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A NEW SPECIES OF THE GENUS *PSORERGATES* TYRELL, 1883 (ACARINA: PROSTIGMATA: PSORERGATIDAE) PARASITIC ON THE TREE-SHREW *TUPAIA DORSALIS* (MAMMALIA: SCANDENTIA) FROM BORNEO

by

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With 11 text-figures and one plate

Abstract

Psorergates tupaiae spec. nov. from *Tupaia dorsalis* Schlegel, 1857 is described and figured. The morphology of the new species is compared with that of other known species and discussed in relation to the systematic positon of the host.

Introduction

Species of the family Psorergatidae Dubinin, 1955 are very small, host specific, itch mites of mammals. To date, only 55 species of the three genera *Psorergates* Tyrell, 1883, *Psorobia* Fain, 1959 and *Psorergatoides* Fain, 1959 have been described. The range of hosts is remarkably wide and includes Insectivora, Chiroptera, primates, Carnivora, Rodentia and Artiodactyla. Correlation of the systematics of hosts and parasites may suggest parallel evolution. A new species, here decribed from a tree shrew widens the range of hosts, and shows hitherto unknown characteristics of the family. For comparison with other species, both known and still to be described, all measurements are in microns (μ) and are given in tabulated form.

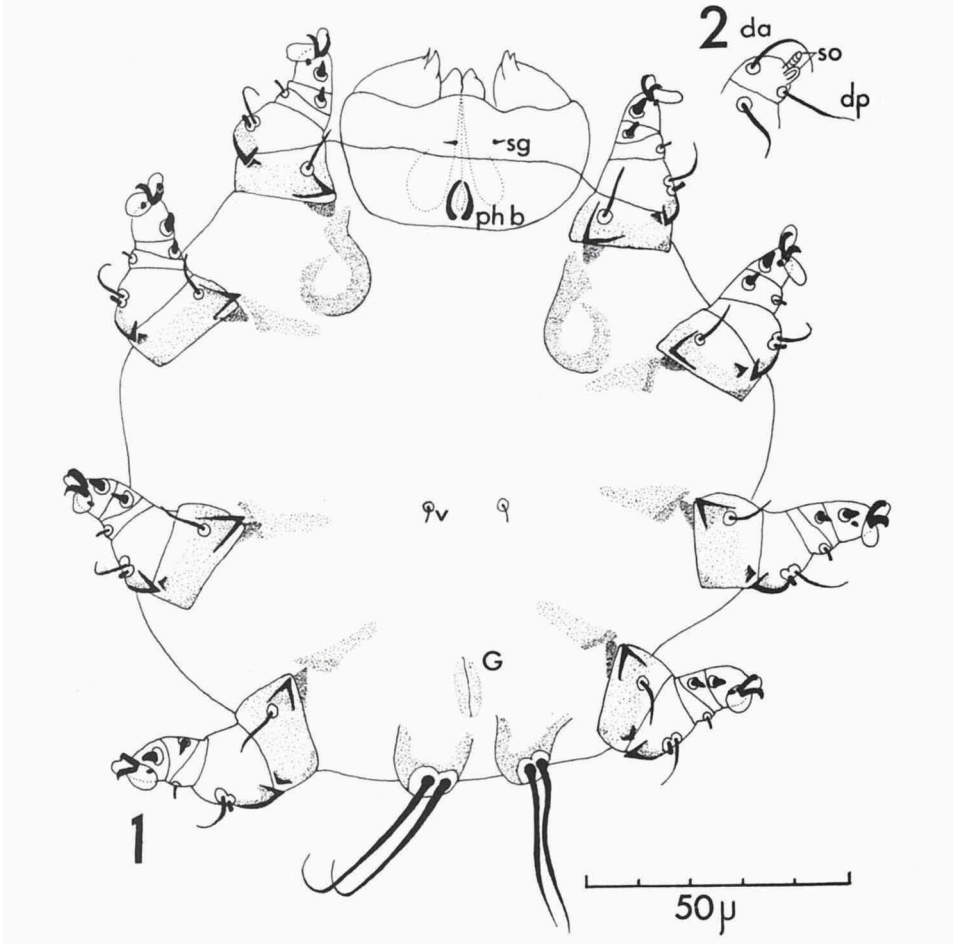
Description

Psorergates tupaiae spec. nov. (figs. 1-11; pl. 1 figs. 1-5)

Diagnosis. — Very small, disc-shaped, uncoulored mites with the characteristics of Psorergatidae and of the genus *Psorergates* Tyrell, 1883; differing from all described species by a combination of strongly unequal femoral setae, short but strong genual setae, presence of tibial spine IV, and relatively short, strong setae.

Female (holotype). — Venter (fig. 1) with smooth cuticle and subequal legs evenly spaced along podosoma. Epimera I recurved laterally to almost completed loops, epimera II-IV straight, directed to middle of venter. Ventral setae (v) between epimera III. Genital slit (G) between prominent paramedian-caudal lobes, each lobe carrying a pair of relatively strong terminal setae.

Legs with five free segments. Trochanter with ventral spur, a relatively thick seta and a strongly sclerotized subintegumental articulation with epimeron. Femur with acute postero-ventral spur and a pair of very unequal setae; the proximal seta short, strong, with a rounded end and the distal one of subequal length on all legs. Genu with short, thick almost spine-like seta, equal on all legs. Tibia with cone-shaped spine ventrally and a piliform dorso-median seta (fig. 2).



Figs. 1-2. *Psorergates tupaiae* spec. nov. female (holotype). 1, venter (G: genital slit, v: ventral seta, ph b: pharyngeal bulb, sg: subgnathosomal seta); 2, tarsus and tibia of leg I, dorsal view (da: dorso-anterior seta, dp: dorso-posterior seta, so: solenidia).

Tarsus with paired one-pointed claws, a sclerotized condylophore inside of tarsus, a bilobed empodium with its smaller part situated dorsally between the claws, a broad cone-shaped ventral spine, and two dorsal setae (da and dp). Dorso-posterior seta absent on leg IV. Tarsi I and II with two solenidia (so), the smaller one enveloped by a skin fold.

Dorsum (fig. 3). — Soft parts of cuticle regularly striated (see also pl. 1 fig. 2 (SC)), sclerotized shield punctate (pl. 1 fig. 2 (pu)). Dorsal shield cordate in outline, with three pairs of lateral setae and a pair of antero-median (am) setae. Lateral setae relatively strong, tapering to rounded end (pl. 1 fig. 1) inserted lateral to large pores (P).

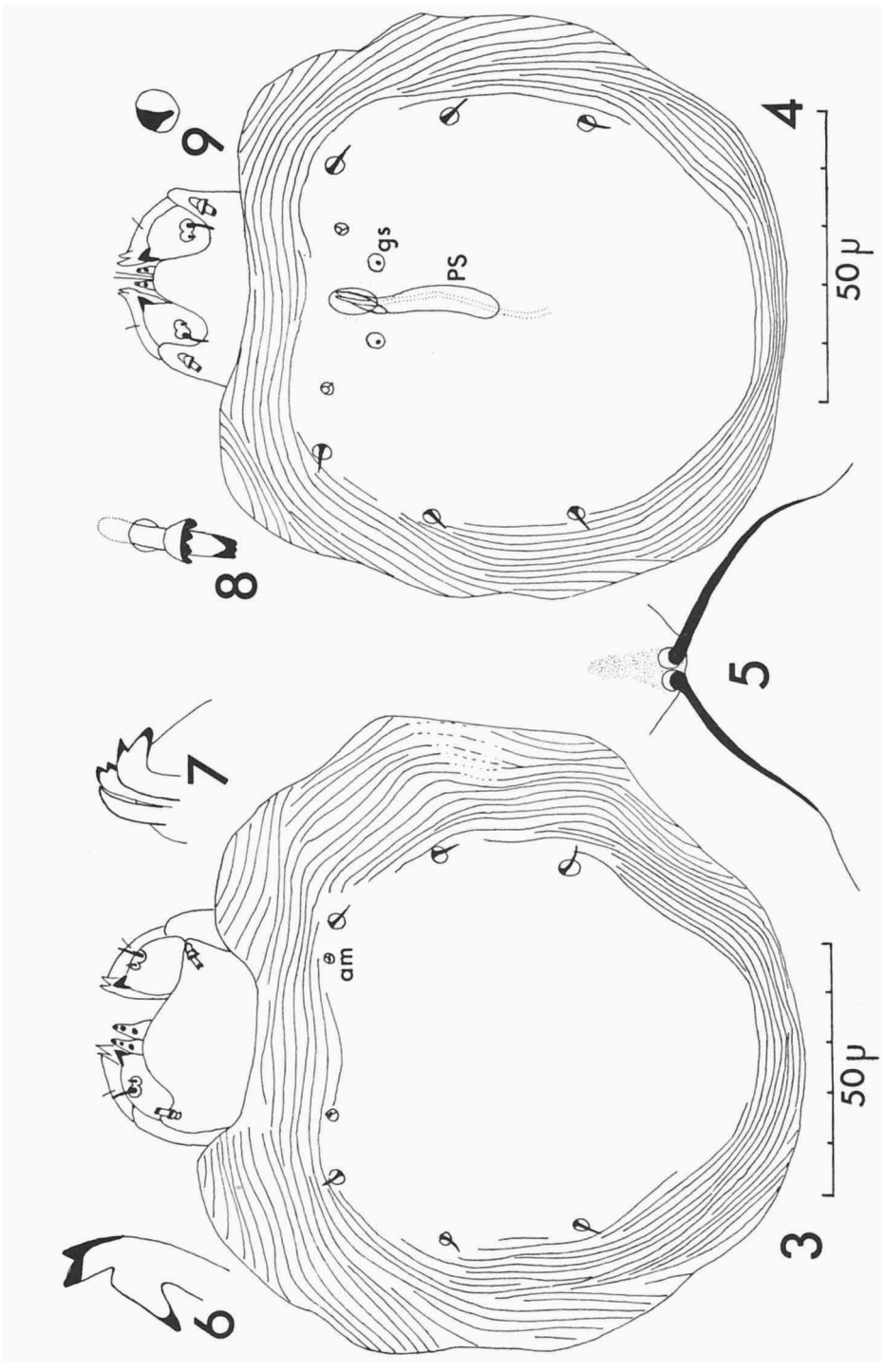
Gnathosoma dorsally with a pair of bilobate gnathosomal (supracoxal) setae of which the basal part is quadridentate (fig. 8; pl. 1 fig. 5); ventrally with a pair of thin subgnathosomal setae (fig. 1 (sg)), pharyngeal bulb (ph b), two-segmented palps and modified chelicerae. Palpaltibia with acute terminal sclerotized spur and two dorsal setae. Palpaltarsus inserted ventro-medially, with one simple and two claw-like spines (fig. 7; pl. 1 fig. 4). Fixed digit of chelicerae dorsally with three teeth (fig. 6; pl. 1 fig. 3), movable digit in the shape of stinging bristles.

For measurements see table I.

TABLE I

Measurements (in μ) of females and males of *Psorergates tupaiae* spec. nov.

	Females			Males		
	Holo-type	$\bar{x}$	min-max (n = 10)	Allo-type	$\bar{x}$	min-max (n = 9)
Body length	137	126	(122-137)	116	114	(106-122)
Body width	122	108	(103-122)	97	99	(91-106)
Shield length	80	81	(78- 84)	76	75	(69- 80)
Shield width	79	76	(74- 81)	73	72	(69- 74)
Length setae						
terminal	38	52	(38- 56)	50	53	(41- 60)
trochanter	9	8	(6- 10)	6	9	(8- 10)
femora I-III (distal)	10	9	(8- 11)	9	10	(9- 12)
femur IV (distal)	10	9	(7- 10)	9	9	(8- 9)
genua I-III	3	3		3	3	
genu IV	3	3		3	3	
tarsus da	10	10	(9- 10)	10	10	(9- 10)
tarsus dp	10	10	(9- 10)	10	10	(9- 11)
lateral shield	4	5	(4- 5)	5	5	
post. palpotibial	5	4	(4- 5)	4	5	(3- 6)
gnathosomal	5	5		4	5	(4- 6)
ventral	4	4	(3- 4)	4	4	
Distance between ventral setae	11	11	(10- 12)	11	11	(9- 12)
Distance between am setae	27	28	(27- 29)	14	14	
Distance between genital setae	—	—		26	26	(25- 28)
Length penis	—	—		36	37	(36- 39)
Length penis sheath	—	—		24	25	(24- 28)
No. femoral setae	2	2		2	2	
No. of clawpoints	1	1		1	1	



Figs. 3-9. *Psorergates tupaiae* spec. nov. female (holotype) and male (allotype). 3, female, dorsum (am: antero-median seta); 4, male, dorsum (gs: genital seta, PS: penis sheath); 5, male, ventral adanal lobe; 6, chelicera of squashed paratype; 7, palpotarsal claws of squashed paratype; 8, supracoxal (gnathosomal) seta; 9, antero-median seta.

Male (allotype). Similar to female, without sexual dimorphism of gnathosomal setation, but with somewhat smaller measurments. Dorsal shield (DS) (fig. 4; pl. 1 fig. 2) with genital opening (O) near anterior border and a pair of genital setae (gs) lateral to and posterior of the genital opening. Genital and antero-median setae arranged in a trapezoid configuration. Penis in the shape of a dorso-ventrally orientated band (pl. 1 fig. 2) inside of simple penis sheath (PS). Venter like that of female; caudally with only one median, slightly protruding lobe with tongue-like sclerotization and two relatively strong terminal setae (fig. 5).

Developmental stages. — Deutonymph (fig. 10) with gnathosoma resembling that of the adult (fig. 11), unstructured idiosoma and four pairs of two-segmented legs, evenly spaced along sides. Epimera much smaller than in adults, as figured. Trochanters with only one ventral spur. Segments femur-tarsus fused, with indistinct, slightly stronger, sclerotized posterior hook and two short, three-pointed claws. Legs I and II with solenidia (so). Average length 129 μ (123-146 μ), width 113 μ (105-123 μ).

Protonymph: length 109 μ (98-116 μ), width 94 μ (86-103 μ). General shape like deutonymph, however legs IV more caudal and close-set.

Larva with gnathosoma of almost adult size and three pairs of legs similar to those of nymph with indistinct solenidia. Length 71-92 μ, width 70-75 μ.

Egg almost spherical without shell pattern, 91 μ (86-93 μ).

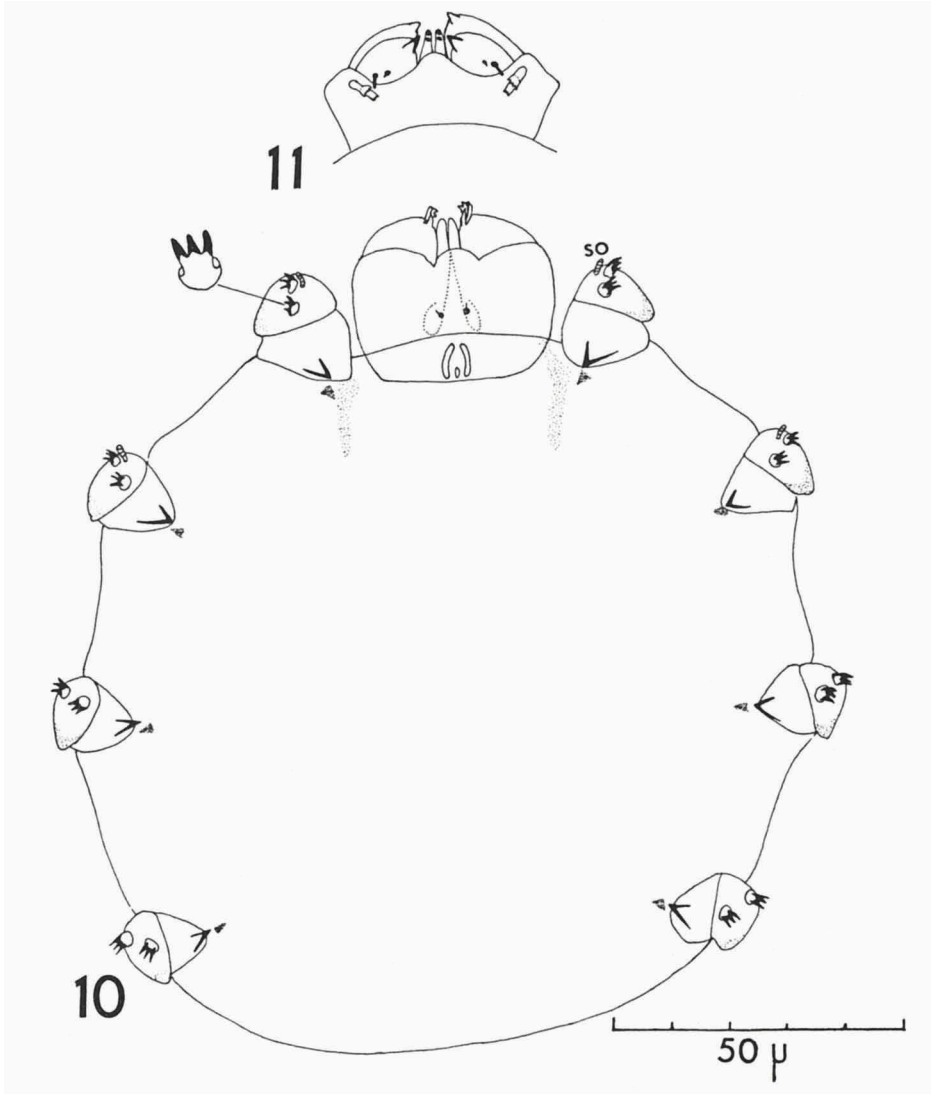
Host and locality. — *Tupaia dorsalis* Schlegel, 1857, Mt. Kenepai, Borneo, December 1893 collected by J. Büttikofer. Host in collection of RMNH, Leiden, coll. no. 26698.

Pathogenity. — The mites were found in swollen hair follicles of fore- and hindlegs. These cyst-like follicles, which, in part, project markedly from the skin surface, were found filled with mites in all developmental stages and with larger amounts of hyperkeratinized skin scales.

Deposition of types. — Holotype and allotype in RMNH, Leiden, type collection no. ♀ P2049, ♂ P2048. 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; The Acarology Laboratory, Columbus, Ohio; Rocky Mountain Laboratory, Hamilton, Montana; Zoologisches Institut und Zoologisches Museum, Hamburg; British Museum (Natural History), London; Institute de Médicine Tropicale "Prins Léopold", Antwerpen; Institute for Medical Research, Kuala Lumpur and in the collection of the authors.

Discussion

Morphological differences within the genus *Psorergates* Tyrell, 1883 caused Fain (1959a, b) to divide the genus into three subgenera: *Psorergates*, *Psorobia* and *Psorergatoides*. Species described later show clearly that the chosen characteristics had been well selected and that they are of phylogenetical importance. Species of



Figs. 10-11. *Psorergates tupaiae* spec. nov. deutonymph. 10, venter; 11, gnathosoma, dorsal view.

Psorergatoides only have been found parasitic on Chiroptera. Those of *Psorobia* on larger sized mammals of the orders Primates, Carnivora, Artiodactyla and the "old" families of Rodentia, while *Psorergates* species are parasitic on small sized rodents and on Insectivora.

Within *Psorergates*, Lukoschus et al. (1967) and Lukoschus (1968) arranged groups of species, which share combinations of characteristics. The eight known species from Insectivora share certain characteristics: absence of tibial spine IV,

dorso-anterior seta on tarsi much shorter than dorso-posterior seta, escutcheon-shaped dorsal shield, terminal setae of male on sclerotized tongue-shaped shield, genual seta IV much longer than on legs I-III, the pairs of femoral setae subequal to unequal (proximal seta twothird of length of distal seta).

Sexual dimorphism of the gnathosomal setae and long, setiform palpotibials in adults and nymphs are, in combination with great distance between the ventral setae, characteristics of the "dissimilis group". Main characteristics of the "apodemi group" are long, blunt palpotibial setae, in combination with genual seta IV much longer than I-III and chitinized tubes running from the genital atrium of the female into the body. Short palpotibial setae and subequal, short genual setae are characteristics of the "muricola group". Members of these groups parasitize Muridae and Cricetidae. To date, only three species of *Psorergates* are known that possess tibial spines IV: *P. glaucomys* Ah et al. (1973), *P. dremomydis* Giesen et al. (1982) and *P. paraxeri* Giesen & Lukoschus (1982). These are all parasites of Sciuridae. When more species of these groups are found and the combinations of characteristics are correlated with the systematic position of the hosts, subdivision of the genus *Psorergates* will probably become necessary.

In several families of host-specific parasites (Myobiidae, Myocoptidae, Listrophoridae, Echinonyssinae) parallel evolution of hosts and parasites is suggested. Parasites from marsupialian hosts always show the most primitive characteristics, while those from higher orders have many reductions and adaptations. So far, no psorergatid species from marsupials has been found; however, it may be expected. The new species *P. tupaiae*, with its deviating characteristics, does not fit in any of the above mentioned groups; the host as well, belongs to an unique systematic group.

The systematic arrangement of the family Tupaiidae has undergone change during history. It was placed within the Insectivora, together with the Macroscelididae, in the Suborder Menotyphla. Carlsson (1922) and many authors, notable Clark (1971) regarded the tree shrews as primates or basal primates. Campbell (1974) has criticized this view. Currently Tupaiidae are regarded by Corbett & Hill (1980) as an Order, Scandentia.

The presence of host-specific mites should be similarly regarded. The two monomorphic Anoplura genera from Tupaiidae, *Satrax* Johnson, 1964, and *Docophtirus* Waterston, 1923, are arranged in the family Polyplacidae (Kim & Ludwig, 1978), whose members also parasitize prosimian Primates, Insectivora, Lagomorpha and Rodentia.

The genus *Lynxacarus* Radford, 1951 (Listrophoridae) with the representatives *tupaiae* Fain, 1970, *semnopitheci* Fain, 1970 and *palawensis* Fain, 1976 on Tupaiidae has species also from Carnivora and Insectivora. Species of the genus *Sciurochirus* Fain, 1972 (Listrophoridae) are parasites of Sciuridae. The species *tupaiae* Fain, 1952 recorded first from *Tupaia glis* (Diard, 1820), has different *Callosciurus* species for habitual hosts.

The heteromorphic deutonymphs of the genus *Dermacarus* Haller, 1880 (Glycyphagidae) are phoretic in this hypopial stage, attached to the hairs of hosts

of various families of Rodentia, Lagomorpha, Insectivora, Carnivora and Tupaiidae. The species *D. tupaiae* Fain 1969 differs from all other species, but is retained within the genus until adults are found. The genus *Tupaiopus* Fain & Uchikawa, 1980 (Glycyphagidae) is monotypic.

In the genus *Apodemopus* Fain, 1967 (Glycyphagidae) the species *anathanae* Fain, 1969 from *Anathana ellioti* (Waterhouse, 1850) is arranged together with species from Rodentia hosts.

In the family Cheyletiellidae the monotypic genus *Criokeron* Volgin, 1966 is parasitic on *Tupaia glis*, while the other genera are reported mainly from birds and some from Lagomorpha, Primates, Rodentia and Carnivora.

These data on the distribution of parasitic mite taxa confirm neither a relation to Primates nor to Insectivora. Aberrant species and monotypic genera on Tupaiidae seem to support the hypothesis of an unique phylogenetic evolution for the Scandentia.

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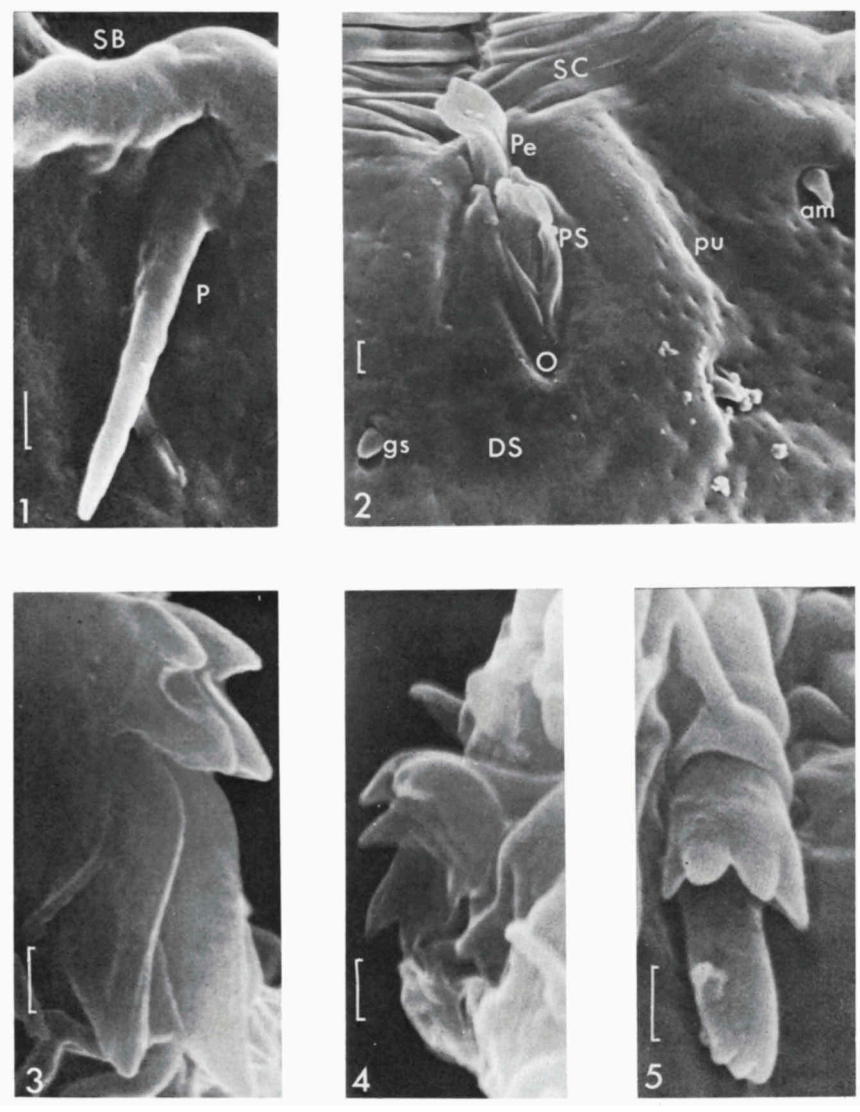

Figs. 1-5. SEM photographs of *Psorergates tupaiae* spec. nov., female and male paratypes. 1, first lateral shield seta (SB: shield border, P: pore); 2, region of penis (SC: striated cuticle, Pe: Penis, PS: penis sheath, O: opening, gs: genital seta, DS: dorsal shield, pu: punctate, am: antero-median seta); 3, chelicerae; 4, palpotarsal claws; 5, supracoxal (gnathosomal) seta. Standard on photographs indicates one micron.