Bonn. zool. Beitr.
34 (1983), Heft 4

Demodex huttereri spec. nov. (Acarina: Prostigmata: Demodicidae) from the Meibomian glands of *Apodemus agrarius* (Rodentia: Muridae)

by

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Introduction

Mites of the genus *Demodex* Owen, 1843, living in all their life stages in the skin epidermis and/or the pilosebaceous complex of mammals are adapted to a narrow biotope by their wormlike shape.Those species living in the multialveolar Meibomian (tarsal) glands of the eye-lids, which have a wider diameter of gland ducts and a stronger secretion flow, show morphological adaptations of inactive stages (eggs and immatures during the molting periodes) against expulsion.

Investigation of blind *Apodemus agrarius* Pall. with xeromorphic scaly cornea of eyes yielded *Demodex* specimens in most of the Meibomian glands. These specimens are closely related to *Demodex gapperi* Nutting et al., 1971, and to *D. peromysci* Lombert et al., 1983. They share the same anchor mechanisms of eggs and immatures: Y-shape of egg, annulated podosomal dorsal finger of larva, sclerotized strongly protruding legs of immatures, curved claws with a strong central spine. The differences in these characteristics of immatures, but not of adults, are so striking, that these specimens cannot be arranged in any described species. They will be described and figured in detail here. A comparsion with the related species also is presented. The measurements are given in micrometers (μm) mainly in tabulated form.

Demodex huttereri spec. nov.

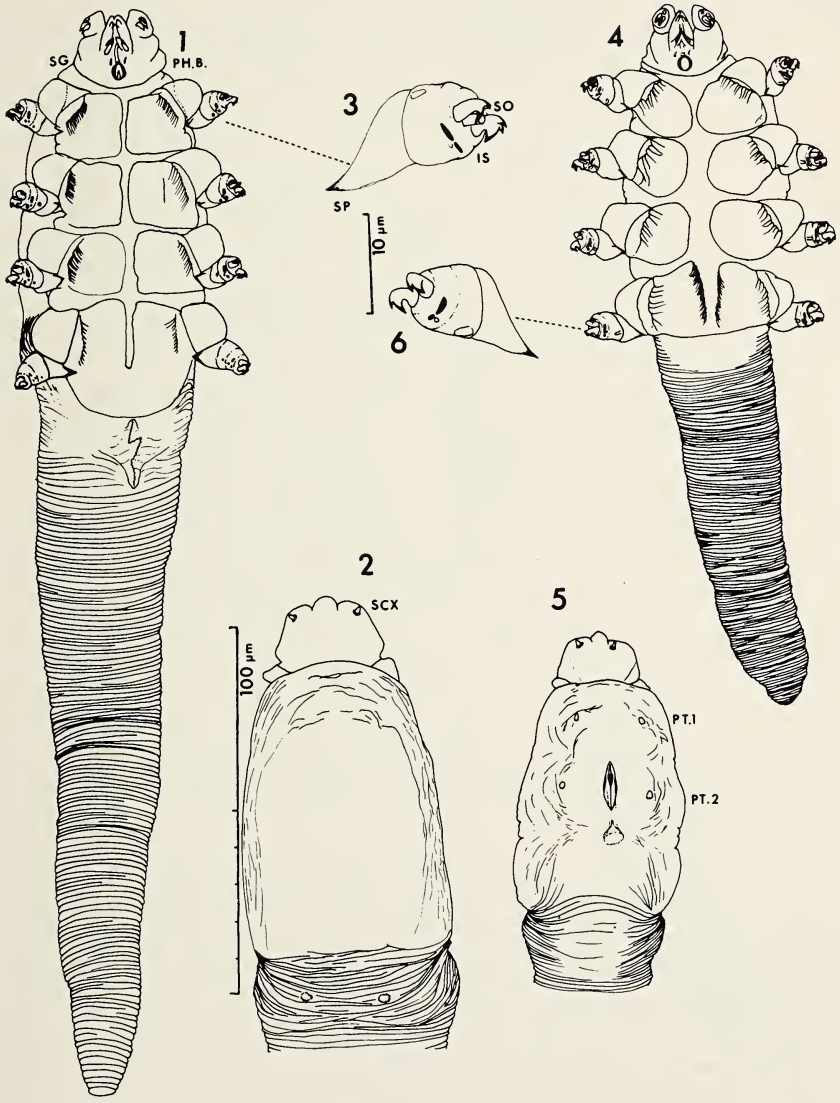
Medium sized species with the characteristics of the genus, largest specimen, a female 423 long, with fairly long opisthosoma of remarkable variability in length in females. Males distinctly shorter than females. Opisthosomal organ absent in both sexes. Immatures with anchoring adaptations: Retrorse palpal spines on gnathosoma, sclerotized legs with multispined claws, and propodosomal dorsal annulated "finger" in larvae. Eggs of broad Y-shape.

Female (holotype): Total length 342, measurements of paratypes in table I. Gnathosoma slightly trapezoidal, basal width 34, length 27. Minute subgnathosomal setae (SG) in front of pharyngeal bulb (PH.B) (Fig. 1). Small conical supracoxal setae (SCX) directed antero-laterad on dorsal side (Fig. 2). Palps with two segments. Palptarsus with two two-pointed clawlike and one simple spine. Podosomal length 95, width 49. Four pairs of equal legs spaced evenly on venter of podosoma with three free segments and large coxal plates joint with ventral surface. Small interspaces separate coxal plates in the midline and aligned. Coxal plates IV longer than broad, partly fused in midline in posterior part. Dentations present on coxal plates towards trochanters. Trochanters triangular, femora (Fig. 3) with postero-ventral pointed spur (SP), fused genua-tibia-tarsus segment cylindrical with faint fusion-line, internal sclerotizations (IS), two equal three-pronged claws. Legs I and II each with one short solenidion (SO) dorsally behind the claws. Anterior part of histeronotum (Fig. 2) with large prodorsal shield with straight posterior border, covering most of podosomal region until legs III. Small lateral shields for muscle attachment in region of legs IV. Opisthosoma 219 long with regular annulation, tapering to rounded end. Opisthosoma very variable in length (189—296) matching egg conformation. In gravid females the eggs fill almost all the opisthosoma and the leg IV region of pododoma. Genital opening 20 long directly posterior to coxal plates IV, somewhat protruding from surface. Opisthosomal organ absent.

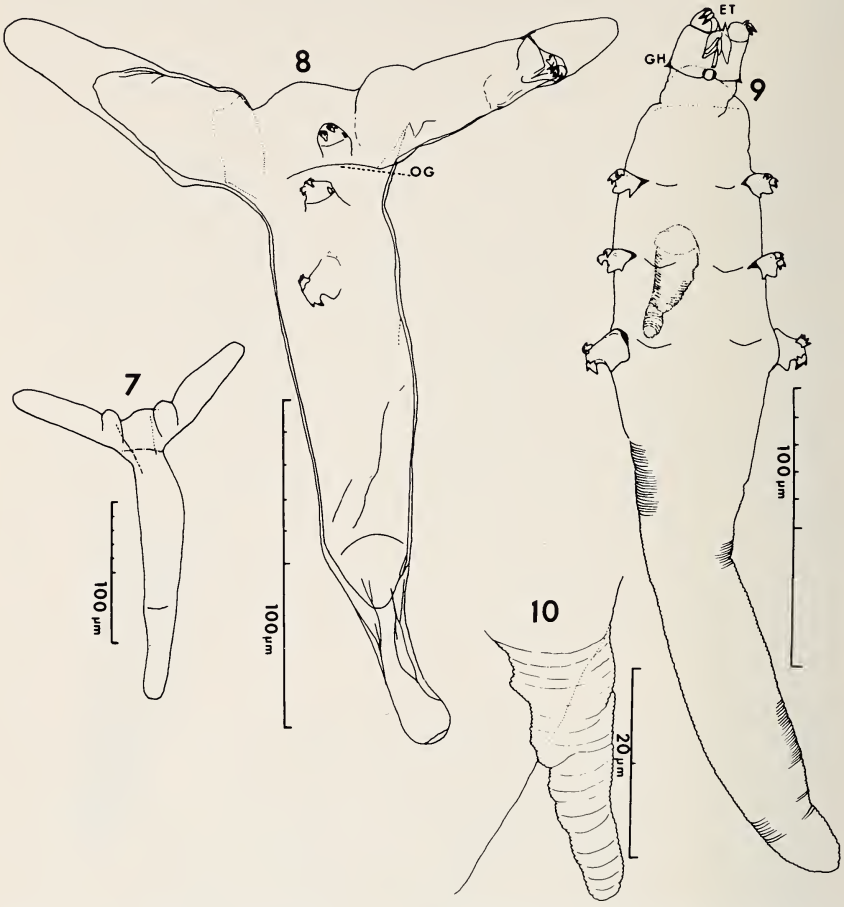
Male (allotype): Total length 257, gnathosomal length 23, width 26, podosomal length 78, width 50, opisthosomal length 118. Measurements of 20 paratypes in table I. Generally like female, but coxal plates (Fig. 4) more oval-shaped, with distinct (10) broad interspace in midline in region II and III. Coxal dentations coarser than in female. Coxal plates IV 23 long, compared to 37 in female. Tarsal claws (Fig. 6) with only two points. Dorsum (Fig. 5) with faintly sclerotized prodorsal shield with encaved posterior border. Prodorsal tubercles arranged in trapezoidal pattern: interspace of first pair (PT 1) 22 (19—25), of second pair (PT 2) 28 (27—31), distance between pairs 23 (21—24). Genital opening at level of legs II, in shape of a split from genital atrium. Penis 20 long with bulbous base.

Egg (Figs. 7, 8): Broadly Y shaped, with 208 (198—220 in 17 measured eggs) long unpaired part, 115 (86—127) long arms in rather obtuse angle and wider rounded median bulb between arms. Width below arms 29 (24—39). Operculate groove (OG) below one arm, which proves, in eggs with developing larva, to contain the gnathosoma and the part of podosoma anterior to legs I. The first pair of legs develops within the rounded bulb between the arms, legs II and III in the unpaired stalk of the Y-shaped egg. The second arm is partly filled with the larval prodorsal finger. Surely another groove is present along postero-lateral side of the egg-arm containing the gnathosoma. In preparation

of mature eggs by pressure of the cover glass the larva partly becomes free through these lineal areas.



Figs. 1—6: *Demodex huttereri* sp. nov. — 1: female holotype venter; 2: female holotype dorsum podosoma; 3: female holotype leg I; 4: male allotype venter; 5: male allotype dorsum podosoma; 6: male allotype leg IV.

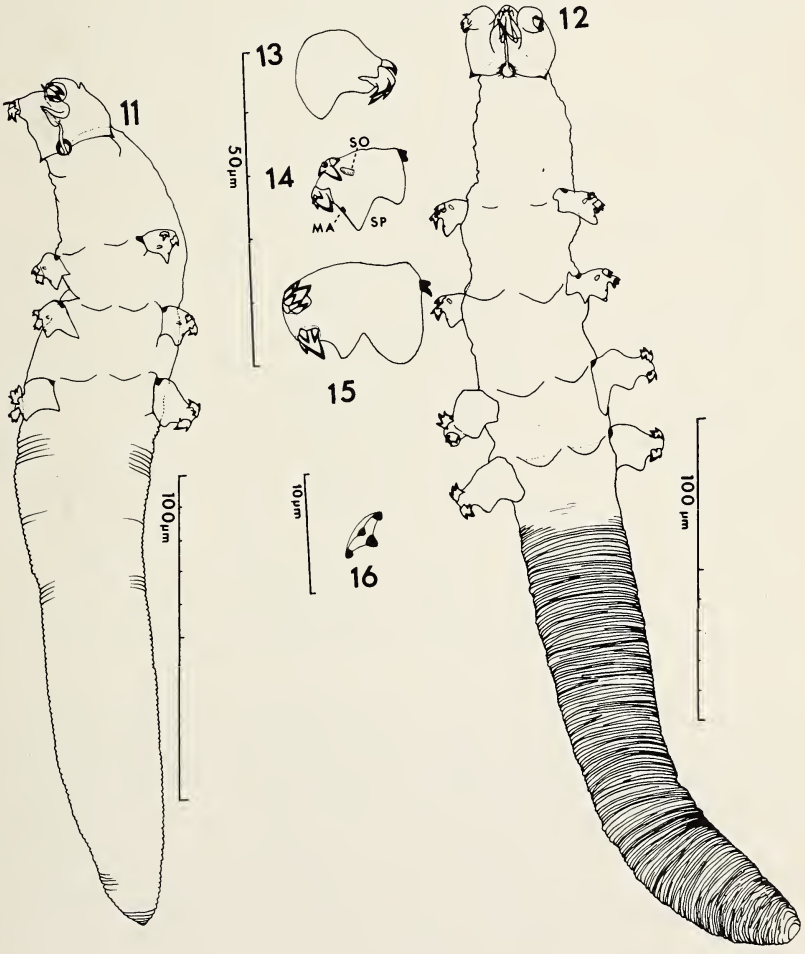


Figs. 7—10: *Demodex huttereri* sp. nov. — 7: egg; 8: larva in egg-shell; 9: larva venter; 10: larval dorsal finger (lateral view).

Larva: Total length of figured specimen 286, width 56, opisthosoma 171, length dorsal finger 32. Gnathosoma 27 long and only 22 broad with remarkable ventro-lateral sclerotized pointed gnathosomal hooks (GH), arising from the neck-like connection to podosoma, probably with anchoring function. Gnathosoma with adult-like pharyngeal bulb, supracoxal spines and puncturing chelicerae. Subgnathosomal setae not observed. Egg teeth present. Palps (Fig. 13) without visible segmentation, relatively long, directed outwards, with two two-pointed and one simple curved spine. Podosoma with three pairs of ventro-laterally inserted sclerotized unsegmented legs, small epimeral scutes, and annulated finger dorso-medially behind region of legs I. Legs III (Fig. 15) longer and broader than legs I and II (Fig. 14) with postero-lateral broad spur

(SP), strongly sclerotized articulation, distinct postero-lateral muscle-attachment (MA) and two unequal claws. Claws with central spine and three smaller surrounding spines. Central spine of posterior claws larger than of anterior claws. Anterior claw of legs III with two additional outer spines. Solenidion present on legs I an II. Opisthosoma with faint annulation.

Protonymph (Fig. 11): Like larva, but "dorsal finger" completely reduced. Scutes somewhat stronger than on larva. Measurements in table I.



Figs. 11—15: *Demodex huttereri* sp. nov. — 11: protonymph venter; 12: tritonymph venter; 13: nymphal palp; 14: tritonymph leg I; 15: tritonymph leg III. — Fig. 16: *Demodex folliculorum* Hirst, 1919, nymphal claw.

Nymph (Fig. 12): Like protonymph with additional fourth pair of legs of same size and with similar claws like leg III. Legs IV inserted laterally without difference in distance to legs III. Podosoma remarkably long (140), distinctly longer than in adults. Opisthosoma narrow and regularly striated.

Table I: Meristic data of *Demodex huttereri* sp. nov.

	male	female	nymph	proto-nymph	larva
Total length					
mean	242	361	376	258	264
min.—max.	235—252	316—423			
Width					
mean	56	54	56	46	47
min.—max.	51—61	48—57			
Gnathosoma length					
mean	26	27	32	31	31
min.—max.	24—28	25—29			
Gnathosoma width					
mean	32	34	23	24	24
min.—max.	28—35	32—35			
Podosoma length					
mean	80	92	140	84	100
min.—max.	77—85	78—96			
Opisthosoma length					
mean	134	240	198	149	155
min.—max.	122—147	189—296			

Pathology: The mites were pressed out off the Meibomian glands of the freshly killed hosts by watchmakers pincers. By this collection technic the contents of the outer part of the gland ducts of the individual glands enters the main gland duct opening, and then, is prepared in a drop of Hoyer's medium. Infested gland ducts contained remarkably small amounts of sebum, consisting mainly of large parts of cell walls and few lipid sebum droplets, compared to large amounts of sebum, consisting of mainly lipid droplets, atrophied nuclei and only a few segments of cell walls in gland ducts not infested by *Demodex*. The majority of the glands of upper and lower eye-lid of both eyes were infested. The corneas of the two blind hosts showed the characteristics of xerophthalmy: scaly, grey, non-transparent surface of the eyes.

Host and locality: *Apodemus agrarius* Pallas, fourth generation laboratory rearing from animals captured near Fulda, Germany. The hosts have been killed and investigated on 15 April 1982.

Deposition of types: Holotype female, allotype male and figured developmental stages within Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Ar 1—7/83. Additional paratypes in U.S. National Museum of Natural History (Smithsonian Institution), Washington, D.C.; Field Museum of Natural History, Chicago; Bernice P. Bishop Museum, Honolulu, Hawaii; Rijksmuseum van Natuurlijke Historie, Leiden; Zoologisches Institut und Zoologisches Museum, Hamburg; Institute of Parasitology, Academy of Sciences, Prague, and in collections of the authors.

Table II: Comparison of adults of *Demodex gapperi*, *D. peromysci* and *D. huttereri*

	D. gapperi	*D. peromysci*	*D. huttereri*
Male			
Total length	262 (±13)	245 (231—279)	242 (235—252)
Width	47 (± 7)	64 (53— 70)	55 (51— 61)
Gnathosoma length	20 (± 3)	27 (24— 28)	26 (24— 28)
width	22 (± 2)	33 (30— 34)	32 (28— 35)
Podosoma length	76 (± 4)	93 (75—101)	80 (77— 85)
Opisthosoma length	164 (±18)	134 (122—173)	134 (122—147)
Intercoxal space	8	13	9
Penis length	20	31	20
Female			
Total length	361 (±29)	392 (323—500)	361 (316—423)
Width	44 (± 4)	71 (61— 80)	54 (48— 57)
Gnathosoma length	22 (± 3)	31 (30— 38)	27 (25— 29)
width	25 (± 4)	35 (32— 41)	34 (32— 35)
Podosoma length	82 (±11)	107 (94—113)	92 (78— 96)
Opisthosoma length	253 (±26)	250 (190—360)	240 (189—296)
Coxal plates IV: posterior border	convex	concave	convex
Tarsal claws: shape	straight	straight	bowd
number of points:			
anterior	2	3	3
posterior	3	3	3

Table III: Comparison of developmental stages of *Demodex gapperi*, *D. peromysci* and *D. huttereri*

	D. gapperi	*D. peromysci*	*D. huttereri*
Egg length	295	241	208
Width between points	45	190	191
Angle between arms	acute (30°)	right (110°)	obtuse (135°)
End of egg	pointed	round	round
Situation of dorsal finger	at level of legs II	at level of legs III	between legs I and II
Larval dorsal finger			
length	50	90	30
width	15	30	11
Leg formation in larva	III stronger than I and II	I and II absent	III stronger than I and II
Dorsal finger in nymph			
length	30	50	—
width	15	30	—
Leg formation in nymphs	I—IV equal	III and IV longer	III and IV longer
Nymphal claw points			
anterior	4	4	6
posterior	4	4	4
Length of leg III	10	20	21
Straddling width of legs III	86	120	76
Epimeral scutes in nymphs	absent	absent	present
Gnathosomal hooks	absent	absent	present

Comparison with related species and discussion: Contrary to the expectation of relationship to *Demodex lacrimalis* Lukoschus & Jongman, 1974, from the same biotope of the related species *Apodemus sylvaticus*, the new species shares morphological adaptations of a group of species with Y-shaped eggs, larval podosomal dorsal extremities, and well formed, sclerotized protruding legs, as for *D. molossi* Desch et al., 1972, *D. gapperi* and *D. peromysci*. In *D. molossi* from the neotropical bat *Molossus molossus* two "dorsal wings" develop in the arms of the rather T- than Y-shaped egg, while the gnathosoma develops in the median bulb between the egg-arms. The legs III of larva (68) and nymphs (127) are extremely long and lack articulation of claws. These characteristics and the large size separate *D. molossi* clearly from the rodent

parasitizing species with unpaired dorsal ''finger'' developing in one arm and gnathosoma developing in the other arm of the egg.

The adults of the species *gapperi*, *peromysci* and *huttereri* show only small differences in the main measurements (table II), requiring observation and description of more details such as the shape of the tarsal claws and the number of the claw points, than possible in photographic presentation. The opisthosomal organs are absent in both sexes, similar to all species hitherto described from the Meibomian glands.

The differences between the immature stages are more striking. They are summarized in table III. In *D. huttereri* they show reduction of the dorsal finger of larva already starting in embryogenesis by not filling all the space of the egg arm, and total reduction during the moulting larva to protonymph, indicating stronger importance for anchoring the egg than for anchoring the immatures. The data on the legs, the possible expansion width of legs III, the presence of epimeral scutes and the unique gnathosomal hooks may suggest that *D. huttereri* is living in a more narrow biotope than the related species. The typical curved multispined claws with stronger central spine may have developed from the funnellike spines of immatures of the hair follicle inhabiting species (Hirst, 1919) like *D. folliculorum* (Fig. 16) by strong development of the proximomedian protuberance of the rhomboid claw-base. On the outside of the anterior claws of legs III and IV of *D. huttereri* two additional points are present, which may have developed by stronger chitin production of intermediate points of this rhomboid border.

In the species from the biotope of the Meibomian glands, described hitherto, the mites have been collected from agile hosts, captured in the field. Only few of the gland ducts have been found parasitized and no remarkable pathology had been reported. There seems no doubt, as in the species from other sebaceous gland biotopes, that the mites feed on the cells of the glands. Reviews on the pathology of *Demodex* species (Nutting, 1975, 1976, Rufli & Mumcoglu, 1981) mention, with the exception of associated micro-organisms, only low grade pathology by action of the mites. In the case of blind hosts with xeromorphic cornea from a laboratory rearing most of the Meibomian gland ducts have been parasitized. The absence of or the only remarkably small amount of sebum in parasitized gland ducts and large amount of sebum in non-infested neighbouring ducts indicate the action of mites. It is suggested that the correlation of strong infestation, absence of sebum and xerophthalmy have a causal relation, damaging the host strongly in his struggle of life.

Acknowledgements

We are obliged to Dr. R. Hutterer, Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, for the infested hosts.

Summary

Demodex huttereri spec. nov. from the Meibomian glands of *Apodemus agrarius* Pall. is described and figured in detail. Biology, egg and developmental stages are compared with the related species *D. gapperi* Nutting et al., 1971 and *D. peromysci* Lombert et al., 1983. The species feeds on the Meibomian gland cells, reducing sebum and, possibly, resulting in xerophthalmy of the cornea.

Zusammenfassung

Demodex huttereri spec. nov. wird aus den Meibomschen Drüsen von *Apodemus agrarius* Pall. beschrieben und im Detail abgebildet. Ein Vergleich mit Biologie, Ei und Entwicklungsstadien der verwandten Arten *D. gapperi* Nutting et. al., 1971, und *D. peromysci* Lombert et. al., 1983, wird angestellt. Die Art ernährt sich von den Drüsenzellen, beeinträchtigt die Talgsekretion und verursacht möglicherweise Xerophthalmie der Cornea.

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