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DESCRIPTION OF LARVA AND DEUTONYMPH OF *PARATROMBIUM INSULARE* (BERLESE, 1910) (ACARI: ACTINOTRICHIDA: TROMBIDIOIDEA) WITH CHARACTERISTICS OF ADULT INSTAR AND REMARKS ON OTHER MEMBERS OF THE GENUS

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Abstract.— A larva of *Paratrombium insulare* (Berlese, 1910), obtained by experimental rearing and a deutonymph collected in the field are described for the first time. The characteristics of adults, completed with biometrical data on females and males, is given. Current problems concerning the taxonomy within *Paratrombium* Bruyant, 1919 with special reference to larval instars are discussed. A key to larvae of *Paratrombium* is provided.

Key words.— acarology, taxonomy, Parasitengona, Trombidiidae, *Paratrombium*, *P. insulare* larvae, key

INTRODUCTION

Paratrombium Bruyant, 1910, having its representatives in all the 5 zoogeographic regions, comprises at present 28 nominal species. Among them, only 6 are known from larvae and postlarval stages whereas 17 species are known exclusively from postlarval stages, and 5 – exclusively from larvae. Larvae of *Paratrombium* are known to parasitize on *Hymenoptera*, *Heteroptera*, *Homoptera* and *Diptera*, the data on host taxa are relatively scarce and restricted to few sources (Bruyant 1912, Goldarazena and Zhang 1997, Goldarazena et al. 1999, Robaux 1974, Southcott 1997, Welbourn 1983). The type species *Paratrombium egregium* Bruyant, 1910 was described from larva and its other instars still remain unknown.

Southcott (1997) proposed a comprehensive key to larvae of *Paratrombium*. Since then one larval species *P. welbourni* Goldarazena and Zhang, 1997 was described.

In the present paper the larva and deutonymph of *P. insulare* are described for the first time. Data on adults are also given. Specimens were assigned to *P. insulare* on the basis of descriptions provided by Berlese (1910, 1912) (see also: Distribution and habitat).

A provisional key to larvae of *Paratrombium*, modified after Southcott (1997) is proposed.

MATERIAL AND METHODS

Free-living, postlarval forms of *Paratrombium* were collected directly, at three different localities in southwestern Archipelago, Finland [1/. 667:19 Korppoo Kulmo, grass and stones at the shore, 2.06.1995, leg. J. Mąkol, G. Gabryś, P.T. Lehtinen; 2/. 669:19 Korppoo Åvensor, Kirmo, Udd, shore meadow, in wet grass, 1.06.1995, leg. J. Mąkol, G. Gabryś, P.T. Lehtinen; 3/. 668:17, Houtskari Jungfruskär, at the shore, under the stones; 1.06.1995; leg. J. Mąkol].

Larvae were obtained by experimental rearing from three females collected at locality no. 1. The females were kept at room temperature, in separate rearing vials filled with the charcoaled Plaster-of-Paris.

The contents of the vials was checked daily during the course of the experiments. The eggs were laid in clutches 5 days after collecting. The first prelarvae appeared after next 12 days. Larvae emerged 11–12 days after the beginning of prelarval stage. Females were put in alcohol within 1–2 days after oviposition. All the larvae were transferred to alcohol within 2 up to 15 days after emerging.

The material was preserved in 70–75% ethyl alcohol. Specimens for light microscope studies were fixed on slides in Faure's fluid after maceration in Nesbitt's fluid. Drawings and measurements were made under Jenaval and Biolar microscopes, respectively. Several specimens (7) were used for scanning electron microscope studies. Photographs of selected morphological structures were taken in SEM LEO 435VP, following drying at critical point (Balzers CPD 010) and gold-coating (Edwards Scancoat Six, Pirani 501).

The terminology applying to morphological structures follows Mąkol and Wohltmann (2000). Altogether

Figure 1. *Paratrombium insulare* (Berlese, 1910). Habitus of larva.

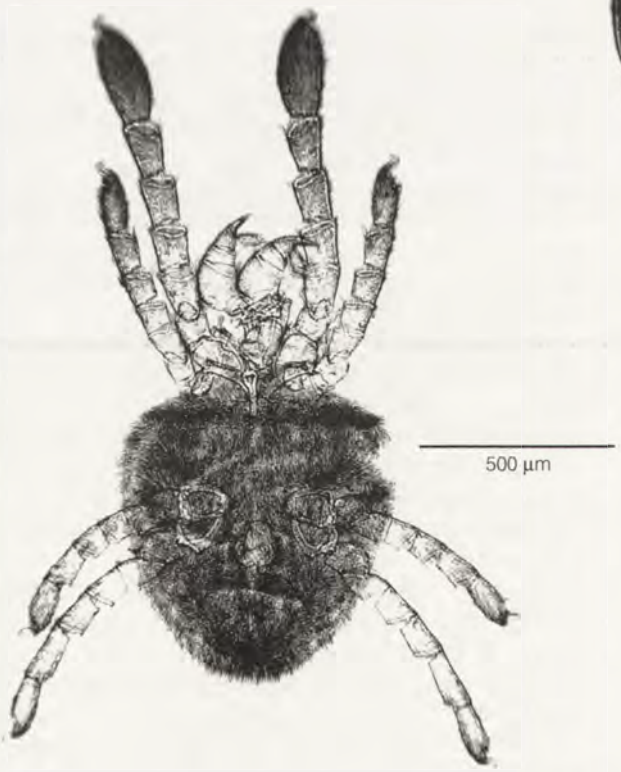


Figure 2. *Paratrombium insulare* (Berlese, 1910). Habitus of deutonymph.

Figure 3. *Paratrombium insulare* (Berlese, 1910). Habitus of adult (male).

35 larvae, 5 deutonymphs, 6 females and 6 males served for morphometric analysis. Damaged or badly visible structures were excluded from the analysis. Standard deviation (SD) was calculated for samples ≥ 7, coefficient of variation (CV) – for samples ≥ 20. All measurements are given in micrometers (μm).

A series of specimens (larva SF/1145, deutonymph SF/1029, female SF/1013, male SF/1017) is deposited in Zoologisches Institut und Zoologisches Museum der Universitaet Hamburg. Other larvae of *P. insulare* originating from laboratory culture as well as deutonymphs and adults that served for analysis, are in the author's collection.

Taxonomy

Paratrombium insulare (Berlese, 1910)
(Figs 1–23, Tables 1–3)

Trombidium insulare Berlese, 1910
Trombidium insulare: Berlese 1912
Dinothrombium insulare: Thor and Willmann 1947, Cooreman 1956

Character	Number of specimens	Mean	Minimum	Maximum	SD	CV
L	35	344,55	312,05	375,25	17,667	5,13
W	35	235,42	213,30	248,85	6,720	2,85
L/W	35	1,46	1,36	1,61	0,061	4,18
AA	32	55,32	49,50	59,40	3,178	5,74
AW	32	197,20	184,14	207,90	5,840	2,96
PW	34	192,58	178,20	199,98	5,026	2,61
SB	35	170,00	154,44	180,18	5,329	3,13
ASB	34	163,12	148,50	170,28	4,079	2,50
PSB	34	45,37	39,60	49,50	2,356	5,19
AP	35	43,50	37,62	49,50	2,563	5,89
AM	35	56,46	51,48	61,38	2,322	4,11
AL	35	67,72	55,44	77,22	4,370	6,45
PL	35	79,03	55,44	87,12	5,247	6,64
S	26	81,26	73,26	91,08	4,391	5,40
MA	35	136,39	124,74	142,56	4,068	2,98
HS	27	65,85	59,40	71,28	2,885	4,19
LSS	32	200,73	188,10	209,98	4,882	2,43
SL	32	85,26	77,22	91,08	4,084	4,79
SS	30	81,11	73,26	89,10	4,010	4,94
DS_MIN	35	73,94	63,36	83,16	4,267	5,77
DS_MAX*	34	86,13	77,22	93,06	3,752	4,36
h_1	33	100,68	95,04	106,92	3,250	3,23
Ch	20	54,75	49,50	57,42	1,609	2,94
Cx_I	35	72,35	65,34	79,20	3,999	5,53
Tr_I	35	43,90	39,60	49,50	2,861	6,52
Fe_I	35	64,04	59,40	69,30	2,756	4,30
Ge_I	35	33,94	29,70	37,62	2,360	6,95
Ti_I	35	56,80	49,50	63,36	3,713	6,54
Ta_I	35	84,46	79,20	89,10	2,446	2,90
LEG I	35	355,49	330,66	372,24	10,054	2,83
Cx_II	34	76,81	69,30	81,18	3,074	4,00
Tr_II	35	41,41	35,64	49,50	2,936	7,09
Fe_II	35	55,84	43,56	61,38	3,714	6,65
Ge_II	35	30,89	27,72	35,64	2,211	7,16
Ti_II	35	50,74	45,54	57,42	2,545	5,02
Ta_II	35	76,43	71,28	81,18	2,550	3,34
LEG II	34	332,23	316,80	346,50	7,765	2,34
Cx_III	30	69,04	59,40	73,26	2,835	4,11
Tr_III	35	46,11	39,60	51,48	3,580	7,76
Fe_III	33	62,10	55,44	69,30	3,201	5,15
Ge_III	35	32,30	27,72	35,64	2,292	7,10
Ti_III	35	57,19	49,50	63,36	3,319	5,80
Ta_III	35	80,61	71,28	85,14	2,611	3,24
LEG III	28	349,96	328,68	368,28	9,171	2,62
IP	28	1039,57	991,98	1077,10	23,887	2,30

Table 1. Morphometric data on larvae of *P. insulare*.

* – without setae h_1

Leg segments	Setae	Leg I	Leg II	Leg III
Tr	n	1	1	1
Fe	n	5	4–5	4
Ge	n	4	3	3
	σ	2	1	1
	κ	1	1	0
Ti	n	5	5	5
	φ	2	2	0
	κ	1	0	0
Ta	n	17	14	13
	ζ	2	0	0
	ω	1	1	0
	ε	1	1	0

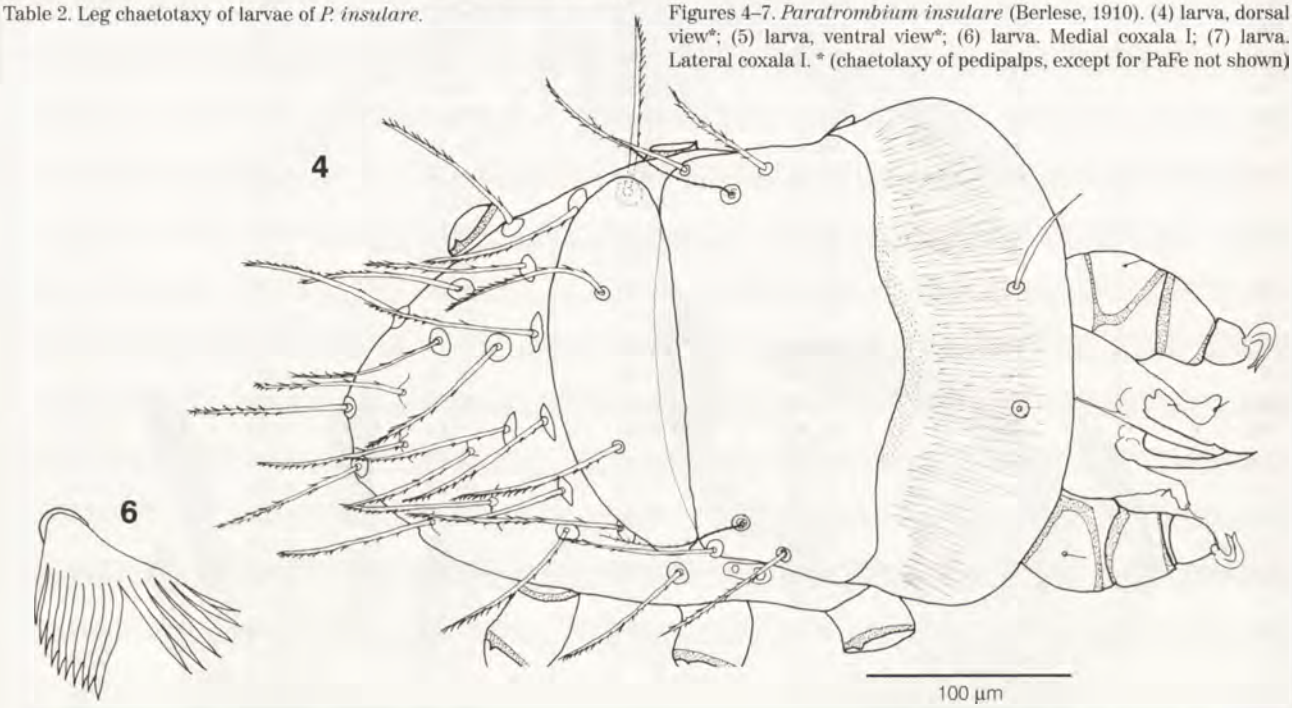
Table 2. Leg chaetotaxy of larvae of *P. insulare*.

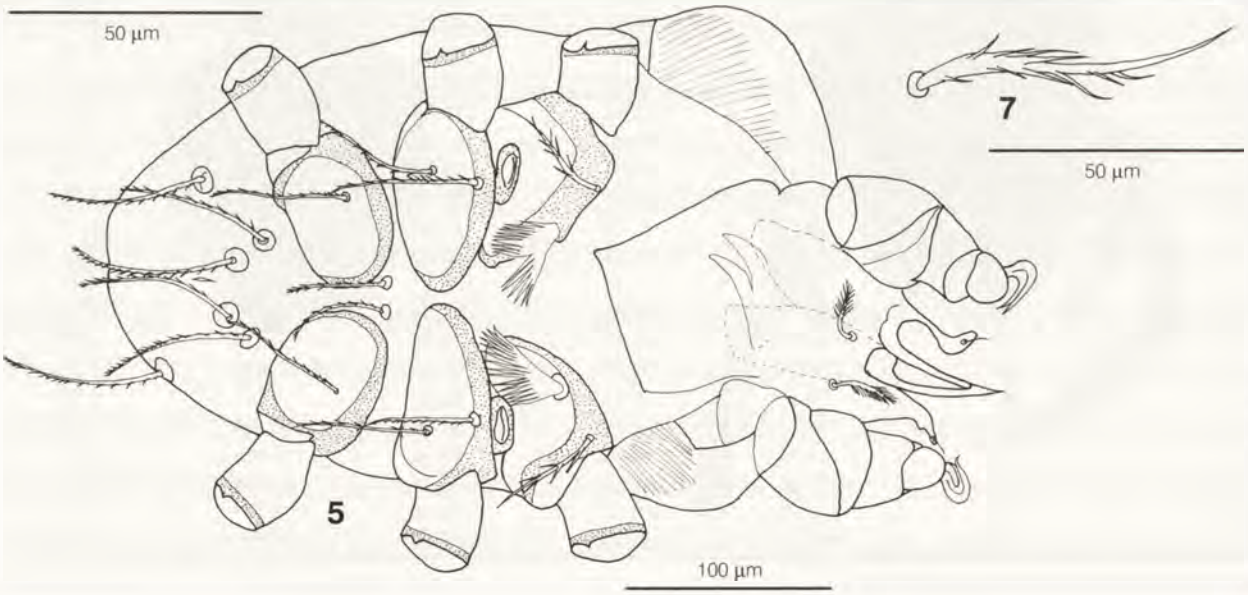
Parathrombium insulare: Robaux 1967
Paratrombium insulare: Southcott 1986, Mąkol 2000b

Description of larva. Standard measurements in Table 1. Body in life light red with darker eye-spots. Habitus as in Fig. 1.

Gnathosoma (Fig. 8). Subcapitular setae (*bs*) (Figs 8, 12) bipectinate. The stem of *bs* much thicker in its proximal part and markedly narrowed terminally. *fch* = 1–0. Cheliceral blade elongated, slightly curved, with tooth-like process in the distal end of internal edge (Ch). Setae *cs* short, acicular (Fig. 8). The pedipalp formula fP_{ρ} = 0-N-0-NNN-3N3ζ2ω comprises one smooth seta on palpfe-

Figures 4–7. *Paratrombium insulare* (Berlese, 1910). (4) larva, dorsal view*; (5) larva, ventral view*; (6) larva. Medial coxala I; (7) larva. Lateral coxala I. * (chaetolaxy of pedipalps, except for PaFe not shown)





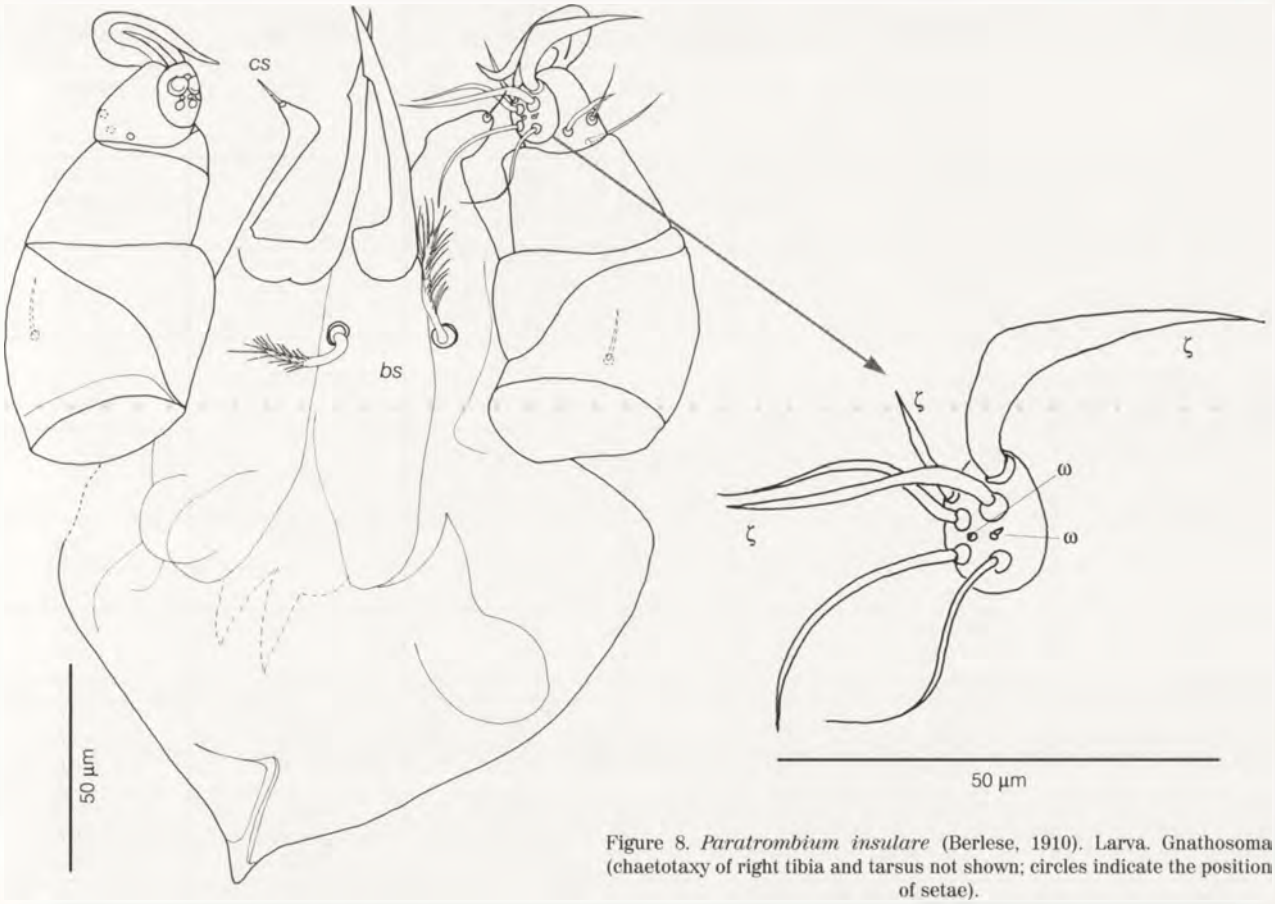


Figure 8. *Paratrombium insulare* (Berlese, 1910). Larva. Gnathosoma (chaetotaxy of right tibia and tarsus not shown; circles indicate the position of setae).

mur, three setae on palptibia, one of which is thicker than the other two, and eight setae on palptarsus (Figs 8, 13). Palptibial claw bifid on entire length except for the basal part. Normal setae on palptarsus without barbs; one of specialized setae thickened and bent at ca. 1/3 of its length (Fig. 8); solenidia (one of which not clearly developed, in form of small protrusion in the palptarsus surface) much shorter than other setae.

Dorsal side of idiosoma (Fig. 4). Scutum strongly developed, covering more than half dorsal side of body. Great part of scutum surface porous. Anterior part of the sclerite widened and longitudinally striated; the effect of striation is visible in specimens mounted on microscopic slides but not present in specimens studied in SEM and thus most probably results from flattening of the poorly sclerified part of scutum (see also: Mąkol and Wohltmann 2000). AM setae stout, without barbs. AL and PL setae with distinct barbs. Sensillae (S) with tiny setules covering the whole shaft. Two pairs of eyes slightly protruding above the idiosoma surface, on oval sclerites placed laterally to scutum, at the level between AL and PL setae. Anterior lens of slightly bigger diameter than the posterior one. Scutellum porous, with one pair of barbed setae. Cuticular ornamentation on the surface of idiosoma (except for scutum and scutellum) arranged in wavy or almost straight lines. Dorsal setae arranged in rows, each seta barbed and placed on separate platelet. Setae h1 much longer than other setae (Tab. 1). *f*D formula: 2-2-6-4-4-2-2.

Ventral side of idiosoma (Fig. 5). Cuticular ornamentation as on dorsal side of idiosoma. *fst* = 0-0-B. A pair of sternalae situated at the level of Cx III. Urstigma elongated, placed between Cx I and Cx II. *fcx* = NBB-BB-B (supracoxala included in the formula; Fig. 14). Medial coxala of leg I pectinate, with 13–17 digitations (Figs 6, 14, 15). Lateral coxala (Figs 7, 14) slender, with several branches. The shafts of ventral setae slightly thinner than on dorsal side of idiosoma. *f*V formula: 2-2-2. Uropore situated behind the second pair of setae forming *f*V formula.

Legs I–III (Figs 9–11). Leg segmentation formula: 6-6-6. Posterior claw of Ta III reduced. For leg chaetotaxy: see Table 2.

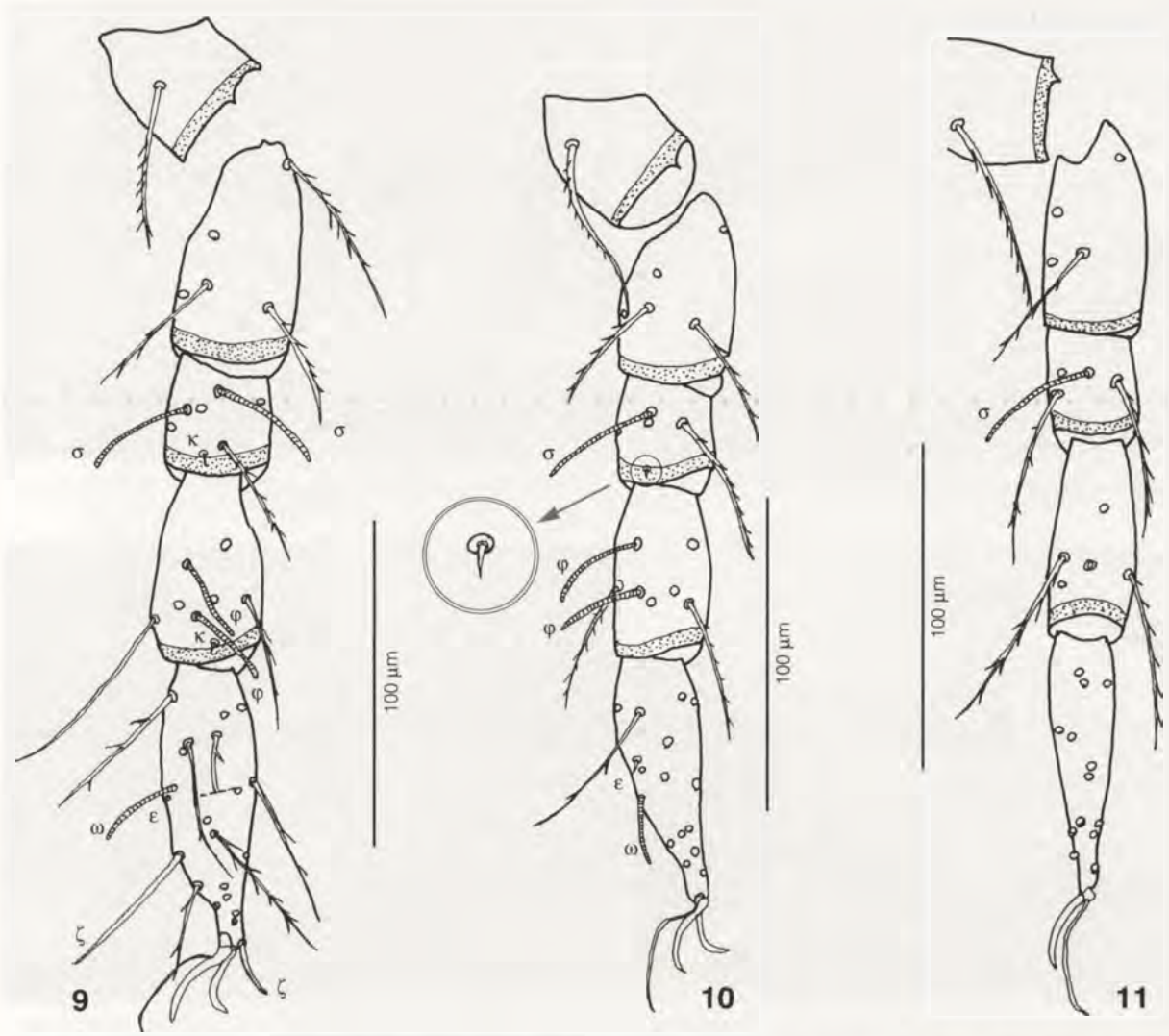
Deutonymph. Standard measurements in Table 3. Colour of the body in life bright red with lighter legs. Idiosoma oval, slightly widened in anterior part. Habitus as in Fig. 2.

Gnathosoma. Two-segmented chelicerae; inner edge of blade slightly serrated; the serrated line bent close to the basis of claw and oriented towards the outer edge of blade (Fig. 16). Pedipalps robust (Fig. 17). Palptibia with at least 1 long eupathidium placed close to palptibial claw. Palptarsus protruding behind the termination of palptibial claw, with numerous solenidia.

Character	Sex/Instar	Number of specimens	Mean	Minimum	Maximum
L	Females	5	1986,60	1694,00	2263,80
	Males	6	1534,87	1416,80	1817,20
	Deutonymphs	5	953,19	815,85	1201,20
W	Females	6	1463,03	1247,40	1709,00
	Males	6	1175,53	1047,20	1339,80
	Deutonymphs	5	769,09	661,50	1001,00
L/W	Females	5	1,35	1,24	1,41
	Males	6	1,31	1,14	1,46
	Deutonymphs	5	1,24	1,20	1,30
CML'*	Females	6	187,62	173,80	201,45
	Males	5	173,31	158,00	191,10
	Deutonymphs	5	117,71	106,65	126,40
S	Females	0	–	–	–
	Males	1	237,00	–	–
	Deutonymphs	0	–	–	–
E	Females	6	101,38	94,80	110,60
	Males	6	98,09	90,85	102,70
	Deutonymphs	5	61,62	51,35	67,15
SB	Females	6	34,89	31,60	39,50
	Males	6	36,87	31,60	43,45
	Deutonymphs	5	23,78	19,95	27,65
Ch	Females	5	46,61	39,50	51,35
	Males	6	43,45	39,50	47,40
	Deutonymphs	5	31,62	27,75	35,55
Ti Cl	Females	6	100,07	90,85	110,60
	Males	6	100,72	90,85	110,60
	Deutonymphs	5	67,94	63,20	75,05
Pa Ta	Females	6	141,54	122,45	158,00
	Males	6	140,88	126,40	169,85
	Deutonymphs	5	74,26	71,10	79,00
p DS	Females	6	30,36	25,74	31,68
	Males	6	26,73	21,78	29,70
	Deutonymphs	5	27,32	23,76	31,68
GOP l	Females	6	285,72	233,05	319,95
	Males	6	232,39	185,65	256,75
	Deutonymphs	5	119,29	106,65	146,15
GOP w	Females	5	204,61	181,70	217,25
	Males	6	173,80	134,30	201,45
	Deutonymphs	3	101,38	94,80	110,60
GOP l/w	Females	5	1,41	1,18	1,65
	Males	6	1,35	1,18	1,54
	Deutonymphs	3	1,13	1,11	1,17
Ti I	Females	6	249,90	227,85	264,60
	Males	6	278,07	249,90	330,75
	Deutonymphs	5	117,71	114,55	118,50
Ta I l	Females	6	486,32	418,95	529,20
	Males	6	556,15	492,45	646,80
	Deutonymphs	5	222,78	213,30	237,00
Ta I w	Females	6	200,90	183,75	220,50
	Males	6	203,35	176,40	235,20
	Deutonymphs	5	106,69	102,70	110,60
Ta I l/w	Females	6	2,42	2,28	2,65
	Males	6	2,74	2,39	2,96
	Deutonymphs	5	2,09	1,96	2,15

Table 3. Morphometric data on active postlarval forms of *P. insulare*.

* – without anterior process



Figures 9–11. *Paratrombium insulare* (Berlese, 1910). Larva. Leg I, trochanter – tarsus (some of normal, setulose setae not shown; their position is indicated with circles).

Dorsal side of idiosoma. Anterior process of crista metopica formed of two parallelsided sclerites, with no clearly marked termination. Sensillary area markedly widened; sensillary setae covered with setules (Fig. 18). Eyes on peduncles. Peduncles narrow at the basis and wider in terminal parts. Sides of peduncles slightly curved (Fig. 18). Idiosomal setae situated on trunk-shaped bases and covered with branchlets. Setae on aspidosoma longer, much slenderer and narrower than the other ones. Shafts of opisthosomal setae covered with relatively long and curved setules (Fig. 19). The ellipsoidal shape of posterodorsal opisthosomal setae results from the arrangement and number of setules.

Ventral side of idiosoma. Setae narrowing apically, slightly longer than pDS. The stem of pVS slenderer than in pDS, covered with almost straight setules (Fig. 20). Genital opening at the level of coxae III/IV. Two pairs of genital acetabula. Centrovalval and epivalval setae setulose (Fig. 21). Anal pore posterior to genital opening, longitudinal.

Legs I–IV. Leg segmentation formula: 7-7-7-7. Femur divided into basifemur and telofemur. Ta I about twice as long as Ti I (Fig. 22). All segments densely covered with setae. Normal setae narrowing apically, setulose. Specialized setae (solenidia, eupathidia and microsetae) especially numerous on Ta I; on other leg segments, when present, they do not exceed 10 in number.

Adult. Standard measurements in Table 3. Colour in life red, with a delicate white shagreening on the tips of dorsal idiosomal setae. Setation more dense than in deutonymphs. Idiosoma oval, markedly widened in anterior part. In females legs in relation to body size shorter than in males. Habitus of male as in Fig. 3.

The serration on cheliceral claw more distinct than in deutonymphs. Eyes with almost straight sides of peduncles. Lens plane forms a sharp angle with one of peduncle

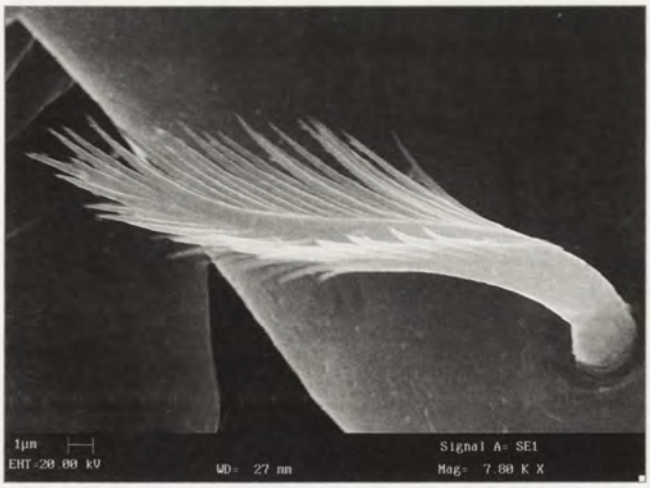


Figure 12. *Paratrombium insulare* (Berlese, 1910). SEM photograph. Larva. Subcapitular seta.

Figure 13. *Paratrombium insulare* (Berlese, 1910). SEM photograph. Larva. Pedipalp.

Figure 14. *Paratrombium insulare* (Berlese, 1910). SEM photograph. Larva. Coxa I.

Figure 15. *Paratrombium insulare* (Berlese, 1910). SEM photograph. Larva. Medial coxala I.

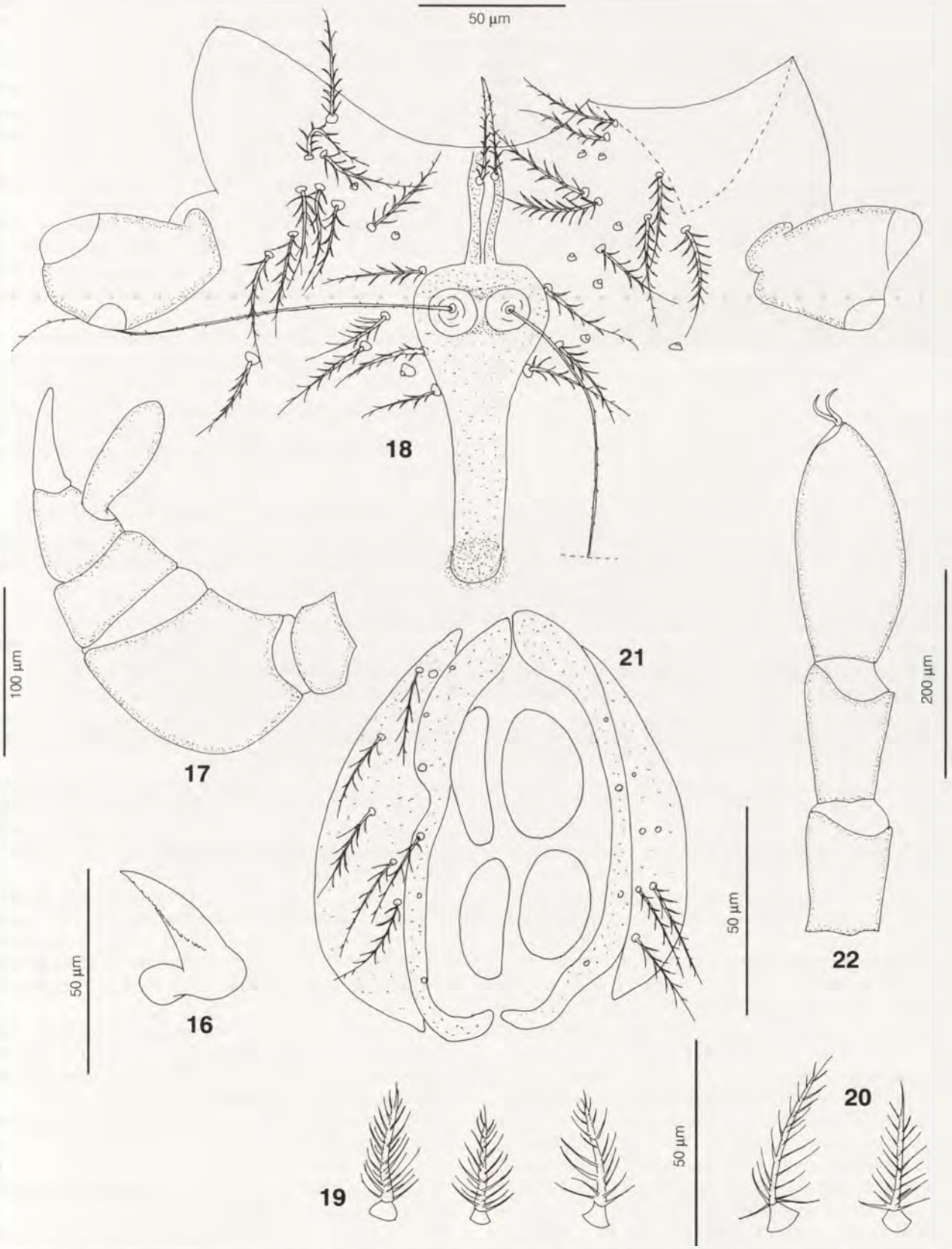
sides. Dorsal opisthosomal setae with more dense cover of setules (Fig. 23). Three pairs of genital acetabula.

Specialized setae on legs more numerous than in deutonymphs.

For other characters – see description of deutonymph.

Distribution and habitat. The hitherto data on *P. insulare* allow to suspect its wide Palearctic distribution, however restricted to a specific type of habitat. The species was described from Corfu, Greece (Berlese 1910). The precise characteristics of the habitat was not given in the original publication. However, the geographic location of Corfu (insular character of the type locality) suspects a similarity to habitat in Finnish Archipelago. Cooreman (1956) recorded *P. insulare* (as *Dinothrombium insulare*) from Algeria. The specimens were collected under stones, at the margin of stream. The material that served for present studies originates from fairly damp habitats. All the specimens were collected at the shore, up to 5 m from the water, between stones and patches of grass. The halophilous character of the species is also very much probable but should be confirmed by more extended material.

Remarks. Among species known from larvae the generic affiliation of *P. quadriseta* Newell, 1958 is still questionable, as already stated by Robaux (1969). Other species known from larvae, should be carefully reappraised with respect to possible variation of some qualitative and quantitative characters. No doubt the larvae of *Paratrombium* display a narrower variation than that found in members of *Podothrombium* (Mąkol 2000a), however some of the characters used to define particular species of *Paratrombium* were found during my analysis to be present in a homogenous series of larvae and thus are variable. One of such characters is the number of setae on Fe II. Out of 47 cases examined (both right and left legs were taken into account), in 34 – there were 5 setae on Fe II, whereas in 13 – 4 setae were present. In 8 specimens out of 17 the number of setae differed between left and right Fe II. Another variable character is the number of digitations in medial coxala (see: Description of



Figures 16–20. *Paratrombium insulare* (Berlese, 1910). Deutonymph. (16) Cheliceral claw; (17) Pedipalp; (18) Aspidosoma; (19) Dorsal opisthosomal setae; (20) Ventral opisthosomal setae; (21) Genital opening; (22) Leg I (genu – tarsus).

Figure 23. *Paratrombium insulare* (Berlese, 1910). SEM photograph. Adult. Dorsal opisthosomal seta.

larva). In this context it is difficult to express opinion on the status of species, especially those known from single specimens.

In further studies special attention should be paid to intraspecific variation. It is not excluded that larvae of closely related species may prove impossible to distinguish, in spite of evident diagnostic characters of active postlarval stages. The stituation has not been definitely confirmed in Parasitengona, though in the case of *Paratrombium* the supposition is supported by e.g. the relatively high constancy, compared to other Trombidiidae, of chaetotaxy of various body regions, and mostly legs of hitherto described species.

There still exists a necessity of redescription of the type species *P. egregium*. It should be stated here that larvae of *P. egregium*, *P. megalochirum*, *P. divisipili* and *P. insulare* are difficult to distinguish. I have seen the specimen of *P. egregium* originating from Oudemans's collection and I cannot confirm the key characters, such as the structure of subcapitular setae and the position of SL setae on scutellum, used by Southcott (1997) in order to differentiate *P. egregium* from *P. divisipili*. In both species the mentioned characters are very much alike.

Robaux (1969), while describing the larva of *P. megalochirum* (Berlese, 1910), pointed out to its probable conspecificity with *P. egregium*. However, the adults of *P. megalochirum* s. Robaux 1966, 1967 can represent a different species than *P. megalochirum* (Berlese, 1910). This is supported by e.g. structure of setae and setal morphometric data. In his characteristics of *P. megalochirum* Robaux (1966, 1967, 1969) did not provide a comparison between his specimens and those originally described by Berlese (1910). The case was already discussed by Southcott (1986).

The adults of *P. divisipili* (Feider, 1950) are reported to have divided idiosomal setae. While studying the material for the present paper I could observe such a shape in some setae examined under light microscope, however it was not confirmed in SEM. That is why a very close relationship, if not conspecificity, of *P. insulare* and *P. divisipili* is unquestionable.

The postulated studies on variation should include also postlarval stages, considering the sex of adult specimens. The morphometric analysis presented here indicates that the sexual dimorphism in *Paratrombium* is manifest among others in the structure of terminal leg segments and in the proportions legs/idiosoma.

Unless the revision is made, the status of some species, especially those, which are known exclusively from postlarval forms, will remain unclear. That is why, for the time being no key to deutonymphs and adults is proposed.

In the key to larvae such species as *P. egregium*, *P. megalochirum*, *P. divisipili* and *P. insulare* are differentiated on the basis of characters, which might fall within intraspecific variability range, however such a decision is only provisional and should be revised by studies of type material accompanied by redescription of species.

Key to larvae of *Paratrombium* Bruyant, 1910

(after Southcott 1997, with modifications; *for *P. egregium* the data given after Oudemans (1912) and on the basis of specimen originating from Oudemans's collection)

1. Posterior dorsal scutum with 4 setae ..... ***P. quadriseta*** Newell, 1958
–. Posterior dorsal scutum with 2 setae **2**
2. Posterior claw on Ta III not reduced **3**
–. Posterior claw on Ta III reduced **8**
3. Setae AL smooth ..... ***P. australe*** Southcott, 1997
–. Setae AL covered with barbs **4**
4. Subcapitular setae palmate, with ca. 7 round ended, finger-like digitations .. ***P. anemone*** Southcott, 1997
–. Subcapitular setae bipectinate or brush-like, with sharpened digitations or setules **5**
5. Medial coxala I with ≥ 24 digitations ..... ***P. lindsayi*** Southcott, 1997
–. Medial coxala I with < 24 digitations **6**
6. ASB+PSB ≥ 200, medial coxala I with ca. 9 digitations ..... ***P. meruense*** Trägårdh, 1908
–. ASB+PSB < 200, medial coxala I with>10 digitations **7**
7. AW ≥ PW ..... ***P. curculionis*** Southcott, 1997
–. AW < PW .. ***P. welbourni*** Goldarazena and Zhang 1997
8. Setae AL smooth ..... ***P. bidactylus*** Newell, 1958
–. Setae AL covered with barbs **9**
9. ASB+PSB ≥ 200 ..... ***P. insulare*** Berlese, 1910
–. ASB+PSB < 200* **10**
10. 5 setae on Fe I **11**
–. 6 setae on Fe I ..... ***P. divisipili*** Feider, 1950
11. Medial coxala I with ≥ 14 digitations ..... ***P. megalochirum*** Berlese, 1910
–. Medial coxala I with < 14 digitations ..... ***P. egregium*** Bruyant, 1910

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