

***Gracilentulus* species of "*gracilis*" group (*Protura*, *Berberentomidae*)**

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Abstract. *Gracilentulus gracilis* (BERL.) is redescribed, *G. europaeus*, *americanus*, *orousseti*, *hyleus*, *corsicanus*, *catulus*, *fjellbergi*, and *atlantidis* are described as new species. Pores on laterotergites and on lateral membranae are described and used as taxonomically important characters. The key for species of *Gracilentulus* is given.

Key words: *Protura*, *Gracilentulus*, taxonomy, porotaxy, Europe, North America.

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I. INTRODUCTION

The genus *Gracilentulus* was created by TUXEN (1963) for *Acerentulus gracilis* BERLESE, 1908. After later revisions (TUXEN & IMADATÉ 1975; TUXEN 1981) and descriptions it comprises 8 species (NOSEK 1979; YIN & IMADATE 1979; TUXEN 1981; IMADATÉ 1982; YIN 1984). Among them *G. gracilis* is characterised by the presence of foretarsal sensilla *b'*, sensilla *d* situated distally to the level of sensillae *b* and *c*, sensilla *f* situated half way between *e* and *g*, and the long sensilla *b* (TUXEN & IMADATÉ 1975).

An abundant material from various areas allowed me to establish that the foretarsal characters mentioned above are common to a group of species (here called "*gracilis*" group). They differ in some distinct features of the body porotaxy and lineation as well as in some biometrical characters. The differences in foretarsal morphology are, on the other hand, rather subtle and in many cases hardly visible.

The material described here was collected in Poland (mostly by Prof. Dr J. RAFALSKI and his co-workers), Austria (Dr E. CHRISTIAN), France and Corsica (Dr J. BOUDINOT and Mr J. OROUSSET), Portugal (by Prof. Dr W. NIEDBAŁA) and Canary Islands (Dr A. FJELLBERG). Some material from United States (collected by Prof. Dr J. RAFALSKI) is included too.

The holotypes of *G. corsicanus* and *orousseti* are preserved in the Museum National d'Histoire naturelle, Paris. Some paratypes of the taxa just named and all the material of the remaining species are kept in the Institute of Systematics and Evolution of Animals, Kraków.

I owe my very cordial thanks to Prof. Dr J. RAFALSKI, Dr A. FJELLBERG, Dr E. CHRISTIAN, Prof. Dr W. NIEDBAŁA, Mr J. OROUSSET and Dr J. BOUDINOT for the presenting me the rich material of *Gracilentulus*; to Prof. Dr R. DALLAI and Dr G. Del BENE for making it possible for me to study of BERLESE's original specimens, to Dr B. POKRYSZKO who corrected the English text, and to Miss M. BIENIEK for her assistance during the preparation of this paper.

II. CHARACTERS OF THE "GRACILIS" GROUP

The head chaetotaxy (Fig. 4) is uniform in all the species studied – additional setae are always lacking. The pseudoculus, mouthparts and filamentum di sostegno (Figs 5, 6) are the same as in the other species of the genus (comp. TUXEN 1964; 1981; NOSEK 1973; 1978a). The metric characters of the head (length of the head, pseudoculus and filamentum) in most specimens are impossible to measure precisely, so the indices based on them (PR and CF) are of no taxonomical value (at least on the specific level). In all the species they vary between 12-20 and 7-10, respectively.

The general arrangement of foretarsal sensillae is exactly as in *G. gracilis* s.l. (comp. TUXEN 1964; NOSEK 1973). Sensilla *b* is always longer than half of *c*, sensillae *d*, *f* and *g* are always thin, seta-like, subequal in shape to *t2*. Species differ in the length and thickness of sensillae *a*, *b*, *c* and *e*, the length and shape of *a'*, and the shape of *t1*. The latter is always more or less "fusiform" (TUXEN, 1977b) but its "head" can be more (in *fjellbergi*, *atlantidis* and *orousseti*) or less (in other species) distinctly delimited. The setae $\beta 1$ and $\delta 5$ are similar in shape (at least in the light-microscope) to setae $\delta 1$ - $\delta 4$.

Development of the foretarsus does not differ from that in many other acerentomoid genera. In larva I sensillae *c'* and *b'* are lacking, the former arises in larva II, the latter in matus junior.

The length of foretarsus and claw (and the index TR) are sometimes taxonomically useful. The empodial appendage is always very short (the index EU is 0.1-0.2). The position of sensilla *t1* is variable, so the index BS (varying between 0.4-0.5) is useless for discrimination between species.

The body chaetotaxy (Table I, II) is nearly identical in all the species studied - only the presence or absence of seta A5 on urotergite I and the number of setae "A" on urotergite VII and VIII are in some cases important. All accessory setae are setiform, uniform over all body, shorter and thinner (more "hair-like") than the principal setae.

The variability of chaetotaxy is slight. The lack of individual setae, the presence of asymmetrical setae and other irregularities are relatively rare. Setae of the row "A" on urotergite VII and seta M1 on VIII are more variable. In all the species except *catulus* the row "A" on urotergite VII contains 7 setae (Ac, A2, A4 and A5). Seta Ac is mostly asymmetrically situated (specimens with right and left position of it are found in nearly equal numbers). Only in about 1/3 specimens it is situated medially and specimens with two setae (A1+A1') instead of Ac are the rarest. On urotergite VIII the chaetotaxy M1+M1' is the commonest, but in some species there exist adult specimens with chaetotaxy of matus junior (seta Mc instead of M1+M1').

Table I

Dorsal chaetotaxy of *Gracilentulus europaeus* sp. n.

Composition of setae		Formula			
		lv1	lv2	mj	pm im
Th I	1, 2	4	4	4	4
Th II-II	M, A2, A4	4	6	6	6
	P1, P1a, P2, P2a, P3, P3a, P4, P5	10	14	16	16
Abd I	<i>A1, A2, A3</i>	0	0	6	6
	P1, P2, P2a, P3, P4	8	10	10	10
Abd II-VI	<i>A1, A2, (A4), A5</i>	0	0	6	8
	P1, P2, P2a, P3, P4, P4a, P5	10	12	14	14
Abd VII	<i>Ac, (A2), A4, A5</i>	0	0	5	7
	P1, P1a, P2, P2a, P3, P4, P4a, P5	10	14	16	16
Abd VIII	<i>A1, A3, A5</i>	0	2	6	6
	(M1)¹, P1, P1a, P2, P2a, P3, P3a, P5	12	14	15 ¹	16
Abd IX	1, 1a, 2, 2a, 3, 3a, 4	0	8	14	14
Abd XI	1, (1a), 2, (2a), 3, 4	0	0	8	12
Abd XII		9	9	9	9

bold print – prelarval and primary setae; normal print – secondary setae; *italics* – tertiary setae;
(in brackets) – complementary setae

¹in maturi juniores – *Mc*

The development of the chaetotaxy seems to be identical with that in *Acerentulus* (cf. Szeptycki 1991), but the prelarva remains unknown. The larval seta disappears mostly in larva II, in *gracilis* it vanishes in maturus junior.

The most important character of the chaetom is the length of principal and accessory setae – here the length of the setae *P1, P1a* and *P2* on mesonotum is used.

Table II
Ventral chaetotaxy of *Gracilentulus europaeus* sp.n.

Composition of setae		Formula			
		lv1	lv2	mj	pm im
Th I	A1, A2, M1, M2	2+2	2+2	4+4	4+4
	P1, P2, P3	4	4	6	6
Th II	Ac, A2, A3, M1	3+2	5+2	5+2	5+2
	P2, P3	2	2	4	4
Th III	Ac, A2, A3, A4, M1	3+2	5+2	7+2	7+2
	P2, P3	2	2	4	4
Abd I	Ac, A2	0	1	3	3
	P1	2	2	2	2
Abd II-III	Ac, A2	0	1	3	3
	Pc, P1a, P2	3	3	5	5
Abd IV-VII	Ac, A2	1	1	3	3
	P1, P1a, P2, P3	4	6	8	8
Abd VIII	1, 2	2	4	4	4
Abd IX	1, 2	0	4	4	4
Abd X	1, 2	0	0	4	4
Abd XI		0	0	2	6
Abd XII		2	0 ¹	0	0
		6	6	6	6

¹In *G. gracilis* $\frac{2}{6}$, larval seta present

The dorsal porotaxy is uniform in all the group. The formula is as follows:

Th.I	0	
Th. II-III	1+1	(<i>l</i>)
Abd. I	1+1	(<i>psm</i>)
Abd. II-VII	2+2	(<i>psm</i> , <i>al</i>)
Abd. VIII	1+1	(<i>psm</i>)
Abd. IX-XII	0	

In contradistinction to the genera described previously (SZEPTYCKI 1988, 1991) the pore *psl* is lacking on all tergites and the medial pore on urotergite XII is absent.

The lateral porotaxy comprises pores on laterotergite VI and VII (laterotergal pores – *lt*) and pores situated on the lateral membranae between the tergite and sternite V and VI (membranal pores – *mb*). The presence or absence of individual pores on the laterotergite and membranae, as well as the position of pores *lt* are very important taxonomical features (Figs 1-3).

The sternal porotaxy (Figs 28,29) is identical in all the group. Pores exist on urosternites V-VII and XII only. On urosternites V-VII they are situated near the hind margin of sternite and are distributed mostly according to the formula $/1+1/2+2/1+1+1/$. Their distribution and number are more or less variable – specimens with formula $3+1$ on urosternite VI and $1+0+2$ on VII are very common. In *G. europaeus*, *corsicanus* and *orouseti* there exists a sexual dimorphism in the number of pores on urosternite VI. In females there are not more than 4 pores (sporadically even less) while in males there exist 5 or even 6 pores, mostly distributed according to the formula $2+3$ (or $3+3$).

On urosternite XII two pores are present, situated in the antero-lateral portion of the sternite. In imagines they are situated close to its anterior margin and mostly are hardly visible.

In larva I pore *psm* exists on urotergites VII-VIII only (on the former it is sometimes lacking), *al* and *lt* are lacking, the ventral porotaxy comprises only pores on urosternite XII. No larvae I of the species with membranal pores present are actually known. In larvae II *psm* is present on urotergites V-VII (on V it is variable), *al* – on urotergite II-VII (as in the subsequent instars), *lt* is lacking, membranal pores are present (at last in some specimens – the pores in younger instars are hardly visible). Sternal pores exist on urosternite V-VII, though on V they are variable and their number is lower than in the older instars (they are mostly distributed according to the formula $/1+0/1+1/1+0+0/$). In maturi juniores pore *psm* is present on urotergite I-VII (as in imago), pore *lt* exists in most species (in *europaeus* it is absent), and the number of sternal pores on urosternite VII is still lower than in adults, the most common formula being $/1+1/1+1/1+0+1$ or $2+0+0/$.

The lineation of most tergites and sternites is uniform, on urosternites IV-VII it is the same in all the species studied. Only the lineation of urosternites II-III and urotergite VII is sometimes important. Two anterior lines on urosternites II-III may be continuous (Fig. 20) or interrupted (Fig. 13) – in some species this character can be variable (e. g. in *fjellbergi*). Two anterior lines on urotergite VII can be medially connected (Fig. 19) or not connected (Fig. 49). Sometimes the shape of the lateral line on urosternite VII is taxonomically useful.

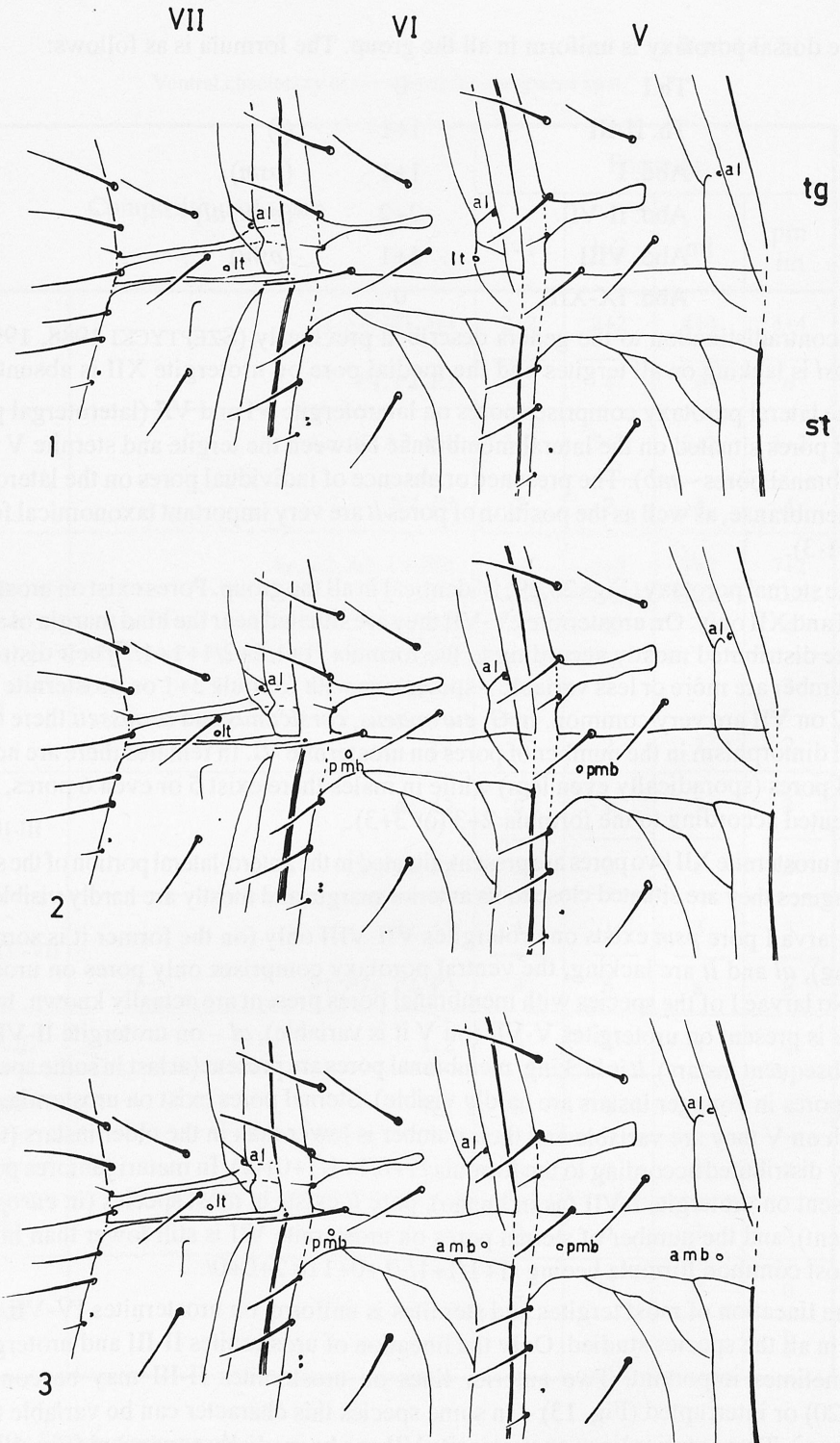


Fig. 1-3. Lateral porotaxy of *G. americanus* (1), *catulus* (2), and *fjellbergi* (3) (al – anterolateral pore, t – laterotergal pore, amb – anterior mambranal pore, pmb – posterior membranal pore).

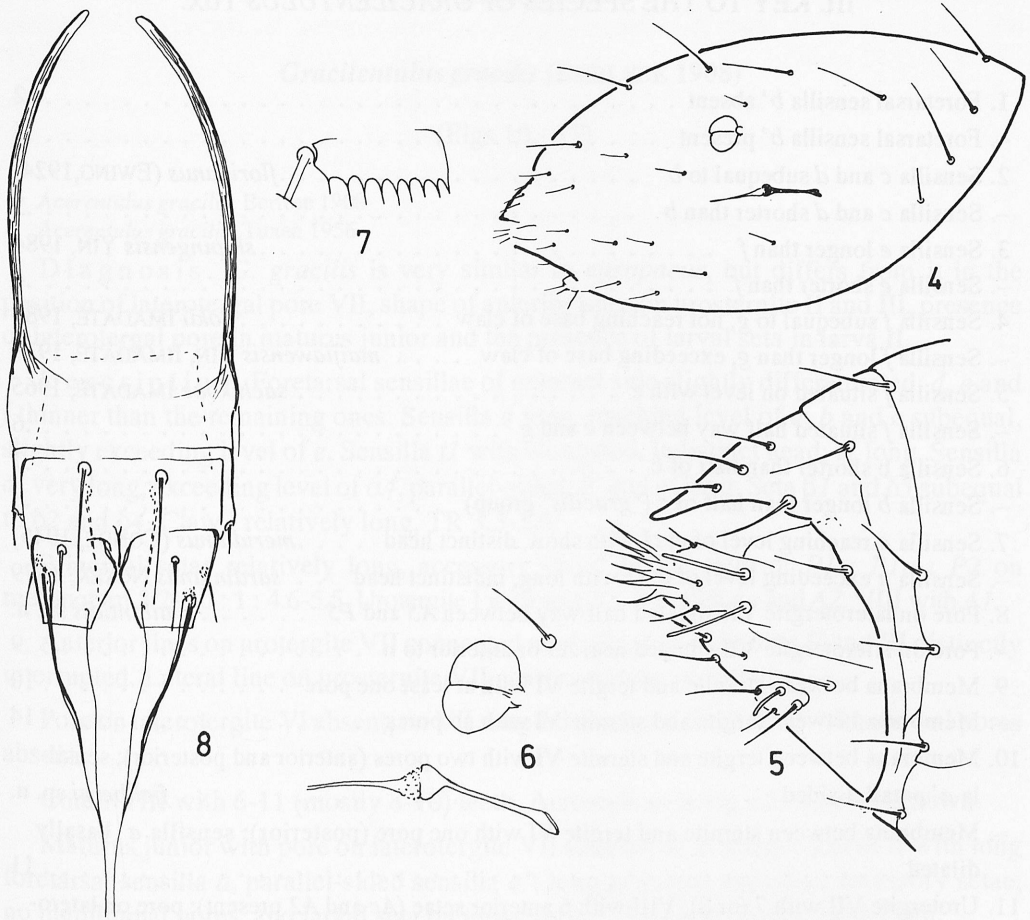


Fig. 4-8. *Gracilentulus europaeus*. 4 – head; 5 – mouthparts, lateral view; 6 – pseudoculus and filamentum di sostegno; 7 – comb VIII; 8 – penis (4-7 – holotype, 8 – paratype from Poznań).

The shape of comb VIII (Fig. 7) is uniform in all the group and has no taxonomical value.

The female squama genitalis is of normal acerentomoid type. The acrostyli are pointed. Penis (Figs 8, 43, 58) is of normal type, with no additional setae and no distinct specific characters.

In the rich material of *Gracilentulus* only few males were found. They exist only in three species (*europaeus*, *corsicanus* and *orousseti*). It is thus possible that most species of "gracilis" group are parthenogenic. Even in *europaeus* males were found only in some samples – a facultative parthenogenesis is also possible.

III. KEY TO THE SPECIES OF *GRACILENTULUS* TUX.

1. Foretarsal sensilla *b'* absent 2
- Foretarsal sensilla *b'* present 5
2. Sensilla *c* and *d* subequal to *b* *floridanus* (EWING, 1924)
- Sensilla *c* and *d* shorter than *b* 3
3. Sensilla *e* longer than *f* *shipingensis* YIN, 1984
- Sensilla *e* shorter than *f* 4
4. Sensilla *f* subequal to *g*, not reaching base of claw *aokii* IMADATÉ, 1982
- Sensilla *f* longer than *g*, exceeding base of claw *maijiawensis* YIN, IMADATÉ, 1979
5. Sensilla *f* situated on level with *e* *sachikoe* IMADATÉ, 1965
- Sensilla *f* situated half way between *e* and *g* 6
6. Sensilla *b* shorter than half of *c* 7
- Sensilla *b* longer than half of *c* ("*gracilis*" group) 8
7. Sensilla *a* reaching level of *e*; *tI* with short, distinct head *meridianus* (CONDÉ, 1945)
- Sensilla *a* exceeding level of *e*; *tI* with long, indistinct head *sardinianus* NOSEK, 1979
8. Pore on laterotergite VII situated half way between *A5* and *P5* *atlantis* sp. n.
- Pore on laterotergite VII situated near *A5* or anterior to it 9
9. Membrana between sternite and tergite VI with at least one pore 10
- Membrana between tergite and sternite VI with no pores 14
10. Membrana between tergite and sternite VI with two pores (anterior and posterior); sensilla *a'* parallel-sided *fjellbergi* sp. n.
- Membrana between sternite and tergite VI with one pore (posterior); sensilla *a'* basally dilated 11
11. Urotergite VII with 7 (or 8), VIII with 6 anterior setae (*Ac* and *A2* present); pore on laterotergite VII situated anteriorly to *A5* 12
- Urotergite VII and VIII with 4 anterior setae (*Ac* and *A2* absent); pore on laterotergite VII situated nearly on level of *A5* *catulus* sp. n.
12. Seta *A5* on urotergite I absent *corsicanus* sp. n.
- Seta *A5* on urotergite I present 13
13. Anterior lines on urotergite VII not connected; foretarsal sensilla *e* distinctly thicker than *f* and *g* *hyleus* sp. n.
- Anterior lines on urotergite VII connected; foretarsal sensilla *e* slightly thicker than *f* and *g* *orousseti* sp. n.
14. Laterotergite VI with pore (anterior to level of *A5*) *americanus* sp. n.
- Laterotergite VI with no pores 11
15. Pore on laterotergite VII situated anteriorly to level of *A5*; anterior lines on urosternite II and II continuous *europaeus* sp. n.
- Pore on laterotergite VII situated on level of *A5*; anterior lines on urosternite II and III interrupted *gracilis* (BERL.)

IV. DESCRIPTIONS

Gracilentulus gracilis (BERLESE 1908)

(Figs 10 - 17)

Acerentulus gracilis: Berlese 1908*Acerentulus gracilis*: Tuxen 1956

Diagnosis. *G. gracilis* is very similar to *europaeus*, but differs from it in the position of laterotergal pore VII, shape of anterior lines on urosternite II and III, presence of laterotergal pore in maturus junior and the presence of larval seta in larva II.

Description. Foretarsal sensillae of external side slightly differentiated: *d*, *e* and *f* thinner than the remaining ones. Sensilla *a* long, reaching level of *e*; *b* and *c* subequal, slightly exceeding level of *e*. Sensilla *t1* with elongated, indistinct head; *t2* long. Sensilla *a'* very long, exceeding level of $\alpha 4$, parallel-sided; *b'* and *c'* long. Seta $\beta 1$ and $\delta 5$ subequal to $\delta 2$ and $\delta 4$. Claw I relatively long, TR 3.3-3.6.

Principal setae relatively long, accessory short; length ratio of *P1* : *P1a* : *P2* on mesonotum 3.2-4.0 : 1 : 4.6-5.5. Urotergite I with seta *A5*, VII with *Ac* and *A2*, VIII with *A1*.

Anterior lines on urotergite VII connected medially, on urosternite II and III distinctly interrupted. Lateral line on urosternite VII nearly straight, indistinct.

Pore on laterotergite VI absent, on VII situated nearly on level of *A5*. Membranal pores absent.

Comb VIII with 6-11 (mostly 8-10) teeth. Acrostyli as in Fig 15, males unknown.

Maturus junior with pore on laterotergite VII situated as in imago. Larva II with long foretarsal sensilla *a*, parallel-sided sensilla *a'*; long principal and short accessory setae; no membranal pores, and larval seta on urosternite XII present. Larva I unknown.

Dimensions (in μm)

	imago	mat.jun.	larva II
foretarsus	75-79	63-67	50-55
claw	21-23	19-20	ca 17
pseudoculus	7-8	6-8	6-7
filamento di sostegno	11-16	10-12	10-11
mesonotal <i>P1</i>	19-23	19-21	15-17
mesonotal <i>P1a</i>	ca 6	ca 6	ca 6
mesonotal <i>P2</i>	27-32	22-27	19-21
maximum body length	1070	820	670
no of specimens studied	16	6	4

Chaetal variability. Imagines (16 specimens). Urotergite VII – presence of $A1+A1$ instead of Ac (1 sp-n), asymmetrical lack of $A2$ (1 sp-n); uroterg. VIII – Mc instead of $M1+M1$ (2 sp-ns)

Maturi juniores (6 sp-ns). Urotergite VI – Ac instead of $A1+A1$ (1 sp-n); uroterg. VII – asymmetrical presence of $A2$ and asymmetrical lack of $A4$ (1 sp-n); asymmetrical lack of $A2$ on urotergite V and its asymmetrical presence on VII (1 sp-n).

Larvae II (4 sp.) – asymmetrical lack of larval seta on urosternite XII (1 sp-n).

Material. **Poland.** Jarczewo near Chojnice. Remnant of abandoned garden on a clearing in an oak-beech forest, rotten wood and plant debris from an old log of apple tree, 23 V 1979, 6 ♀, leg. J. RAFALSKI. Rogalin near Poznań. Abandoned part of the park, in deep layer of litter, 18 IV 1972, 1 ♀, leg. J. RAFALSKI. Czerna near Krzeszowice. Young beech forest with pine, linden etc. near the walls of a monastery, soil with roots. 28 IX 1978, 1 ♀, leg. J. RAFALSKI.

Austria. Vienna: Leopoldsberg. Litter under *Quercus pubescens*, 11 V 1987. 8 ♀, 6 mj, 4 lv2, leg. E. CHRISTIAN.

Remarks. *G. gracilis* was described by BERLESE (1908) under the name *Ace-rentulus gracilis*. It was redescribed by TUXEN (1956) (lectotype designation: TUXEN 1960). The characters of the lectotype (nr 3.5 of Berlese's collection in the Instituto di Entomologia Agraria in Firenze) agree well with the redescription given above. At present the species is known from Italy, Austria and Poland. Other data from many European countries (ALDABA 1985; CONDÉ 1980; CASSAGNAU & NOSEK 1969; NOSEK 1973; 1978b; TUXEN 1964; 1982), Marocco (NOSEK 1973), Cape Province (CONDÉ 1955; TUXEN 1977a), Australia (TUXEN 1967) and New Zealand (TUXEN 1985); should be revised in the future. The present paper contains the revision of the Polish data (SZEPTYCKI 1969a; b) only.

Gracilentulus europaeus sp. n.

(Figs 4 - 8, 18 - 31)

Gracilentulus gracilis: Szeptycki 1969a

Gracilentulus gracilis: Nosek 1973 (Polish data, partim)

Diagnosis – see *gracilis*.

Description. Foretarsal sensillae of external side slightly differentiated: a , c and e slightly thicker than the remaining ones. Sensilla a very long, reaching nearly base of f ; b long, reaching level of $\beta 5$; c slightly longer than b , exceeding base of f . Sensilla $t1$ with elongated, indistinct head; $t2$ long. Sensilla a' short, not reaching level of $\alpha 4$, parallel-sided; b' and c' long. Seta $\beta 1$ and $\delta 5$ longer than $\delta 2$ and $\delta 4$. Claw I relatively long, TR 3.0-3.6.

Principal setae relatively long, accessory short; length ratio of $P1 : P1a : P2$ on mesonotum 2.8-4.8 : 1 : 3.7-6.3. Urotergite I with seta $A5$, VII with Ac (or $A1+A1$) and $A2$, VIII with $A1$.

Anterior lines on urotergite VII connected medially, on urosternite II and III continuous. Lateral line on urosternite VII straight, distinct.

Pore on laterotergite VI absent, on VII situated anterior to level of $A5$. Membranal pores absent.

Comb VIII with 7-13 (mostly 9-11) teeth. Squama genitalis ♀ as in fig. 22, penis as in Fig. 8.

Maturus junior with no pore on laterotergite VII. Larva II with long foretarsal sensilla *a*; relatively short, parallel-sided sensilla *a'*; long principal and short accessory setae, and larval seta absent. Larva I with larval seta.

Dimensions (in μm)

	imago	preim.	mat.jun.	larva II	larva I
foretarsus	71-85	ca 72	66-92	55-58	45-49
claw	22-28	?	20-23	19-21	15-18
pseudoculus	6-9	ca 6	6-8	5-7	5-6
filamento di sostegno	11-16	ca 11	9-14	9-13	9-10
mesonotal <i>P1</i>	21-28	ca 21	17-23	15-19	11-13
mesonotal <i>P1a</i>	5-9	ca 5	4-8	6-8	---
mesonotal <i>P2</i>	29-35	ca 30	22-29	18-23	14-17
maximum body length	1180	?	1040	780	600
no of specimens studied	118	2	18	23	5

Chaetal variability. Imagines (118 sp-ns). urotergite II - asymmetrical lack of *A4* (1 sp-n); uroterg. III - asymmetrical lack of *A1* (1 sp-n), and *A4* (1 sp-n); uroterg. V - asymmetrical lack of *A4* (2 sp-ns) and of *A5* (1 sp-n); uroterg. VII - presence of *A1* + *A1* instead of *Ac* (5 sp-ns), asymmetrical lack of *A2* (2 sp-ns), symmetrical lack of *A2* (1 sp-n), asymmetrical lack of *A4* (2 sp-ns); additional, asymmetrical seta on uroterg. II, III, VII and urostern. VIII (1 sp-n); *Ac* instead of *A1* + *A1* on uroterg. II, central seta instead of *I* + *I* on uroterg. IX, *Pc* on uroterg. VII and *Ia* on urostern. VIII (1 sp-n).

Maturi juniores (19 specimens). Urotergite VI - asymmetrical presence of *A4* (1 sp-n); uroterg. VII - asymmetrical presence of *A2* (6 sp-ns), asymmetrical lack of *A4* (1 sp-n); uroterg. VIII - asymmetrical lack of *A1* (1 sp-n); urostern. VIII - presence of *Pc* (1 sp-n).

Larvae II (23 sp-ns). Urosternite XII - asymmetrical presence of larval seta (1 sp-n).

Larvae I (5 sp-ns) - not observed.

Holotype ♀ (nr. 3800): **Poland.** Gołuchów. Park - Arboretum, wet litter (mostly leaves) on sandy soil under dense shrubs of *Symphoricarpos* and *Lonicera*, 20 VIII 1977, leg. J. RAFALSKI.

Paratypes: **Poland.** Together with holotype; 67 ♀, 12 mj, 11 lv2, 5 lv1. Dzikowo near Myślibórz. Park; 10 VI 1967, 3 ♂, 3 ♀, leg. J. RAFALSKI and C. BŁASZAK. Moryń near Chojna Odrzańska. Park on the lake; 1 ♀, 1 pm, 2 mj, 1 lv2, 9 VI 1967, leg. ZMZ. Gorzyń near Międzychód. Litter and soil under old trees (mostly beeches) on the steep shore of Gorzyńskie-lake. 16 VIII 1985, 1 ♂, 1 ♀, 1 lv2, leg. J. RAFALSKI. Lisi Jar near Jastrzębia Góra. Litter on the NE slope, 10 VIII 1987, 1 ♂, leg. E. BAZYLI. Kadyny near Elbląg. Small gorge in the forest with beech, oak, hornbeam etc., litter; 3 X 1985, 2 ♂, leg. J. RAFALSKI. Poznań-Golecin. Abandoned park, decaying leaves, soil and plant - debris under a stump; 21 X 1977, 3 ♂, 5 ♀, leg. J. RAFALSKI. Warszawa-Lasek Bielański. Hornbeam forest with admixture of alder on a dune-terrace, soil, rotten leaves, moss etc.; 4 XI 1983, 1 ♀, leg. J. RAFALSKI. Żagań. Castle park, wet litter, soil and mosses under shrubs shaded by old trees (mostly maples and oaks), 30 VIII 1977, 4 ♀, leg. ZMZ. Kamień Śląski near Krapkowice. Abandoned castle park, deep layer of rotten wood mixed with soil and decaying leaves at base of an old tree. 28 V 1980, 2 ♀, 1 lv2, leg. J. RAFALSKI. Repty near Tarnowskie Góry. Park-forest, portion with

mixed forest, wet rotten wood with leaves from old stump of an oak; 14 XII 1984, 1 ♀, leg. J. RAFALSKI. Zawisć near Tychy. Old park of a sanatorium, rotten wood, plant debris, remnants of fungi under the trunk of very old maple tree; 22 V 1986, 7 ♀, 2 mj, leg. J. RAFALSKI. Murcki near Katowice. Park-forest, nest of mole built of decaying leaves 50-60 cm deep; 21 V 1986, 9 ♀, 1 mj, leg. J. RAFALSKI. Katowice-Ligota. Park of the Franciscans monastery, litter, soil and plant-debris; 9 IV 1987, 1 ♀ and 27 IV 1987, 1 ♂, 3 ♀, leg. J. RAFALSKI.

France. Forêt de Fontainebleau, Plaine de Chamfroy; 22 VIII 1990, 5 ♀, 1 mj, leg. J. BOUDINOT.

Portugal. Porto. Hills S of the town, mixed forest; 27 X 1983, 7 ♀, 2 mj, leg. W. NIEDBAŁA.

USA. Delaware, Willmington. Valley Garden Park, mixed forest with many climbers, litter, 8 VII 1984, 1 ♀, leg. J. RAFALSKI.

Gracilentulus americanus sp. n.

(Figs 32 - 36)

Diagnosis. The species is very similar (in the lack of membranal pores and in the proportion of body setae) to *gracilis* and *europaeus*. It differs from all the species of the group in the presence of pore on laterotergite VI.

Description. Foretarsal sensillae of external side slightly differentiated: *d*, *e* and *f* thinner than the remaining ones. Sensilla *a* long, reaching base of *e*; *b* reaching level of *e*; *c* distinctly longer than *b*, exceeding base of *f*. Sensilla *t1* with elongated, indistinct head; *t2* long. Sensilla *a'* short, not reaching level of $\alpha 4$, distinctly dilated in proximal half; *b'* and *c'* long. Seta $\beta 1$ and $\delta 5$ shorter than $\delta 2$ and $\delta 4$. Claw I relatively long; TR about 3.3.

Principal setae relatively long, accessory short; length ratio of *P1* : *P1a* : *P2* on mesonotum 4.5 : 1 : 6.2. Urotergite I with seta *A5*, VII with *Ac* and *A2*, VIII with *A1*.

Anterior lines on urotergite VII connected medially, on urosternite II-III continuous. Lateral line on urosternite VII slightly flexed, distinct.

Pore on laterotergite VI and VII present, situated anterior to level of *A5*. Membranal pores absent.

Comb VIII with 9-10 teeth. Acrostyli (in single specimen) invisible, males and younger instars unknown.

Dimensions (in μm): foretarsus 79, claw 24, mesonotal *P1* 24, *P1a* 5, *P2* 32. Body length about 1030. Other dimensions not taken.

Holotype ♀ (nr 3925): **USA.** Delaware, Willmington, Clifton Park. Old deciduous forest with oak, beech, *Sassafras*, maple, hazel. Sample of soil and litter, 24 VI 1984. leg. J. RAFALSKI.

Only the holotype is known.

Gracilentulus orousseti sp. n.

(Figs 37 - 44)

Diagnosis. The species is similar to other species with one membranal pore (*hyleus*, *corsicanus* and *catulus*) but differs from them in the slightly differentiated foretarsal sensillae and relatively longer setae (Fig. 9).

Description. Foretarsal sensillae of external side slightly differentiated: *b*, *c* and *e* slightly thicker than the remaining ones. Sensilla *a* long, reaching level of *e*; *b* and *c* nearly subequal, reaching level of $\alpha 5$. Sensilla *t1* with short, distinct head, *t2* long. Sensilla *a'* short, not reaching level of $\alpha 4$, slightly dilated basally; *b'* and *c'* long. Setae $\beta 1$ and $\delta 5$ subequal to $\delta 2$ and $\delta 4$. Claw I relatively long, TR 2.8-3.2.

Principal and accessory setae long; length ratio of *P1* : *P1a* : *P2* on mesonotum 3.0-3.5 : 1 : 4.2-4.5. Urotergite I with seta *A5*, VII with *Ac* and *A2*, VIII with *A1*.

Anterior lines on urotergite VII connected (anterior one sometimes hardly visible), on urosternite II-III continuous. Lateral line on urosternite VII straight, distinct.

Pore on laterotergite VI absent, on VII situated slightly anterior to level of *A5*. Membrana between urosternites and urotergites V and VI with one (posterior) pore.

Comb VIII with 7-11 teeth, acrostyli as in fig. 43, penis as in Fig. 44.

Younger instars unknown.

Chaetal variability – not observed.

Dimensions (in μm) (in brackets – dimensions of single specimen of preimago): foretarsus 67-71 (64), claw 22-24 (20), pseudoculus 7-9 (8), filamento di sostegno 11-13 (10), mesonotal seta *P1* 21-23 (20), *P1a* 6-7 (6), *P2* 25-31 (26), maximum body length about 970 (770).

Holotype ♀ (nr 4284): Corsica. Muracciole, H-te Corse, between Vivario et Muracciole: entrance of the tunnel of Muracciole. litter and soil along the wall, 600 m asl, 5 X 1984., leg. J. OROUSSET.

Paratypes: Together with holotype; 2 ♂, 3 ♀, 1 pm.

Derivatio nominis: named in honour of Mr. J. OROUSSET, the co-worker of the Museum national d'Histoire Naturelle and eminent collector of the soil fauna.

Gracilentulus hyleus sp. n.

(Figs 45 - 51)

Gracilentulus gracilis: Szeptycki 1969b (partim)

Gracilentulus gracilis: Nosek 1973 (Polish data, partim)

Diagnosis. In the presence of one membranal pore and the strongly differentiated foretarsal sensillae the species in question is most similar to *corsicanus*. It differs from it in relatively shorter setae (Fig. 9) and the presence of seta *A5* on urotergite I.

Description. Foretarsal sensillae of external side distinctly differentiated: *a*, *c* and *e* much thicker than *b*; *b* thicker than *d*, *f* and *g*. Sensilla *a* long, reaching base of *e*; *b* exceeding base of *e*; *c* distinctly longer than *b*, exceeding base of *f*. Sensilla *t1* with elongated, indistinct head; *t2* long. Sensilla *a'* short, not reaching level of $\alpha 4$, distinctly dilated in proximal half. Seta $\beta 1$ and $\delta 5$ shorter than $\delta 2$ and $\delta 4$. Claw I relatively long; TR 3.4-3.7.

Principal setae short, accessory long; length ratio of *P1* : *P1a* : *P2* on mesonotum 1.8-2.4 : 1 : 2.7-3.2. Urotergite I with seta *A5*, VII with *Ac* and *A2*, VIII with *A1*.

Anterior lines on urotergite VII not connected, on urosternites II-III continuous. Lateral line on urosternite VII straight, in- distinct (in some specimens invisible).

Pore on laterotergite VI absent, on VII situated distinctly anteriorly to level of A5. Membranae between urotergite and urosternite V and VI with one (posterior) pore.

Comb VIII with 6-11 (mostly 8) teeth. Acrostyli as in Fig. 51, males unknown.

Maturus junior with pore on laterotergite VII situated as in imago. Larva II with long foretarsal sensilla *a*; dilated sensilla *a'*; short principal and long accessory setae; posterior membranal pore present and no larval seta on urosternite XII. Larva I unknown.

Dimensions (in μm)

	imago	mat.jun.	larva II
foretarsus	74-82	ca 66	ca 56
claw	21-24	?	?
pseudoculus	6-9	7-8	ca 6
filamento di sostegno	13-15	11-12	10-11
mesonotal <i>P1</i>	15-18	15-17	12-14
mesonotal <i>P1a</i>	6-9	6-7	6-7
mesonotal <i>P2</i>	21-25	19-21	16-17
maximum body length	1090	880	?
no of specimens studied	8	2	2

Chaetal variability. Imagines (8 specimens). Urotergite V – additional (asymmetrical) seta near A4 (1 sp-n).

Maturi juniores (2 sp-ns). Urotergite VII – asymmetrical presence of A2 (1 sp-n); asymmetrical presence of A2 on urotergite VII and asymmetrical lack of A1 on VIII (1 sp-n).

Larvae II (2 sp-ns) – not observed.

Holotype ♀ (nr. 3899): **Poland.** Skalki Kroczyckie near Zawiercie: Kołaczyk. Beech forest with some old trees on stony. W slope, soil and litter; 11 IX 1987, leg. J. RAFALSKI.

Paratypes : **Poland.** Together with holotype; 1 ♀, 1 lv2. "Ostra Góra" reserve near Trzebinia. Stony, calcareous hill with scattered old beeches, soil with roots and litter under shrubs. 28 IV 1979, 4 ♀, leg. J. RAFALSKI. Ojców National Park: S slope of Koronna Mt., *Corylo-Peucedanetum*, organic soil, 14 VI 1964, 1 ♀; Koronna Mt., *Tilio-Carpinetum*, rough humus, 2 VI 1964, 1 ♀; Eslope of Prądnik valley, *Tilio-Carpinetum*, soil, 2 VI 1964, 1 mj; Sąpowska Valley, *Fagetum carpaticum*, litter with humus, 2 VI 1964, 1 mj, 1 lv2, leg. A. Rajski.

Derivatio nominis: the species was found in various types of forest, hence *hyleus* – forest-dwelling.

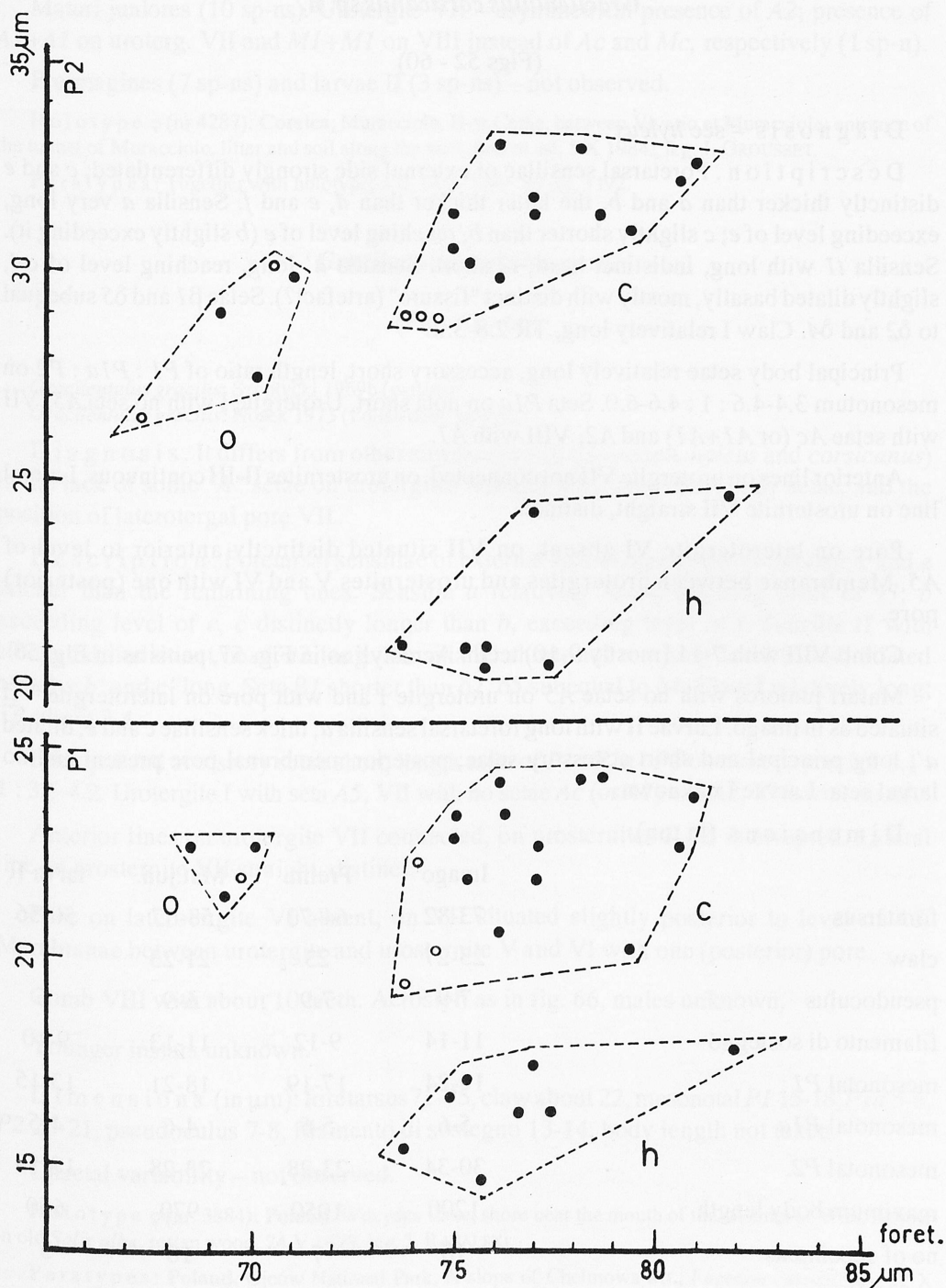


Fig. 9. Scatter diagram of the length of foretarsus and mesonotal seta *P1* (lower) and *P2* (upper) in *G. orousseti* (o), *G. corsicanus* (c) and *G. hyleus* (h).

Gracilentulus corsicanus sp. n.

(Figs 52 - 60)

Diagnosis – see *hyleus*

Description. Foretarsal sensillae of external side strongly differentiated; *c* and *e* distinctly thicker than *a* and *b*, the latter thicker than *d*, *e* and *f*. Sensilla *a* very long, exceeding level of *e*; *c* slightly shorter than *b*, reaching level of *e* (*b* slightly exceeding it). Sensilla *t1* with long, indistinct head; *t2* short. Sensilla *a'* long, reaching level of $\alpha 4$, slightly dilated basally, mostly with distinct "fissure" (artefact?). Setae $\beta 1$ and $\delta 5$ subequal to $\delta 2$ and $\delta 4$. Claw I relatively long, TR 2.8-3.2.

Principal body setae relatively long, accessory short, length ratio of *P1* : *P1a* : *P2* on mesonotum 3.4-4.6 : 1 : 4.6-6.0. Seta *P1a* on nota short. Urotergite I with no seta *A5*, VII with setae *Ac* (or *A1*+*A1*) and *A2*, VIII with *A1*.

Anterior lines on urotergite VII not connected, on urosternites II-III continuous. Lateral line on urosternite VII straight, distinct.

Pore on laterotergite VI absent, on VII situated distinctly anterior to level of *A5*. Membranae between urotergites and urosternites V and VI with one (posterior) pore.

Comb VIII with 7-11 (mostly 9-10) teeth. Acrostyli as in Fig. 57, penis as in Fig. 58.

Maturi juniores with no setae *A5* on urotergite I and with pore on laterotergite VII situated as in imago. Larvae II with long foretarsal sensilla *a*; thick sensillae *c* and *e*; dilated *a'*; long principal and short accessory setae; posterior membranal pore present and no larval seta. Larvae I unknown.

Dimensions (in μm)

	Imago	Preim.	Mat.jun.	larva II
foretarsus	73-82	64-70	58-67	50-56
claw	23-27	23	21-23	?
pseudoculus	7-9	7-9	6-9	6
filamento di sostegno	11-14	9-12	11-13	9-10
mesonotal <i>P1</i>	19-24	17-19	18-21	13-15
mesonotal <i>P1a</i>	5-6	5-6	4-6	4-5
mesonotal <i>P2</i> .	30-34	23-28	23-28	18-19
maximum body length	1200	1050	970	650
no of specimens	18	7	10	3

Chaetal variability. Imagines (18 specimens). Urotergite V – asymmetrical lack of *A1*; uroterg. VII – presence of *A1*+*A1* instead of *Ac* and asymmetrical lack of *A2* (1 sp-n); uroterg. VIII – seta *Ac* instead of *A1*+*A1* (1 sp-n).

Maturi juniores (10 sp.-ns). Urotergite VII – asymmetrical presence of A2; presence of A1+A1 on uroterg. VII and M1+M1 on VIII instead of Ac and Mc, respectively (1 sp.-n).

Preimagines (7 sp.-ns) and larvae II (3 sp.-ns) – not observed.

Holotype ♀ (nr 4287): Corsica, Muracciole, H-te Corse, between Vivario et Muracciole: entrance of the tunnel of Muracciole, litter and soil along the wall, 600 m asl, 5 X 1984., leg. J. OROUSSET.

Paratypes: Together with holotype; 4 ♂, 14 ♀, 7 pm, 10 mj, 3 lv2.

Gracilentulus catulus sp. n.

(Figs 61 - 66)

Gracilentulus gracilis: Szeptycki 1969b (partim)

Gracilentulus gracilis: Nosek 1973 (Polish data, partim)

D i a g n o s i s. It differs from other similar species (*orousseti*, *hyleus* and *corsicanus*) in the lack of some "A" setae on urotergites VII and VIII, very short body setae, and the position of laterotergal pore VII.

D e s c r i p t i o n. Foretarsal sensillae of external side distinctly differentiated: *c* and *e* thicker than the remaining ones. Sensilla *a* relatively short, reaching level of $\gamma 3$; *b* exceeding level of *e*, *c* distinctly longer than *b*, exceeding level of *f*. Sensilla *t1* with elongated, indistinct head; *t2* long. Sensilla *a'* short, not reaching level of $\alpha 4$, dilated basally; *b'* and *c'* long. Seta $\beta 1$ shorter than $\delta 2$, $\delta 5$ subequal to $\delta 4$. Claw I relatively long; TR about 3.4.

Principal and accessory setae short, length ratio of *P1* : *P1a* : *P2* on mesonotum 2.9-3.1 : 1 : 3.5-4.2. Urotergite I with seta A5, VII with no setae Ac (or A1) and A2, VIII with no A1.

Anterior lines on urotergite VII connected, on urosternites II-III interrupted. Lateral line on urosternite VII straight, distinct.

Pore on laterotergite VI absent, on VII situated slightly posterior to level of A5. Membranae between urotergite and urosternite V and VI with one (posterior) pore.

Comb VIII with about 10 teeth. Acrostyli as in fig. 66, males unknown.

Younger instars unknown.

D i m e n s i o n s (in μm): foretarsus 71-75, claw about 22, mesonotal *P1* 15-18, *P1a* 5-6, *P2* 20-21, pseudoculus 7-8, filamento di sostegno 13-14, body length not taken.

Chaetal variability – not observed.

Holotype ♀ (nr. 3884): Poland. Wdzydze Lake, shore near the mouth of the channel of Wda, hollow in old *Salix alba*, rotten wood, 24 V 1979, leg. J. RAFALSKI.

Paratypes: Poland. Ojców National Park, N slope of Chełmowa Mt., *Fagetum carpaticum*, 22 X 1963, 1 ♀, leg. A. RAJSKI. Bogucin Duży near Klucze, dense young pine-forest with oaks and rowan tree, litter, 30 IX 1988, 2 ♀, leg. A. SZEPTYCKI.

Not included into the type material: Zakopane, IV 1928, 1 ♀, leg. J. STACH.

D e r i v a t i o n o m i n i s: *catulus* (lat.) – young animal, especially dog or cat.

Gracilentulus fjellbergi sp.n.

(Figs 67 - 75)

Diagnosis. The new species differs from all species of the group in the large body dimensions, undifferentiated foretarsal sensillae and the presence of anterior membranal pore.

Description. Foretarsal sensillae of external side not differentiated: all sensillae thin. Sensilla *a* long, reaching base of *e*; *b* long, reaching level of *e*; *c* distinctly longer than *b*, reaching level of *f*. Sensilla *t1* with rounded, distinct head; *t2* long. Sensilla *a'* long, reaching nearly level of $\alpha 4$, slender, parallel-sided; *b'* and *c'* very long. Setae $\beta 1$ and $\delta 5$ longer than $\delta 2$ and $\delta 4$. Claw I relatively long; TR 3.1-3.7.

Principal and accessory setae long; length ratio of *P1* : *P1a* : *P2* on mesonotum 2.2-2.8 : 1 : 2.5-3.4. Urotergite I with seta *A5*, VII with *Ac* (or *A1*+*A1*) and *A2*, VIII with *A1*. Seta *M1* on urotergite VIII very variable.

Anterior lines on urotergite VII not connected, on urosternites II and III mostly continuous (in some specimens interrupted). Lateral line on urosternite VII straight.

Pore on laterotergite VI absent, on VII situated anteriorly to level of *A5*. Membranae between urotergites and urosternites V and VI with two (anterior and posterior) pores.

Comb VIII with 7-13 (mostly 10-11) teeth. Acrostyli as in Fig. 74, males unknown.

Maturus junior with pore on laterotergite VII situated as in imago. Larva II with long foretarsal sensilla *a*; long, parallel-sided sensilla *a'*; long principal and accessory setae, and no larval seta on urosternite XII. Larva I unknown.

Dimensions (in μm)

	imago	mat.jun.	larva II
foretarsus	81-94	73-74	59-62
claw	24-28	22-23	?
pseudoculus	6-8	6-7	ca 6
filamento di sostegno	12-16	ca 13	?
mesonotal <i>P1</i>	28-35	24-28	ca 21
mesonotal <i>P1a</i>	11-15	9-13	9-1
mesonotal <i>P2</i>	35-41	31-34	ca 26
maximum body length	1180	970	750
no of specimens studied	43	8	2

Chaetal variability. Imagines (44 specimens). Urotergite IV – asymmetrical lack of *A4* (2 sp-ns), uroterg. V – ditto (1 sp-n), uroterg. VI – asymmetrical lack of *A1* (1 sp-n); uroterg. VII – presence of *A1*+*A1* instead of *Ac* (9 sp-ns), asymmetrical lack of *A2* (2 sp-ns), symmetrical lack of *A2* (2 sp-ns); uroterg. VIII – *Mc* instead of *M1*+*M1* (15 sp-ns), presence of additional seta in row "A" (1 sp-n); asymmetrical lack of *A1* on uroterg.

IV and A2 on VII (1 sp-n); asymmetrical lack of A2 on uroterg. VII and asymmetrical lack of P2a on urostern. VII (1 sp-n).

Maturi juniores (9 sp-ns). Urotergite VII – presence of A1 + A1 instead of Ac (3 sp-ns), asymmetrical presence of A2 (2 sp-ns).

Larvae II (2 sp-ns) – not observed

Holotype ♀ (nr. 3966): **Portugal**. Porto, hills S of the town, mixed forest; 27 X 1983, leg. W. NIEDBAŁA.

Paratypes: **Portugal**. Together with holotype, 23 ♀, 7 mj.

Canary Islands (leg. A. FJELLBERG). Tenerife: Tagueste. Litter and soil under planted cork-oak, 440 m asl, 2 VII 1987, 5 ♀. El Hierro: La Frontera. Litter from banana plantation, 90 m asl; 17 III 1988, 4 ♀. Lanzarote: La Geria. Litter under vineyard in depression on black lava gravel; 21 I 1988, 4 ♀. Gran Canaria: Los Tiles de Moya. Laurisilva, litter and soil, 540 m asl; 1 ♀. Gran Canaria: El Brezal del Palmital. Young *Illex-laurisilva*, soil and litter, 650 m asl; 9 I 1988, 2 ♀.

Poland. Wrocław. Greenhouse of Botanical Garden, pavilion with palms; 13 VI 1975, 1 ♀, leg. J. RAFALSKI. Nałęczów near Puławy, soil and debris from flower-pots with old palms, 10 XII 1971, 1 ♀, leg. J. RAFALSKI. Darłowo near Sławno, deciduous forest; 20 VII 1967, 1 ♀, leg. J. RAFALSKI.

Derivation nominis: named in honour of my friend and eminent collembologist, Dr Arne FJELLBERG from Tromsø.

Gracilentulus atlantidis sp. n.

(Figs 76 - 84)

Diagnosis. The new species differs from all the species of the group in the peculiar position of laterotergal pore VII, relatively short foretarsal sensillae, and the shape of lateral line on urosternite VII.

Description. Foretarsal sensillae of external side slightly differentiated: *d*, *e* and *f* thinner than the remaining ones. Sensilla *a* short, not reaching level of γ_3 ; *b* short, reaching level of γ_3 , slightly shorter than *c*; *c* short, reaching level of *e*. Sensilla *t1* with rounded, distinct head; *t2* short. Sensilla *a'* short, not reaching level of α_4 , distinctly dilated in proximal half; *b'* and *c'* short. Seta β_1 and δ_5 shorter than δ_2 and δ_4 . Claw I relatively short; TR 3.8-4.4.

Principal and accessory setae relatively short; length ratio of *P1* : *P1a* : *P2* on mesonotum 2.0-3.3 : 1 : 3.1-4.6. Urotergite I with seta A5, VII with Ac and A2, VIII with A1.

Anterior lines on urotergite VII not connected, on urosternites II and III interrupted. Lateral line on urosternite VII strongly flexed, V-shaped, distinct.

Pore on laterotergite VI absent, on VII situated half way between A5 and P5. Membranae between urotergites and urosternites V and VI with one (posterior) pore.

Comb VIII with 7-11 (mostly 8-10) teeth, acrostyli as in fig. 82. Males unknown.

Maturus junior with pore on laterotergite VII situated as in imago. Larva II with short foretarsal sensilla *a*; dilated sensilla *a'*; short principal and accessory setae; posterior membranal pore present, and with no larval seta on urosternite XII. Larva I unknown.

Dimensions (in μm)

	imago	mat.jun.	larva II
foretarsus	79-86	66-74	55-58
claw	19-22	17-20	15-17
pseudoculus	6-9	6-7	6-7
filamento di sostegno	12-16	11-14	10-12
mesonotal <i>P1</i>	15-19	14-17	12-15
mesonotal <i>P1a</i>	6-8	6-7	5-6
mesonotal <i>P2</i>	23-28	19-25	17-21
maximum body length	1020	970	760
no of specimens studied	43	8	6

Chaetal variability. Imagines (41 specimens). Urotergite VII – asymmetrical lack of *A2* (1 sp-n), lack of *Ac* and asymmetrical lack of *A2* (1 sp-n), additional seta between *A4* and *A5* (1 sp-n); uroterg. VIII – seta *Mc* instead of *M1+M1* (2 sp-ns).

Maturi juniores (7 sp-ns). Urotergite VII – lack of *Ac* and asymmetrical presence of *A2* (1 sp-n).

Larvae II (6 sp-ns) – not observed.

Holotype ♀ (nr 4000): **Canary Islands**. Tenerife: Mesa de Tejina. Litter and soil under rosettes of big thistles, expanded plateau, 580 m asl; 21 VII 1987, leg. A. Fjellberg.

Paratypes: **Canary Islands** (leg. A. FJELLBERG). Together with holotype; 7 ♀, 3 mj, 1 lv2. Tenerife: Faro de Anaga. Deep soil in grass meadow above light-house; 13 X 1987, 8 ♀, and grassy meadow with *Arisarum* etc., 330 m asl; 23 XI 1987, 2 ♀. Tenerife: Teno. N-facing rocks, moss and *Monanthes*, 220 m asl; 14 X 1987, 1 ♀. Tenerife: Ladera de Guimar. Lush slope with annuals, 430 m asl, 2 XI 1987, 7 ♀. Tenerife: Icod de los Vinos. Warm slopes with thickets of *Hypericum*, *Opuntia*, *Sonchus* etc., 160 m asl.; 28 XI 1987, 1 ♀. El Hierro: ca 1 km E of Sabinosa. Litter under *Juniperus phoenicea* and *Myrica faya*, 370 m asl.; 17 III 1988, 10 ♀, 1 mj, 1 lv2. Gomera: Vallehermoso, Roque Cano. Litter and soil under *Juniperus phoenicea*, 530 m asl.; 3 XII 1987, 4 ♀.

Portugal. Porto. Hills S of the town, mixed forest; 27 X 1983, 1 ♀, 1 mj, 4 lv2, leg. W. NIEDBALA.

Derivatio nominis: named after the mythical land of Atlantis.

REFERENCES

- ALDABA J. 1985. Contribución al conocimiento de la familia *Acerentomidae* (Protura: Insecta) del País Vasco. II. Géneros *Acerella* BERLESE, *Acerentomon* SILVESTRI, *Gracilentulus* TUXEN y *Proacerella* BERNARD. Munibe (Cienc. nat.), 37: 87-100.
- BERLESE A. 1908. Osservazioni intorno agli Acerentomidi. Redia, 5: 110-122.
- CASSAGNAU P., NOSEK J. 1969. Protoures de Grece. Biol. Gallo - Helenica, 2: 119-122.
- CONDÉ B. 1955. Un Protoure de Congo Belge. Rev. Zool. Bot. Afr., 51: 336-338.
- CONDÉ B. 1980. Nouvelles recoltes de Protoures de Corse. Rev. Ecol. Biol. Sol, 17: 255-302.
- IMADATÉ G. 1982. A new species of the genus *Gracilentulus* (Protura) from Shikoku, Southwest Japan. Annot. zool. jap., 55: 180-183.

- NOSEK J. 1973. The European *Protura*. Their taxonomy, ecology and distribution. With keys for determination. Mus. d'Hist. Nat., Geneve, 345 pp.
- NOSEK J. 1978a. Key and diagnoses of Proturan genera of the world. Annotnes zool. bot. Bratislava, No 122: 1-59.
- NOSEK J. 1978b. New records of *Protura* (*Insecta*) from Greece. Rev. suisse zool., 85: 301-306.
- NOSEK J. 1979. A new proturan species from Sardinia/ *Protura: Acerentomoidea/ Gracilentulus* [sic!] *sardinianus* n. sp.. Redia, 62: 335-337.
- SZEPTYCKI A. 1969a. Materiały do fauny *Protura* Polski. Acta zool. cracov., 14: 451-464, pls XXIX-XXXV.
- SZEPTYCKI A. 1969b. Fauna of *Protura* of the Ojców National Park in Poland. Acta zool. cracov., 14: 465-470, pls XXXVI-XXXVIII.
- SZEPTYCKI A. 1988. New genera and species of *Protura* from the Altai Mts. Acta zool. cracov., 31: 297-362.
- SZEPTYCKI A. 1991. Polish *Protura*. V. Genus *Acerentulus* BERLESE, 1908 (*Acerentomidae*). Acta zool. cracov. 34(1): 1-64.
- TUXEN S. L. 1956. Neues über die von BERLESE beschriebenen Proturen. Redia, 41: 227-258.
- TUXEN S. L. 1960. Ergänzendes über die von SILVESTRI und BERLESE beschriebenen Proturen. Ent. Meddr., 29: 294-303.
- TUXEN S. L. 1963. Art- und Gattungsmerkmale bei den Proturen. Ent. Meddr., 32: 84-98.
- TUXEN S. L. 1964. The *Protura*. A revision of the species of the world with keys for determination. Hermann, Paris, 360 pp.
- TUXEN S. L. 1967. Australian *Protura*, their phylogeny and zoogeography. Z. Zool. Syst. Evol. Forsch., 5: 1-53.
- TUXEN S. L. 1977a. *Protura* (*Insecta*) from Angola and Nigeria. With a key to Subsaharan *Protura*. Publ. cult. Co. Diam. Ang. Lisboa, (1977): 175-193.
- TUXEN S. L. 1977b. The genus *Berberentulus* (*Insecta, Protura*) with a key and phylogenetical considerations. Rev. Ecol. Biol. Sol, 14: 597-611.
- TUXEN S. L. 1981. The systematic importance of "the striate band" and the abdominal legs in *Acerentomidae* (*Insecta: Protura*). With a tentative key to acerentomid genera. Ent. Scand. Suppl., 15: 125-140.
- TUXEN S. L. 1982. The *Protura* (*Insecta*) of Madeira. Bocagiana, 65: 1-20.
- TUXEN S. L. 1985. *Protura* (*Insecta*). Fauna N. Z., 9: 1-50.
- TUXEN S. L., IMADATÉ G. 1975. The *Protura* of the Bismarck Archipelago and Solomon Islands. Bull. Brit. Mus. (Nat. Hist.), 31: 331-375.
- YIN W. 1984. A new genus and three new species of *Protura*. Contr. Shanghai Inst. Entomol., 4: 169-176.
- YIN W., IMADATÉ G. 1979. A new species of the genus *Gracilentulus* (*Protura*) from East China. Bull. natn. Sci. Mus. A (Zoology), Tokyo, 5: 1-5.

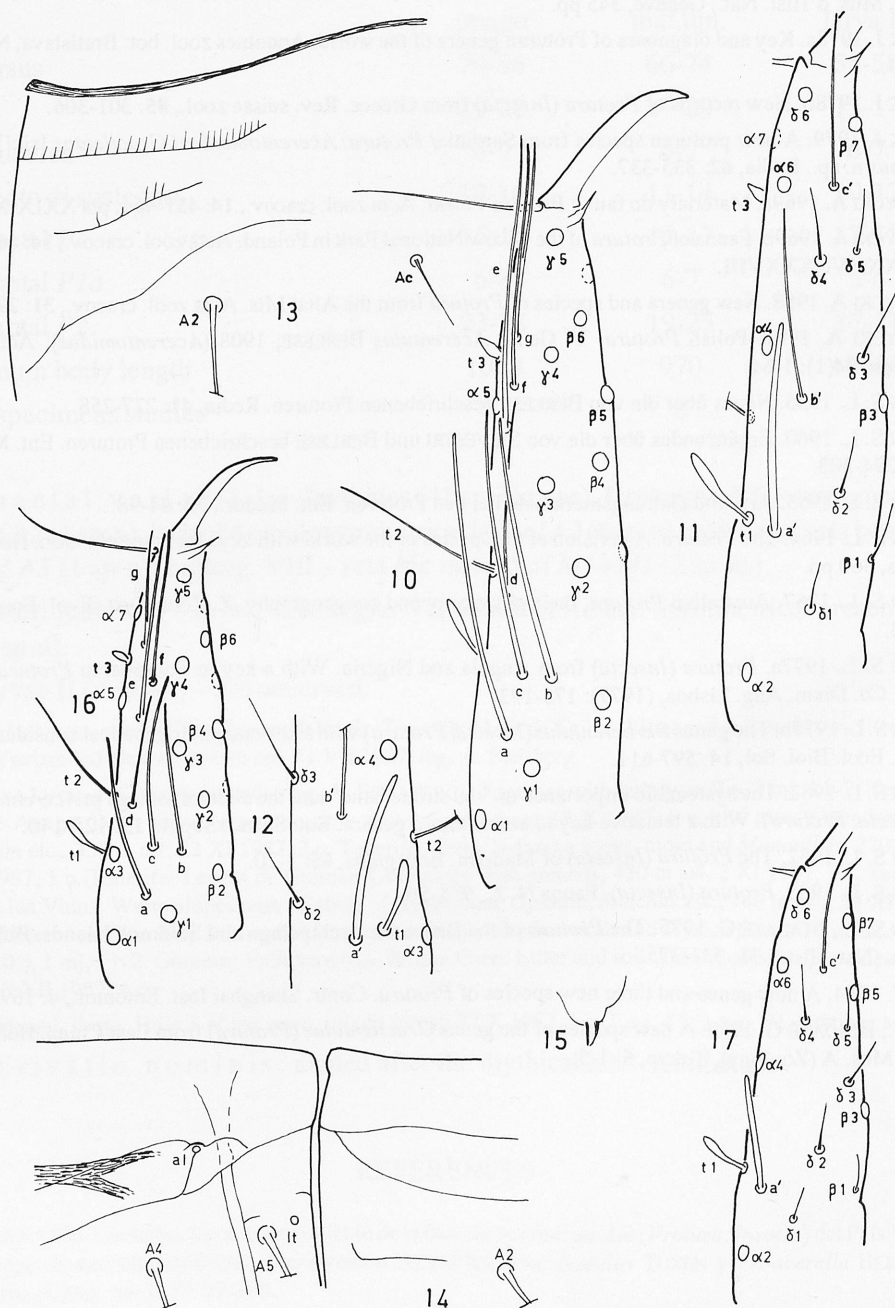


Fig. 10-17. *Gracilentulus gracilis*. 10 – foretarsus, external view; 11 – foretarsus, internal view; 12 – foretarsal sensilla a' , dorsal view; 13 – anterior lines on urosterite III; 14 – antero-lateral part of abdominal segment VII; 15 – acrostylus; 16 – foretarsus of larva II, external view; 17 – foretarsus of larva II, internal view (10-15 – specimens from Jarczewo, 16-17 – specimen from Vienna).

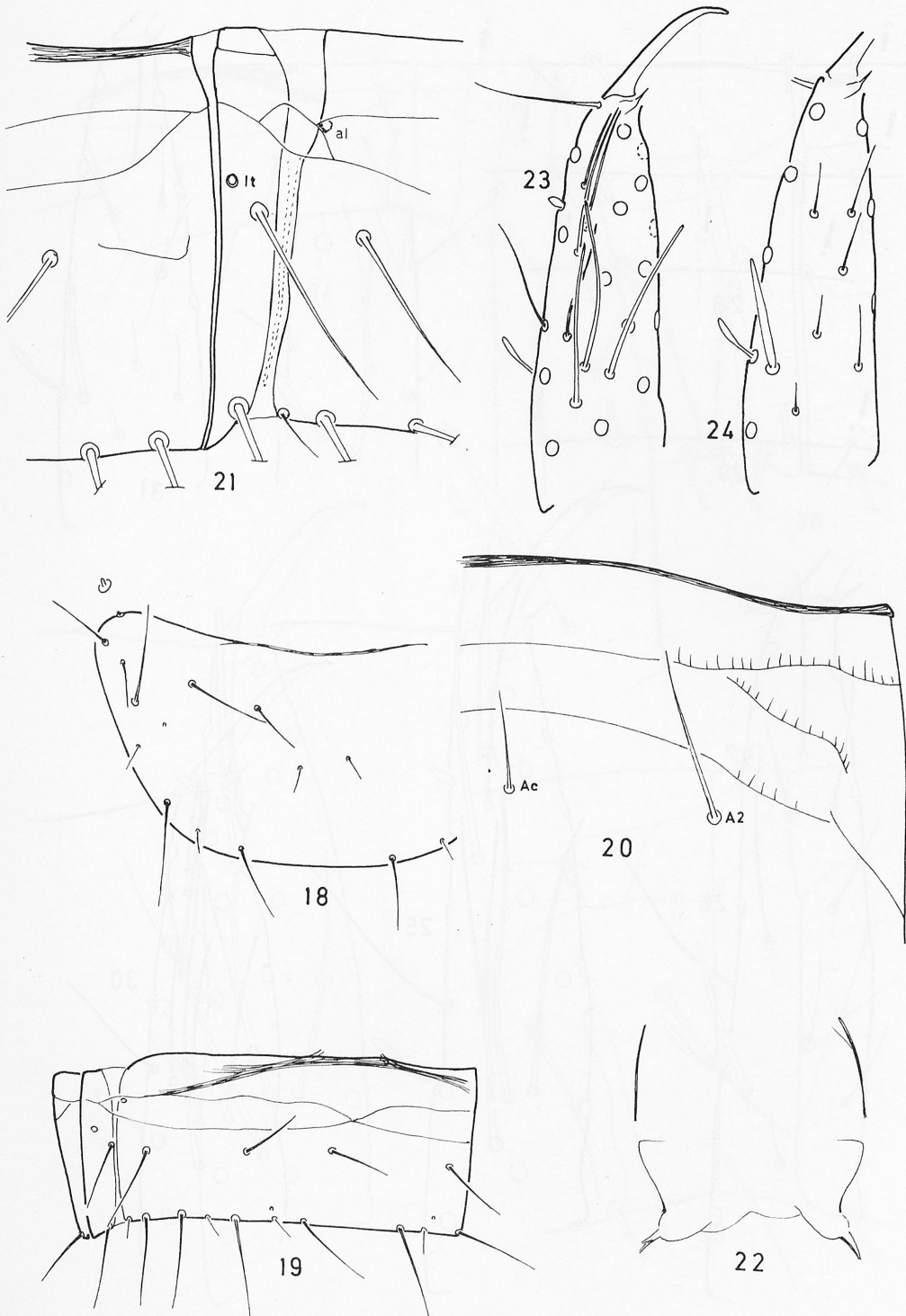


Fig. 18-24. *Gracilentulus europaeus*. 18 – mesonotum; 19 – urotergite VII; 20 – anterior lines on urosternite III; 21 – lateral part of abdominal segment VII; 22 – squama genitalis ♂; 23 – foretarsus of larva I, external view; 24 – foretarsus of larva I, internal view (18-19 – holotype, other – paratypes from Goluchów).

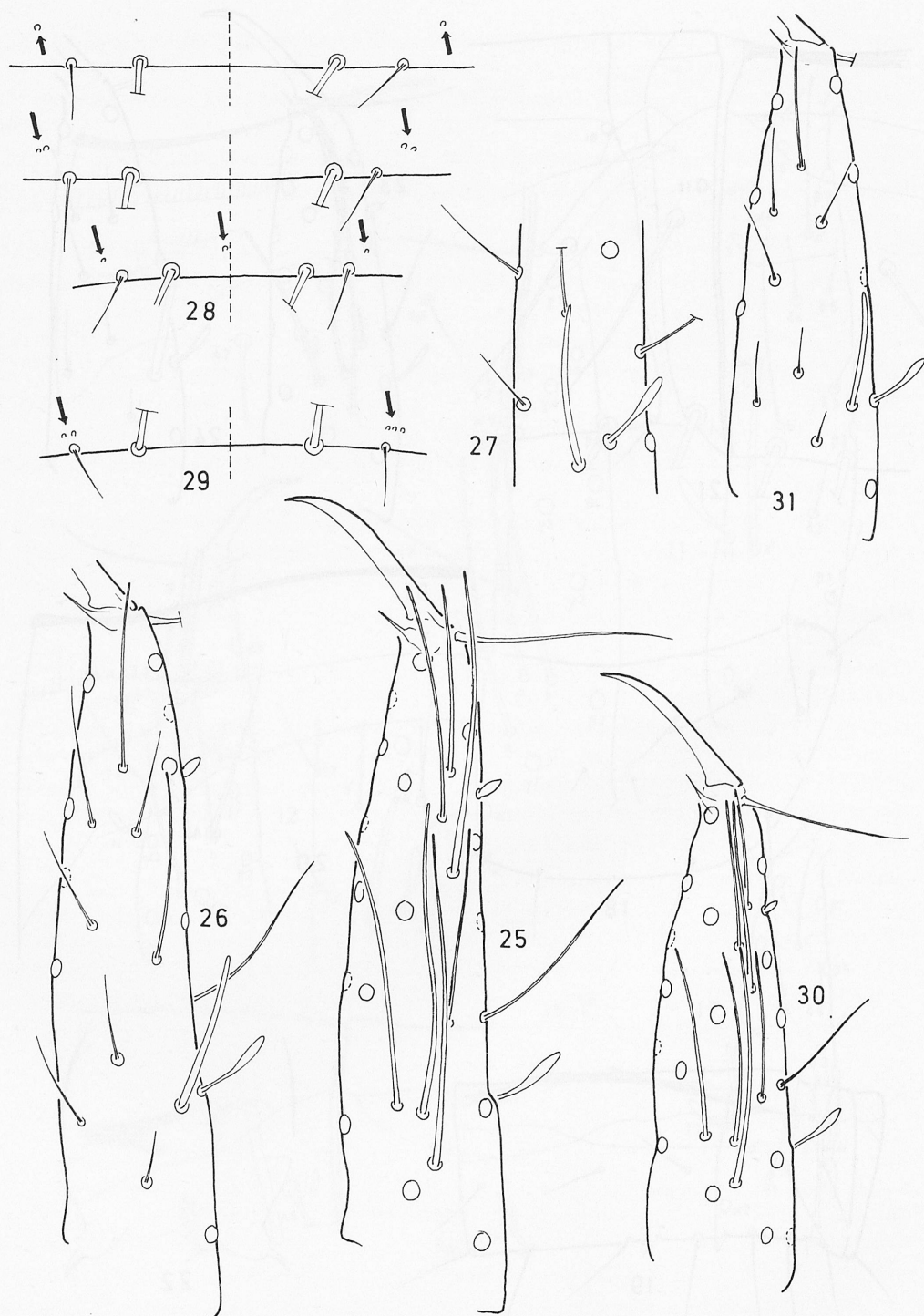


Fig. 25-31. *Gracilentulus europaeus*. 25 – foretarsus, external view; 26 – foretarsus, internal view; 27 – foretarsal sensilla *a'*, dorsal view; 28 – porotaxy of urosternite V-VII of female; 29 – porotaxy of urosternite VI of male (arrows – pores); 30 – foretarsus of larva II, external view; 31 – foretarsus of larva II, internal view (25, 26 and 28 – holotype, 27, 30, 31 – paratypes from Gołuchów, 29 – paratype from Poznań).

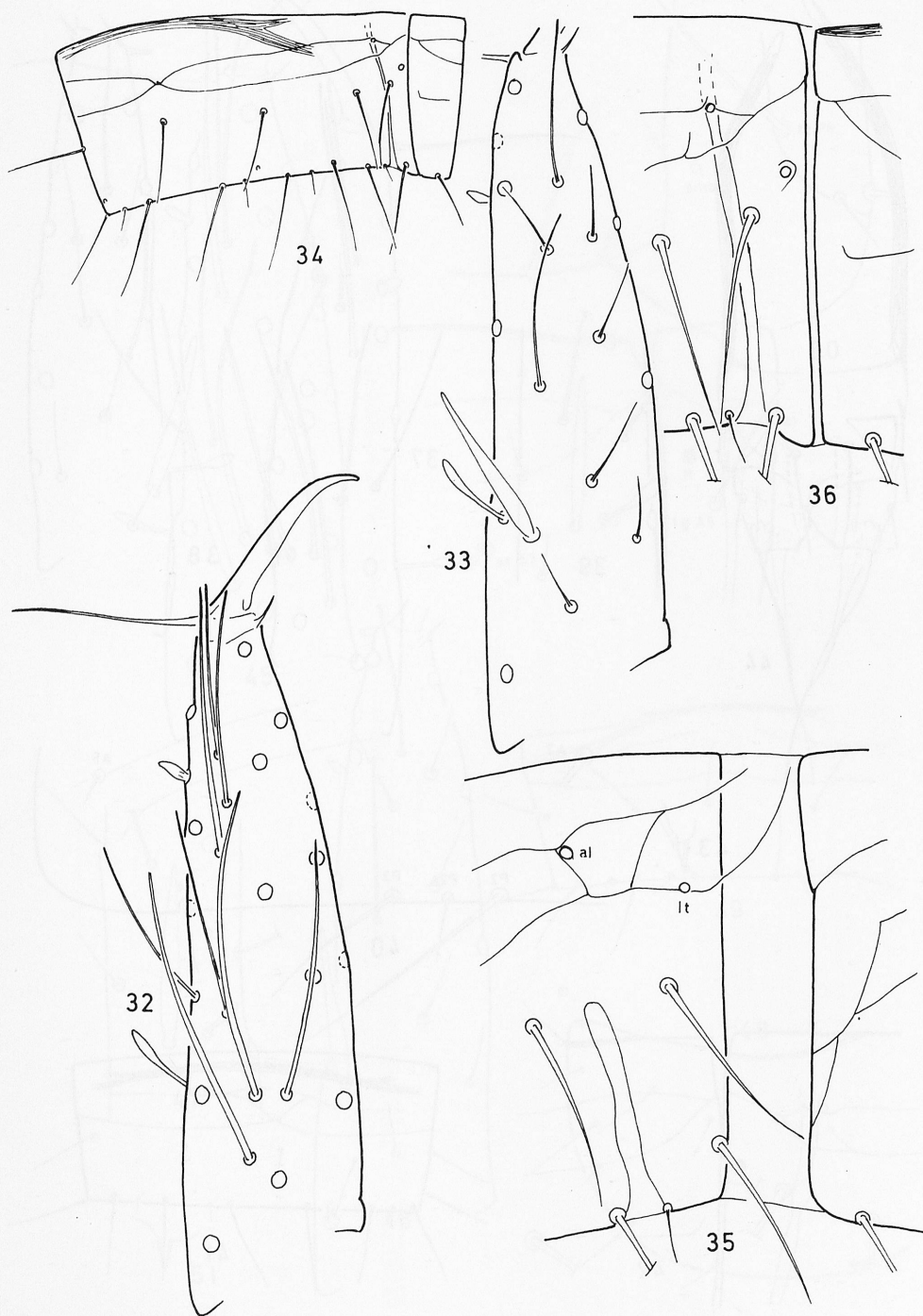


Fig. 32-36. *Gracilentulus americanus* (holotype). 32 – foretarsus, external view; 33 – foretarsus, internal view; 34 – urotergite VII; 35 – lateral portion of abdominal segment VI; 36 – lateral portion of abdominal segment VII.

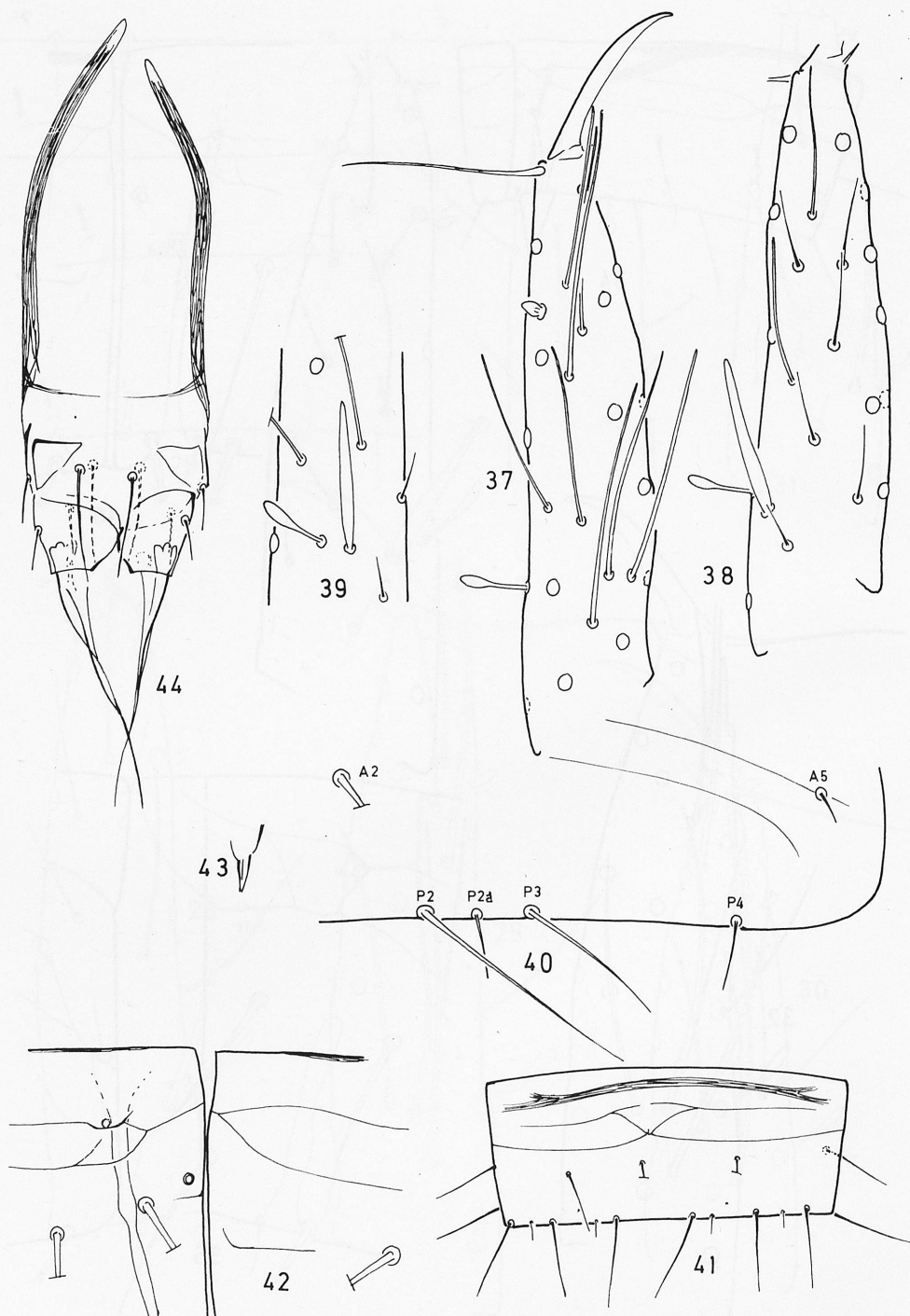


Fig. 37-44. *Gracilentulus orousseti*. 37 – foretarsus, external view; 38 – foretarsus, internal view; 39 – foretarsal sensilla *a'*, dorsal view; 40 – lateral part of urotergite I; 41 – urotergite VII; 42 – antero – lateral part of abdominal segment VII; 43 – acrostylus; 44 – penis (37, 38, 43 – holotype, other – paratypes).

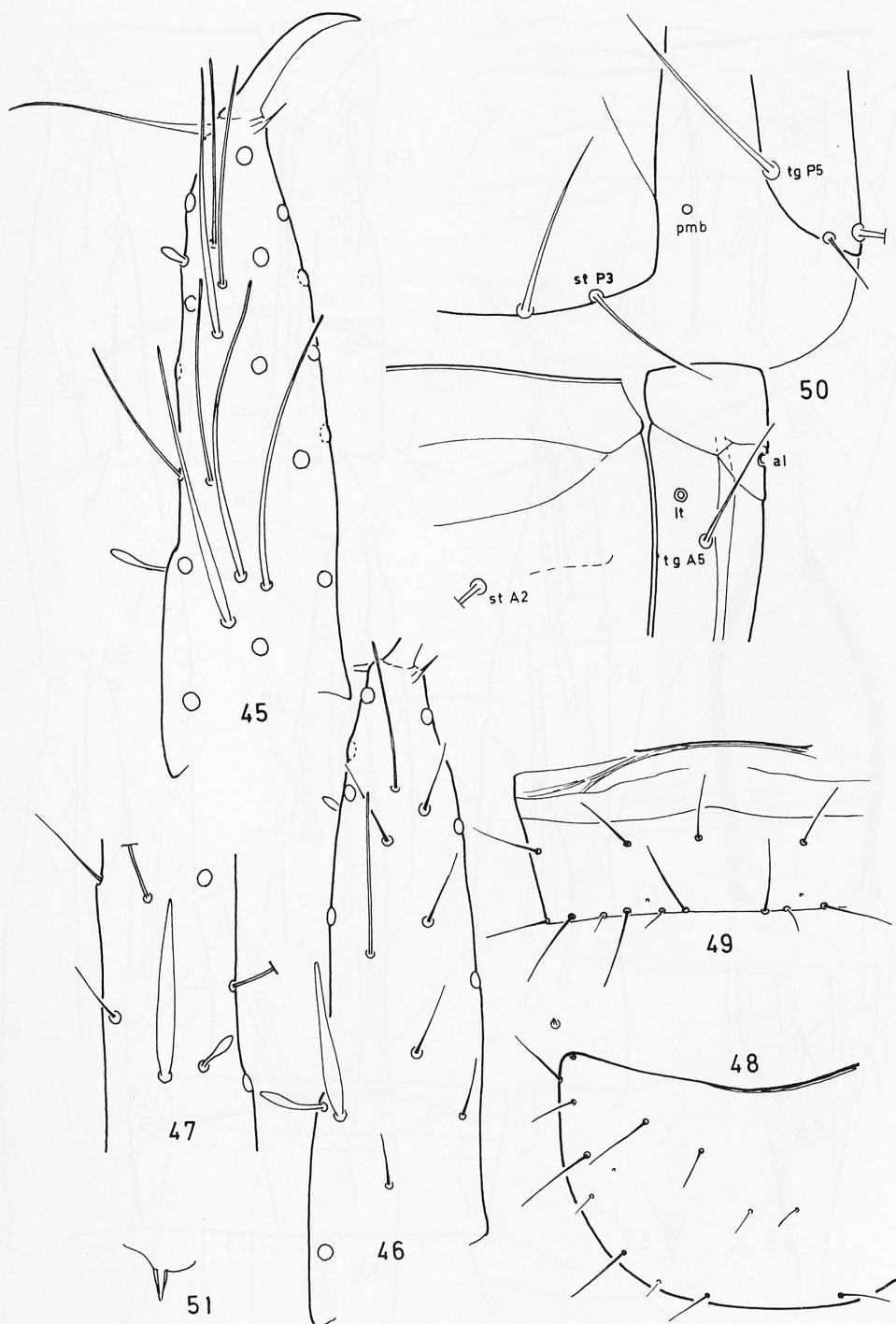


Fig. 45-51. *Gracilentulus hyleus*. 45 – foretarsus, external view; 46 – foretarsus, internal view; 47 – foretarsal sensilla *a'*, dorsal view; 48 – mesonotum; 49 – urotergite VII; 50 – lateral portion of abdominal segment VI (posterior part) and VII (anterior part); 51 – acrostylus (48-50 – holotype, 45, 46 – paratype from Ojców, 51 – paratype from Ostra Góra).

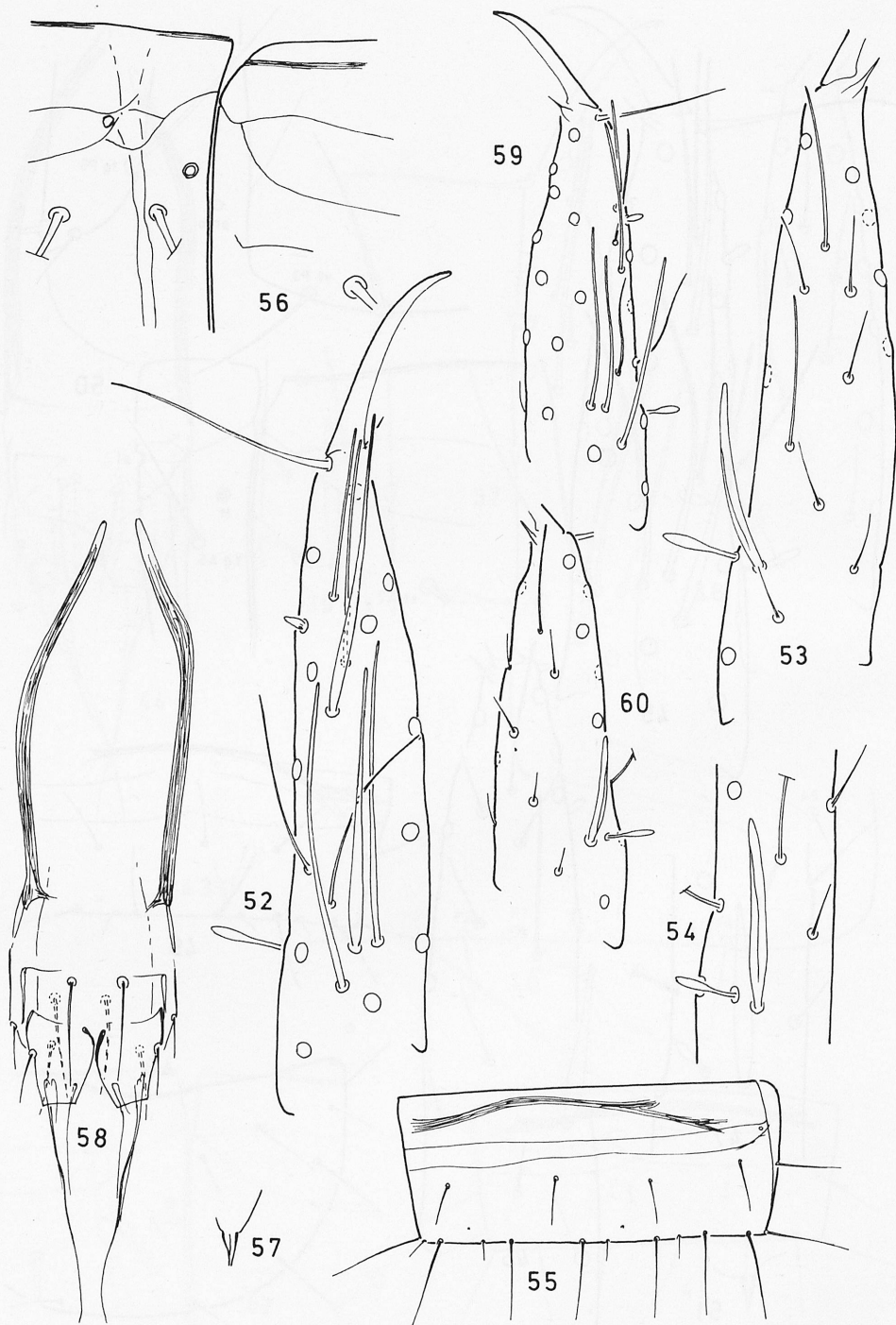


Fig. 52-60. *Gracilentulus corsicanus*. 52 – foretarsus, external view; 53 – foretarsus, internal view; 54 – foretarsal sensilla *a'*, dorsal view; 55 – urotergite VII; 56 – antero-lateral part of abdominal segment VII; 57 – acrostylus; 58 – penis; 59 – foretarsus of larva II, external view; 60 – foretarsus of larva II, internal view (52, 53 – holotype, other – paratypes).

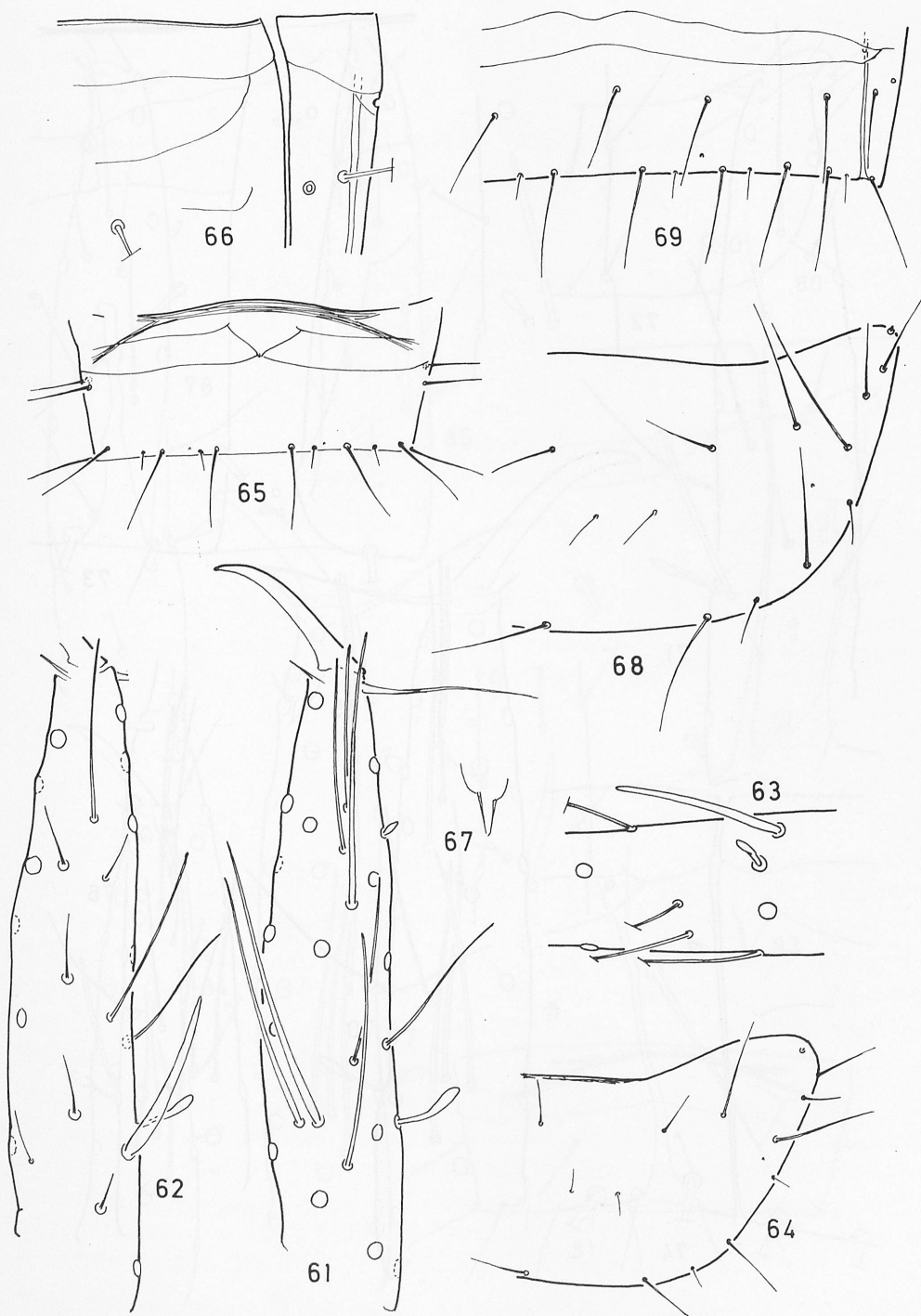


Fig. 61-69. *Gracilentulus catulus* (61-67) and *fjellbergi* (68-69). 61 - foretarsus, external view; 62 - foretarsus, internal view; 63 - sensilla a' of paratype; 64 - mesonotum; 65 - urotergite VII; 66 - antero-lateral portion of abdominal segment VII; 67 - acrostylus (63 - paratype from Bogucin, other - holotype); 68 - mesonotum; 69 - urotergite VII (paratypes from Porto).

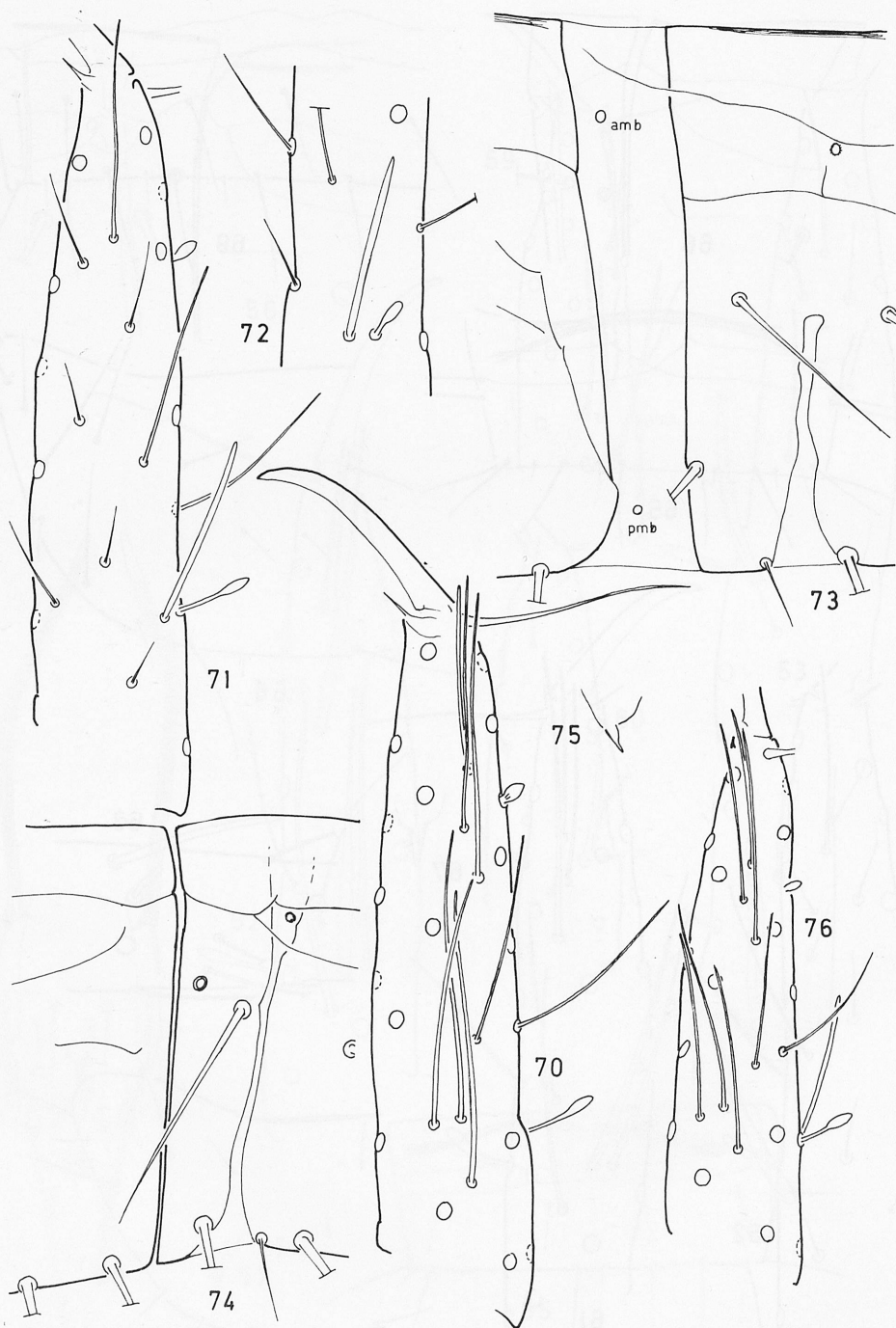


Fig. 70-76. *Gracilentulus fjellbergi*. 70 – foretarsus, external view; 71 – foretarsus, internal view; 72 – foretarsal sensilla *a'*, dorsal view; 73 – lateral part of abdominal segment VI; 74 – lateral part of abdominal segment VII; 75 – acrostylus; 76 – foretarsus of larva II, external view (69, 70, 72, 73 – holotype, other – paratypes from Porto).

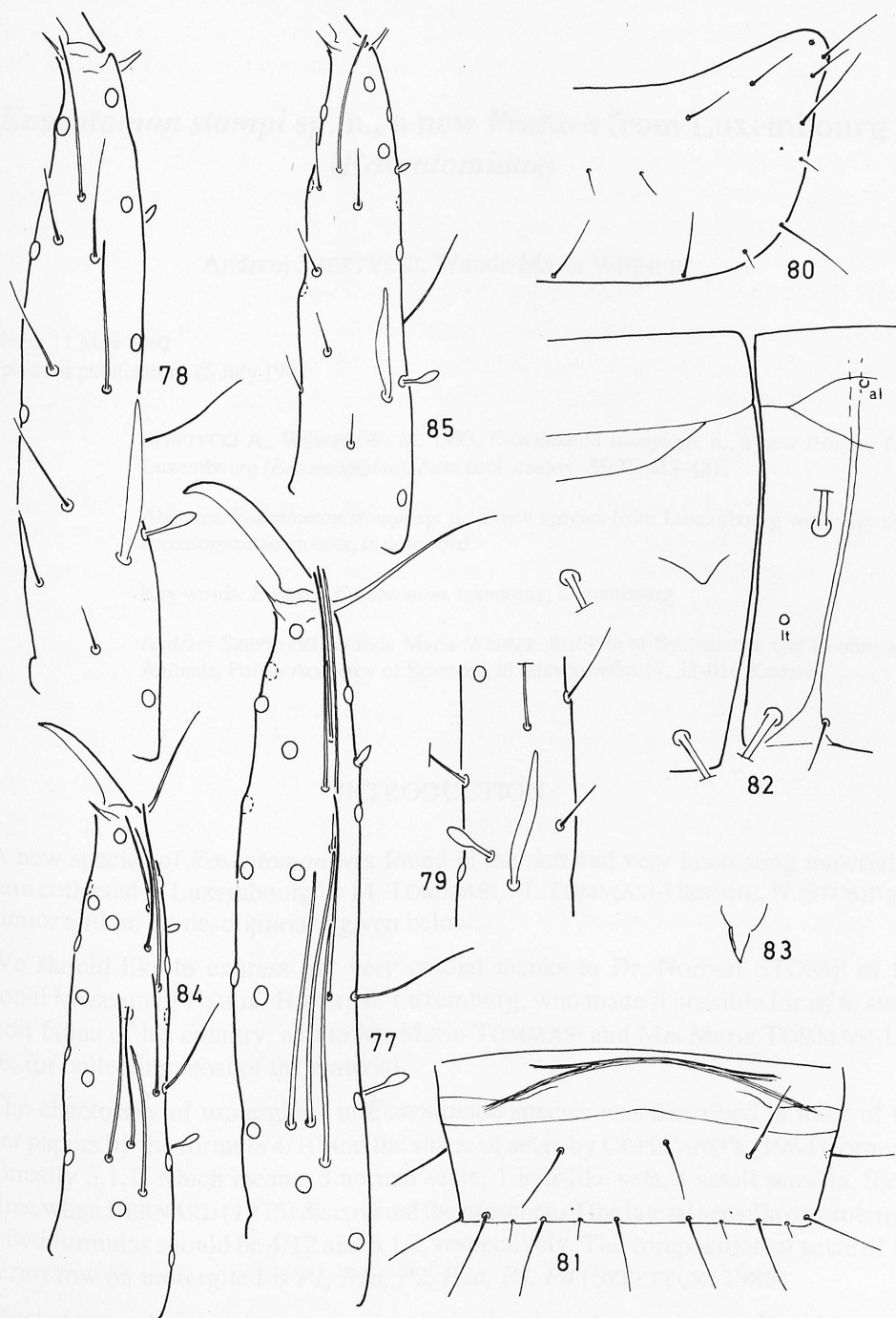


Fig. 77-85. *Gracilentulus atlantis*. 77 – foretarsus, external view; 78 – foretarsus, internal view; 79 – foretarsal sensilla *a'*, dorsal view; 80 – mesonotum; 81 – urotergite VII; 82 – lateral part of abdominal segment VII; 83 – acrostylus; 84 – foretarsus of larva II, external view; 85 – foretarsus of larva II, internal view (76, 77, 79-81 – holotype, other – paratypes from Tenerife).

