

A C T A   Z O O L O G I C A  
C R A C O V I E N S I A

Tom XIV

Kraków, 31. I. 1969

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***Psilococcus parvus* BORCHSENIUS (*Homoptera, Coccoidea*)**  
**- morphology, biology and taxonomy**

(Pp. 21—41, pls. III—VII)

Badania nad morfologią, biologią i taksonomią  
***Psilococcus parvus* BORCHSENIUS (*Homoptera, Coccoidea*)**

Исследования по морфологии, биологии и таксономии  
***Psilococcus parvus* BORCHSENIUS (*Homoptera, Coccoidea*)**

Abstract. The external morphology of the adult female and male of *Psilococcus parvus* BORCHS. and all its developmental stages have been described in detail. Host plants, as well as the data concerning the biology, phenology and geographical distribution of this species are given. On the basis of male characters the genus *Psilococcus* BORCHS. is included in the *Eriopeltis* group sensu GILMEE (1967).

INTRODUCTION

Literature on *Psilococcus parvus* BORCHSENIUS consists of a short original description (1957), notes on host plants, habitat and new localities of this species in the Leningrad region (DANZIG, 1959, 1960, 1964) and a redescription of the female given by TEREZNYKOVA (1967). In 1962 one but very numerous population of *Psilococcus parvus* BORCHS. was found in Las Wolski (Cracow). This gave occasion to a close investigation of the morphology and biology of this interesting species. The present study deals with the external morphology and dermal structures of all the developmental stages including the adult male, the data on host plants, habitat, development, biology and geographical distribution of *Psilococcus parvus* BORCHS. and eventually with its systematic position.

About 200 specimens of *Psilococcus parvus* BORCHS. from the Cracow locality, 2 specimens from the Leningrad region (4. 8. 1957, leg. E. DANZIG) and 1 from the Don region (3. 7. 1962, leg. E. TEREZNYKOVA) were studied. Four specimens of *Psilococcus ruber* BORCHS. (1. 8. 1950, leg. N. BORCHSENIUS) were examined for comparison. Preparations were made by the routine technique. The description of the adult male (description of morphological details, measurements, illustrations, etc.) follows the scheme adopted by GILIOMEË (1967).

I should like to express my gratitude to Dr E. DANZIG, of the Zoological Institute, Academy of Sciences in Leningrad, for identification of my material and loan of preparations from her collection.

## MORPHOLOGY

### Adult Female

Body elongated, flattened dorsoventrally; anal cleft very short, preantennal part of body elongated as in some species of *Luzulaspis* CKILL.; antennae and legs short, the latter often incompletely developed; eyes present. Cuticle on dorsum and venter not very well sclerotized. The ventral surface of the body is sculptured in the form of delicate small scallops. Young females are yellowish-red, without any distinct pattern; after oviposition they become light brown. The length of mature specimens mounted on slides is 3.5—6.4 (4.62) mm<sup>1</sup>, the width 1—1.4 (1.22) mm; the width: length ratio is as 1:3.1—1:4.5 (1:3.8). The length of young females after moulting ranges between 2.1 and 3.4 mm.

Antennae 6-, rarely, 5- or 4-segmented; in the last two cases the 4th and 5th segments are atrophied or fused with the 6th one. Lengths of segments: I—about 25  $\mu$ , II—10—18 (14)  $\mu$ , III—27—41 (31)  $\mu$ , IV—7—15 (11)  $\mu$ , V—7—11 (10)  $\mu$ , VI—17—38 (29)  $\mu$ ; total length—85—125 (109)  $\mu$ . The length ratio of antenna to body is, on the average, as 1:40. Widths of segments: I—40—62 (47)  $\mu$ , III—25—37 (31)  $\mu$ , VI—17—22 (20)  $\mu$ . The antennae bear two types of setae, hair-like setae (h. s.) and fleshy ones (f. s.). The former are 5—85  $\mu$  long (the longest on the last segment), the latter 25—30  $\mu$ . Number of setae on particular segments: I—3 h. s., II—2 h. s., III—3 h. s., IV—1 f. s. and occasionally 1 h. s., V—1 f. s., and 1 h. s., VI—2 h. s., 8 (rarely 7 or 9) f. s. and 2 sensilla basiconica. The antennae are as often as not situated nearer to the coxae of the fore legs than to the anterior end of the body. The ratio of the frons-antenna distance to that between the antenna and the coxa is as 1:0.5—1:1.3, averaging 1:0.7.

Rostrum globular, short, at base about 80  $\mu$  wide, with 4 pairs of setae 12—17  $\mu$  long.

<sup>1</sup> Figures given in brackets are averages.



Spiracles (anterior spiracles about  $37\ \mu$  in diameter, posterior ones  $46\ \mu$ ) situated in depressions of body. Groups of quinquelocular pores on anterior walls of depressions. Typical spiracular bands of pores and marginal spiracular setae absent.

Legs relatively short (length ratio of hind leg to body, on the average, as 1:16.5), often atrophied in a greater or less degree. The measurements of normally developed legs are as follows (in microns):

leg		coxa	troch.+femur	tibia	tarsus	claw	total
I	length	50	80—100	55—75	47—50	12—17	252—285 (270)
	width	50—57	37— 45	22—30	15—20		
II	length	40—50	87— 95	62—75	45—55	12—17	260—282 (272)
	width	50—57	27— 45	25	17—25		
III	length	50—52	80—107	57—75	50—62	12—15	255—302 (279)
	width	55	37— 42	25	17—25		

Coxa with 5 setae  $30\text{--}60\ \mu$  long and a short seta about  $7\ \mu$  in length, needle-shaped, set in distal part of base; trochanter with 1 apical seta  $37\text{--}65\ \mu$  long, 2 very short setae, about  $5\ \mu$  long, needle-shaped, on basal ridge, and 4 oval sensilla; femur bearing 2—3 setae and tibia 1—3 setae,  $10\text{--}25\ \mu$  long in both cases, tarsus with 2—5 setae,  $10\text{--}15\ \mu$  long. The uneven anterior and posterior tarsal digitules are, respectively,  $33\text{--}40$  ( $36$ )  $\mu$  and  $35\text{--}40$  ( $38$ )  $\mu$  long on the fore leg, about 35 and  $40\ \mu$  long on the middle leg and  $33\text{--}42$  ( $35$ )  $\mu$  and  $38\text{--}45$  ( $40$ )  $\mu$  long on the hind leg. Ungual digitules also unevenly developed, anterior digitule stout, about  $23\ \mu$  long, posterior slender, about  $26\ \mu$  in length.

As has been mentioned, the legs of this species are often abnormally well developed or reduced. In the *Coccidae* the reduction of legs occurs also in some other species, but the degree of reduction is more or less uniform in all the members of a given species: in *Eriopeltis* females and third instar larvae of *Lacano-pis* all the segments are short and thick, in *Scythia craniumequinum* KIRIČENKO the legs are composed of two segments, in *S. festuceti* (ŠULC) they occur in the form of short processes only. The reduction of legs in the species under study is particularly interesting, because its degree varies markedly from specimen to specimen and from leg to leg even, ranging from slight shortening of individual segments to nearly complete reduction of legs resulting in the formation of short conical processes. Figure 9b shows several examples of reduced legs. The percentage of specimens with anomalous legs, the commonest

forms of anomalies and the percentage frequency of anomalies in pairs of legs are given in Tables I—III.

Anal plates conical, 50—60  $\mu$  long, at base 30—50  $\mu$  wide, with 3 apical setae, 1 or, very rarely, 2 ventral setae, 1 seta at median margin and 1 pair of fringe setae. Length of setae 15—37  $\mu$ .

Anal ring well sclerotized, round, with about 30 pores and 3 pairs of setae, 75—87  $\mu$  long. The outer diameter of the ring is about 30  $\mu$ . The anal opening is oval and narrow, its diameters being about 12 and 25  $\mu$ .

Cuticular structures: Setae on body stout, occasionally needle-shaped, but not spiniform or conical; marginal spiracular setae absent. Marginal setae (those situated beside the band of quinquelocular pores) 15—25  $\mu$  long on frons, 12—17  $\mu$  at edges and 12—22  $\mu$  on anal lobes, distances between setae being respectively 20—120  $\mu$ , 150—500  $\mu$  and 20—200  $\mu$ . The numbers of the setae (on one side of the body) are as follows: 7—12 (9.1) from the frons to the anterior spiracle, 3—5 (3.3) between the spiracles and 7—14 (9.2) from the posterior spiracle to the anal cleft. The length of the submarginal setae (setae situated within and internally to the band of quinquelocular pores) and the distances between them are similar to those given above for the marginal setae. Their numbers in the above-distinguished sections of the margin of body (on one side only) are 9—20 (13.3), 5—10 (6.8) and 16—31 (21.7), respectively. On the dorsum there occur similar but often smaller setae, 10—20 on each tergite. 5—8 large setae (12—70  $\mu$ ) are disposed between the antennae, 1 pair in the middle part of each of abdominal sternites V—VIII. Some small setae (like those at the margin) are present in the preantennal area (about 5 in number) and near the bases of the coxae (0—5 in number). A few setae accompany the large setae on the abdominal segments, one or two occur on the distal part of each sternite and a group of about 10 setae is situated in front of the vaginal opening.

Ventral tubular ducts, 15—18  $\mu$  long and 3—3.5  $\mu$  wide, form bands at the body margin, one on either side, extending from the antennae to the anal lobes. On the thoracic sternites the bands are narrow (1—4 ducts on each), posteriorly they become wider. The number of ducts on the whole ventral surface is about 650 (one specimen was examined in this respect). Dorsal tubular ducts, 11—16  $\mu$  long and 3.5—4.5  $\mu$  wide occur on abdominal tergites III—VII, being very numerous on the anal lobes. Their total number in the only specimen examined was about 400.

Multilocular pores, 7—8  $\mu$  in diameter, with 7—11 loculi, occur on the last abdominal sternites and on the anal lobes; they are very numerous at the internal margin of the lobes. Their total number (20 specimens examined) is from 160—286, with an average of 213.

Quinquelocular pores, 5—6.5  $\mu$  in diameter, with 5, rarely 3, 4 or 6 loculi, form groups on the anterior walls of the spiracular depressions and bands ventrally, at the edges of the body. There are 13—26 (19) pores in the depression of the anterior spiracle and 16—32 (21) in that of the posterior (50 specimens

examined). The marginal band has usually 1—3 pores across; their number increases only near the spiracles, whereas on the frons there are no pores at all in some specimens. At the median margins of the anal lobes the bands of pores pass on to the dorsal surface. The anterior part of the band, up to the anterior spiracle, consists of 96—263 (159), its portion between the spiracles of 88—236 (145) pores and that from the posterior spiracle to the anal cleft of 204—588 (405) pores on either side of the body. The total number of pores in the band of one side of body is 444—1094 (749) (50 specimens examined).

Large disc pores, 5—8  $\mu$  in diameter, form a median elongated group of 125—331 (189) pores (20 specimens examined) anterior to the base of the anal plates.

Dorsal minute disc pores, 2.5—3.2  $\mu$  in diameter, occur in the marginal part of the body and form transversal bands on the last abdominal tergites. In the only specimen examined in this respect the number of these pores was about 380.

Ventral minute disc pores, 2.5—3  $\mu$  in diameter, are disposed all over the preantennal area, at the margin of the body and on the sternites, where they form transversal groups or bands. About 600 pores were counted in one specimen examined.

Bilocular pores, oval in shape, with respective diameters of about 1.6—2.1  $\mu$  and 2.6—3.1  $\mu$ , are present on the frontal surface and, in transversal bands, on the thoracic and abdominal tergites; they are missing at the margin of the body and in front of the anal plates. About 350 pores were counted. The bilocular pores of the species under study differ from those described in other *Coccidae* (ŠULC, 1932; BORATYŃSKI & WILLIAMS, 1964; and others). In *Psilococcus parvus* the two loculi are difficult to detect and the „thin filament“ is indiscernible; it is, therefore, impossible to distinguish the bilocular pores from the dorsal minute disc pores in some cases.

Ventral dark-rimmed pores, about 2—2.5  $\mu$  in diameter, differing in shape and with their openings invaginated in a greater or less degree are numerous in front of and between the antennae and near the rostrum. These pores form groups in the middle of the thoracic sternites and also occur singly on some abdominal sternites. In one specimen examined about 360 pores were counted, two-thirds of the total occurring on the preantennal area.

The ovisac of *Psilococcus parvus* BORCHS. is weakly produced, it only protects the eggs.

### Male

Living specimens light reddish yellow; short, slender, with comparatively long antennae, short legs and a large number of setae on the body and appendages. Total body length of mounted animal 1.1—1.3 (1.18) mm; width at mesothorax 0.24—0.3 (0.26) mm. Wing expanse 2.0—2.5 (2.34) mm<sup>1</sup>.

<sup>1</sup> All the averages concerning the morphology of the male have been calculated from the values obtained for 10 specimens.



Head subconical in dorsal view; in lateral view flat, not elongated obliquely dorsoventrally; anterodorsal bulge not pronounced; length from apex to pronotal ridge 150—165 (157)  $\mu$ , width across genae 165—200 (180)  $\mu$ . Median crest sclerotized, distinctly polygonally reticulated, with 7—11 (8.6) hair-like (h. s.) and 1—6 (3) fleshy (f. s.) dorsal head setae. Midcranial ridge dorsally absent and ventrally reduced to a median bar (about 36  $\mu$  long) with lateral branches; surrounding area is not sclerotized but showing a distinct polygonal reticulation. Genae large, sclerotized, with faint polygonal reticulation and 8—18 (12.4) f. s. and 0—2 (0.2) h. s. each. Eyes (2 pairs) subequal 20—30 (25)  $\mu$  in diameter. Distance between dorsal eyes 1.8—2.2 (2.0) times as long as their diameter; that between ventral eyes 0.7—1.5 (1.0) times as long. Ocelli small, about 12  $\mu$  in diameter. Ocular sclerite well sclerotized, clearly polygonally reticulated throughout. Preocular ridge rather short, its ventral arms sometimes completely absent. Postocular ridge well developed, tapering dorsally, in one specimen furcated below ocellus (!). Interocular ridge very wide. Dorsal ocular setae: 0—3 (0.3) f. s. and 0—2 (0.6) h. s. on each side. Ventral head setae: 8—17 (12) f. s. and 3—11 (6.4) h. s. arranged in a broad band on the anterior part of the ocular sclerite and 1—8 (3.9) f. s. and 0—4 (1.5) h. s. on the area in front of the ocular sclerite; a pair of hair-like setae in the middle of the sclerite is evidently longer than the rest. Preoral ridge developed. Cranial apophysis of medium length, extending to the level of the middle of the ventral eyes. Apex bifurcate. Mouth opening irregular. In front of mouth opening occasionally 1—2 short setae.

Antennae 10-segmented, filiform, 574—827 (745)  $\mu$  long, i. e., longer than half body length (length ratio of antenna to body as 1:1.57—1:1.92, av. 1:1.58), longer than hind leg (1:1.24—1:1.44, av. 1:1.35) and penial sheath (1:3.0—1:3.8, av. 1:1.35). Scape, 28—43 (34)  $\mu$  long and 33—42 (38)  $\mu$  wide, with 2—3 h. s. and, occasionally, 1 f. s. Pedical polygonally reticulated, 38—52 (47)  $\mu$  long and 28—33 (31)  $\mu$  wide, with 3—7 (4.3) f. s. 6—10 (8) h. s. and a sensillum placodeum. Segment III somewhat club-shaped, 47—76 (67)  $\mu$  long and 19  $\mu$  wide (width:length ratio as 1:2.47—1:4.0, av. 1:3.53); with 0—2 (1.1) h. s. and 2 sensilla basiconica. Segments IV—IX cylindrical; their lengths (in  $\mu$ ) 95—142 (118), 76—123 (98), 66—109 (98), 71—85 (80), 57—71 (68) and 47—71 (63), respectively; their widths ranging from 14 to 19  $\mu$ , segment IX being somewhat wider than proximal ones; numbers of f. s.: 7—13 (8.2), 7—17 (10.7), 10—19 (15), 10—18 (13.7), 8—14 (11) and 9—12 (10.8) respectively, hair-like setae being very rare and single. Segment X: terminal part not constricted; 47—76 (67)  $\mu$  long and 14—19 (16)  $\mu$  wide; carrying 6—9 (7.6) f. s., 3 (rarely 4) capitate subapical setae and 5 antennal bristles, of which the long ones are about two-thirds length of the segment and the short ones, 2 in number, are shorter than the fleshy setae. It bears 2 sensilla basiconica ventrally, one near the apex and the other more proximally.

Thorax 370—475 (422)  $\mu$  long.

Prothorax largely membranous, with only a few ridges and sclerites. Pronotal ridge strong, medially interrupted by poor sclerotization. Lateral pronotal sclerite and setae absent. Medial pronotal setae and pores missing. Posttergites moderately large; derm irregularly striated, without setae. Proepisternum + cervical sclerite typical of *Coccidae*. Sternum with strong transverse ridge; median ridge present as short basal stalk; surrounding triangular area poorly sclerotized. Anteprosternal setae: 0—4 (1.2) f. s. on each side. Prosternal setae: 3.9 (4—3) f. s. and 0.2 (0.8) h. s., none of them situated anteriorly to spiracles.

Mesothorax. Prescutum 47—71 (57)  $\mu$  long and 70—104 (98)  $\mu$  wide; its length to width ratio on the average as 1:1.7; anterior margin curved, laterally bounded by prescutal ridges and posteriorly by prescutal suture; heavily sclerotized medially, but not reticulated. Scutum: median membranous area, 70—76 (68)  $\mu$  long and 90—114 (99)  $\mu$  wide, length: width ratio being as 1:1.4; it has 4—6 (5.1) h. s. and no polygonal reticulation. Anterior arms of scutum not reticulated. Scutellum, 24—28 (26)  $\mu$  long and 80—109 (92)  $\mu$  wide, length: width ratio on the average as 1:3.5; scutellar foramen, if present, small and very narrow; setae absent. Postnotum with anterior margin irregular, sclerotized, not overlapped by metathoracic fold; postnotal apophysis and postalarare well developed. Mesopleuron: mesopleural ridge stout, not interrupted above coxal articulation; pleural apophysis and pleural wing process well developed, the latter connected with episternum by small basalare. Subalare small. Episternum without polygonal reticulation; subepisternal ridge broadening ventrally, but below membranous cleft indistinct and only marked by band of dark sclerotization. Epimeron absent. Lateropleurite partly bounded anteriorly by extension of marginal ridge. Basisternum large, 80—109 (96)  $\mu$  long, 114—147 (126)  $\mu$  wide, i. e., on the average 1.7 times as long as membranous area of scutum; median ridge missing; marginal and precoxal ridges well developed, without setae. Furca well developed. Mesothoracic spiracle with well-developed peritreme; postmesospiracular setae absent. Tegula small, membranous bulge with 2—5 (3.4) h. s. on each side. Third axillary wing sclerite with small oval projection at base. Additional sclerite poorly developed, but distinct. Antemetaspiracular setae absent.

Metathorax. Metanotum with posterior margin thickened throughout; suspensorial sclerites wanting. Postnotum formed by a large irregular sclerite on either side. Metatergal setae: 0—1 (0.8) h. s. and occasionally 1 f. s. on each side. Pleural ridge considerably reduced and extending only a short distance above coxal articulation. Episternum reduced to small subtriangular plate, epimeron produced posteriorly. Metathoracic spiracle similar to mesothoracic one. Dorsospiracular setae absent. Postmetaspiracular setae: 0—18 (12) f. s. and 0—3 (1.4) h. s. on each side. Metasternal plate large, transverse, subrectangular. Anterior metasternal setae: 1—19 (13) f. s., hair-like setae missing; posterior metasternal setae: 2—9 (5.1) f. s. and occasionally 1 h. s.

Wing hyaline; long (1—1.13 averaging 1.06 mm) and narrow (width 0.3—0.35 averaging 0.32 mm), width:length ratio averaging as 1:3.3; alar lobes and alar setae absent. Hamulohalteres absent.

Legs short and moderately slender, all 3 pairs subequal in size, fore legs being only slightly shorter; length ratio of hind leg to body on the average as 1:2.1. Lengths of segments (in  $\mu$ ):

Leg	Coxa	Trochanter	Femur	Tibia	Tarsus	Claw	Total
I	32—52 (40)	47—71 (59)	109—142 (126)	142—180 (169)	71—85 (79)	19—28 (26)	437—541 (498)
II	47—61 (54)	52—71 (68)	118—142 (132)	142—190 (177)	71—95 (78)	24—28 (26)	456—579 (536)
III	47—57 (52)	52—66 (61)	114—142 (128)	142—190 (178)	76—95 (84)	24—28 (26)	465—575 (541)

Fore, middle and hind coxae with 1—7 (3.7), 3—7 (6.7) and 4—9 (6.7) f. s., respectively, and with 6—14 (10.2) h. s. each; apical seta on fore coxa short, about half as long as trochanter. Trochanter about 26  $\mu$  wide, with 6 oval sensilla, 1—4 f. s. and 7—14 h. s., these last including 2 minute setae near basal ridge; apical seta approximately as long as or somewhat longer than width of trochanter. Femur about 33  $\mu$  wide (width:length ratio of hind femur on the average as 1:3.9), with 0—5 (2) f. s. and 7—19 (13.5) h. s. Tibiae about 25  $\mu$  wide (width:length ratio of hind tibia as 1:7), each with 28—49 setae (hair-like setae more numerous than fleshy ones) about half longer than width of tibia; apical spurs subequal on all tibiae. Tarsi about 20  $\mu$  wide (width:length ratio of hind tarsus as 1:3.3), with 14—28 (19.2) setae each; tarsal digitules subequal, 28—38  $\mu$  long. Claws short (hind claw equal to or somewhat longer than width of tarsus), slightly curved, without denticle; ungual digitules subequal, about as long as claw.

Abdomen 380—498 (484)  $\mu$  long and 204—261 (229)  $\mu$  wide.

Segments I—VIII: tergite of segment I composed of 2 lateral triangular sclerites and that of segment II of one narrow transverse sclerite. The tergites of segments III—VII occur in the form of large irregularly subrectangular sclerites, the sclerite on segment VIII being rounded. Sternites of all segments consisting of transverse sclerites resembling tergal ones in shape but larger in size. Small round pleurites present on segments IV—VI and absent on anterior segments. Caudal extension of segment VII small, poorly sclerotized



lateroventrally. Caudal extension of segment VIII forming small simple lobe; glandular pouch or other depressions and glandular pores absent. No tergite IX is observed, neither are circular pores in the ante-anal area. Numbers of setae on abdominal segments I—VII are as follows:

Segment	Dorsal Setae		Ventral Setae		Dorsopleural S.		Ventrepleural S.	
	f. s.	h. s.	f. s.	h. s.	f. s.	h. s.	f. s.	h. s.
I	0—6 (3)	0—3 (2)	0	0	0	0	0	0
II	0—14 (7)	0—1 (0·3)	0—16 (10)	0—1 (0·3)	0	0—1 (0·6)	0	0
III	1—18 (8·7)	0—2 (0·7)	4—12 (8·5)	1—2 (1·8)	0	0—2 (1)	0	0—2 (0·7)
IV	2—13 (6)	2—4 (2·3)	1—9 (4·3)	2—5 (3·5)	0	0—2 (1·7)	0	0—1 (0·8)
V	6—10 (7·7)	1—3 (2)	0—4 (1·7)	2	0—2 (0·3)	2—3 (2)	0—2 (0·5)	0—2 (1)
VI	4—9 (6)	1—3 (2)	0—3 (0·5)	4	0	2—3 (2·3)	0	0—1 (1)
VII	0—5 (0·2)	2	0—2 (0·3)	2—4 (3·5)	0—1 (0·1)	2—3 (2·5)	0—2 (0·3)	0—3 (1·5)

No dorsal and ventral setae on segment VIII; 2—3 long setae present at tip of caudal extension and 1—3 shorter ones more proximally; one ante-anal seta occurs occasionally.

Genital segment. Penial sheath 190—218 (204)  $\mu$  long and 24—33 (32)  $\mu$  wide (length ratio of penial sheath to body on the average as 1:5·8); lateral sclerotizations joined over small space anterior to anus; basal rod, 62—95 (78)  $\mu$  long, extending from base of aedeagus cephalad for from a half to three-quarters of the distance to basal membranous area; apex of sheath without membranous extension. Area from base of sheath to tip of aedeagus with 7—15 (11)

small setae; a cluster of small sensilla situated ventrally near apex of sheath. Aedeagus short, 47—52 (49)  $\mu$  in length, penial sheath and basisternum longer, their length ratios being on the average as 1:4.1 and 1:2, respectively.

### First Instar Larva

The build of the larva is typical of the family. Body length after hatching 525—650  $\mu$ , width 210—250  $\mu$ .

Antennae 6-segmented, 112—130  $\mu$  long. Length of segments (in microns): I — about 20, II — 12—15, III — 27, IV — 10—17, V — 17—20, VI — 25—30. Width of segments: I — about 25  $\mu$ , III — 17  $\mu$ , VI — 15  $\mu$ . Setae on particular segments: I — 3 h. s., II — 2 h. s., III — 3 h. s., IV — 1 f. s., V — 1 f. s. and 1 h. s., VI — 8 f. s., 2 h. s. and 2 sensilla basiconica.

Rostrum globular, short, at base about 50  $\mu$  wide, with 4 pairs of setae. Spiracles about 5  $\mu$  in diameter.

Legs subequal; measurements of hind leg segments: coxa — 30—37  $\mu$  long and about 35  $\mu$  wide, trochanter+femur — 65—87  $\mu$  long, femur about 25  $\mu$  wide, tibia — 42—57  $\mu$  long and 15  $\mu$  wide, tarsus — about 40  $\mu$  long and 10  $\mu$  wide, claw — 15—17  $\mu$  long. Total length 190—240  $\mu$ . Tarsal digitules unequal, 25—50  $\mu$  long; only one digitule present on fore leg. Ungual digitules equal, about 20  $\mu$  long. There are 6—8 setae on the coxa, 3 (2 very short) on the trochanter, 3 on the femur, 4 on the tibia and 4 on the tarsus.

Anal plates 45—50  $\mu$  long and about 30  $\mu$  wide, with 3 apical (longest up to 200  $\mu$ ), 1 median and 1 ventral setae; 1 pair of fringe setae.

Anal ring round, about 25  $\mu$  in diameter, with 6 setae and some pores.

Cuticular structures. Marginal setae hair-like, 5—25  $\mu$  long. There are 8 setae from the frons to the anterior spiracle, 3 between the spiracles and 8—9 between the posterior spiracle and the anal cleft. Respective numbers of sub-marginal setae: 1, 1 and 6—7. Dorsal setae very short, present only on head and thoracic segments. Large ventral setae: 1 pair between antennae, 1 pair in front of rostrum and 3—4 pairs on terminal abdominal segments. Minute ventral setae present on thoracic and abdominal segments, 2—4 pairs on each segment. Quinquelocular pores with 3—6 loculi occur near the spiracles (one pore near each) and form short rows at the edge of the body, 2—3 pores beside the anterior spiracle and 3—6 beside the posterior. Minute pores also occur on the dorsal and ventral surfaces.

### Second Instar Larva

Body shape like that in female, yellow, antennae and legs well developed, eyes present. Body length 1.3—1.6 mm, width 0.4—0.55 mm; width: length ratio, before moulting, more or less as 1:3.

Antennae, 90—112  $\mu$  long, 6-segmented in female larvae and 7-segmented in male larvae. Lengths of segments (in microns): female — I — about 20, II — 15, III — 20, IV — 10, V — 12, VI — 20—32; male — I — about

20, II — 10—15, III — 12—17, IV — 10—12, V — 7—10, VI — 20—32. Width of segments: I — 25—35  $\mu$ , III — 20  $\mu$ , VI — 10—15  $\mu$ . Numbers of setae on particular segments of female larva: I — 3 h. s., II — 2 h. s., III — 3 h. s., IV — 1 f. s., V — 1 h. s. and 1 f. s., VI — 2 h. s. and 7—8 f. s. Segment III of male larva always without setae, segment IV with as many setae as segment III of female larva and so on.

Rostrum globular, short, at base 50—60  $\mu$  wide, with 4 pairs of setae.

Spiracles like those in first instar larva.

Legs subequal; measurements of segments: coxa — 27—35  $\mu$  long and 43—50  $\mu$  wide, trochanter+femur — 75—87  $\mu$  long, femur — about 25  $\mu$  wide, tibia — 57—64  $\mu$  long and 15—22  $\mu$  wide, tarsus — 40—45  $\mu$  long and 10—15  $\mu$  wide, claw — about 25  $\mu$  long. Total length of leg — 212—242  $\mu$ . Tarsal digitules unequal, 25—37  $\mu$  long; ungual digitules also varying in size, anterior digitule large, posterior thin, about 17  $\mu$  in length. There are 5 setae on the coxa, 3 (2 very short) on the trochanter, 3 on the femur, 3—4 on the tibia and 4 on the tarsus.

Anal plates, about 50  $\mu$  long and 30  $\mu$  wide, with 3 apical, 1 median and 1 ventral setae and 1 pair of fringe setae.

Anal ring round, about 25  $\mu$  in diameter, with 6 setae (approximately 60  $\mu$  long) and 18 pores.

Cuticular structures. Marginal setae like those of females, 9—11 between the frons and the anterior spiracle, 3 between the spiracles and 9—10 between the posterior spiracle and the anal cleft; numbers of submarginal setae in respective sections of edge: 3, 1 and 7—8. Dorsal setae very short, 2, rarely 3 or 4 on each segment. Large ventral setae similar to those in the first instar larva. Minute ventral setae, 2—4 on each thoracic and abdominal segment.

Minute disc pores occur on the dorsal surface at the body margin. Pores with 2—6 loculi form groups near the spiracles (2—4 pores in each) and 2 rows ventrally at the margin. In the anterior portion of each row (up to the anterior spiracle) there are 23—30 pores, between the spiracles 18—25 and from the posterior spiracle up to the anal cleft 34—58 pores. Single dark-rimmed disc pores are present on the ventral side. Very small pores, supposedly bilocular ones, also occur on the dorsal surface. In the male larva there are, besides, two groups of dorsal tubular ducts (about 8 ducts in a group) on the fifth abdominal segment.

Male puparium typical of species of *Eriopeltis* group (sensu GILMEE, 1967).

### Third Instar Larva

Body like that of female in shape, yellow in colour; anal cleft short, preantennal part of body elongated; antennae and legs short but completely developed; eyes present. Cuticle poorly sclerotized, ventral surface sculptured in form of delicate scallops. Body length 1.6—2.6 mm, width 0.5—0.7 mm; body width:length ratio, for specimens before moulting, on the average, as 1:3.7.



Antennae 6-segmented, 100—110  $\mu$  long. Lengths of segments (in microns): I — 18—25, II — 12—17, III — 20—25, IV — 5—10, V — 5—12, VI — 20—22. Widths of segments: I — about 40  $\mu$ , III — 25  $\mu$ , VI — 15  $\mu$ . Numbers of setae, of which hair-like ones 20—27  $\mu$  long, on particular segments: I — 3 h. s., II — 1—2 h. s., III — 3 h. s., IV — 1 f. s., V — 1 h. s. and 1 f. s., VI — 2—3 h. s. and 7 f. s. Antennae half way between frons and fore legs. Ratio of frons-antenna distance to that between antenna and coxa, on the average, as 1:1.2.

Rostrum globular, short, at base about 70  $\mu$  wide, with 4 pairs of setae.

Spiracles situated in body depressions; anterior wall of depression with a group of quinquelocular pores. Anterior spiracle about 18  $\mu$  in diameter, posterior 22  $\mu$ . Groups of pores take place of typical bands of spiracular pores.

Legs subequal; measurements of segments as follows: coxa — 37—45  $\mu$  long and about 50  $\mu$  wide, trochanter + femur — 80—92  $\mu$  long, width of femur — 32—40  $\mu$ , tibia — 55—72  $\mu$  long and about 23  $\mu$  wide, tarsus — 50—57  $\mu$  long and 13  $\mu$  wide, claw — 12  $\mu$  long. Total length — 232—267  $\mu$ . Tarsal digitules about 35  $\mu$  long, ungual digitules 22  $\mu$  long. Numbers of setae on leg segments: coxa — 6, trochanter — 3, femur — 2—3, tibia — 2—3, tarsus — 2—4.

Anal plates conical, about 50  $\mu$  long and 30  $\mu$  wide, with 3, rarely 4 apical, 1 median and 1 ventral setae, 1 pair of fringe setae.

Anal ring round, 25  $\mu$  in diameter, with 6 setae (about 60  $\mu$  long) and 18 pores. Anal opening oval, its diameters 7.5 by 15  $\mu$ .

Cuticular structures. Setae on body in shape and size like those in female. Numbers of marginal setae (on one side of body): 7—10 from frons to anterior spiracle, 3 rarely 4 between spiracles and 9 from posterior spiracle to anal cleft; submarginal setae respectively 7—17, 5—11 and 15—29. On dorsum 4—8 very short setae on each tergite. Large ventral setae disposed between antennae (2 pairs), in front of rostrum (1 pair) and on abdominal sternites V—VIII (1 pair on each). Small setae present on preantennal surface, near coxae (2—5 setae in each group), in transverse rows on abdominal sternites and in a large band along body margin.

Minute disc pores occur on the dorsal and ventral surfaces of the body margin. Pores with 2—6 loculi („quinquelocular pores“) form groups in the spiracular depressions (5—8 pores near the anterior spiracle and 4—9 near the posterior one) and 2 bands ventrally at the margins. The anterior portion of each band (up to the anterior spiracle) contains 54—72 pores, that between the spiracles 36—60 pores, whereas there are 108—167 pores between the posterior spiracle and the anal cleft. Dark-rimmed disc pores occur on the whole preantennal area, form a group behind the rostrum and a band round the ventral surface of the body. Very small pores (probably bilocular or dorsal disc pores) are also present on the dorsal surface, especially on the last abdominal tergites.

TEREZNYKOVA (1967) writes about multilocular and large dorsal pores in

the „larva“ of *Psilococcus parvus* BORCHS. The author has not found these pores in any larval stages of this species.

### Male Pronymph

Body length 1.1—1.3 (1.22) mm, width about 0.3 mm. Ventral and dorsal surfaces sculptured in form of delicate scallops. Antennae indistinctly segmented, 25—30  $\mu$  long. Legs 5-segmented, hind leg 15—20  $\mu$  long. Wings 25—30  $\mu$  long.

Cuticular structures. Setae on body scarce: 3 on frons, 2 pairs at edges of each abdominal segment, 3 setae on caudal extensions, 1 pair dorsally on each abdominal segment and 2—3 pairs on ventral surface of each segment; no setae were observed on the thorax. The quinquelocular pores form groups in front of the anterior spiracle (3—7 pores in each group), an occasional pore may occur near the posterior spiracle. No other pores were observed.

### Male Nymph

Body length 1.1—1.2 (1.14) mm, width about 0.3 mm. Sculpture of cuticle like that in pronymph. Antennae 10-segmented, 55—60  $\mu$  long, with 3—4 apical protuberances. Legs 5-segmented, hind legs about 40  $\mu$  long; wings 50  $\mu$  long.

Cuticular structures. Setae on body similar to those of pronymph. Groups of 7—11 quinquelocular pores near anterior spiracles, 0—2 pores near each posterior spiracle.

## BIOLOGY

The biology of *Psilococcus parvus* BORCHS. resembles that of *Luzulaspis frontalis* GREEN (KOTEJA, 1966), with which it occurs in the same locality. It, too, has only one generation in the year, reproduces bisexually and hibernates as an egg. The development of the female includes three larval stages, that of the male two larval and two nymphal stages. The female imago emerges from the larva of the third instar and lays eggs under leaf sheaths.

Host plants: *Carex pallescens* L., *C. canescens* L. (Leningrad region), *C. divulsa* STOKES (Don region), *C. brizoides* L. (Poland).

Habitat: In Poland this species lives in moderately damp mixed forests.

Geographical distribution: USSR (Latvia, Leningrad region, Ukraine), Poland (Las Wolski near Cracow).

## SYSTEMATIC POSITION OF THE GENUS *PSILOCOCCUS* BORCHS.

BORCHSENIUS (1957) included this genus in the subfamily *Filippiinae* BORCHS. of the family *Coccidae*. KOTEJA (1965, unpublished dissertation for doctor's degree) established on the basis of some characters of adult males and females and male puparia as well as some biological data that the genera

*Luzulaspis* CKLL., *Psilococcus* BORCHS., *Eriopeltis* TARG. and *Scythia* KIR. do not belong to the same subfamily as *Filippia* TARG. and *Parafairmairia* CKLL. He placed the first four genera provisionally in the tribe *Eriopeltini* ŠULC 1941, in a new combination. On the basis of adult male characters of 19 genera (23 species) GILIOMEE (1967) divided the *Coccidae* into 4 groups of genera: the *Eulecanium*, *Eriopeltis*, *Inglisia* and *Coccus* group. Out of the 120 characters compared, 34 are important to the distinction of these groups of genera (GILIOMEE, 1967, Tables II and IIa). In the present study the characters of male *Psilococcus parvus* BORCHS. have been compared with those 34 characters (Table IV).

The comparison shows that the species under study belongs to the *Eriopeltis* group; three-quarters of the characters compared (of which 2 are exclusive) are common to *Psilococcus parvus* BORCHS. and this group. With other groups this species shares less than half the characters, of which none is exclusive. The exclusive characters shared by *Psilococcus parvus* BORCHS. and the *Eriopeltis* group are the relative dorsoventral flattening of the head and the narrowness of the wings.

It should be emphasized that one exclusive character of the group *Eriopeltis* — the absence of a short anterior branch of the postocular ridge below the ocellus — is not exclusive in *Psilococcus parvus* BORCHS., because in some specimens of this species the postocular ridge forks below the ocellus. In addition, an exclusive character of the *Eulecanium* group, the small number of fleshy posterior metasternal setae (fewer than 4), was found in some specimens of the species investigated.

The inclusion of the *Psilococcus* characters in the considerations made the differences between the particular groups less distinct (e. g., the number of characters allowing the distinction between the *Coccus* and *Eriopeltis* groups was reduced from 20 to 16). This is also true of the differences between pairs of groups (the reduction of exclusive characters of the *Coccus*+*Inglisia* groups and those of the *Eulecanium*+*Eriopeltis* groups from 6 to 4 in both cases).

The relations between *Psilococcus* BORCHS. and the other genera of the *Eriopeltis* group established on the basis of the characters of adult males are shown in Tables V and VI.

The genus *Luzulaspis*, sharing 12 characters with *Eriopeltis* and 10 with *Psilococcus*, holds an intermediate position between these two genera, which have 5 characters in common and 25 differentiating ones. The genera *Eriopeltis* and *Luzulaspis* are closer to each other (12 shared and 14 differentiating characters) than *Luzulaspis* and *Psilococcus* (11 shared and 14 differentiating characters). This situation is also indicated by the number of exclusive characters, 10 in *Psilococcus*, 9 in *Eriopeltis* and 4 in *Luzulaspis*. It should, however, be mentioned that the generic characters of *Psilococcus* refer to one species, the characters of *Eriopeltis* to two species (*E. sp.*, *E. ? festucae* (FONSC.)) and those of *Luzulaspis* to three species (*L. luzulae* (DUF.)), *L. frontalis* GREEN and *L. nemorosa* KOTEJA).



## TABLES

Table I

Distribution of anomalies of legs in female *Psilococcus parvus* BORCHS. according to number of legs affected (100 specimens examined)

Number of legs affected by anomaly	0	1	2	3	4	5	6
Percentage of specimens	16	13	20	15	17	4	15

Table II

Percentage frequency of the commonest anomalies of legs in female *Psilococcus parvus* BORCHS. (560 legs examined)

Anomaly	%
Legs with all segments well or nearly well developed	48
Legs with tarsus completely reduced (other anomalies possible)	11
Legs with tarsus and tibia completely reduced (other anomalies possible)	9.3
Legs with coxa only	2.9
Remarkable anomalies of tarsus	3.5
Remarkable anomalies of tibia (often accompanying lack of tarsus)	4.3
Remarkable anomalies of femur (anomalies in other segments possible)	6
Anomalies in some segments	27
Complete reduction of tarsal articulation	17

Table III

Occurrence of anomalies of legs in female *Psilococcus parvus* BORCHS. in particular pairs of legs

	fore legs	middle legs	hind legs
Number of legs examined	285	288	290
Percentage of legs affected by anomalies	33.4	33.8	43.7

Table IV

Characters shared, exclusive and differentiating male *Psilococcus parvus* BORCHS. and the groups of genera of *Coccidae* (Comparison with data given by GILIOMEE 1967)

Group of genera	Number of characters			
	shared	exclusive	differentiating	partly shared
<i>Eulecanium</i>	12	—	10	11
<i>Eriopeltis</i>	24	2	4	5
<i>Inglisia</i>	13	—	19	1
<i>Coccus</i>	14	—	17	2

Table V

List of male characters separating the genera *Eriopeltis* TARG., *Luzulaspis* CKLL. and *Psilococcus* BORCHS.

Characters	<i>Eriopeltis</i>	<i>Psilococcus</i>	<i>Luzulaspis</i>
1	2	3	4
Head			
Postocular ridge:			
A. dorsally strong			
B. dorsally weak	A	A	AB
A. forking below ocellus			
B. not so	B	AB	B
Mideranian ridge:			
A. lateral arms present			
B. lateral arms reduced	AB	A	A
On each side ventrally:			
A. sclerotized			
B. not sclerotized	A	B	B
Preocular ridge:			
A. ventrally short			
B. ventrally long	B	A	AB
Dorsal simple eyes:			
Distance between eyes			
A. about 2 times as long as diameter of cornea			
B. more than 2.5 times as long	B	A	B
Ventral simple eyes: Ditto —			
A. equal or shorter			
B. equal or longer	B	AB	B
Preoral ridge:			
A. absent			
B. present	A	B	AB
Cranial apophysis:			
A. long			
B. of medium length	B	B	A
Apex (central lobe excepting):			
A. bifurcate			
B. trifurcate			
C. truncate	BC	A	AC
Dorsal head setae:			
A. fleshy setae present			
B. fleshy setae absent	B	A	B



Table V. Continuation

Characters	<i>Eriopeltis</i>	<i>Psilococcus</i>	<i>Luzulaspis</i>
1	2	3	4
Dorsal ocular setae: A. present on at least one side B. absent	B	A	B
Ventral head setae: A. with a pair of setae in the middle distinctly longer than rest B. not so	B	A	A
Genal setae: A. present B. absent	B	A	AB
Antennae 3rd segment: A. 4—6 times longer than wide B. 3—4 times longer than wide	A	B	B
Hair-like setae on 3rd segment: A. absent B. usually present	A	B	B
Thorax Reticulation on prescutum: A. present B. absent or very weak	B	B	A
Median ridge of basisternum: A. present B. absent or reduced	B	B	A
Posterior metasternal setae: A. fleshy setae numerous (7—19) B. f. s. less numerous (2—9)	A	B	A
Mesepimeron: A. present B. absent	A	B	A
Fore legs: A. longer than the rest B. shorter than the rest	A	B	B
Apical seta of fore coxa: A. long (about as long as trochanter) B. short (about half as long as trochanter)	A	B	A

Table V. Continuation

Characters	<i>Eriopeltis</i>	<i>Psilococcus</i>	<i>Luzulaspis</i>
1	2	3	4
Apical seta on fore trochanter: A. long (more than 3 times as long as width of trochanter) B. short (less than 2.5 times as long as width of trochanter)	A	B	B
Hind claw: A. about 1.5 times as long as width of tarsus B. equal to or a little longer than width of tarsus	A	B	B
Abdomen Tergites: A. present on all the segments B. not so	B	A	A
Tergites between 1st and 2nd segments: A. separate plates on each side B. continuous from side to side	A	B	A
Pleural sclerotization: A. present on segm. VII B. present on segm. IV—VII	A	B	A
Glandular pouch: A. absent B. present	B	A	AB
Abdominal dorsal setae: A. fleshy setae on segm. I usually more than one B. usually one or none	B	A	B
Ante-anal setae: A. usually present B. usually absent	A	B	B
Circular pores in ante-anal region: A. present B. absent	B	B	A
Length of penial sheath in relation to body length: A. body length 5.5 or more times longer B. body length less than 5.5 times longer	B	A	A

Table VI

Number of characters shared and differentiating males of *Eriopeltis* TARG., *Psilococcus* BORCHS. and *Luzulaspis* CKLL.

Pairs of genera	Number of characters		
	shared	differentiating	partly shared
<i>Eriopeltis-Psilococcus</i>	5	25	3
<i>Eriopeltis-Luzulaspis</i>	12	14	7
<i>Luzulaspis-Psilococcus</i>	11	14	8

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## STRESZCZENIE

Praca niniejsza zawiera opis morfologii zewnętrznej i struktur kutikularnych wszystkich stadiów larwalnych i osobników dojrzałych *Psilococcus parvus* BORCHS. W morfologii samicy szczególną uwagę zwrócono na budowę nóg.



Stwierdzono, że obok osobników o nogach w pełni rozwiniętych są takie, u których część lub wszystkie nogi wykazują mniejszy lub większy stopień redukcji. W krańcowych przypadkach nogi są zredukowane do niedużych stożkowatych wyrostków (tablica I—III, rysunek 9b). Zjawisko zaniku nóg u tego gatunku jest przypuszczalnie związane z osiadłym trybem życia, jaki samice prowadzą pod pochewkami liściowymi turzyc.

*Psilococcus parvus* BORCHS. jest oligofagiem turzyc. Ma jedno pokolenie w roku, zimuje w stadium jaja. Rozwój samiec odbywa się poprzez trzy stadia larwalne, samców podobnie jak u innych *Coccidae*. Larwy wylęgają się pod koniec maja — na początku czerwca. Składanie jaj odbywa się w sierpniu. Kokon jajowy jest luźny, osłania tylko jaja.

W oparciu o budowę samca zrewidowano stanowisko systematyczne *Psilococcus* BORCHS. i stwierdzono, że najbliższymi mu rodzajami są *Eriopeltis* TARG. i *Luzulaspis* SKLL.

#### РЕЗЮМЕ

Настоящее исследование посвящено морфологии и кутикулярным образованиям всех личиночных возрастов и взрослых насекомых *Psilococcus parvus* BORCHS.

В морфологии самок особое внимание обращено на строение ног. Установлено, что наряду с особями с нормально развитыми ногами встречаются особи с разной степенью редукции ног. В крайних случаях ноги представлены конусовидными выступами (табл. I—III, рис. 9 В). Явление редукции ног у этого вида возникает по всей вероятности в связи с неподвижным образом жизни самок под влагищем листьев осок.

*Psilococcus parvus* BORCHS. является олигофагом осок. У него одно поколение в году, зимуют яйца. Развитие самок происходит в трех личиночных стадиях, а развитие самцов сходно с другими *Coccidae*. Выход личинок происходит в конце мая — начале июня, яйцекладка в августе. Яйцевой мешок плохо развит и расположен позади тела самки.

На основании исследования морфологии самца проверяется систематическое положение *Psilococcus* BORCHS. и подтверждается, что этот род является ближайшим к *Eriopeltis* TARG. и *Luzulaspis* SKLL.

Plate III

Fig. 1. *Psilococcus parvus* BORCHS. ♀; a — c — dorsal and ventral aspects, d — f — marginal setae, g — small ventral setae, h — large ventral setae, i — dorsal setae, j — minute dorsal, ventral and marginal disc pores, k — dorsal bilocular pores, l — ventral dark-rimmed pores, m — quinquelocular pores, n — multilocular pores, o — large dorsal pores, p — ventral and dorsal tubular ducts (the number and distribution of morphological details are in agreement with natural relations)

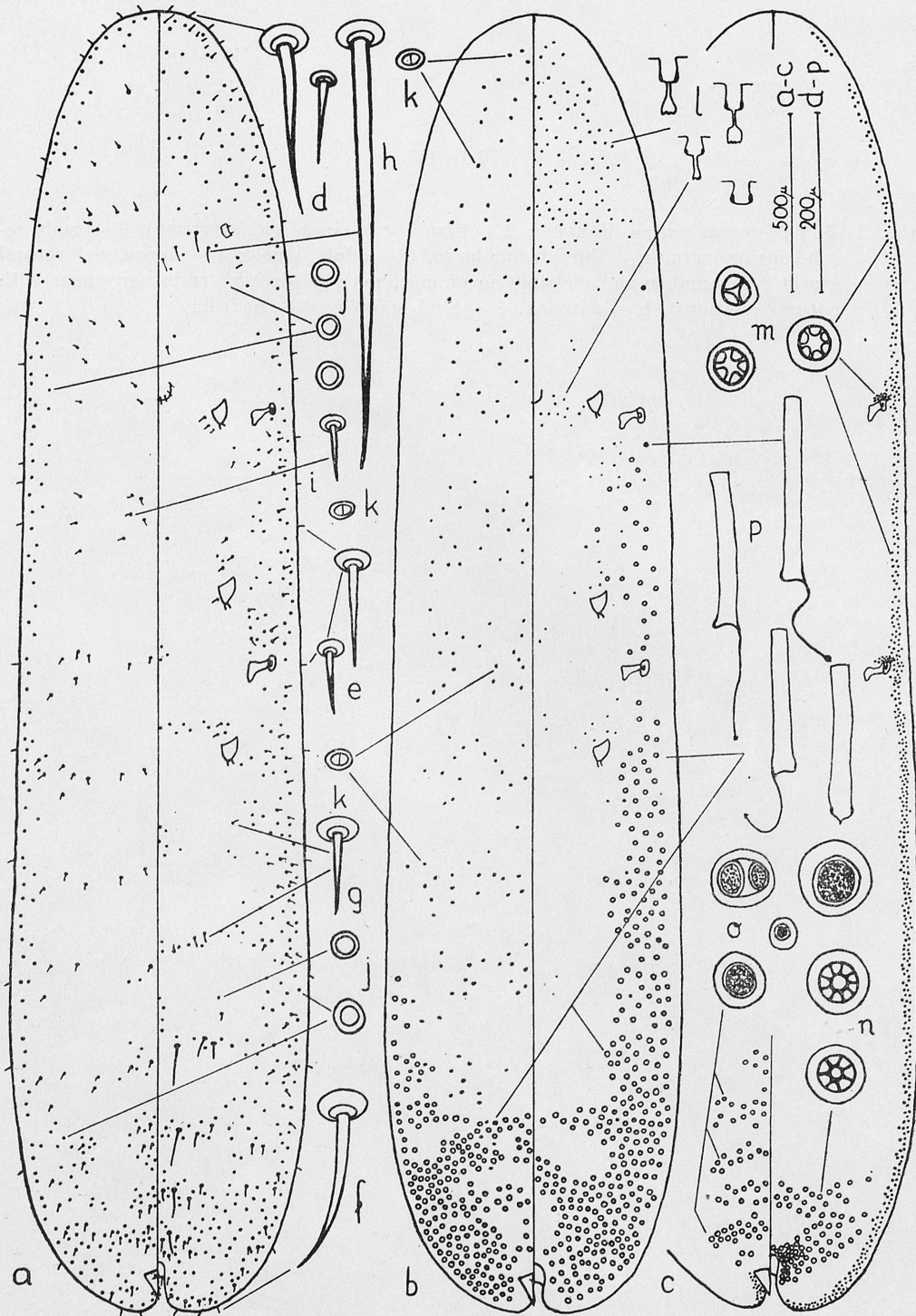




Plate IV

Fig. 2—5. *Psilococcus parvus* BORCHS.; 2 — first instar larva (old specimen), 3 — male second instar larva, 4 — third instar larva, 5 — adult female; a — dorsal and ventral aspect (the number and distribution of morphological details are in agreement with natural relations), b — antenna, c — hind spiracle, d — rostrum

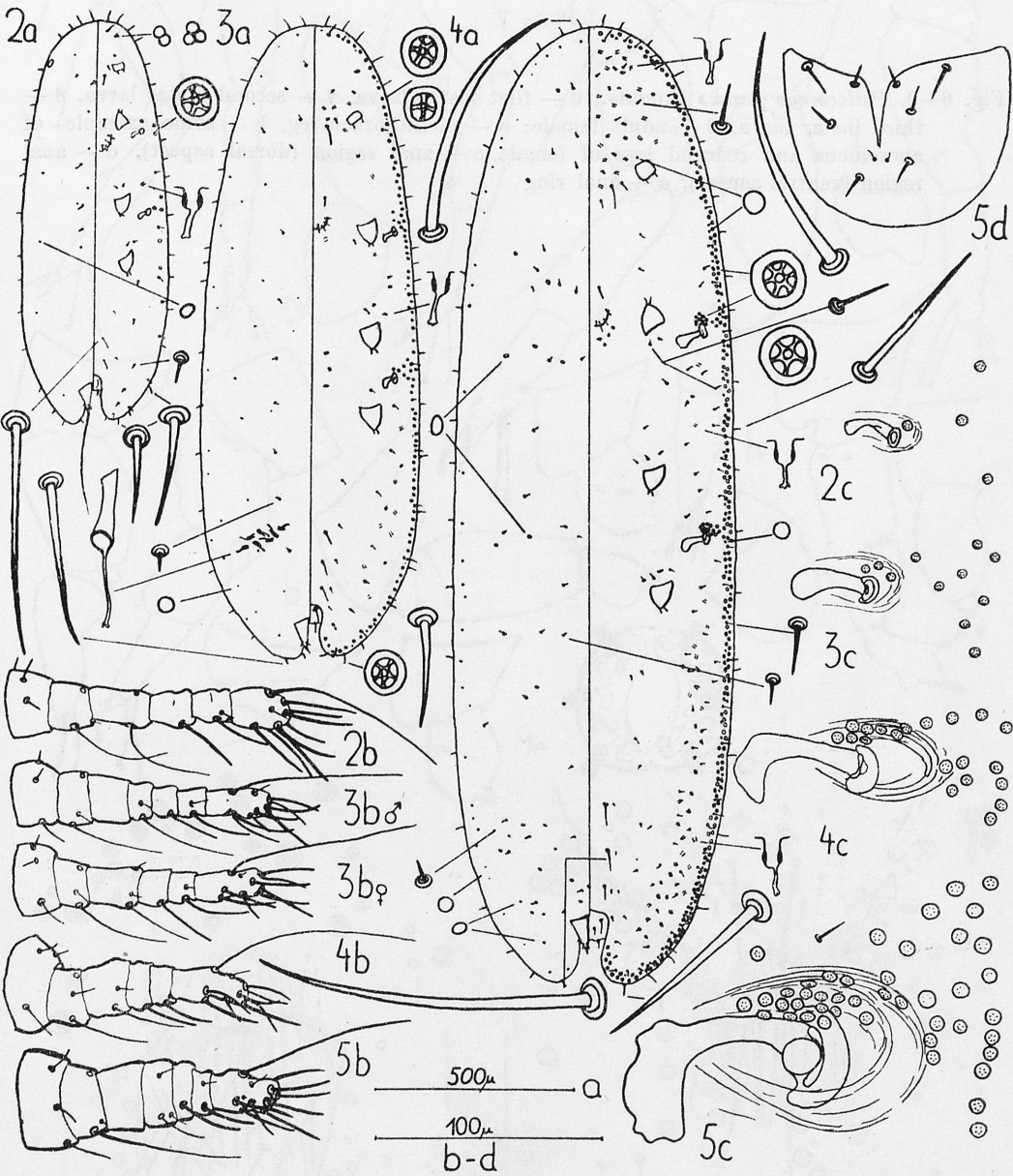
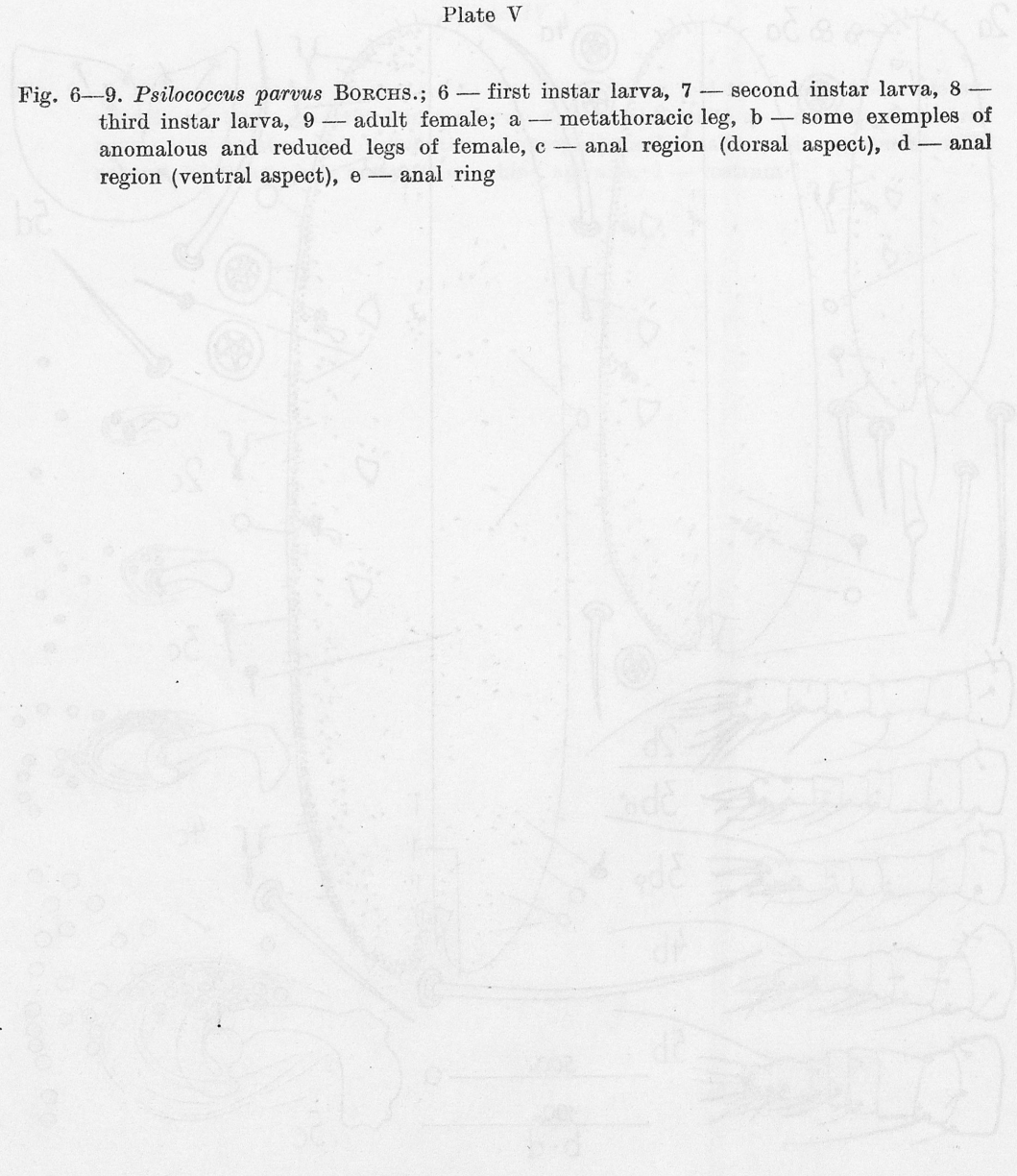


Plate V

Fig. 6—9. *Psilococcus parvus* BORCHS.; 6 — first instar larva, 7 — second instar larva, 8 — third instar larva, 9 — adult female; a — metathoracic leg, b — some examples of anomalous and reduced legs of female, c — anal region (dorsal aspect), d — anal region (ventral aspect), e — anal ring





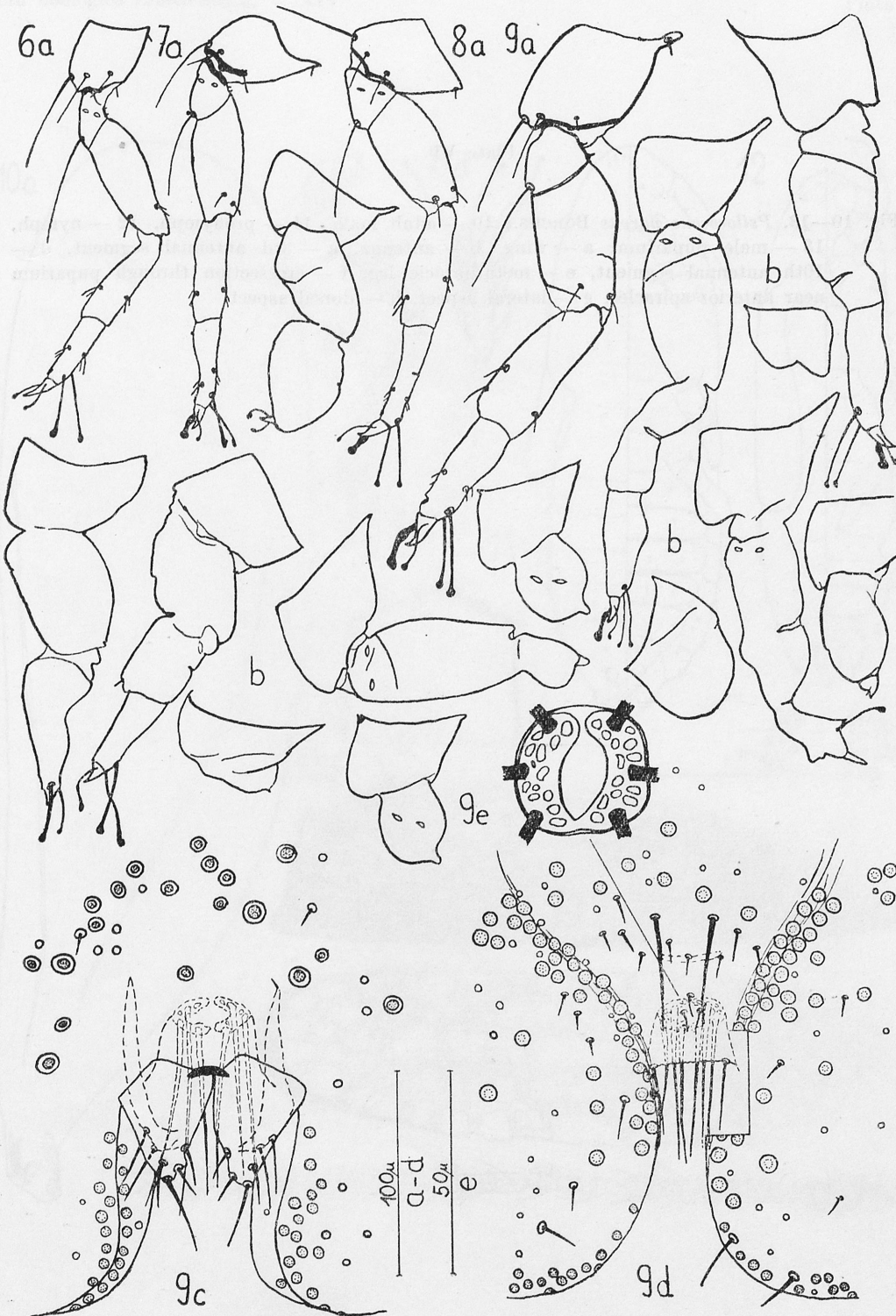


Plate VI

Fig. 10—13. *Psilococcus parvus* BORCHS.; 10 — adult male, 11 — pronymph, 12 — nymph, 13 — male puparium; a — wing, b — antenna, c — 3rd antennal segment, d — 10th antennal segment, e — metathoracic leg, f — crosssection through puparium near anterior spiracles, g — lateral aspect, h — dorsal aspect

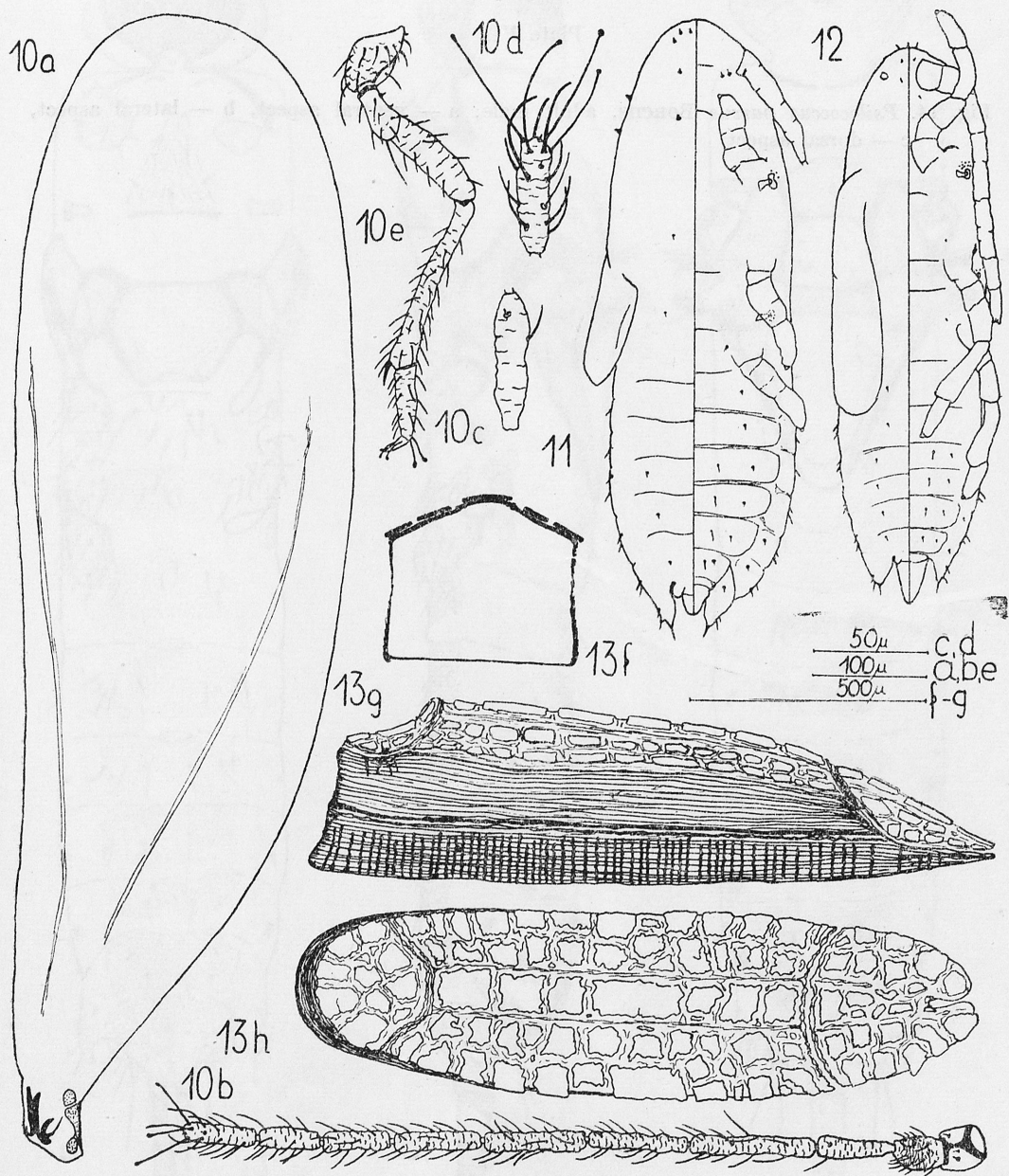
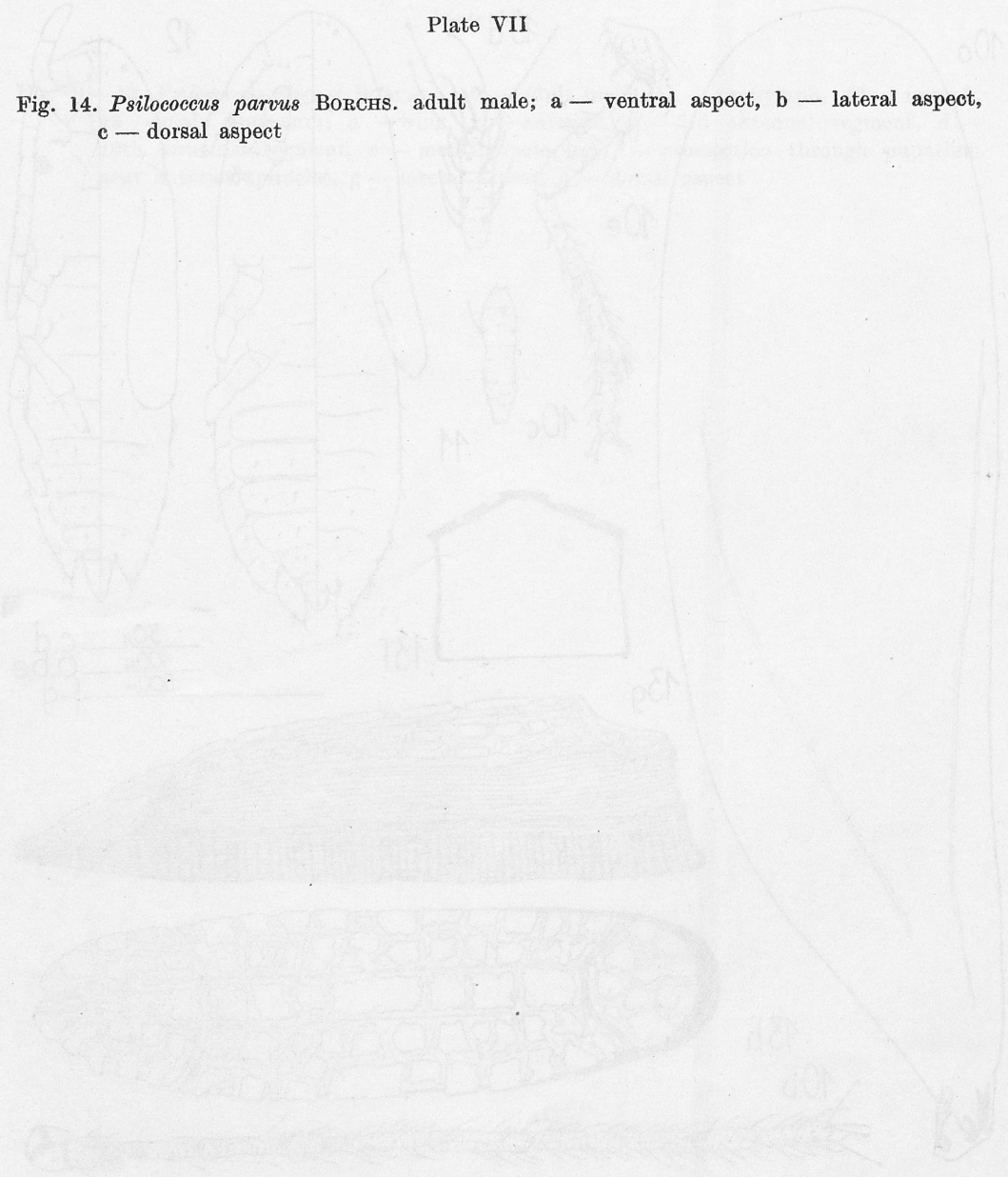
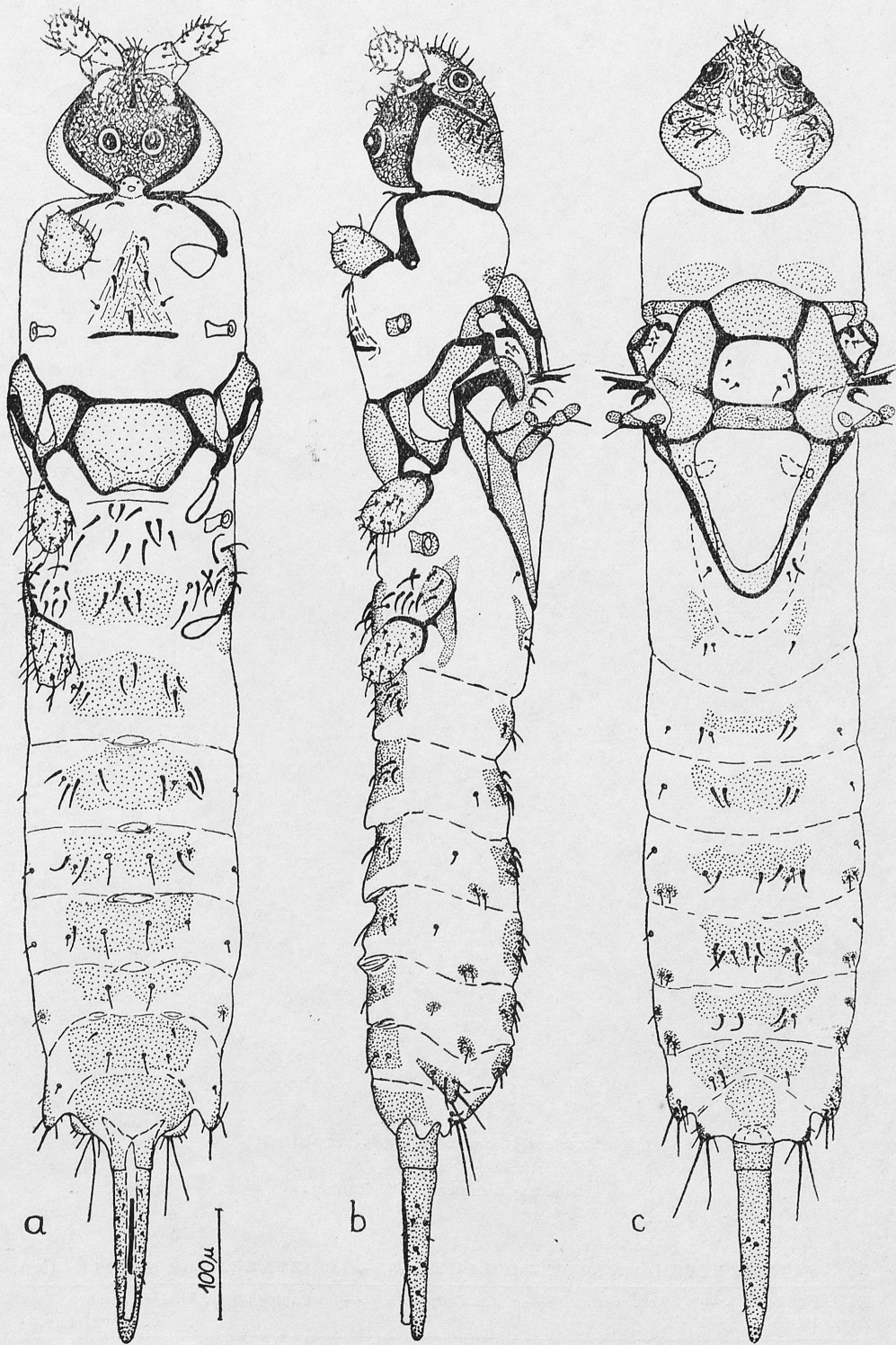




Plate VII

Fig. 14. *Psilococcus parvus* BORCHS. adult male; a — ventral aspect, b — lateral aspect, c — dorsal aspect







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Nakład 700+90 — Ark. wyd. 2 — Ark. druk. 2 — Papier ilustr. kl. III, 70×100, 80 g  
Zam. 451/68 Cena zł 10.—

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