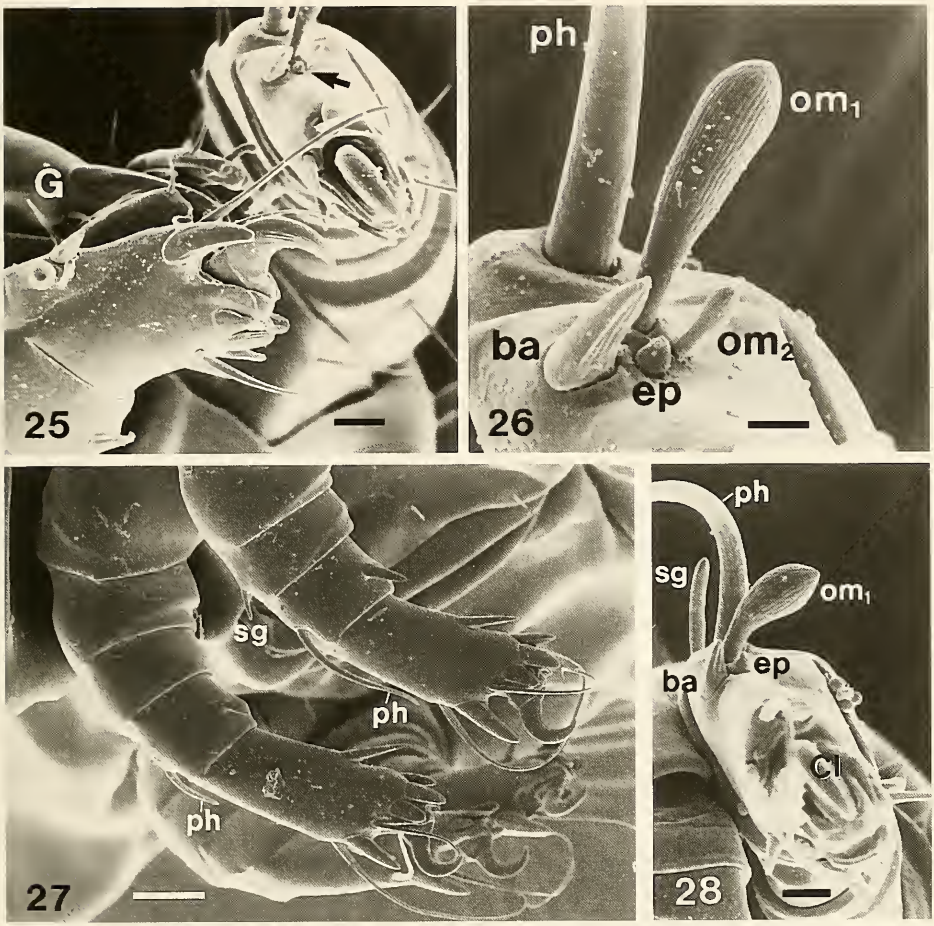
Figs. 17–20. *Schwiebea talpa.* – 17. Female, frontal view; *C* = chelicera, *P* = palp (scale bar: 10 µm); – 18. tritonymph, gnathosoma, ventral view (scale bar: 10 µm); – 19. tritonymph, gnathosoma, detail of Fig. 18 (scale bar: 2 µm); – 20. female, proterosoma, lateral view; *arrow,* inset: supracoxal seta scx, *C* = chelicera (scale bar: 20 µm, scale bar inset: 2 µm).

The genus *Tyroglyphus* Latreille, 1796 has been placed on the Official Index of Rejected and Invalid Names in Zoology. It is considered as a younger synonym of *Acarus* L., 1758 (Hemming & Noakes 1958). The genus *Tyroglyphus,* as used by Oudemans (1916b), was later split in the genera *Acarus, Tyrophagus, Tyrolichus* etc. The "dorsal shield" of Oudemans (1916b) apparently is the propodosomatal shield. At that time Oudemans erroneously believed that this genus (like other genera of the "Tyroglyphidae") lacks a propodosomatal shield. This interpretation of the "dorsal shield" is also supported by Oudemans (1924a) himself in his "Analytical Key for the Classification of Families and Genera of Diacrotricha Oudms, 1906" in which he uses literally the term "propodosomatic shield"[4]. The two setae on the posterior half of the propodosoma refer to the setae se.

[4]) In a later and revised key (Oudemans 1924b) he corrected this mistake.



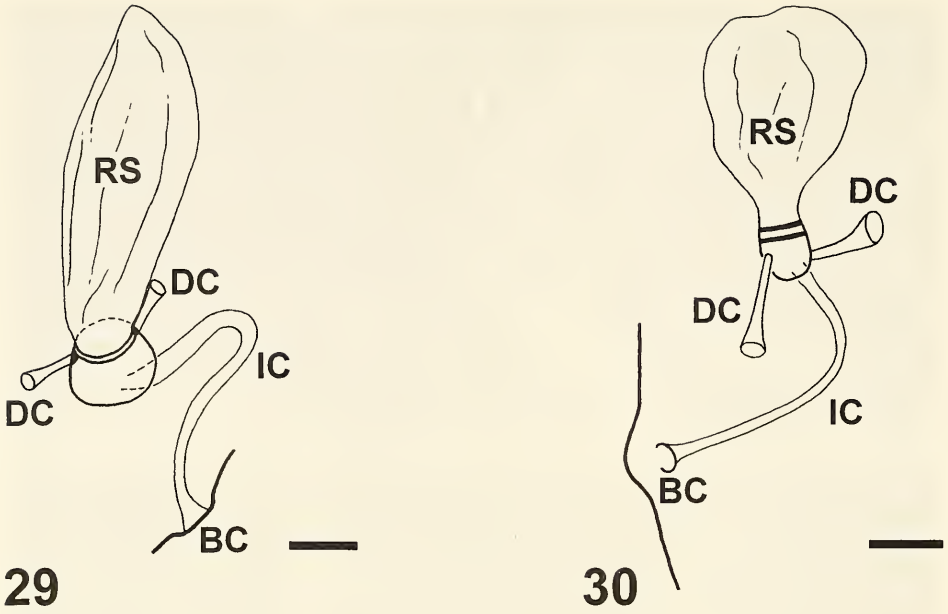
Figs. 21–24. *Schwiebea talpa,* female. – 21. Leg I; – 22. leg II; – 23. leg III; – 24. leg IV. – Legs are shown in dorsal view. In addition, the insert shows the tarsus from the opposite side. - Scale bar: 15 µm.



Figs. 25–28. *Schwiebea talpa.* – 25. Female, lateral view, showing gnathosoma *(G)* and distal end of legs I. Further *explication*: *arrow*: detail shown in Fig. 26 (scale bar: 5 µm). – 26. Female, complex of solenidia on tarsus of left leg I (detail of Fig. 25, *arrow*). Further *explications*: *ep* = famulus epsilon, *ph* = solenidion phi of tibia, om_1 = solenidion omega 1, om_2 = solenidion omega 2, *ba*: seta (scale bar: 2 µm). – 27. Female, lateral view, showing legs III and IV; further *explications*: *ph* = solenidion phi, *sg* = solenidion sigma (scale bar: 10 µm). – 28. Larva, left leg I in frontal view; *ba*: seta, *Cl* = claw, *ep* = famulus epsilon, om_1 = solenidion omega 1, *ph* = solenidion phi of tibia, *sg* = solenidion sigma of genu (scale bar: 2 µm).

Taking into account the little information given in the descriptions in OUDEMANS (1916b), problems arising from the classification of species by other acarologists were inevitable. Thus, VITZTHUM (1923) notes that "no radical differentiation character" exists between *Rhizoglyphus echinopus* and *S. talpa* and he concludes that *S. talpa* could be a younger synonym of *Rhizoglyphus echinopus.*

Apparently as a reaction to these legitimate objections, OUDEMANS (1924c) published "More distinctive criteria for *Rhizoglyphus* Clap. 1869 and *Schwiebea* Oudms. 1916". They are obviously influenced by observations on *S. italica,* a new



Figs. 29–30. 29. *Schwiebea talpa,* female; receptaculum seminis and appendages (scale bar: 5 µm). – 30. Schwiebea nesbitti, female, receptaculum seminis and appendages (scale bar: 5 µm). – *Explications*: *BC* = bursa copulatrix, *DC* = ductus conjunctivus, *IC* = inseminatory canal, *RS* = sac of receptaculum seminis.

species described in that paper (the terms for structures and setae in our terminology are added in *square brackets*):

"*Schwiebea:* Larva with short urstigmata [Claparède organs]. Nymphs II [hypopi] with ventral vertical hairs [vi]. For the rest: No nuchal hairs [ve] (apart from larva and nymph I); no pseudostigmatal bristles [scx]; propodosoma with a transverse row of only 2 bristles [se]; anterior half of the hysterosoma bare (apart from nymph I: four setae arranged in a quarter-circle, and on nymph III two setae); epipharynx reaching beyond the mandibles, sometimes lying above mandibles; palps are one-segmented; no clasping organ; male with suckers at the anus and tarsi IV; besides, heteromorphic male with hysterosomatal shield."

The structure called "clasping organ" refers to small teeth on the hypostome, covered by the chelicerae. However, these are also present in *Schwiebea.* An evaluation of the deviations in chaetotaxy given by Oudemans (1924c) for the juvenile instars will be possible only after a reevaluation of the life-cycle of *S. italica.*

Jacot (1936) erected a new genus *Megninietta* which, already at the time of his publication, had to be considered as a younger synonym of *Schwiebea* (the terms for setae in our terminology are added in *square brackets*):

"Similar to *Histiogaster* but body much slendar; bristles rather short, in females rarely as long as breadth of abdomen; scent-club of tarsi I and II [ω_1] nobbed; tarsi I and II with distinct spines; males with tarsi IV without suckers but with dorsal bristle of tibiae IV [φ] forming a stout spur or spike; pygidial plate not lobed. Type: *Megninietta ulmi.*"

The suckers on tibia IV have apparently been overlooked. The new species *Megninietta ulmi* described by Jacot most probably is closely related to *Schwiebea nova.*

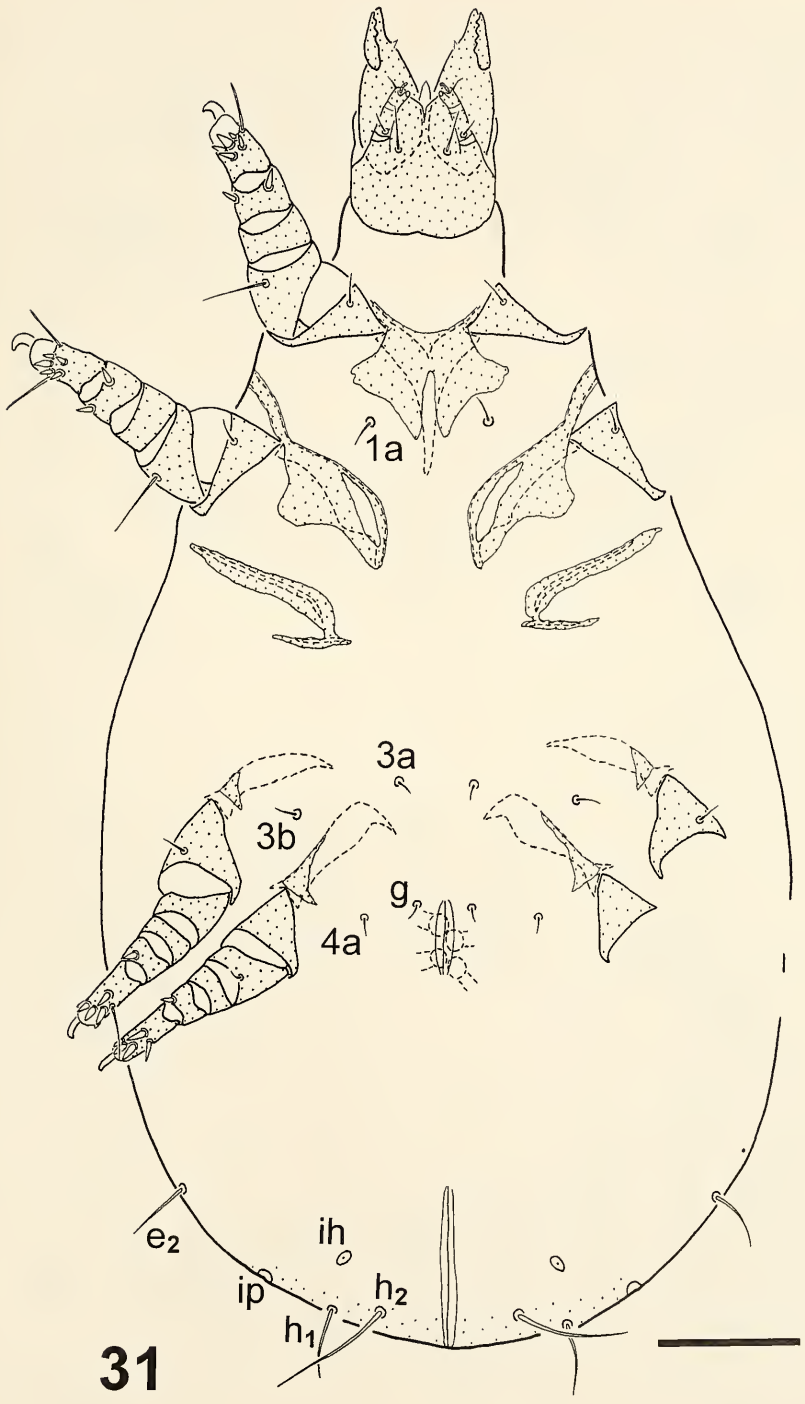
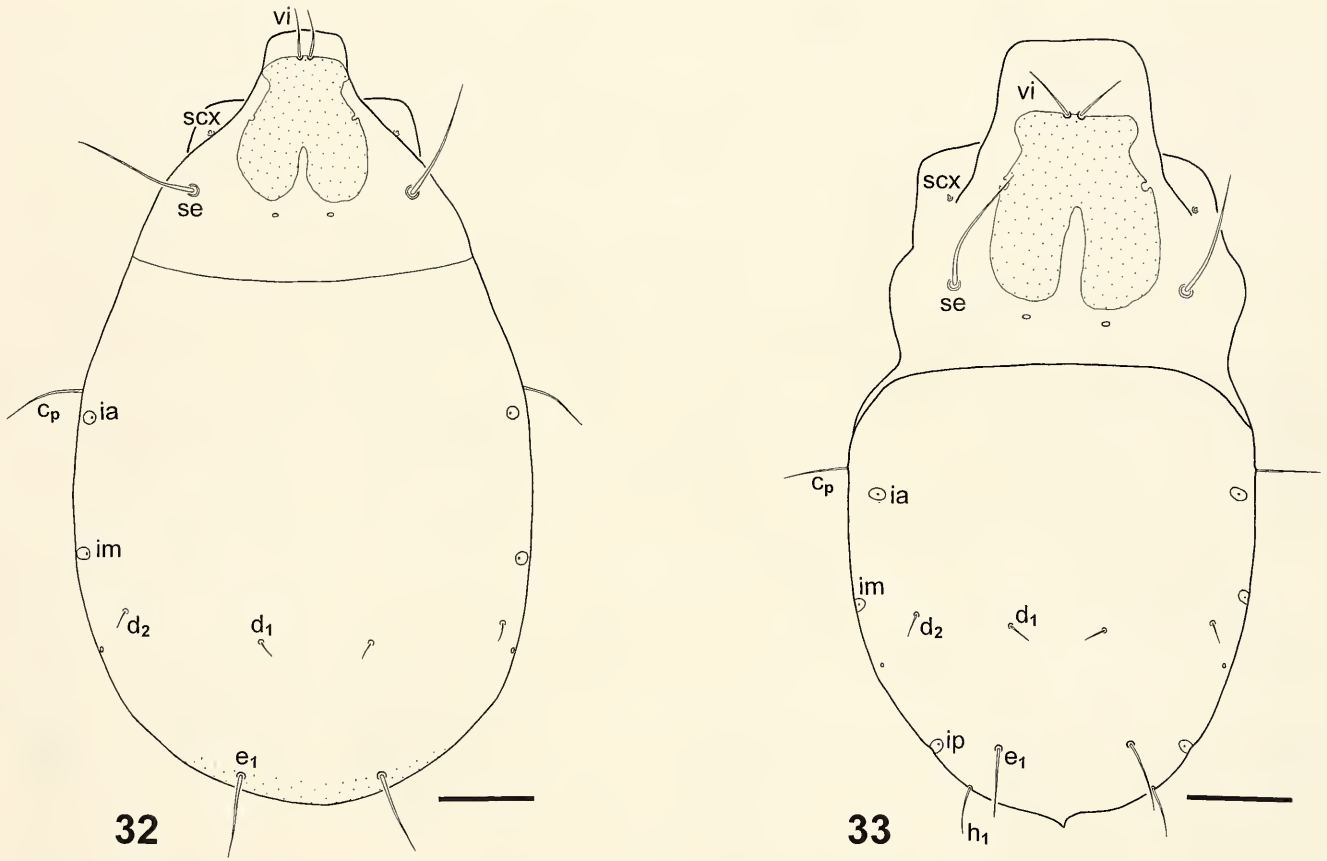
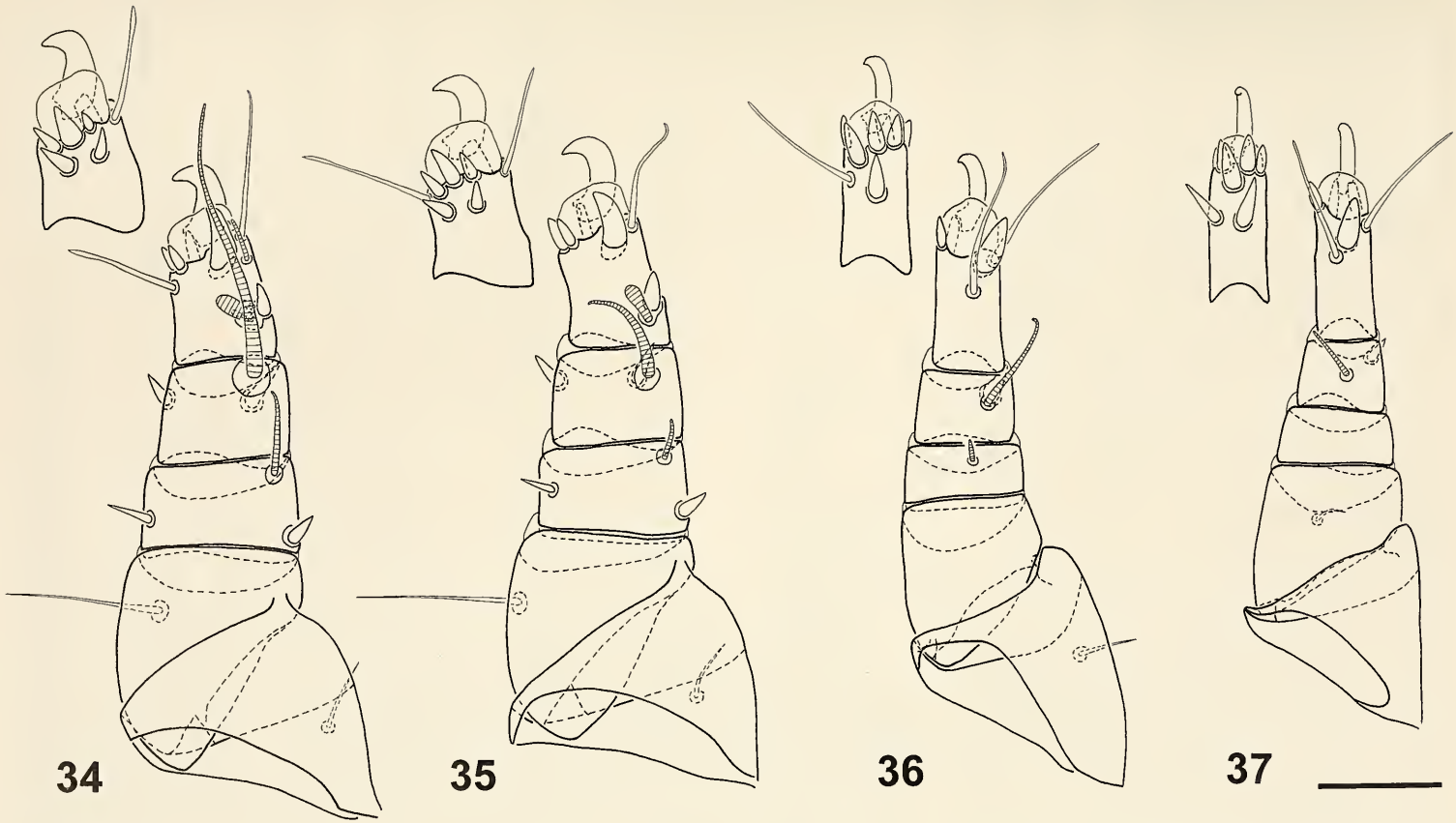


Fig. 31. *Schwiebea talpa*, tritonymph; ventral view, left legs partly omitted. – Scale bar: 40 µm.



Figs. 32–33. *Schwiebea talpa.* – 32. Tritonymph; idiosoma, dorsal view (scale bar: 40 µm); – 33. protonymph; idiosoma, dorsal view (scale bar: 25 µm).



Figs. 34–37. *Schwiebea talpa*, tritonymph. – 34. Leg I; – 35. leg II; – 36. leg III; – 37. leg IV. – Legs are shown in dorsal view. In addition, the insert shows the tarsus from the opposite side. – Scale bar: 15 µm.

ZACHVATKIN (1941) characterized the genus *Schwiebea* in the following way (the terms for setae in our terminology are added in *square brackets*):

"V e [ve], sc i [si], the pseudostigmatic organ, h i, d_1, d_2 [c_2, c_1, d_1], and in most cases d_3 [e_1] and 1 a [d_2], are absent, as well as one of the pairs of posterior setae (sa e [f_2]). Epimeres III and IV approach each other and even sometimes join at their internal ends. The legs are short and massive, powerfully armed; the ventral setae of the tibia, the basal and external setae of the genu, the internal and middle setae and eta [meaning epsilon; ba] of tarsi I and II are represented by strong, conical spines; delta [ω_2] arises near the base of the sensory rod [ω_1] and eta [meaning epsilon; ba] is placed immediately anterior to it; the middle apical seta of tarsus I and II is shaped like an elongated plate, which is arched and bent ventrally; the external ventral seta [ra] is capilliform; correlated with the shortness of the tarsi, the 5 ventral setae (represented by spines) [p, q, s, u, v] are clustered round the apex of the joint; 1 large dorsal spine is also present. The claws are very large and massive (particularly on legs I and II); the praetarsus is completely reduced. Sexual dimorphism is sharply defined.

Male: ... on the dorsal surface of the opisthosomal plate, there is only one pair of setae (d_4) [e_1] in most cases displaced to the very edges of the plate (only in *S. vitzthumi* are d_4 central in position). P_1 and p_2 [d_1, d_2] are represented by minute microsetae.

Female: The idiosoma is usually narrower and larger than in the male, and cylindrical; the opisthosomal plate is absent and the posterior end of the body unmodified; only one pair of anal setae [h_2] is present."

ZACHVATKIN distinguished between two subgenera:

Subgenus *Schwiebea:*

- Genu I with one solenidion only,
- Ratio of body length to body width between 1.65 und 2.00 in the female,
- Distance between bases of legs II und III not large,
- Ends of epimeres III and IV not connected.

Subgenus *Megninietta:*

- Genu I with two solenidia,
- Ratio of body length to body width between 2.3 und 2.4 in the female,
- Distance between bases of legs II and III very large,
- Ends of epimeres III und IV merged.

With the argument that the "genus diagnosis by OUDEMANS does not show the essential characters of the genus", TÜRK & TÜRK (1957: 127) give a further diagnosis for the genus *Schwiebea* (the terms for setae in our terminology are added in *square brackets*):

"Inner propodosomatal hairs [si] lacking. In the hitherto known species neither inner [c_1] and middle [c_2] humeral nor first lumbal hairs [d_1] exist. No supracoxal hair [scx] present. Without lanceolate hairs at tarsi I und II. Female without adanal and postanal hairs [ps_1, ps_2, ps_3, ad_1, ad_2, ad_3]. Male with opisthosomatal shield. Polymorphism of males."

For the differentiation between *Rhizoglyphus* and *Schwiebea,* FAIN (1977) gives the following characters (the terms for setae in our terminology are added in *square, brackets*):

- s cx [scx] present but very short and formed like a short spine or subglobular,
- Grandjean organ lacking,
- v e, sc i, s h, d 1, d 2, d 5, l 1 [ve, si, c_3, c_1, d_1, h_3, c_2] lacking,
- Anal setae usually lacking in female, in certain species, though, one pair of anal setae [ps_3] present,
- in male three pairs of anal setae (a i, a e, a 3) [ps_3, ps_2, ps_1] present.

FAIN (1976a, 1977) divides *Schwiebea* in two subgenera:

Subgenus *Schwiebea* (type species: *Schwiebea talpa*):

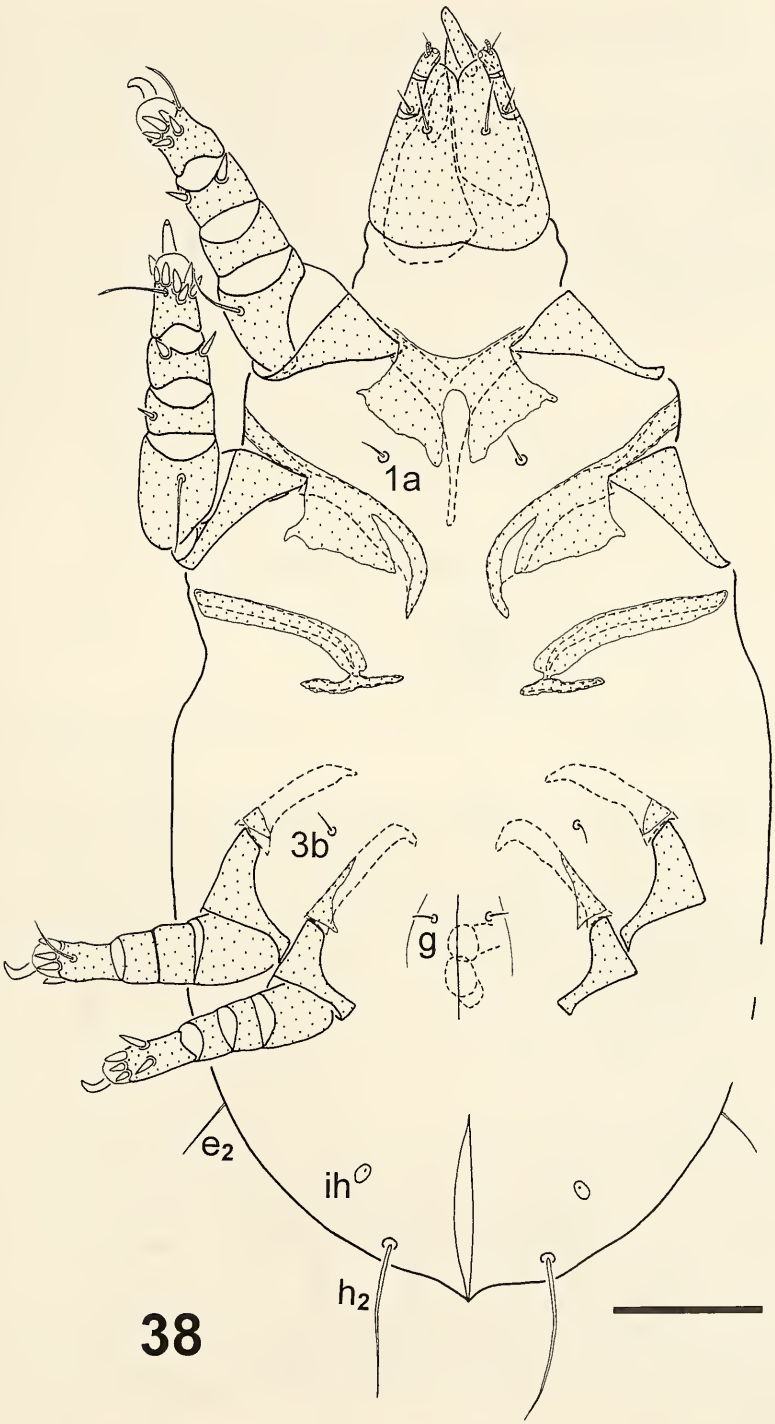
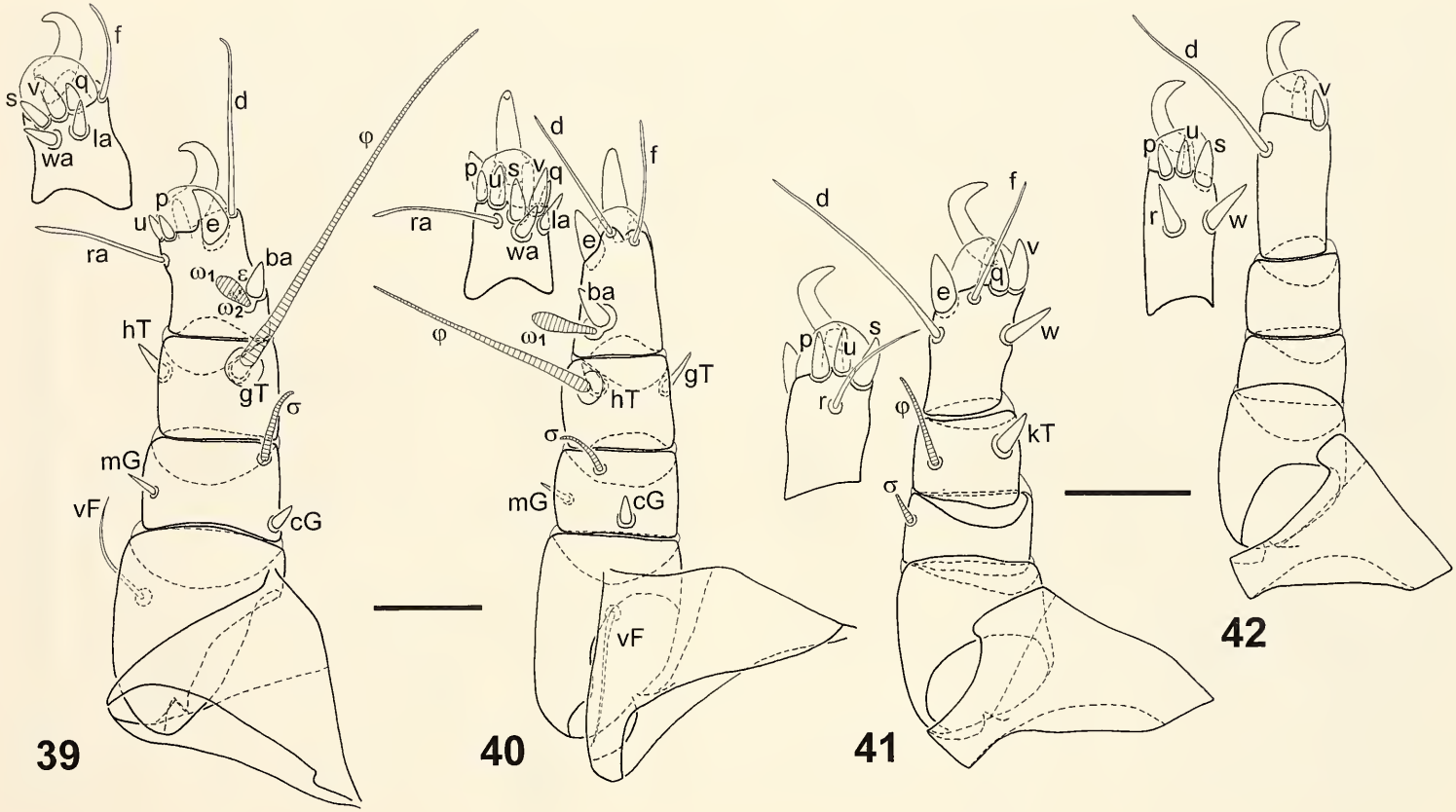


Fig. 38. *Schwiebea talpa*, protonymph; ventral view, left legs partly omitted. – Scale bar: 25 µm.



Figs. 39–42. *Schwiebea talpa*, protonymph. – 39. Leg I; – 40. leg II (scale bar Figs. 39 and 40: 10 µm); – 41. leg III; – 42. leg IV (scale bar Figs. 41 and 42: 10 µm). – Legs are shown in dorsal view. In addition, the insert shows the tarsus from the opposite side.

– female body only moderately elongated, one solenidion on genu I.
Subgenus *Jacotietta* (type species: *Schwiebea falticis* Woodring, 1966):
– female body elongated, two solenidia on genu I.

The justification of a subdivision based on the number of solenidia of genu I will be dealt with in a later publication.

On the basis of our work with the genus *Schwiebea,* we give the following diagnosis:
Retroconjugate mites with facultative hypopody. scx of non-hypopial instars a short spine; tarsi of non-hypopial instars without lanceolate setae.
Idiosomal chaetome:
– female: scx, vi, se, c_p, d_1, d_2, e_1, e_2, h_1, h_2, 1a, 3a, 3b, g, 4a;
– male: as given for female but additionally ps_1, ps_2, ps_3.
The following deviations of this configuration of characters were found in some species: Occurrence of ps_3 also in females, tritonymphs and protonymphs. Lack of d_1 and d_2.

5. *Schwiebea talpa* Oudemans, 1916

5.1. General Aspects

5.1.1. Historical Record

The description of Oudemans (1916b) is based on one female and, in our translation, is as follows:

"*S. talpa* nov. spec., looks like a mole en minature, is 333 µm long, with 3 to 4 short, robust spines on all tarsi; the short legs with these 'burrowing nails' immediately suggest a burrowing way of life, like the one of *Acarus* [= *Sarcoptes*]."

Drawings are not given by Oudemans (1916b), neither did he publish any drawings later. The Oudemans collection in Leiden, though, contains drawings of *S. talpa,* which are reproduced here for the first time (Figs. 2–3). As already mentioned in chapter 4., the scantiness of the description led to confusion in later treatments of the genus. Thus, it was almost inevitable that Oudemans (1924b) rejected the idea that the mite described by Vitzthum (1923) as *"S. talpa"* is in fact conspecific; later, Vitzthum (1932) named it *"S. ipidis"*.

The confusion was even increased by an article by Hughes (1957) who actually tried to clarify the identity of *S. talpa.* Though the orignial *S. talpa* drawings made by Oudemans were available to the author, she describes several *Schwiebea* species under this species name. This can readily be deduced from the fact that mites with one or two solenidia on genu I are referred to as two different "forms" of this species.

Türk & Türk (1957) erroneously described *S. talpa* under the name of *S. cavernicola* Vitzthum, 1932. It is not certain if the deutonymph presented in Türk & Türk (1957) actually belongs to *S. talpa.* Rearing experiments are not mentioned in the text, and laboratory notes from that time do not exist any more (personal communication by Dr. F. Türk).

A significant progress was achieved only in 1976 when Fain (1976b) redescribed all *Schwiebea* species originally described by Oudemans based on the original speci-

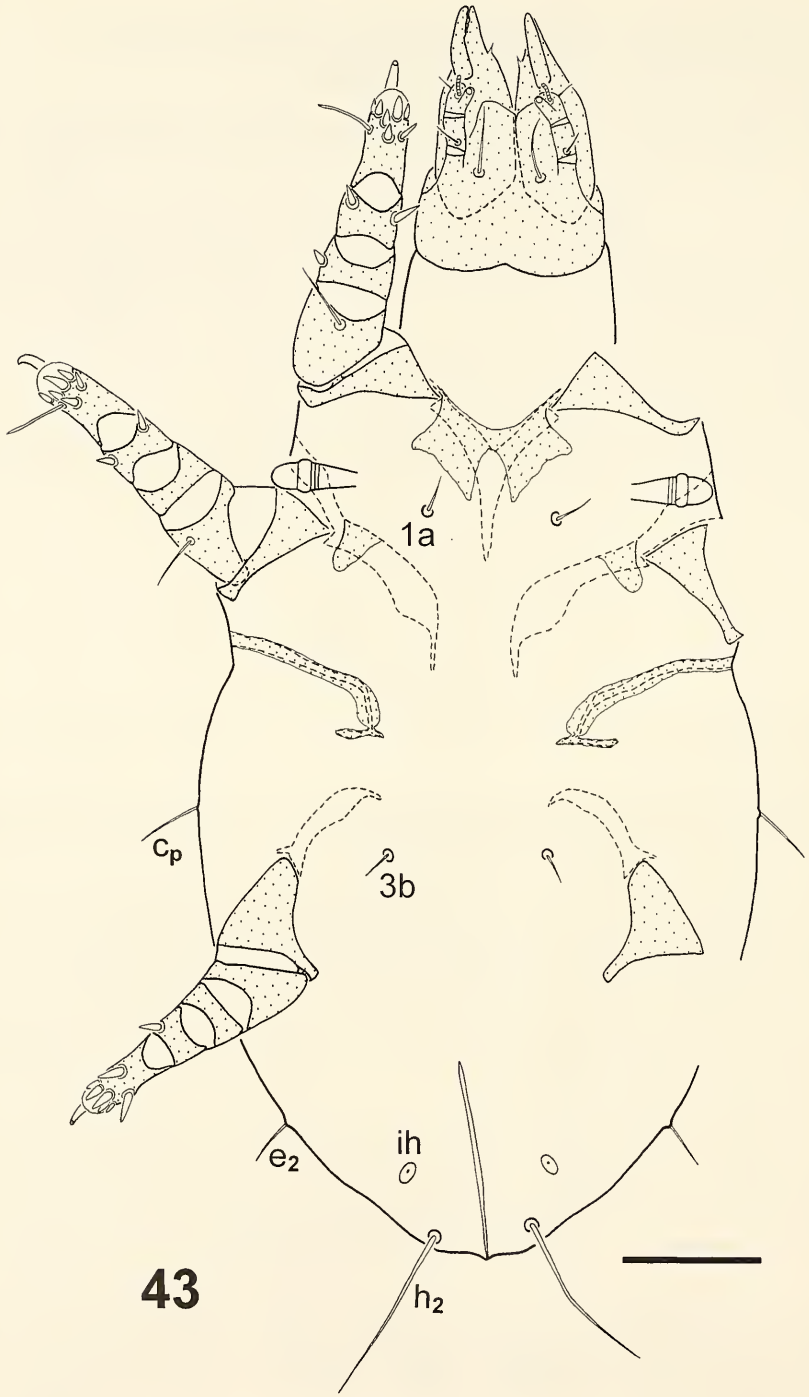


Fig. 43. *Schwiebea talpa*, larva; ventral view, left legs partly omitted. – Scale bar: 20 µm.

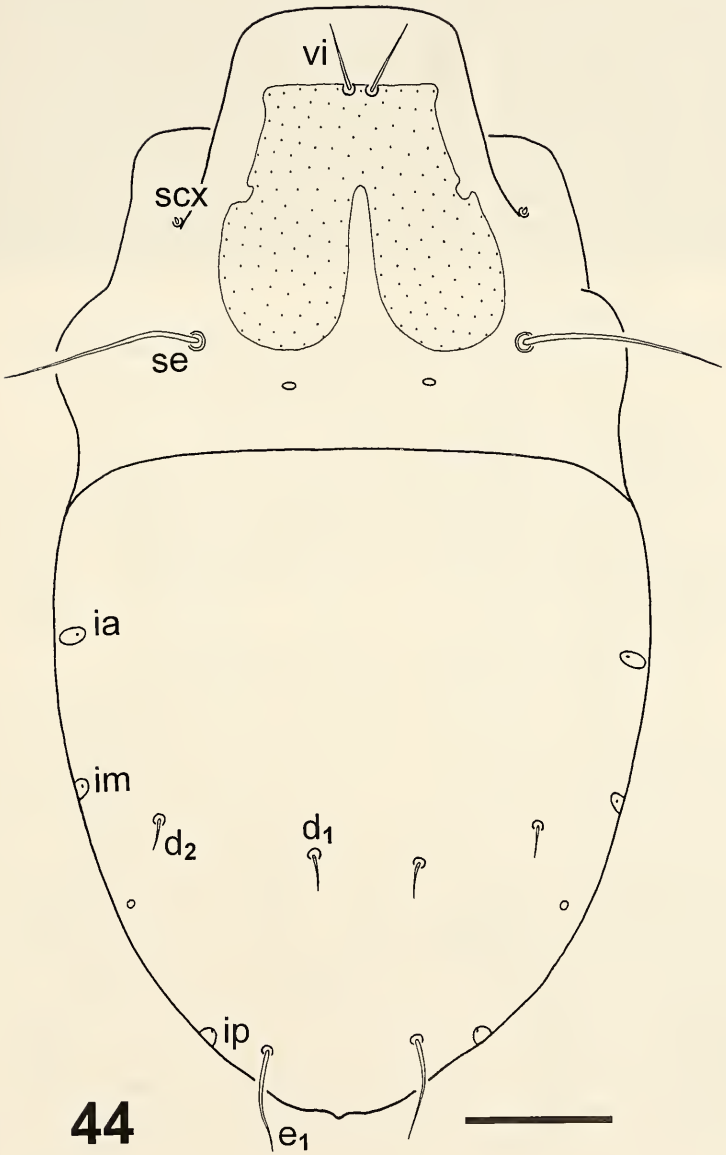
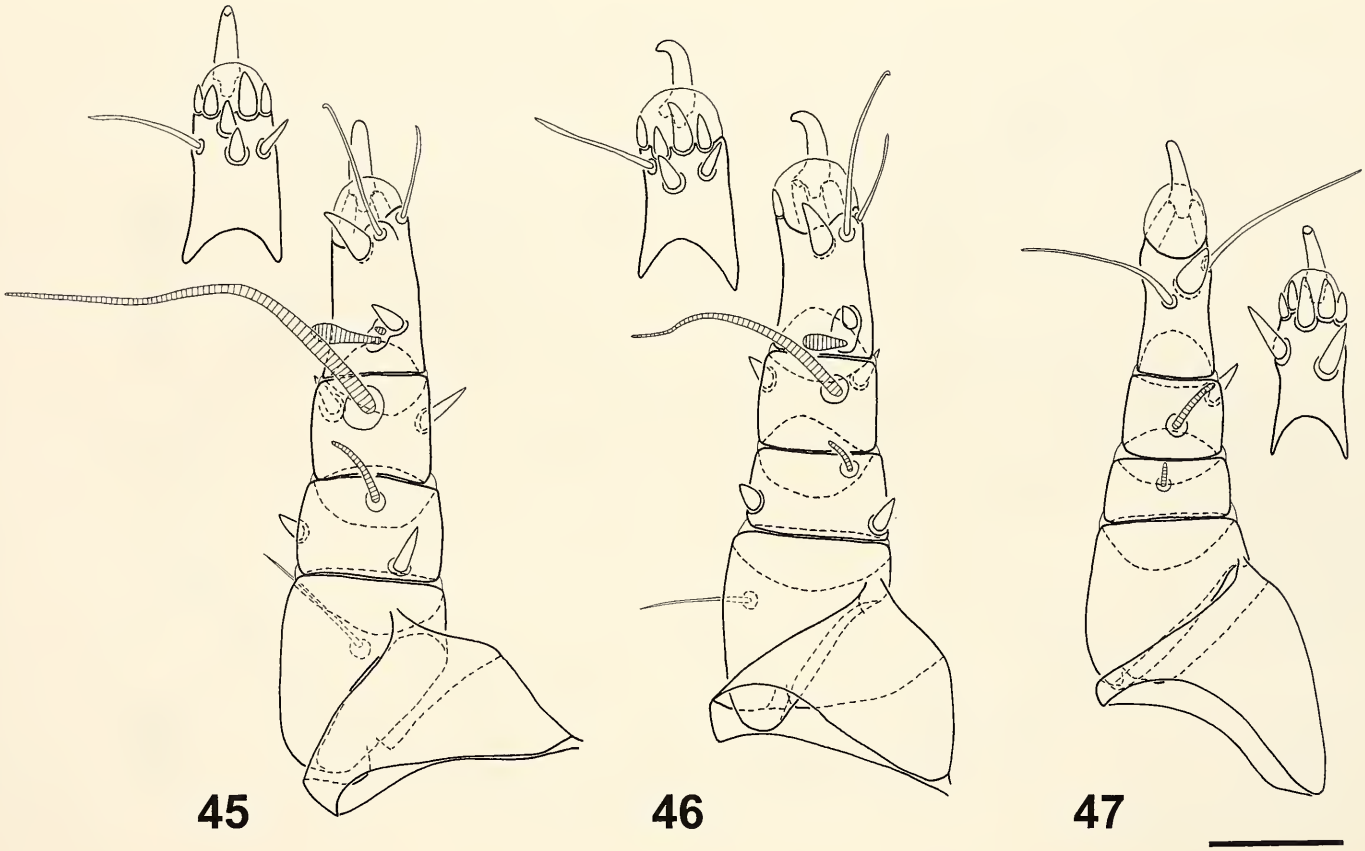
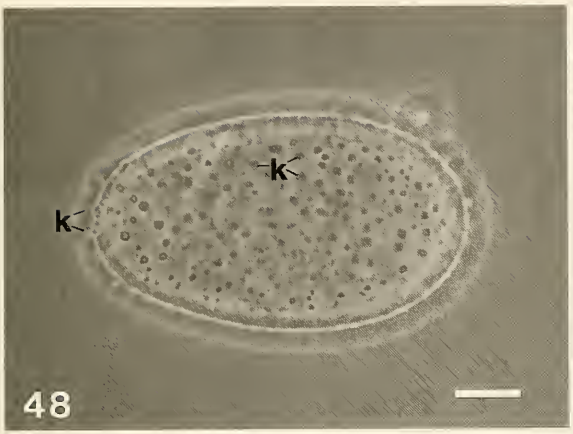
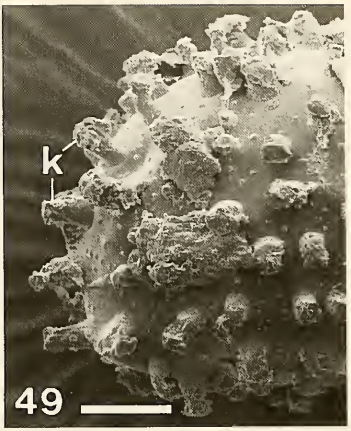


Fig. 44. *Schwiebea talpa,* larva; idiosoma, dorsal view. – Scale bar: 20 µm.



Figs. 45–47. *Schwiebea talpa,* larva. – 45. Leg I; – 46. leg II; – 47. leg III. – Legs are shown in dorsal view. In addition, the insert shows the tarsus from the opposite side. – Scale bar: 10 µm.





Figs. 48–49. *Schwiebea talpa*, egg. – 48. Light micrograph showing the distribution of small "knobs" *(k)* covering the egg shell (scale bar: 20 µm). – 49. Scanning electron microscopic image of egg with "knobs" *(k)* (scale bar: 10 µm).

mens of the OUDEMANS collection. Unfortunately numerous characters are not correctly reproduced in FAIN's (1976b) drawings, as we observed in 1990 after a reexamination of the original slide preparation of *S. talpa*. FAIN (1976a) also erected a subspecies *S. talpa subantarctica* which occurs on some offshore islands of Antarctica.

5.1.2. Materials from the OUDEMANS Collection

5.1.2.1. Slide Preparations

In the National Museum of Natural History, Leiden (Netherlands) (formerly Rijksmuseum van Natuurlijke Historie) three slides of the OUDEMANS collection are deposited labeled with "*Schwiebea talpa*": One of them ("Verz. A. C. OUDEMANS Cat. No. 1") is labeled: "rotte bladen, Bonn. VII. 1901, Oudemans".

The description of *S. talpa* apparently was based on this specimen, since OUDEMANS (1916a) states that he has found only one female. A label on the back of the slide carries the inscription "Holotypus, III. 1959 überführt in Liquido de Swann, K. Samsinak". This means the specimen was transferred into Swann's medium in March 1959 by K. SAMSINAK and was declared by him as "holotype". This slide mount also must have been the base for the redescription by FAIN (1976b), who had equally designated it as "holotype". The sealing on the mount was done with a resin which, by 1990, had caused a darkening of the mounting medium. Since our last examination in 1990, numerous crystals have formed in the whole mount which today render the observation of important characters impossible. For this, we had to go back to our drawings from 1990.

The other two slides ("Verz. A. C. OUDEMANS Cat. No. 2 and No. 3") are labeled "in Humus, Fichtenwald [in humous soil, pine forest]; Schonen, Zuid Zweden, X.1928, Trägårdh". Apparently OUDEMANS had received the specimens (altogether three females) from I. TRÄGÅRDH. They were correctly labeled as *S. talpa*.

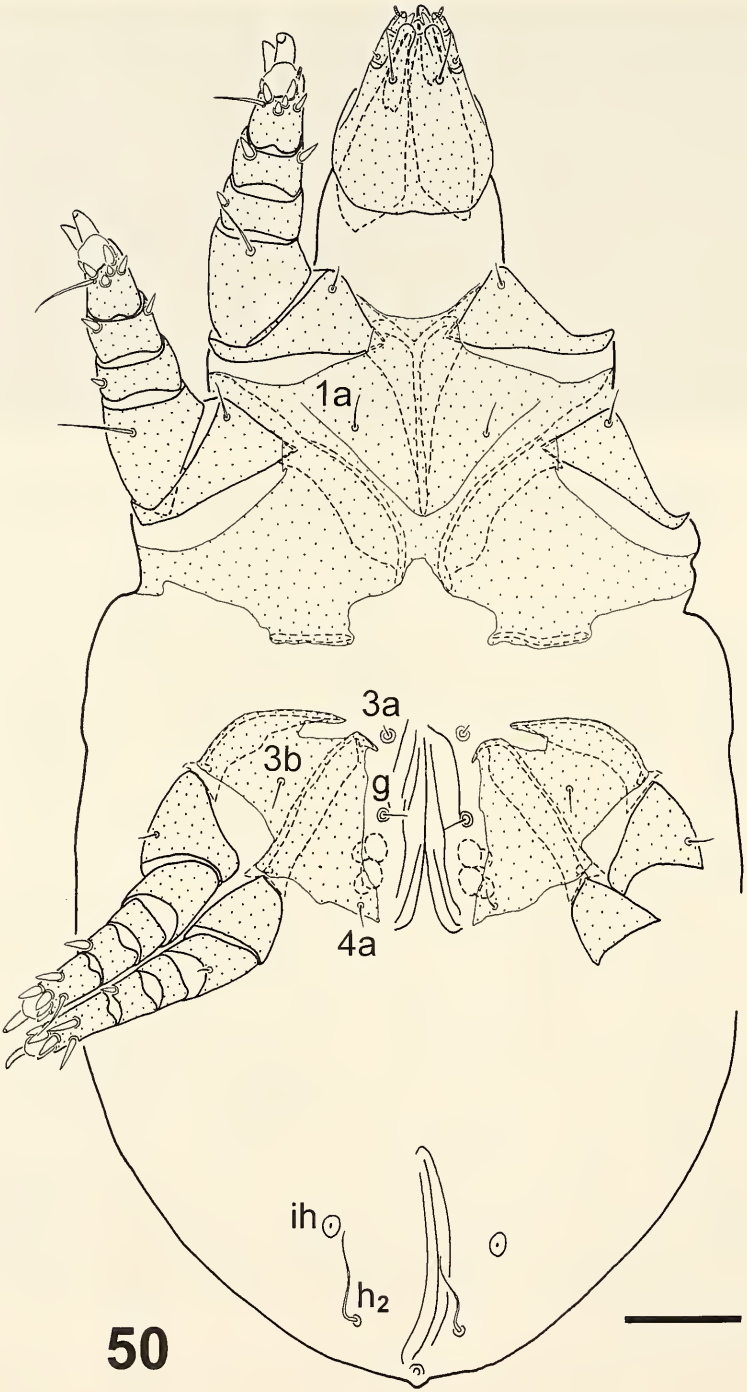


Fig. 50. Schwiebea nesbitti, female; ventral view, left legs partly omitted. – Scale bar: 30 µm.

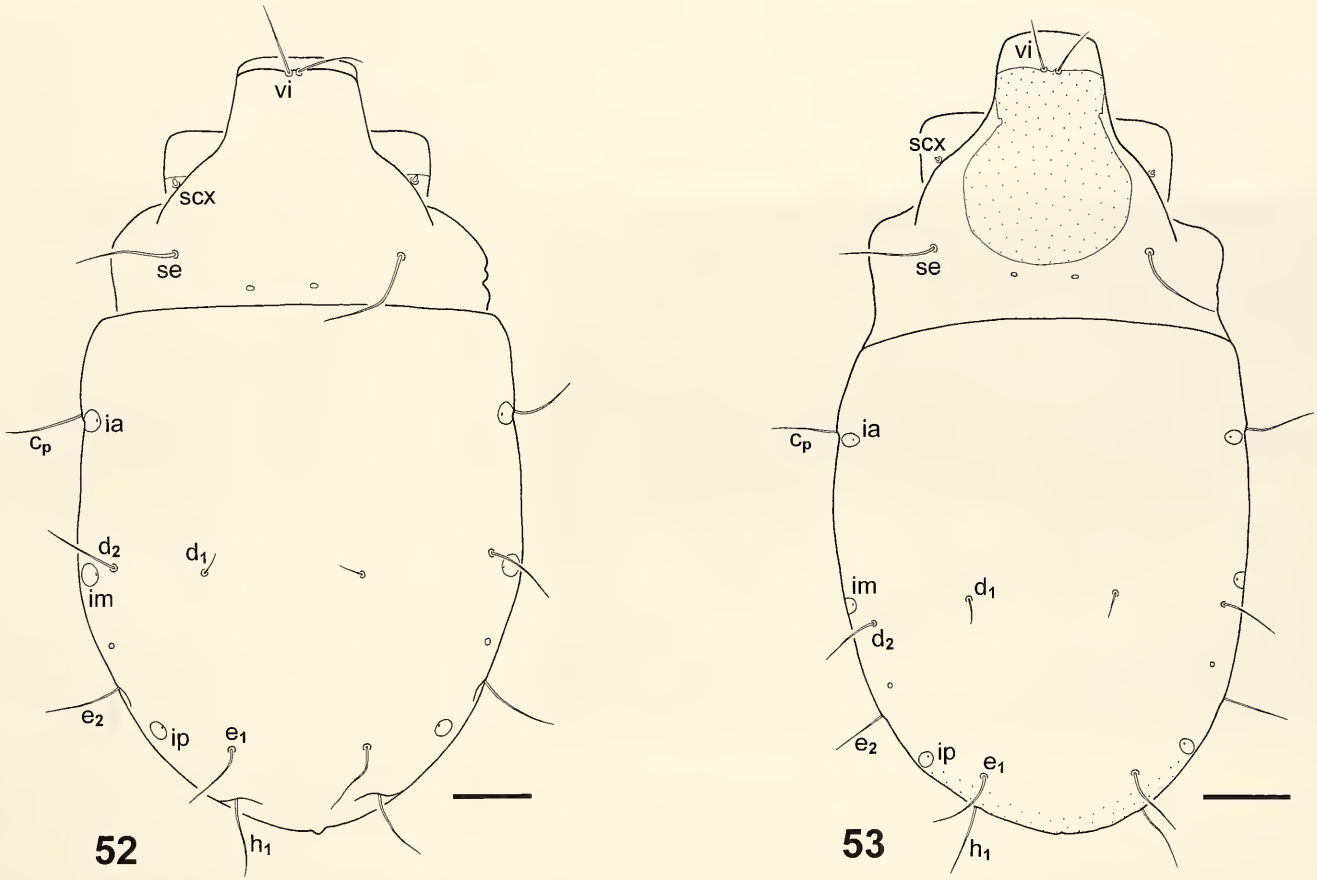
Fig. 51. Schwiebea nesbitti, female, ventral view; *A* = anus, *OP* = oviporus, *arrow*, inset: bursa copulatrix (scale bar inset: 5 µm). – Scale bar: 20 µm.

5.1.2.2. Drawings

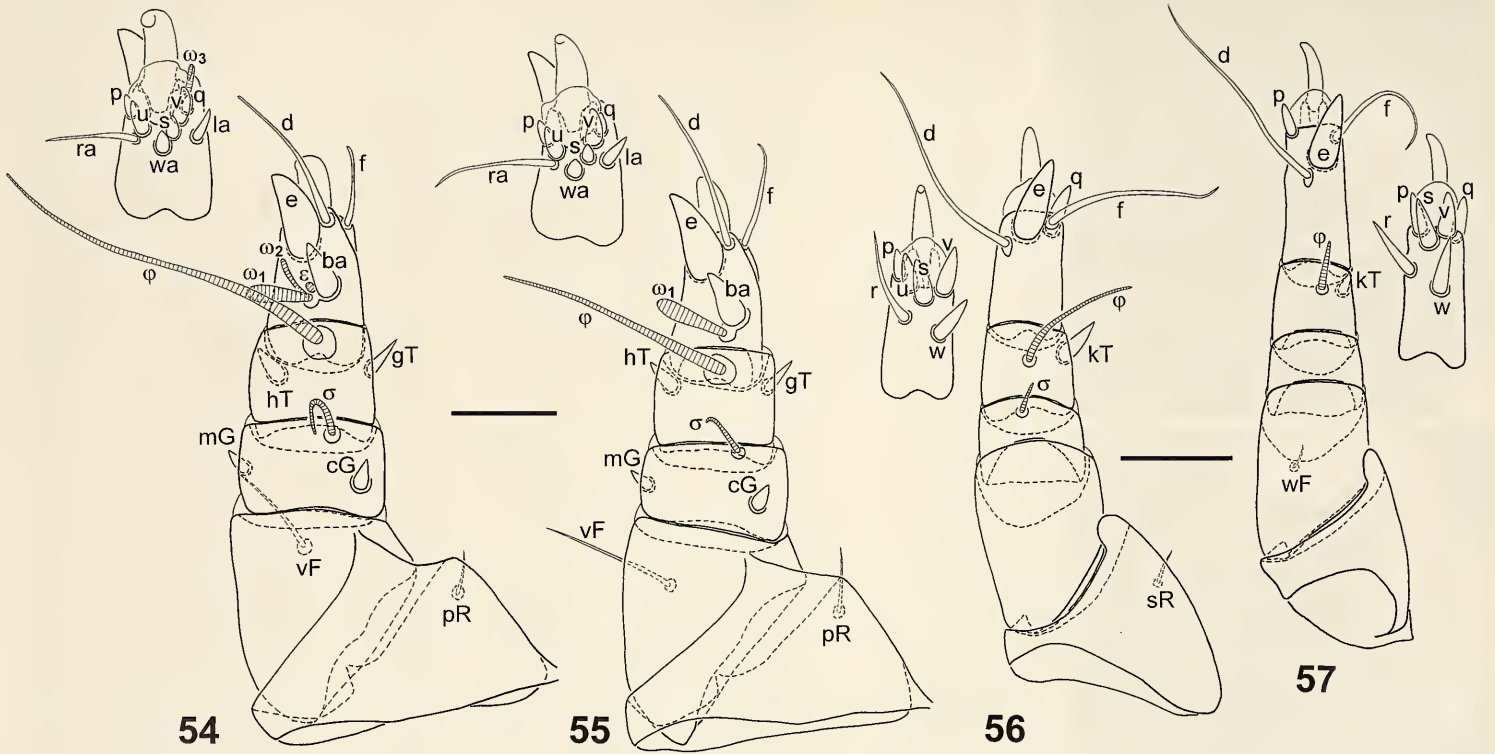
Also deposited in the National Museum of Natural History, Leiden (Netherlands) are two sheets of paper with hitherto unpublished drawings by OUDEMANS. They are reproduced here in 48 per cent of their original size (Figs. 2–3). Hand-written notes by OUDEMANS on the back of the sheets translate as follows:

Fig. 2: (1388) "July 7th 1915. Schwiebea talpa Oudms ×360, ♀. The dotted part is hard (a shield). Also the part without setae on the dorsum between the bristles ist hard, rigid, leathery, does not wrinkle, yet is not a 'shield' (marked by dots). Besides the pair of excretory pores [openings of the oil glands] one can see another 3 pairs of ringlets which are by no means seta-ringlets [sockets of setae]. Probably dermal glands?? I can't see openings!"

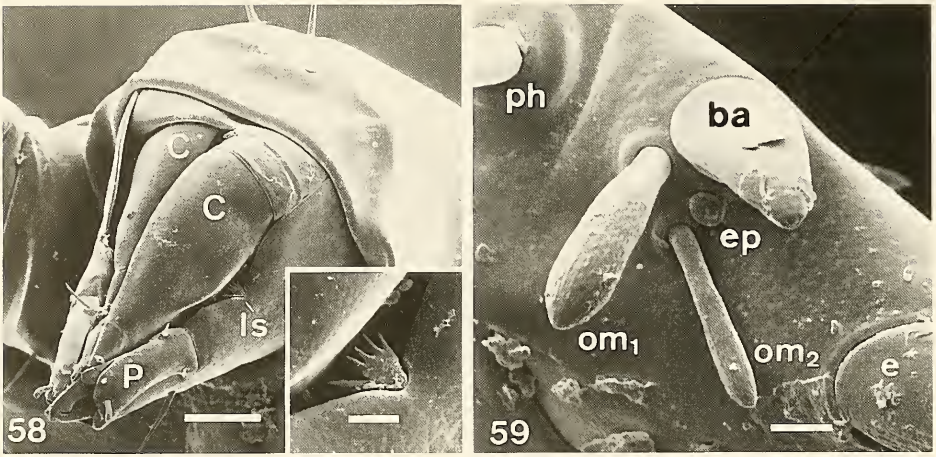
Fig. 3: (1389) "May 24th 1923. Schwiebea talpa Oudms 1906, ♀. Rotten leaves, Bonn. After receiving Vitzthum's presumption that Schwiebea talpa is supposed to be identical with Rhizoglyphus echinopus I have drawn additional details at the same time as I did on Rhizoglyphus echinopus ♀. – Fig. 1. Maxillae und hypostome, ventral view, ×1220. – The maxillicoxae are fused with the hypostome over their whole length. Also visible are the hypopharynx shaped like a hock-flask and dito epipharynx. – Fig. 2. Mandibula, ventral view, ×1220. – The left (now right) one is somewhat rotated. Peculiar are the strangely shaped lobes; one of



Figs. 52–53. Schwiebea nesbitti. – 52. Female; idiosoma, dorsal view (scale bar: 30 µm): – 53. tritonymph; idiosoma, dorsal view (scale bar: 30 µm).



Figs. 54–57. Schwiebea nesbitti, female. – 54. Leg I; – 55. leg II (scale bar Figs. 54 and 55: 15 µm); – 56. leg III; – 57. leg IV (scale bar Figs. 56 and 57: 15 µm). – Legs are shown in dorsal view. In addition, the insert shows the tarsus from the opposite side.



Figs. 58–59. Schwiebea nesbitti, female. – 58. Gnathosoma (scale bar: 10 µm); *C* = chelicera, *P* = palp, *ls, inset* = laterocoxal seta (scale bar inset: 2 µm); – 59. detail of leg I showing the complex of solenidia on tarsus; *ba, e*: setae, *ep* = famulus epsilon, om_1 = solenidion omega 1, om_2 = solenidion omega 2, *ph* = solenidion phi of tibia (scale bar: 2 µm).

them strongly chitinized, on the digitus mobilis; the other one, at distal end of genu, is membranous. Also visible the biting organ. – Fig. 3. Left tarsus I (now right) from ventrally (see fig. 2 of previous plate [Fig. 2, above right] × 1220. Somewhat oblique, therefore too short! – No caruncle [membranous pretarsus]!"

5.2. Redescription of *Schwiebea talpa* Oudemans, 1916

Schwiebea talpa Oudemans (1916): Entomologische Berichten 4 (88): 265 [near Bonn, Germany].

Schwiebea cavernicola Türk & Türk (1957) [non Vitzthum, 1932]: Systematik und Ökologie der Tyroglyphiden Mitteleuropas. – *In:* Stammer, H.-J. (ed.): Beiträge zur Systematik und Ökologie mitteleuropäischer Acarina. – Vol. 1 Tyroglyphidae und Tarsonemini: 126–129.

All idiosomal setae smooth; length of d_1 and d_2 approximately equal in all non-hypopial instars; all non-hypopial instars with demarcated propodosomatal shield; mG thin in all non-hypopial instars except larva; genu I with one solenidion only.

5.2.1. Adults

5.2.1.1. Male (homeomorphic)

Length of idiosoma about 275 µm, colour: beige.

Dorsum (Fig. 5): Idiosomal chaetome: scx, vi, se, c_p, d_1, d_2, e_1, ia, im, ip. – Propodosomatal shield without indentation at posterior margin; d_1 and d_2 short (about 10 µm); with opisthosomatal shield between e_1.

Ventrum (Fig. 4): Idiosomal chaetome: 1a, 3a, 3b, 4a, g, e_2, h_1, h_2, ps_1, ps_2, ps_3, ih. – Sternum and epimera II and IV covered by lobed sclerotized areas, epimera III only in their distal region covered by a sclerotized patch; a sclerotized band also follows the border between proterosoma and hysterosoma. – Aedeagus (Figs. 13–15)

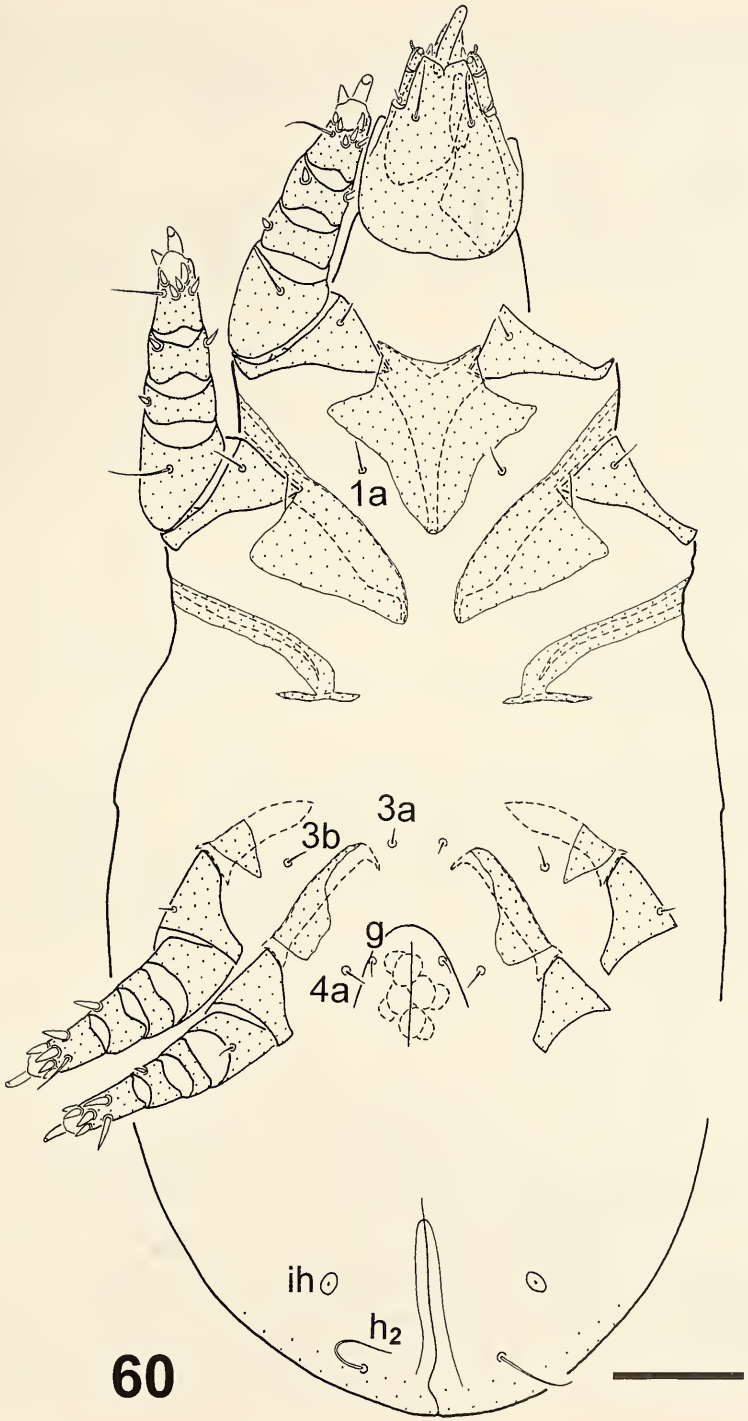
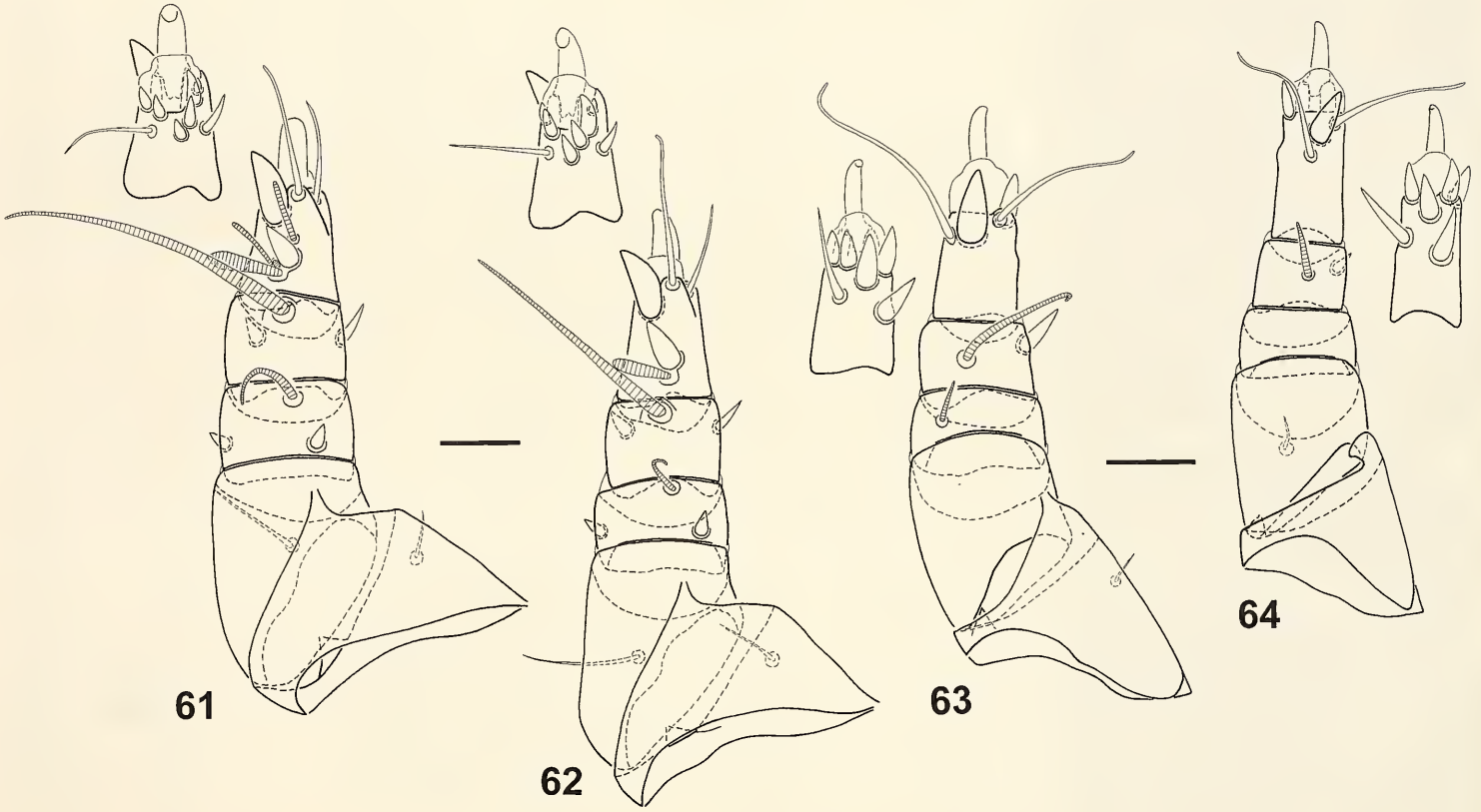


Fig. 60. Schwiebea nesbitti, tritonymph; ventral view, left legs partly omitted. – Scale bar: 30 µm.



Figs. 61–64. Schwiebea nesbitti, tritonymph. – 61. Leg I; – 62. leg II (scale bar Figs. 61 and 62: 10 µm); – 63. leg III; – 64. leg IV (scale bar Figs. 63 and 64: 10 µm). – Legs are shown in dorsal view. In addition, the insert shows the tarsus from the opposite side.

strongly sclerotized, hidden under genital folds forming a triangle; one pair of adanal copulatory suckers (Fig. 11). – ps_3 short and fine, ps_1 and ps_2 short spines.

Legs (Figs. 7–10, 12): Chaetome see Table 1; ω_1 gradually tapering towards its base.

5.2.1.2. Female

Length of idiosoma about 325 µm, colour: beige.

Dorsum (Figs. 6, 17, 20): Idiosomal chaetome: scx, vi, se, c_p, d_1, d_2, e_1, h_1, ia, im. – Propodosomatal shield without indentation at posterior margin; d_1 and d_2 short (about 10 µm); bursa copulatrix, inseminatory canal and receptaculum seminis (Fig. 29) sometimes missing.

Ventrum (Fig. 16): Idiosomal chaetome: 1a, 3a, 3b, 4a, g, e_2, h_2, ip, ih. – Sternum and epimera II and IV covered by lobed sclerotized areas, epimera III only partly covered with small sclerotized patches proximally and distally; a sclerotized band also follows the border between proterosoma and hysterosoma.

Legs (Figs. 21–27): Chaetome see Table 1; ω_1 gradually tapering towards its base.

5.2.2. Tritonymph

Length of idiosoma about 275 µm, colour: white, end of opisthosoma brownish (indicating a slight sclerotization).

Dorsum (Fig. 32): Idiosomal chaetome: scx, vi, se, c_p, d_1, d_2, e_1, ia, im. – Propodosomatal shield with indentation at its posterior margin; d_1 and d_2 short (about 8 µm).

Ventrum (Figs. 18–19, 31): Idiosomal chaetome: 1a, 3a, 3b, 4a, g, e_2, h_1, h_2, ip, ih. – Sclerotized area covering the sternum with deep indentation at its posterior end; lobed sclerotized area of epimera II with an unsclerotized zone; epimera III and IV with sclerotized patches at their distal end; a sclerotized band also follows the border between proterosoma and hysterosoma.

Legs (Figs. 18, 34–37): Chaetome see Table 1.

5.2.3. Deutonymph

Not found.

5.2.4. Protonymph

Length of idiosoma about 185 µm, colour: white.

Dorsum (Fig. 33): Idiosomal chaetome: scx, vi, se, c_p, d_1, d_2, e_1, h_1, ia, im, ip. – Propodosomatal shield with indentation at its posterior margin; d_1 and d_2 short (about 6 µm).

Ventrum (Fig. 38): Idiosomal chaetome: 1a, 3b, g, e_2, h_2, ih. – Sclerotized areas covering the sternum and epimera II with deep indentation at posterior end; epimera III and IV with sclerotized patches at their distal end; a sclerotized band also follows the border between proterosoma and hysterosoma.

Legs (Figs. 39–42): Chaetome see Table 1.

5.2.5. Larva and Egg

Length of idiosoma about 145 µm, colour: white.

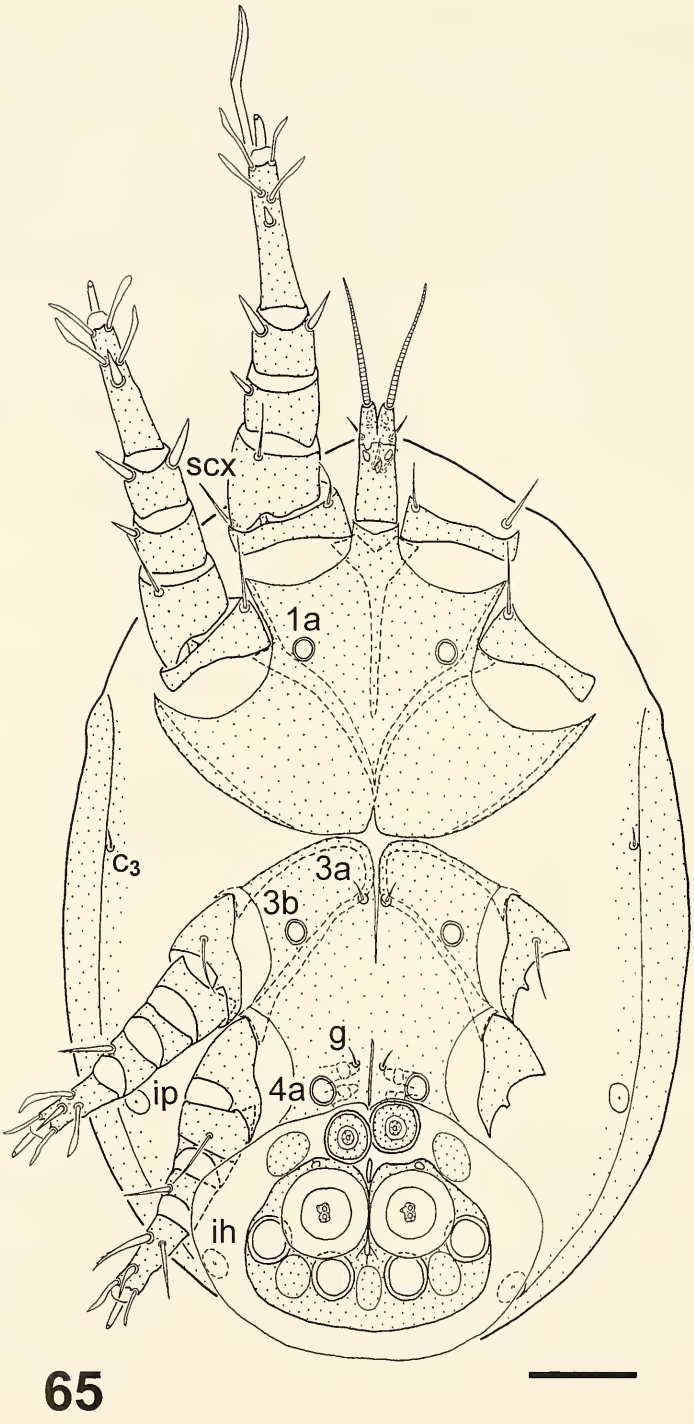
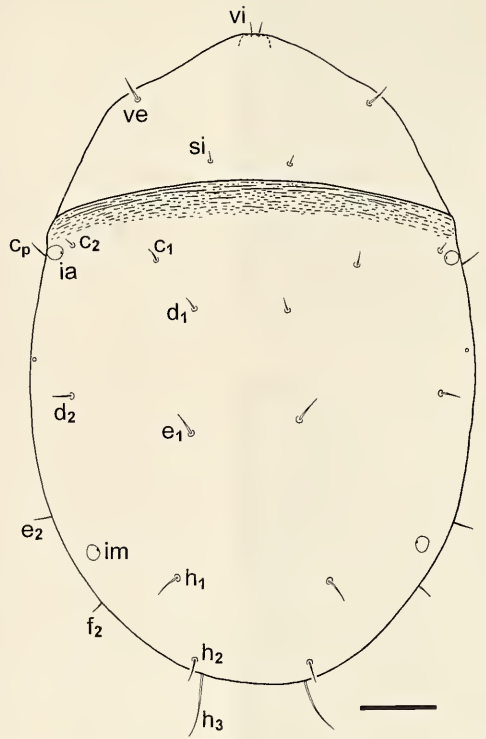
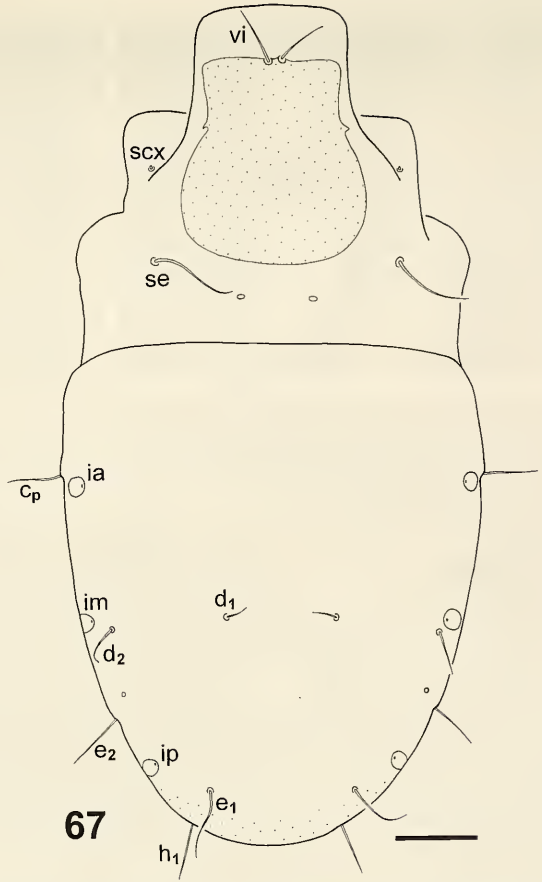
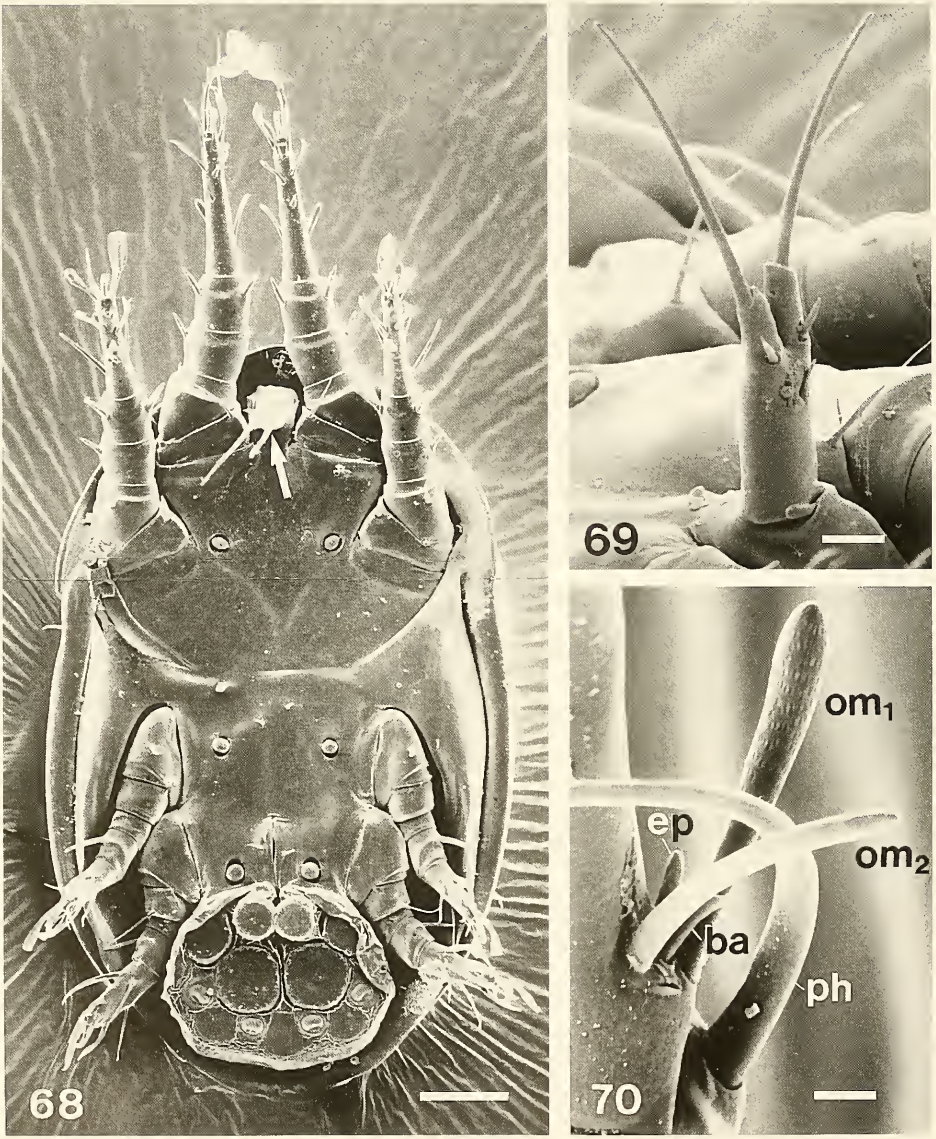


Fig. 65. Schwiebea nesbitti, deutonymph; ventral view, left legs partly omitted. – Scale bar: 20 µm.





Figs. 66–67. Schwiebea nesbitti. – 66. Deutonymph; idiosoma, dorsal view (scale bar: 20 µm); – 67. protonymph; idiosoma, dorsal view (scale bar: 20 µm).



Figs. 68–70. Schwiebea nesbitti, deutonymph. – 68. Ventral view; palposoma *(arrow)* is bent forwards (scale bar: 20 µm); – 69. palposoma in dorsolateral view (scale bar: 5 µm); – 70. detail of leg I showing the complex of solenidia on tarsus; *ba*: seta, *ep* = famulus epsilon, om_1 = solenidion omega 1, om_2 = solenidion omega 2, *ph* = solenidion phi of tibia (scale bar: 2 µm).

Dorsum (Fig. 44): Idiosomal chaetome: scx, vi, se, d_1, d_2, e_1, ia, im, ip. – Propodosomatal shield with indentation at its posterior margin; d_1 and d_2 short (about 5 µm).

Ventrum (Fig. 43): Idiosomal chaetome: 1a, c_p, 3b, e_2, h_2, ih. – Sclerotized area covering the sternum with deep indentation at its posterior end; epimera II covered with a small sclerotized patch at distal end; coxal field of leg III without sclerotiza-

Table 1. Chaetotactic formulae for setae and solenidia of the legs of *Schwiebea talpa* and Schwiebea nesbitti.

Setae				
	leg I	leg II	leg III	leg IV
larva	12. 2. 2. 1. 0	12. 2. 2. 1. 0	10. 1. 0. 0. 0	–
protonymph	12. 2. 2. 1. 0	12. 2. 2. 1. 0	10. 1. 0. 0. 0	7. 0. 0. 0. 0
deutonymph*)	9. 2. 2. 1. 1	9. 2. 2. 1. 1	8. 1. 0. 0. 1	8. 1. 0. 1. 0
tritonymph	12. 2. 2. 1. 1	12. 2. 2. 1. 1	10. 1. 0. 0. 1	10. 1. 0. 1. 0
adults	12. 2. 2. 1. 1	12. 2. 2. 1. 1	10. 1. 0. 0. 1	10. 1. 0. 1. 0
Solenidia				
	leg I	leg II	leg III	leg IV
larva	1 + ε. 1. 1. 0. 0	1. 1. 1. 0. 0	0. 1. 1. 0. 0	–
protonymph	2 + ε. 1. 1. 0. 0	1. 1. 1. 0. 0	0. 1. 1. 0. 0	0. 0. 0. 0. 0
deutonymph*)	2 + ε. 1. 1. 0. 0	1. 1. 1. 0. 0	0. 1. 0. 0. 0	0. 1. 0. 0. 0
tritonymph	3 + ε. 1. 1. 0. 0	1. 1. 1. 0. 0	0. 1. 1. 0. 0	0. 1. 0. 0. 0
adults	3 + ε. 1. 1. 0. 0	1. 1. 1. 0. 0	0. 1. 1. 0. 0	0. 1. 0. 0. 0

*) applies only to S. nesbitti

tion; a sclerotized band also follows the border between proterosoma and hysterosoma. With prominent Claparède organs (Fig. 90).

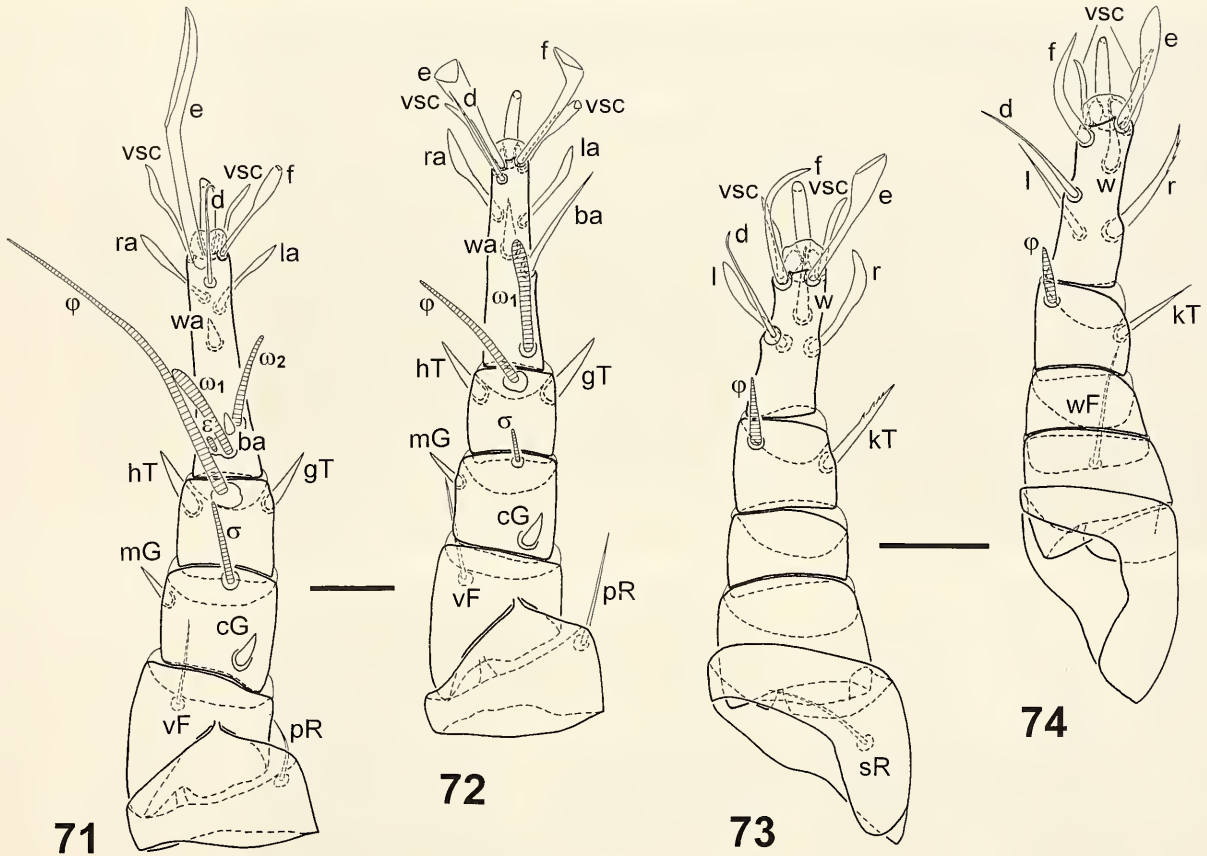
Legs (Figs. 28, 45–47): Chaetome see Table 1.

Egg (Figs. 48–49): Length about 115 µm; surface covered with small "knobs".

5.2.6. Remarks

Males were exceedingly rare in the central European populations of *Schwiebea talpa* investigated by us. Only one male each was found in the material from localities No. 1a and No. 16a. Males were more frequent in the population from Tenerife, but still were clearly in the minority compared to the number of females. Fain (1976a, 1977) also mentioned the unequal distribution of sexes in *S. talpa:* In a sample from a Berlese trap made up from fallen leaves from a small forest near Chimay (Belgium) there were only 4 males among the approximately 100 adults. This lack of males is accompanied by the absence of the copulatory opening and all appendages (inseminatory canal, receptaculum seminis) in numerous females of all populations. The only exception is the population from Tenerife. There, all females investigated (n = 24) possessed the complete set of copulatory organs.

Heteromorphic males were never found by us. This corresponds to the observations made by Fain (1976a, 1977), who also found exclusively homeomorphic males of *S. talpa.* However, Hughes (1957: Figs. 7–8) shows a heteromorphic male in two of her figures, and Türk & Türk (1957: Fig. 78) also depict a heteromorphic male. In both these cases, genu I shows only one solenidion and the propodosomatal shield is shown as having a smooth posterior margin. This discrepancy between Fain's (1976a, 1977) and our findings and the apparent presence of heteromorphic males in the populations studied by Hughes (1957) and Türk & Türk (1957) could not be solved by a reexamination of the specimens from the Türk collection, because it



Figs. 71–74. Schwiebea nesbitti, deutonymph. – 71. Leg I; – 72. leg II (scale bar Figs. 71 and 72: 10 µm); – 73. leg III; – 74. leg IV (scale bar Figs. 73 and 74: 10 µm).

contains only two females (the first originally labeled "Schwiebea nova (?)", the other one without original labeling). Slide preparations which could have been served as base for the description of the heteromorphic male do not exist.

The development of deutonymphs in *S. talpa* was never observed in spite of intensive rearing efforts with mites of two different populations. FAIN (1977), after investigating material from several localities concludes that this species apparently lacks a hypopus. In their work on *S. cavernicola* (= *S. talpa*), TÜRK & TÜRK (1957) describe a hypopus, yet in the text they do not refer to rearing experiments which could justify such a reference. This hypopus is documented in the TÜRK collection by two specimens (one is originally labeled "Schwiebea talpa", the other one "Saproglyphus neglectus"), but both do not contain notes on either locality or date. We also found this hypopus, though very rarely. The two specimens discovered during the last ten years, however, were preserved without prior attempts to induce further development. BUGROV (1996) reports on the presence of adults of *S. talpa* under the elytra of a carabid beetle (*Carabus jankovskii*). This finding, suggesting a phoretic behaviour, represents a "pure accident for that species" according to S. BUGROV (pers. commun.).

5.3. Habitats of *Schwiebea talpa*

We found *S. talpa* in a variety of substrates: Under bark of old wood, in treestumps, in fallen leaves. For food, this species apparently prefers faeces of other destruents (e.g. larvae of mycetophilids). As habitat for *S. talpa,* TÜRK & TÜRK (1957) report rotten wood, leave litter, ground water and dens of mole. FAIN (1977, 1982) reports them from leave litter, sphagnum moss, humous soil, peat soil, ground water and a den of mole.

In the literature one finds many different actual or alleged habitats of *S. talpa.* We are not able, though, to assess whether the species mentioned actually belong to *S. talpa.* For those interested, FAIN (1977) gives a compilation of references. As reliable informations on the habitats of *S. talpa* we only consider the informations by FAIN (1977, 1982) and FAIN & WAUTHY (1979) and the habitat description provided on the labels of the OUDEMANS collection. The numbers below refer to the numbers in chapter 2.1. and in Fig. 1.

5.3.1. Specimens of the OUDEMANS Collection

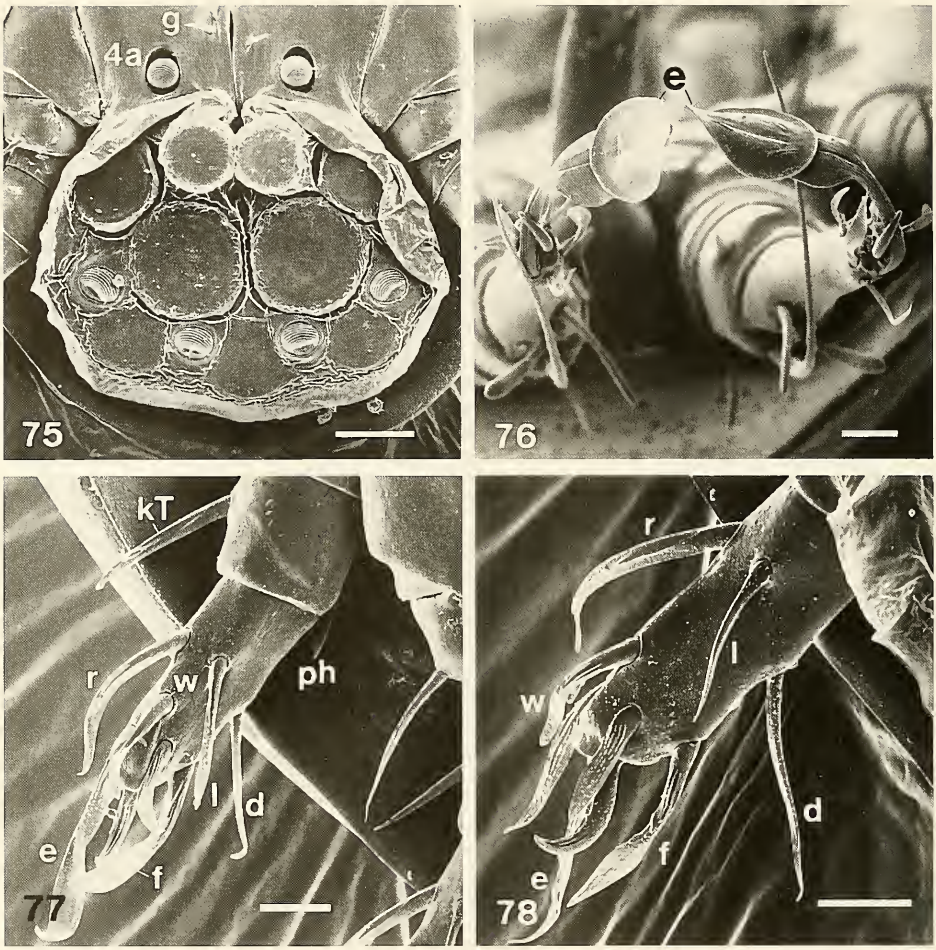
No. 19: 07.1901. 1 ♀, near Bonn; in rotten leaves. – **No. 20:** 10.1928. 3 ♀♀, Schonen (South Sweden), pine forest; in humous soil.

5.3.2. Own Collections

Nos.: 1a, 2, 3, 5b, 5e, 5g, 6, 7, 8, 9, 12, 13, 14, 15, 16, 17, 18, and Tenerife.

5.3.3. Habitat Description from the Literature

Belgium – No. 21: 10.73, 06.76, 10.76. Bois de Blanches Roches near Bohan (south of Gedinne); (FAIN & WAUTHY 1979). – **No. 22:** a) autumn 74, 06.76, 10.76. Bois de Croij near Culdes-Sarts (south of Couvin); (FAIN & WAUTHY 1979); b) 25.05.75. Chimay west of Couvin; under fallen leaves of a forest (FAIN 1977). – **No. 23:** a) 10.75, 06.76, 10.76: Bois de Broquefosse near Thynes (at Dinant); (FAIN & WAUTHY 1979); b) 10.75, 06.76, 10.76. Vallée du Ruisseau de Crupet near Crupet (at Namur); (FAIN & WAUTHY 1979); c) 10.75, 06.76, 10.76. Bois



Figs. 75–78. Schwiebea nesbitti, deutonymph. – 75. The so–called sucker plate at the end of opisthosoma; g, *4a*: setae (scale bar: 10 µm); – 76. legs I showing the adhesive setae *(e)* (scale bar: 5 µm); – 77. tibia and tarsus of leg III; *ph* = solenidion phi of tibia, *d, e, f, kT, l, r, w*: setae (scale bar: 5 µm); – 78. tarsus of leg IV; *d, e, f, l, r, w*: setae (scale bar: 5 µm).

de Sanzinne near Houyet (at Dinant); (Fain & Wauthy 1979); d) autumn 73, 06.76, 10.76. Bois Marli near Annevoie (at Namur); (Fain & Wauthy 1979); e) 10.75, 06.76, 10.76. Bois de Grand Pré near Courrière (at Namur); (Fain & Wauthy 1979). – **No. 24:** a) autumn 74, 06.76, 10.76. La Taille à Franes near Ham-sur-Heure (south of Charleroi); (Fain & Wauthy 1979); b) autumn 74, 06.76, 10.76. Bois de Louvroi near Tarciennes (south of Charleroi); (Fain & Wauthy 1979). – **No. 25:** a) autumn 74, 06.76, 10.76. Bois de Montreuil near Eugies (at Dour); (Fain & Wauthy 1979); b) autumn 74, 06.76, 10.76. Bois d'Angre near Angre (at Dour); (Fain & Wauthy 1979). – **No. 26:** 10.75, 06.76, 10.76. Bois de l'Hôpital near Arquennes (at Nivelles); (Fain & Wauthy 1979). – **No. 27:** a) autumn 74, 06.76, 10.76. Bois de Grand-Leez (near Gembloux); (Fain & Wauthy 1979); b) 04.74. Louvain-La-Neuve; in humous soil (Fain 1977). – **No. 28:** a) 10.75, 06.76, 10.76. Bois "Fond-de-Marche" near Marche-Les-Dames (at Namur); (Fain & Wauthy 1979); b) autumn 74, 06.76, 10.76. Bois de Rée near Marneffe (at Huy); (Fain & Wauthy 1979). – **No. 29:** a) 22.04.61. La Roche-en-Ardenne (east of Marche-en-Famenne); in sphagnum moss (Fain 1977); b) 10.73, 06.76, 10.76. Bois du Pays near Sâdzo (at Erezée);

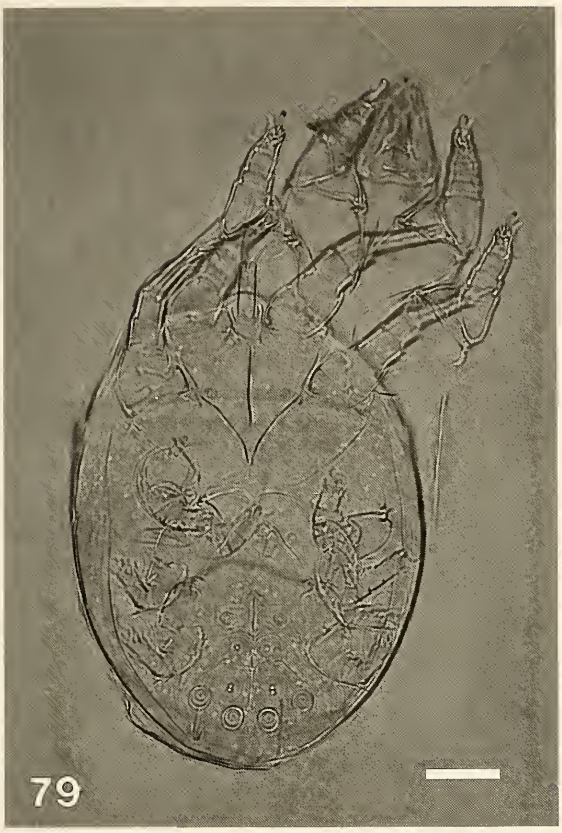


Fig. 79. Schwiebea nesbitti; deutonymph during hatching, enclosed in protonymphal exuvia (light micrograph). – Scale bar: 25 µm.

(Fain & Wauthy 1979); c) autumn 74, 06.76, 10.76. Bois de Chevémont near Malempré; (Fain & Wauthy 1979); d) 10.75, 06.76, 10.76. Les Anciennes Tourbières de Roûmont near Dochamps; (Fain & Wauthy 1979). – **No. 30:** 14.04.74. Hautes Fagnes near Liège; in peat soil (Fain 1977). – **No. 31:** a) autumn 74, 06.76, 10.76. Veursbos near Fouron-St.-Martin (north of Verviers); (Fain & Wauthy 1979); b) 10.73, 06.76, 10.76. Hertogenwald east of Liège; (Fain & Wauthy 1979); c) 10.73, 06.76, 10.76. Region of Brachkopf near Eupen; (Fain & Wauthy 1979). – **No. 32:** a) 25.10.75. Parc de Woluwé (Brussels); in fallen leaves (Fain 1977); b) 03.11.75. Forêt de Meerdael near Tervuren (at Brussels); in fallen leaves (Fain 1977). – **No. 33:** 20.04.68. Lichtaart (Antwerpen); in humous soil (Fain 1977). – **No. 34:** 1972. Gent; in a den of mole (Fain 1977). – **No. 35:** autumn 74; 06.76, 10.76. Vrijbos near Houthulst (at Roeselare west Gent); (Fain & Wauthy 1979).

France – No. 36: 17.03.67. Wintzenheim near Colmar (Fain 1977). – **No. 37:** 22.04.68. Forêt de Sedan (Fain 1977). – **No. 38:** 05.05.64. Forêt de la Chaux (southeast of Dijon) (Fain 1977). – **No. 39:** a) 09.12.1963. Between Longecourt-en-Plaine and Corcelles-lès-Cîteaux (south of Dijon); in forest soil and soil litter (Fain 1977); b) 31.05.64. Ternant, Bois de Chavigny (south of Dijon) (Fain 1977). – **No. 40:** 29.09.64. Blaisy-Haut (west of Dijon); in meadow (Fain 1977). – **No 41:** a) 30.05.67. St.-Agnan; in soil litter in forest (northwest of Autun) (Fain 1977); b) 30.05.67. Brassy (northwest of Autun) (Fain 1977). – **No. 42:** 23.02.64. Forêt de la Serra (Jura); in humous soil of forest under fallen leaves (Fain 1977). – 20.05.67. Sonne, Vallée du Goulat (Nièvre) (Fain 1977).

England – In a den of mole (Fain 1977).

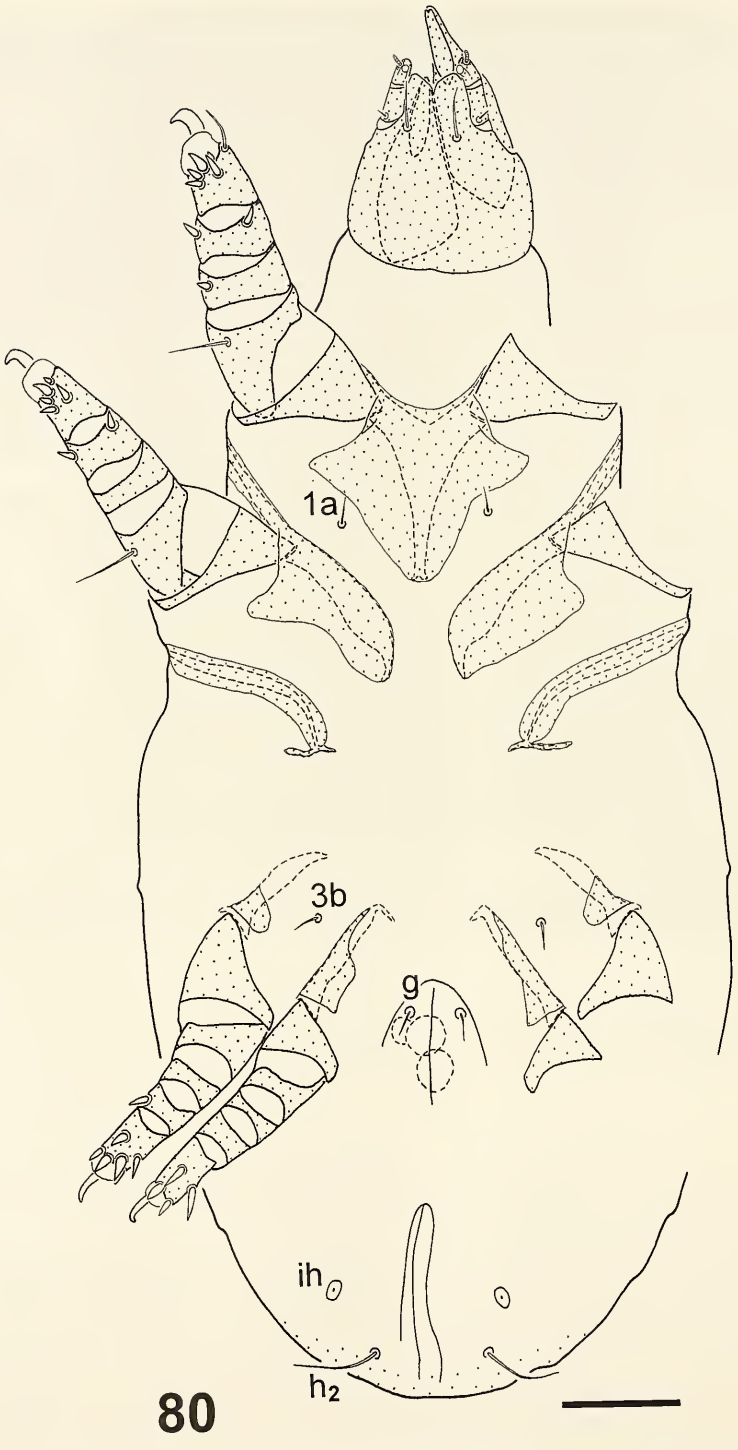
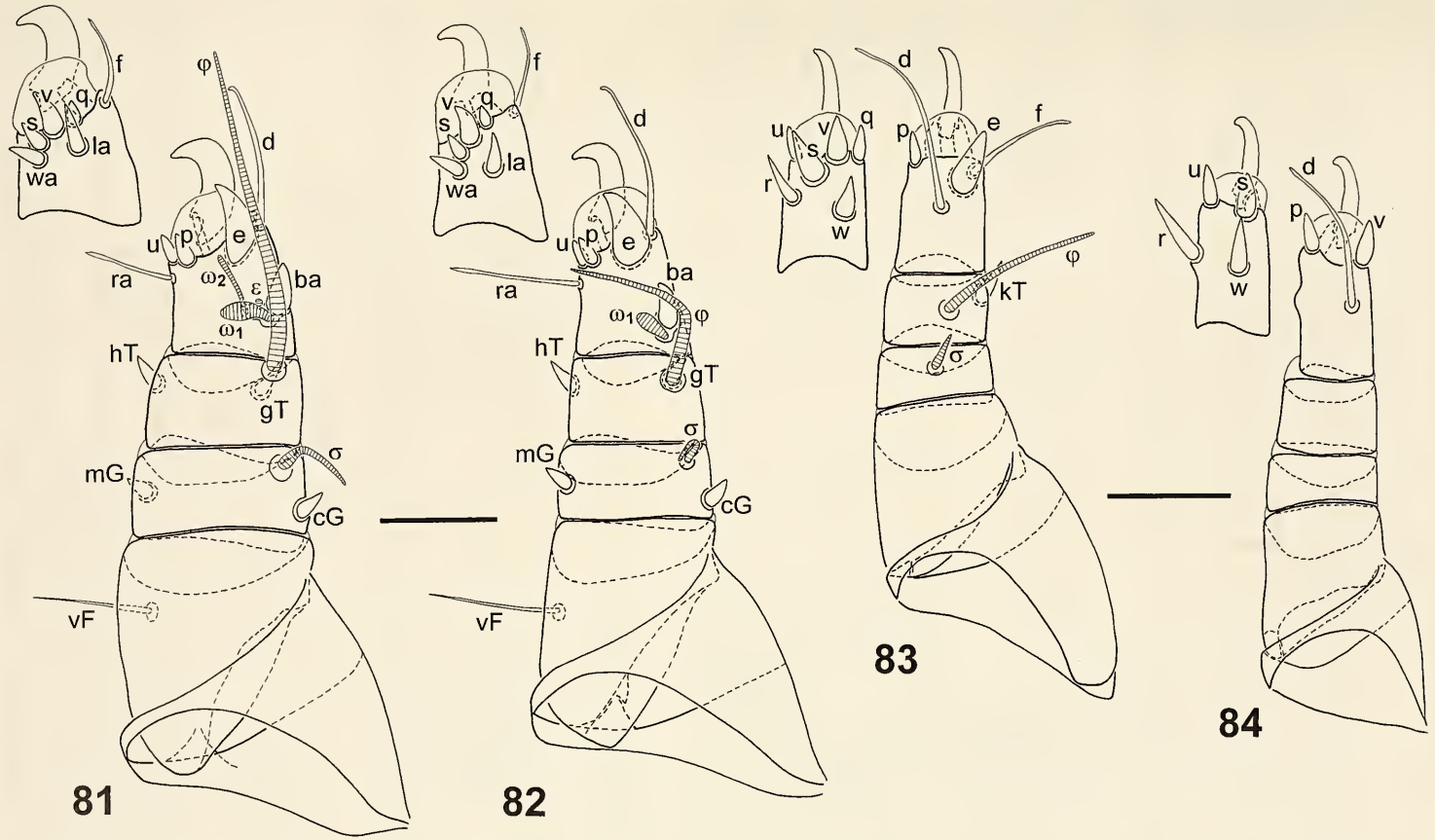


Fig. 80. Schwiebea nesbitti, protonymph; ventral view, left legs partly omitted. – Scale bar: 20 µm.



Figs. 81–84. Schwiebea nesbitti, protonymph. – 81. Leg I; – 82. leg II (scale bar Figs. 81 and 82: 10 µm); – 83. leg III; – 84. leg IV (scale bar Figs. 83 and 84: 10 µm). – Legs are shown in dorsal view. In addition, the insert shows the tarsus from the opposite side.

6. The group of phena described as *Schwiebea nesbitti* Türk & Türk, 1957

6.1. Historical Record

The description by Türk & Türk (1957) is based on the deutonymph only.

Zachvatkin (1941) described *Schwiebea pachyderma* from a female specimen only. *S. pachyderma* was later repeatedly synonymized with *S. talpa* (Hughes 1957; Fain 1976a, 1977, 1982). The description by Zachvatkin (1941: 276), though, refers to characters that differentiate *S. pachyderma* uneqivocally from *S. talpa:*

"The cuticle is very dense, thicker than in other species of *Schwiebea* and indeed, than in all known species of Tyroglyphoidea; it is faintly coloured a dirty brown and there is no well-defined propodosomal shield."

Even if the Oudemans collection is not considered, a synonymy of *S. pachyderma* with *S. talpa* should not have been made, because Oudemans (1916b) in his genus diagnosis (see chapter 4.) especially stresses the presence of a deliminated propodosomatal shield!

From rearing experiments, we obtained all instars of a *Schwiebea.* Their deutonymphs correspond very well to the description as *S. nesbitti.* However, many of the characters seen in the females correspond to those described by Zachvatkin (1941) in his work on female *S. pachyderma.* In the Türk collection no specimen of *S. nesbitti* is present. The description by Türk & Türk (1957), however, is sufficient enough to refer the deutonymphs unequivocally to that "species". Unfortunately, a final decision if *S. pachyderma* is an older synonym of *S. nesbitti* is not possible, because the description by Zachvatkin (1941) is very poor and no specimens of the Zachvatkin collection are left (pers. commun. by S. Mironov, St. Petersburg).

6.2. Redescription of *Schwiebea nesbitti* as a Group of Phena in Ontogenetical Succession

Schwiebea nesbitti Türk & Türk (1957): Systematik und Ökologie der Tyroglyphiden Mitteleuropas. – *In:* Stammer, H.-J. (ed.): Beiträge zur Systematik und Ökologie mitteleuropäischer Acarina. – Vol. 1 Tyroglyphidae und Tarsonemini: 136 [Surroundings of Erlangen, Franken].

All idiosomal setae smooth; in all non-hypopial instars d_2 about twice the length of d_1; mG in all non-hypopial instars a thick spine; genu I with one solenidion only.

6.2.1. Adults

6.2.1.1. Male

Not found.

6.2.1.2. Female

Length of idiosoma about 315 µm, colour: dark brown, indicating a strong sclerotization.

Dorsum (Figs. 52, 58): Idiosomal chaetome: scx, vi, se, c_p, d_1, d_2, e_1, e_2, h_1, ia, im, ip. – Propodosomatal shield not discernible.

Ventrum (Figs. 50–51): Idiosomal chaetome: 1a, 3a, 3b, 4a, g, h_2, ih. – Coxal fields I and II covered by a continuous sclerotized area; coxal fields III and IV also

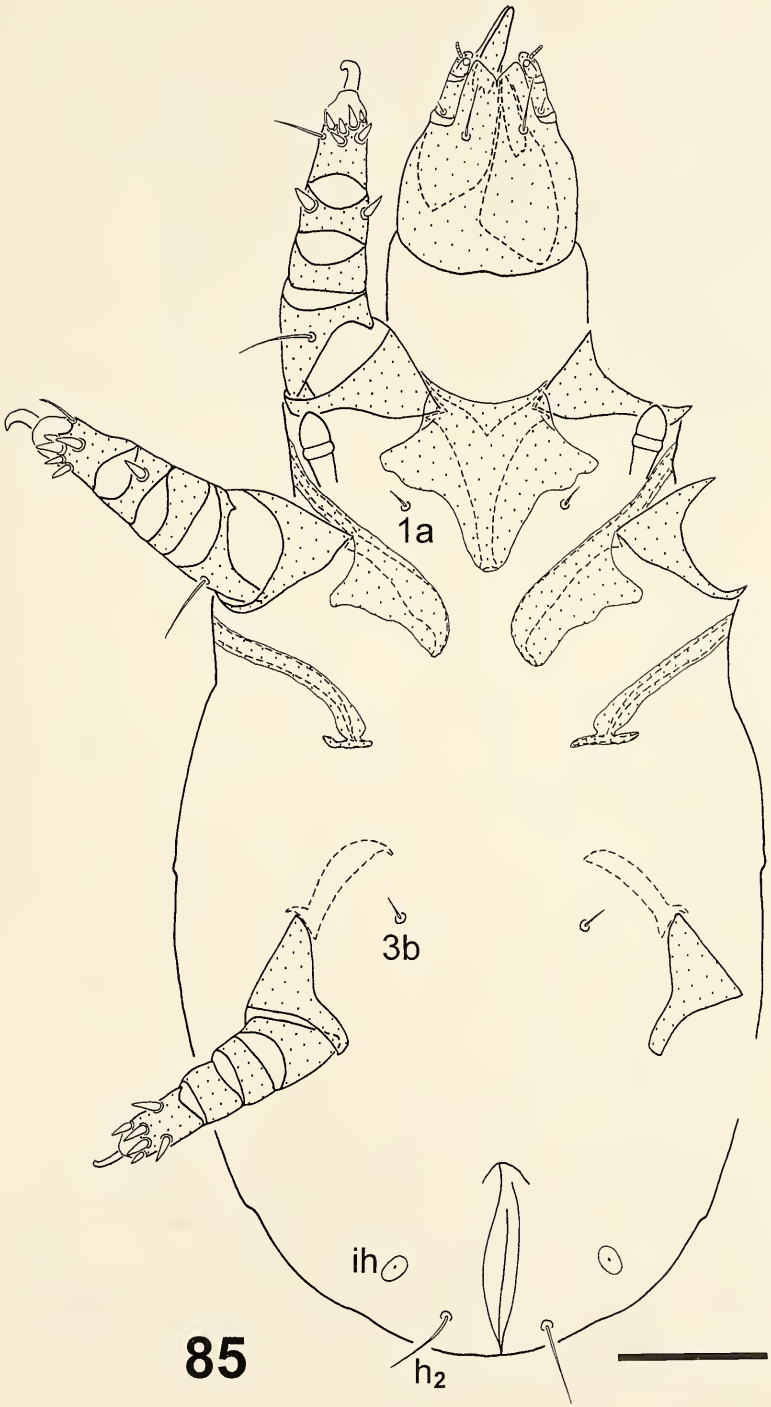


Fig. 85. Schwiebea nesbitti, larva; ventral view, left legs partly omitted. – Scale bar: 20 µm.

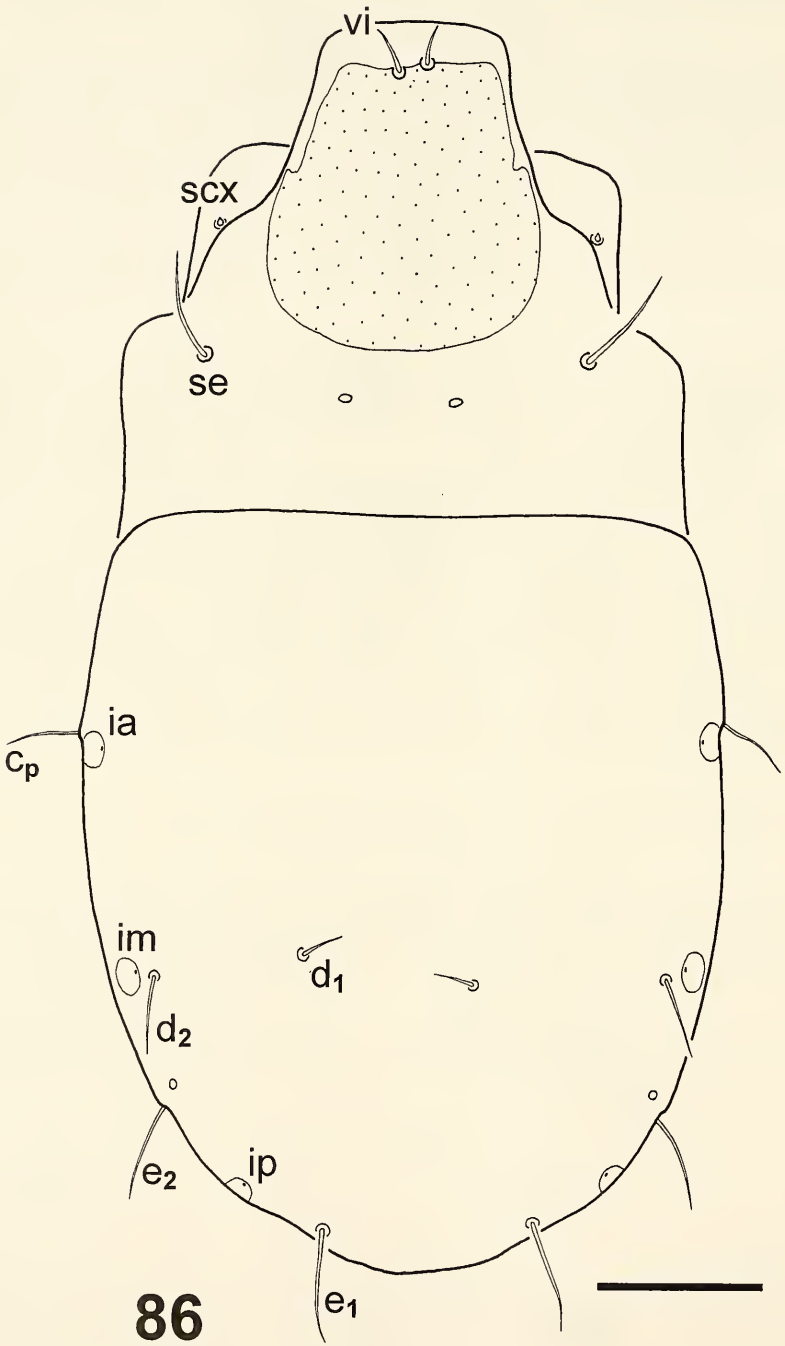
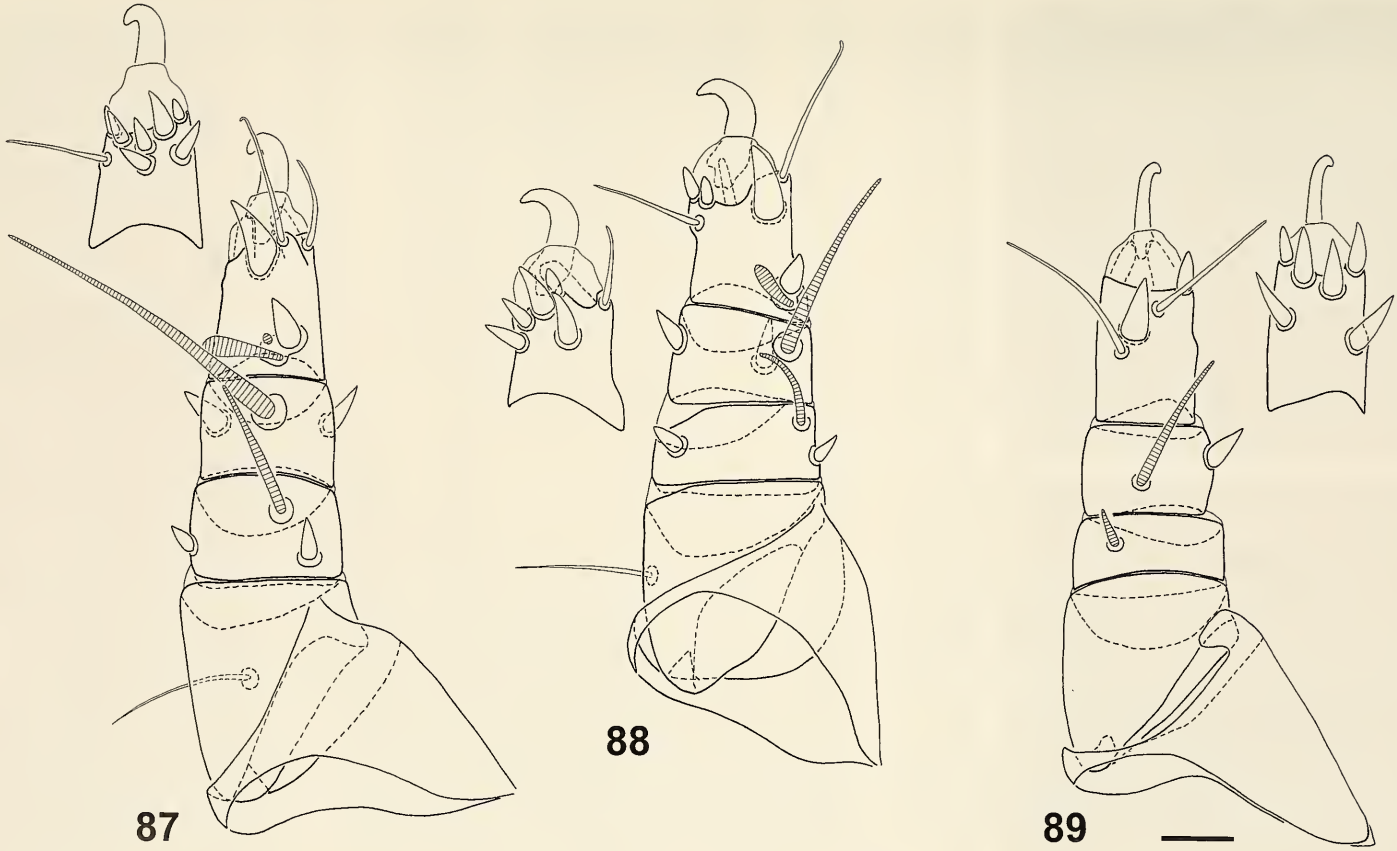
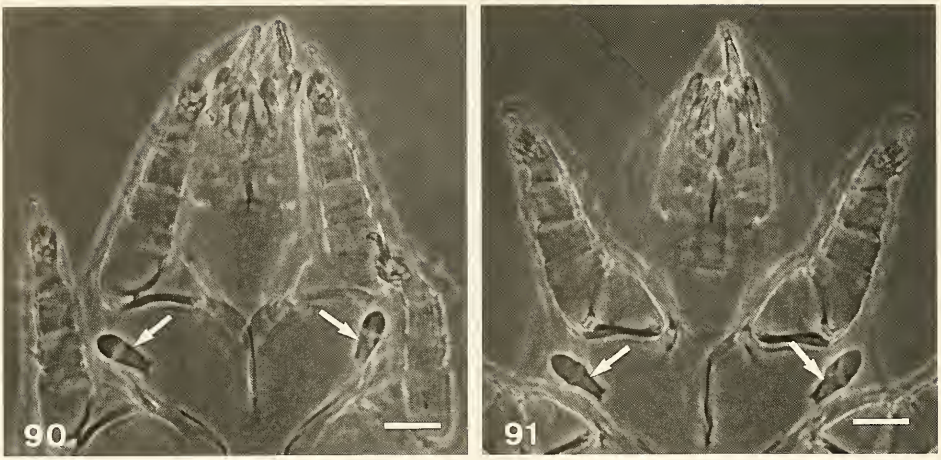


Fig. 86. Schwiebea nesbitti, larva; idiosoma, dorsal view. – Scale bar: 20 µm.



Figs. 87–89. Schwiebea nesbitti, larva. – 87. Leg I; – 88. leg II; – 89. leg III. – Legs are shown in dorsal view. In addition, the insert shows the tarsus from the opposite side. – Scale bar: 5 µm.



Figs. 90–91. 90. *Schwiebea talpa,* larva, proterosoma (light micrograph) showing Claparède organs *(arrows)* (scale bar 10 µm). – 91. Schwiebea nesbitti, larva, proterosoma (light micrograph) showing Claparède organs *(arrows)* (scale bar: 10 µm).

covered by a continuous sclerotized area, only interrupted by the oviporus. Bursa copulatrix (Fig. 51) immediately behind anal opening; for receptaculum seminis and appendages see Fig. 30.

Legs (Figs. 54–57, 59): Chaetome see Table 1. ω_1 gradually tapering towards its base.

6.2.2. Tritonymph

Length of idiosoma about 250 µm, colour: white, end of opisthosoma brownish (indicating a slight sclerotization).

Dorsum (Fig. 53): Idiosomal chaetome: scx, vi, se, c_p, d_1, d_2, e_1, e_2, h_1, ia, im, ip. – Propodosomatal shield with smooth margin posteriorly.

Ventrum (Fig. 60): Idiosomal chaetome: 1a, 3a, 3b, 4a, g, h_2, ih. – Sternum and epimera II and IV covered by lobed sclerotized areas, epimera III only in their distal region covered with a sclerotized patch; a sclerotized band also follows the border between proterosoma and hysterosoma.

Legs (Figs. 61–64): Chaetome see Table 1.

6.2.3. Deutonymph

Length of idiosoma about 170 µm, colour: white.

Dorsum (Fig. 66): Idiosomal chaetome: ve, si, c_1, c_2, c_p, d_1, d_2, e_1, e_2, f_2, h_1, h_2, h_3, ia, im.

Ventrum (Figs. 65, 68, 75, 79): Idiosomal chaetome: scx, vi, 1a, c_3, 3a, 3b, 4a, g, ip, ih. – Palposoma (Fig. 69) reaching beyond the propodosoma. Coxal fields I and II covered by a continuous sclerotized area; epimera II and epimerites II curved and delimitating an oval area, epimera II connect to each other in the middle of the body; sternum relatively long and almost reaching to this point of contact; coxal fields III and IV also covered by a continuous sclerotized area; 1a, 3b, 4a shaped as conoids.

Legs (Figs. 70–74, 76–78): Chaetome see Table 1.

6.2.4. Protonymph

Length of idiosoma about 195 µm, colour: white, end of opisthosoma brownish (indicating a slight sclerotization).

Dorsum (Fig. 67): Idiosomal chaetome: scx, vi, se, c_p, d_1, d_2, e_1, e_2, h_1, ia, im, ip. – Propodosomatal shield with smooth margin posteriorly.

Ventrum (Figs. 79–80): Idiosomal chaetome: 1a, 3b, g, h_2, ih. – Otherwise as given for tritonymph.

Legs (Figs. 81–84): Chaetome see Table 1.

6.2.5. Larva and Egg

Length of idiosoma about 155 µm, colour: white.

Dorsum (Fig. 86): Idiosomal chaetome: scx, vi, se, c_p, d_1, d_2, e_1, e_2, ia, im, ip. – Propodosomatal shield with smooth margin posteriorly.

Ventrum (Fig. 85): Idiosomal chaetome: 1a, 3b, h_2, ih. – Coxal regions of legs I and II as given for tritonymph, without sclerotization on coxal region of leg III; a sclerotized band follows the border between proterosoma and hysterosoma. With prominent Claparède organs (Fig. 91).

Legs (Figs. 87–89): Chaetome see Table 1.

Egg: Length about 115 µm. Surface of egg covered with small "spikes".

6.3. Habitats of S. nesbitti

We found this mite almost always in the deeper layers of rotten wood, especially in rotten tree stumps. The deutonymph occurred on *Serviformica fusca* (Insecta: Hymenoptera: Formicidae). Türk & Türk (1957) found the hypopus on *Dorcus parallelopipedus* (Insecta: Coleoptera: Lucanidae), larvae of *Melanotus rufipes* (Insecta: Coleoptera: Elateridae), *Unciger foetidus* (Diplopoda: Julidae), and *Perostichus anthracinus* (Insecta: Coleoptera: Carabidae).

The numbers below refer to the numbers in chapter 2.1. and in Fig. 1.

6.3.1. Own collections

Nos.: 1, 4, 5a, 5c, 5d, 5f, 10, 11.

6.3.2. Habitat Description from the Literature

No. **43:** Surroundings of Erlangen (Germany) (Türk & Türk 1957).

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Authors' address:

Dipl.-Biol. Eberhard Wurst and Prof. Dr. Brigitte Frank, Institut für Zoologie (Fachgebiet Parasitologie), Universität Stuttgart-Hohenheim, Emil-Wolff-Str. 34, D-70599 Stuttgart, F.R. Germany.

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