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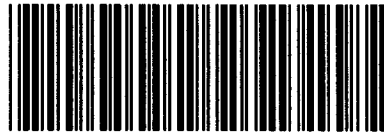
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Contributions to the Biology of Flower Flies of the Genus *Brachyopa* (Diptera, Syrphidae)

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Abstract—Larvae of four species of the genus *Brachyopa*, *B. dorsata* Ztt., *B. panzeri* Goffe, *B. paradoxa* Kriv., and *B. stackelbergi* Kriv., are described for first time. Data on their biology are given. A key to larvae of eight species of the genus, also including *B. bicolor* Fll., *B. insensilis* Collin, *B. pilosa* Collin, and *B. vittata* Ztt., is provided. The larvae differ in the structure of the dorsal terminal plate and papillae situated on it.

The genus *Brachyopa* Meigen comprises 33 species, among which 20 are distributed in the Palaearctic Region and 13, in the Nearctic Region. Most of species of the genus are ecologically associated with trees, the larvae live in sap bead on the trunks, under the bark, and in tunnels of other insects. The mode of life and morphology of the larvae have been studied in seven Palaearctic species, including five European ones: *B. bicolor* (Fallén), *B. insensilis* Collin, *B. pilosa* Collin, *B. vittata* Ztt. [under the name *B. conica* (Panzer)] (Krivosheina and Mamaev, 1967; Rotheray, 1991), and *B. scutellaris* R.-D. (Rotheray, 1996). Larvae of the Far Eastern *B. primorica* Mutin and *B. violovitshi* Mutin (Sivova *et al.*, 1999) have been already described briefly. Unfortunately, the larvae have been described using different diagnostic characters, and this circumstance complicates elaboration of a complete key to larvae of all the known species.

In the present paper, larvae of *B. dorsata* Ztt., *B. panzeri* Goffe, *B. paradoxa* Krivosheina, and *B. stackelbergi* Krivosheina are described for the first time, and *B. bicolor*, *B. insensilis*, *B. pilosa*, and *B. vittata* are described in more detail. A key to larvae of the eight the above-mentioned species is given. The larvae are deposited at the Institute of Ecology and Evolution, Russian Academy of Science, Moscow.

Genus *BRACHYOPA* Meigen, 1822

Description. Larvae amphipneustic. Body cylindrical or slightly flattened dorsoventrally, with widely rounded anterior end and strongly narrowed posterior one. Pseudopods undeveloped, 1st-instar larvae occasionally with crawling carinae.

Antennal-maxillary complex 2-segmented, basal segment not separated, apical one with deep emargination. Boundaries of three thoracic segments easily determined through arrangements of papillae. Abdominal part of body formed by wide segments I–VI and by narrow, ribbon-shaped segment VII; part of segment VII probably a part of to terminal platform. Boundaries of abdominal segments occasionally indistinct because of presence of secondary transverse folds.

Terminal platform on dorsal side of body formed by segment VIII, subdivided into 3 secondary segments by 2 deep folds; median segment divided into two by incomplete fold. Anal papillae well developed, forming 6 pairs, usually indrawn into body.

Length of spiracular tube more than 3 times its width and equal to, or slightly exceeding width of body. Tube straight and sclerotized along entire length.

Anterior spiracles in the form of small tubercles on dorsal side of prothorax, with 3 oval openings in the species examined. Posterior spiracles situated at end of spiracular tube. Each spiracles with 3 narrow simple slit-shaped openings.

Dorsal and lateral papillae of body rather large and distinct. Two pairs of dorsal papillae (median and intermediate) not separated from each other by grooves and situated at one level. Marginal ones separated by groove and shifted backwards. End of body with 7 pairs of large papillae in the form of conical or cylindrical thick processes bounding terminal platform. Two pairs of papillae (median and intermediate) situated on dorsal side of body and 5 pairs, at margins. Body covered with fine and rather sparse hairs and

spines varying in shape and size, or with dark polygonal plates forming mosaic pattern. Examination of the material available has shown that the structure of the papillae and cuticular formations vary with the instar of larvae. Abdominal tergite I with wide glabrous symmetric areas between anterior margin of tergite and median and intermediate papillae. This is location of embryonic discs of puparial spiracles.

The structure of the papillae in larvae of *Brachyopa* should be discussed. Many authors recognize in the larvae the presence of cuticular formations of the following three types: sensilla, papillae, and thick processes. The sensilla are baculiform processes usually situated in the form of an asterisk on the common round flat base. However, such structures in larvae of *Brachyopa* gradually transform (from the anterior, toward the posterior ends of the body) into the formations, in which baculiform appendages are situated at the apex and, more frequently, over the entire lateral surfaces of the tuberculate bases varying in length. At the end of the body, they are replaced by large, thick processes bearing appendages varying in shape. To avoid any confusion, I use in descriptions only one term, the papillae, and indicate their shape, size, arrangement of appendages, and other characteristics.

Differential diagnosis. In the larval morphology, the genus *Brachyopa* is most closely related to the genera *Hammerschmidtia* Schummel (Krivosheina, 2003) and *Graptomyza* Wiedemann (Krivosheina and Krivosheina, 1996). Larvae of *Brachyopa* differ from the others in the following characters: two pairs of dorsal papillae (median and intermediate) lying at one level, terminal platform present, spiracular tube entirely sclerotized, and spiracular openings of posterior spiracles in the form of slits.

In larvae of the closely related genus *Hammerschmidtia*, median dorsal papillae separated from intermediate ones by deep groove, and intermediate papillae shifted backwards (not situated at one level with median ones). All papillae of abdominal segment VIII situated on lateral sides of body (terminal platform absent). In addition, base of spiracular tube pale and nonsclerotized along considerable part of length. Spiracular openings of posterior spiracles oval and slightly curved.

Larvae of the genus *Graptomyza* also differ from those of *Brachyopa* in the following characters: median dorsal papillae separated by oblique groove from other ones shifted backwards, large conical lateral

papillae on ultimate segment of body densely pubescent, dorsal papillae of ultimate segment small and inconspicuous, spiracular openings of posterior spiracles oval or slightly arcuate.

***Brachyopa bicolor* (Fallén) (Figs. 1, 1–3; 2, 9, 11)**

Material. Russia: 3 larvae, 1 puparium, Tellerman, Voronezh Prov., 28.IX.1960, larvae in sap bead on elm trunk; 3 larvae, Krasnaya Polyana, northern Caucasus, 8.VIII.1966, larvae in dripping-out sap on fir trunk (B. Mamaev); Ukraine: 2 larvae, Khust, Transcarpathia, 17.VII.1963, no. 147, larvae in moist dust (N. Krivosheina).

Description. Larva. Body length 8 mm, width 3 mm. Carina surrounding antennal-maxillary complex with separate lateral tubercle, uniformly covered with fine pale spines reaching dorsal papillae of prothorax. Dorsal papillae of prothorax formed by 3 long baculiform appendages situated on round flat base. Posterior median pair of papillae situated before level of anterior spiracles. Meso- and metathorax before median papillae with large dark plates closely adjoining one another and bounded by simple row of tapered spines. Dorsal papillae of these segments with 3 long, and 1 short appendages. Median and intermediate papillae of abdominal tergites I–V formed by flat round base bearing 2 long and thick, and 1 short and small baculiform appendages. Median and intermediate papillae of abdominal tergite VI with 2 or 3 large appendages. Anterior margins of middle parts of tergites with small tapered spines forming 2 or 3 short transverse rows. Larger spines forming simple rows bounding row of papillae and also double row along posterior margin of tergite. Terminal platform widely rounded at anterior end and narrowed at posterior one. Median and intermediate papillae bounding terminal platform at anterior margin with 3 thickened appendages. Distance between them 0.33 times that between median and marginal papillae. Other papillae situated over lateral surface of terminal platform, becoming distinctly longer toward posterior margin, cylindrical, with numerous branches along entire length. Terminal platform densely covered with flat polygonal plates in anterior part and bearing 3 rows of tapered spines in posterior part. Ventral surface of body uniformly covered with fine tapered spines. Anal opening bounded by 6 fine papillae at anterior margin, 2 larger papillae laterally, and 4 ones at posterior margin; 2 more papillae situated behind 4 last papillae closer to lateral surface. All 6 papillae behind anal opening large, con-

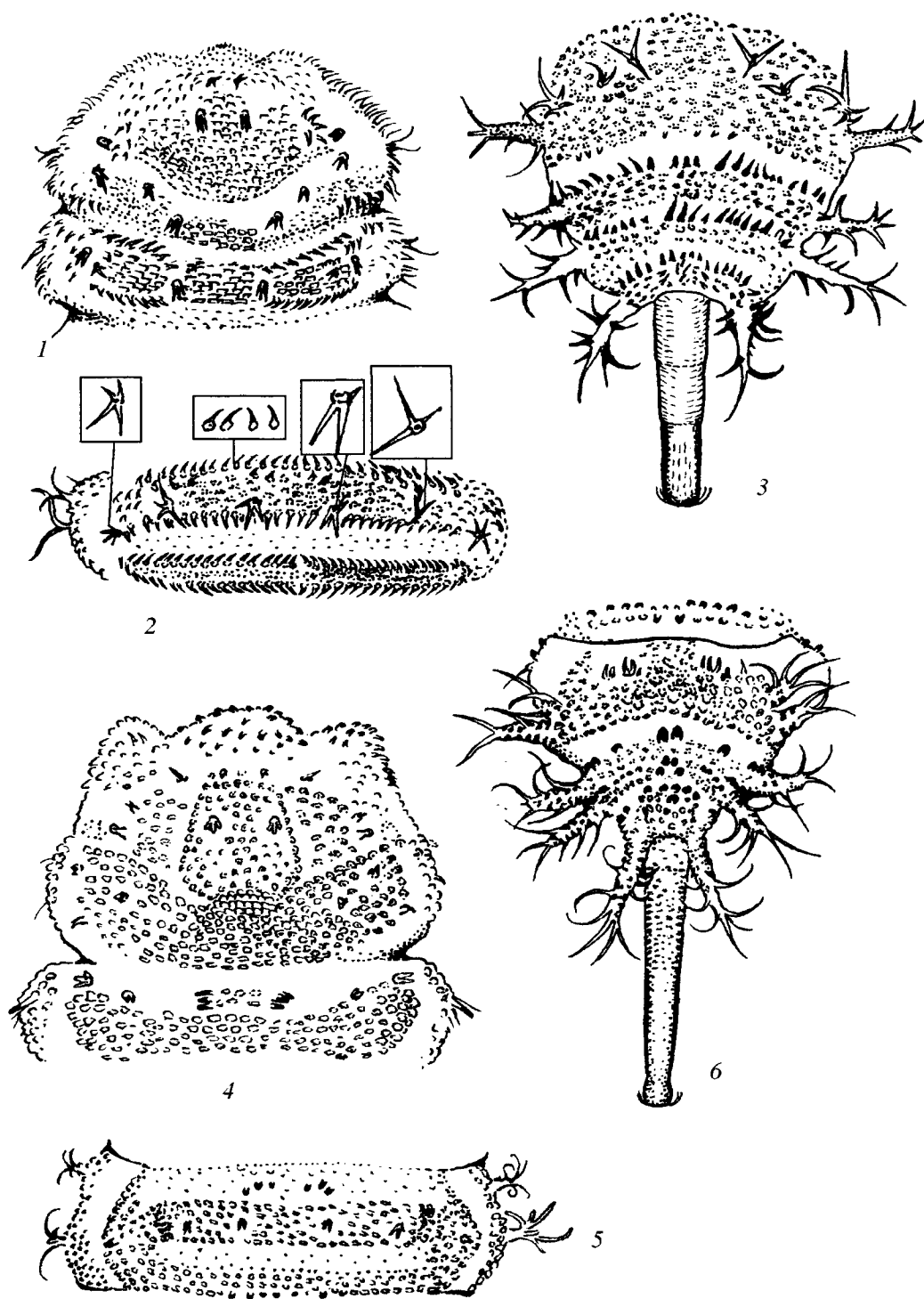


Fig. 1. *Brachyopa bicolor* (1-3), *B. insensilis* (4-6), larva: (1, 4) thoracic segments, dorsal view; (2, 5) cuticular structures of abdominal segment III, dorsal view; (3, 6) end of body (terminal platform and spiracular tube), dorsal view.

sisting of flat round base bearing 2 large thickened baculiform appendages. Anterior spiracles in the form of short wide dark cylindrical tubercles. Spiracular tube at least 6 times as long as wide, of uniform width along entire length, fuscous, coarsely wrinkled

in basal 1/3, finely wrinkled in middle part, and smooth at apex.

Differential diagnosis. The larva of this species clearly differs from larvae of the congeners in the dor-

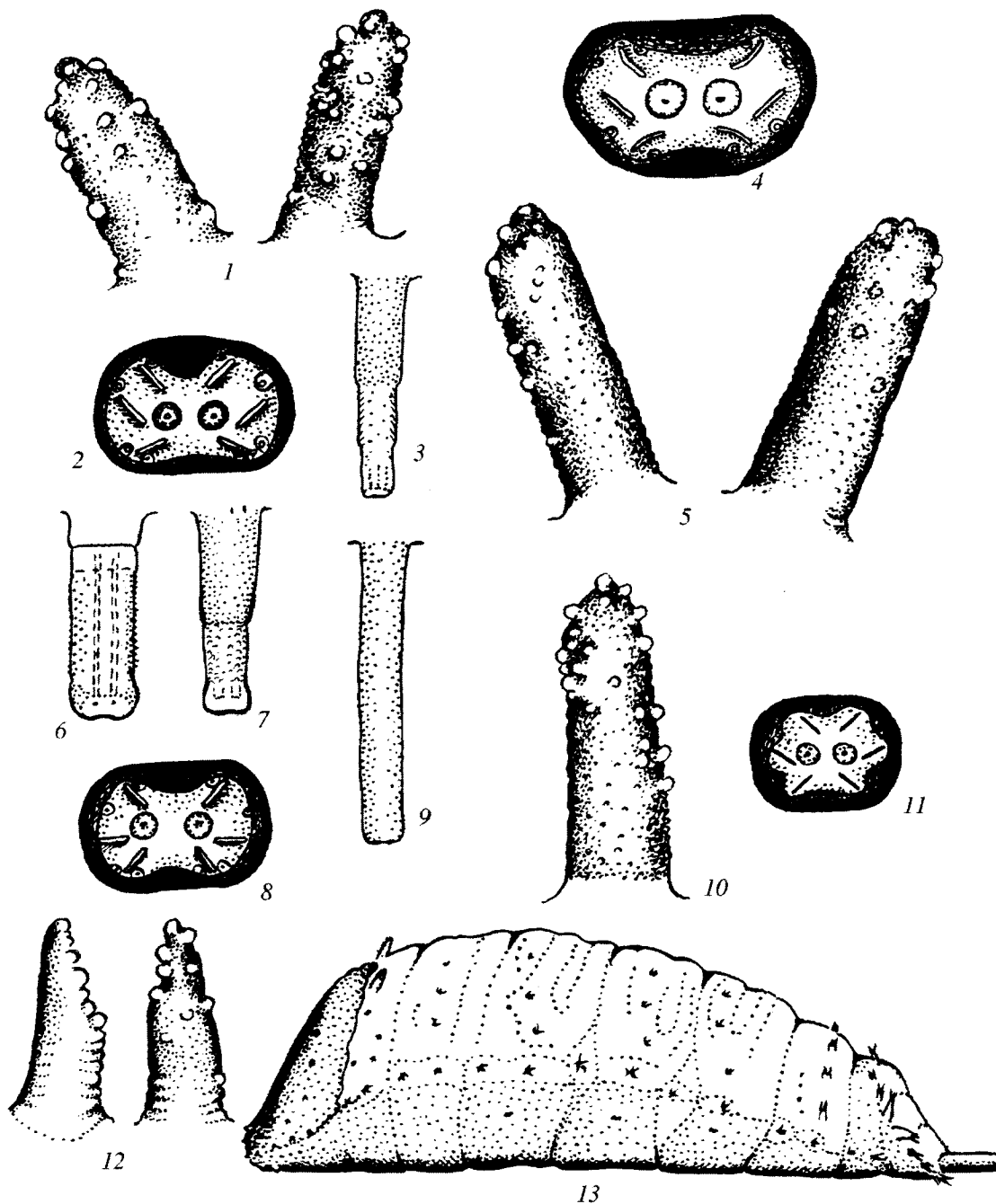


Fig. 2. *Brachyopa dorsata* (1-3), *B. vittata* (4-6), *B. pilosa* (7, 8, 10), *B. bicolor* (9, 11), *B. paradoxa* (12, 13), puparia: (1, 5, 10, 12) spiracular tubercles; (2, 4, 8, 11) posterior spiracles; (3, 6, 7, 9) spiracular tube; (13) puparium, lateral view.

sal side of the body bearing simple distinct rows of spines widened at the base and tapered at apex.

Notes. The larvae develop in sap beads on trunks of *Quercus*, *Ulmus*, and *Fagus*. They were also found in tunnels of *Cossus cossus* on the poplar (Lundbeck, 1916). The larvae examined by me were found in sap beads on trunks of the beech (in Transcarpathia) and firs (in the northern Caucasus). The larva described is

very similar in the morphology to the larva of *B. violovitshi* Mutin, which lives under the bark and in the soil sodden with a wood sap. The description of the latter (Sivova *et al.*, 1999) gives no diagnostic character for the reliable differentiation of these species.

Brachyopa dorsata Zetterstedt (Figs. 2, 1-3; 3)

Material. Russia: 3 larvae, Ugory, Kostroma Prov., 5.VIII.1981, no. 175, birch trunk; 2 larvae, Nikol'skoe,

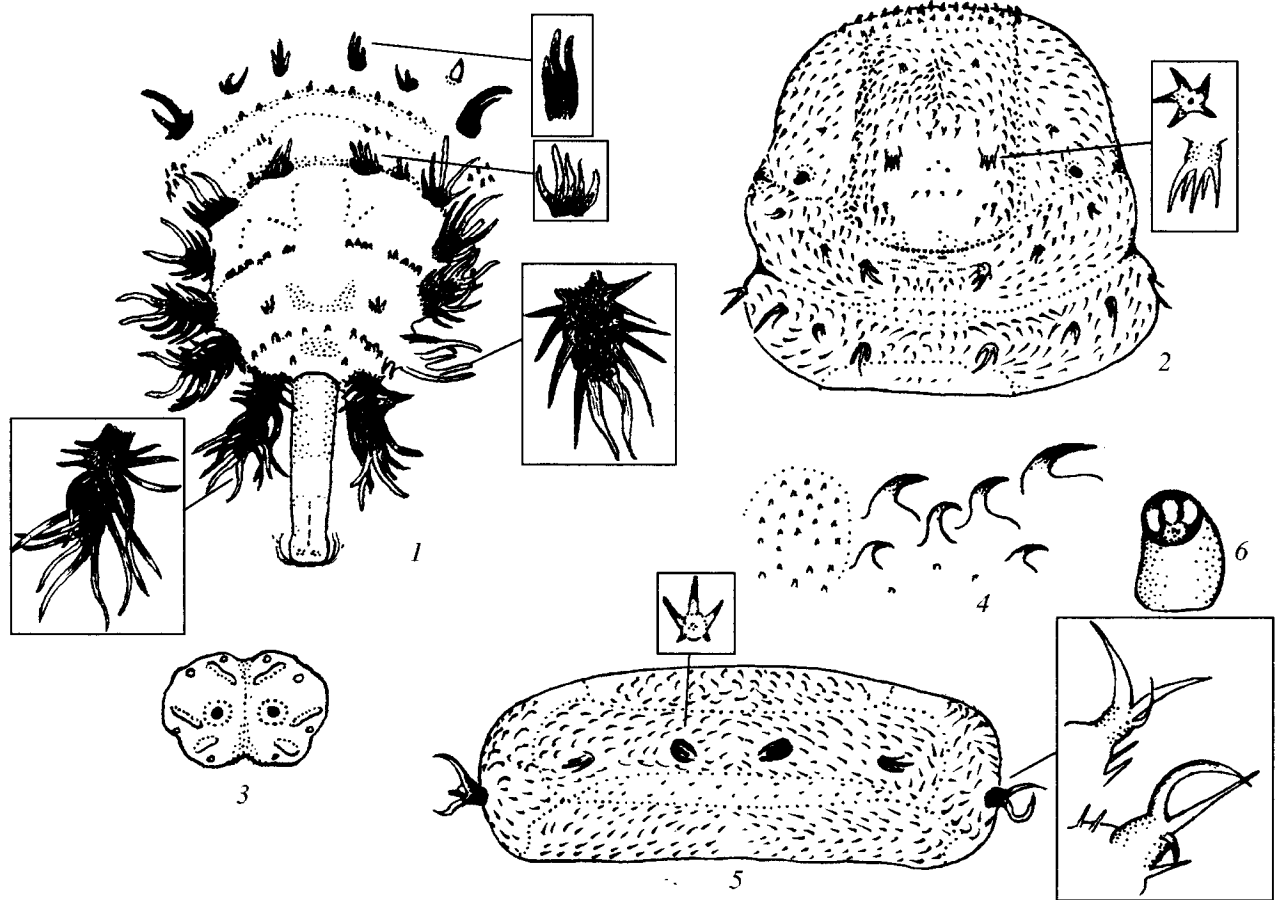


Fig. 3. *Brachyopa dorsata*, larva: (1) end of body, dorsal view; (2) posterior spiracles; (3) thoracic segments, dorsal view; (4) cuticular structures of anterior end of body; (5) cuticular structures of abdominal tergite III; (6) anterior spiracles.

Ust'-Kubenskii Distr., Vologda Prov., 27.VI.1983, no. 16, birch trunk; 1 larva, Artybash, coast of Lake Teletskoe, mountain Altai, 30.V.1981, no. 7, birch bast; 4 larvae, same locality, 10.VI.1981, no. 2, 11.VI.1981, no. 40, 19.VI.1981, birch bast; 1 larva, 2 puparia, Ishti-Khem, environs of Shigonar, Tuva, 14.VIII.1973, nos. 143 and 145, birch trunk, emergence of adults on 20-25.III.1974; 2 larvae, Taiga, southwards of Babushkin railway station, Buryatia, 24.VI.1976, no. 223, in tunnels of Lymexylonidae in birch trunk, 1 puparium, Bychikha, 25 km SW Khabarovsk, 8.V.1976, no. 244, under bark of aspen; 4 larvae, Kozyrevsk, Kamchatka, 20.VI.1984, no. 59; 1 larva, same locality, 22.VI.1984, birch wood; 1 larva, "Kedrovaya Pad" Nature Reserve, Primorskaya railway station, Primorskii Terr., 17.IX.1968, no. 97, poplar wood; 1 larva, Ussuriiskii Nature Reserve, Primorskii Terr., 19.IV.1967, in tunnels of Lymexylonidae in elm trunk (N. Krivosheina).

Description. Larva. Body length 8 mm, width 2 mm. Lateral tubercles, bounding mouth opening,

with fine dark spines in upper part and with colorless hairs in lower one. Carina, bounding antennal-maxillary complex, subdivided into weakly separated 4 tubercles bearing large arcuate dark spines. Prothorax with dorsal papillae in the form of small tubercle bearing 5 appendages varying in size and also bearing fine, irregularly arranged spines. Largest median dorsal papillae of second row situated nearly at one level with anterior spiracles; 2 or 3 oval dark plates lying between them, and area of numerous tapered spines lying before them. Median area behind papillae as far as boundary with mesothorax and area around spiracles nearly glabrous, with inconspicuous polygonal plates. Median papillae and longitudinal grooves bounding them separated by double row of spines. Rest of dorsal surface of prothorax with numerous tapered fine spines. Boundary with mesothorax bearing arcuate row of weakly sclerotized, sparse, oval plates scattered along median line of body. Anterior margin of mesothorax without spines before median and intermediate papillae, with double row of spines

between median papillae, and with stripe without spines behind it. Rest of surface with fine elongate pale spines. Metathorax with spines over greater part of surface, except for area behind median papillae. Dorsal papillae of thoracic segments with 3 long large tapered appendages and 1 or 2 shorter ones. Papillae on abdominal segments with 5 appendages of various length situated on rather long tubercles. Segments I–V densely covered with pale tapered spines smaller in transverse depression and at boundaries. Spines on segment VI larger and sparser. Short dark spines before papillae forming no rows. Rather large area adjacent to median and intermediate papillae without spines, with polygonal dark plates. Sharp spines forming transverse row in posterior part of segment. Median dorsal papillae with 5 long appendages varying in size; intermediate ones with 2 large appendages varying in length and with 2 or 3 small additional appendages; marginal papillae with larger appendages varying in length. Segment VII in the form of a narrow stripe, bearing 3 or 4 small dark spines adjoining middle part of body and with group of 7 or 8 spines near lateral surface. Terminal platform oval, pale, with rather pale numerous plates; its margins slightly elevated above surface of body. Anterior secondary segment of terminal platform covered with small oval dark plates forming 2 longitudinal median rows and shorter 2 lateral rows. Anterior margin of secondary median and terminal segments with transverse row of dark tapered spines scattered along median line. Single spines situated in middle part of platform; 2 similar spines present at base of each posterior marginal papilla. Seven pairs of papillae bounding oval platform. Two first pairs of papillae distinctly larger than others, with short approximate appendages, resembling tubercles. Other papillae with elongate fine appendages; papillae gradually becoming larger toward posterior end of body. Three pairs of posterior papillae flat, elongate, 1.5–2.0 and 2.5–3.0 times as long as wide, respectively. Entire lateral surface of papillae with numerous flat, tapered, but rather narrow appendages, among which lateral ones dark, and 2 or 3 apical ones pale. Terminal papillae directed backwards and situated along spiracular tube. Entire ventral surface of segments with fine short spines. Lateral surfaces of segments I–VII with long fine hairs. Lateral surfaces of segment VIII with spines reaching terminal platform. Lateral papillae in the form of tubercles bearing 2 or 3 appendages and gradually becoming larger (including bearing tubercle) toward posterior end of body. Posterior lateral papillae largest. Anal opening

surrounded with numerous transverse rows of microspines. Papillae poorly developed. Spiracular tube 4.5 times as long as wide at base, uniformly colored.

Puparium. Spiracles 3.0 times as long as wide. Spiracular tubercles situated in apical 2/3. Spiracular tube narrowed before apex, with fine transverse striation.

Differential diagnosis. This larva is similar to the larva of *B. vittata* Zetterstedt. It has an elongate cylindrical body and distinctly separated terminal platform. It differs in the following characters: 3 posterior pairs of marginal papillae of terminal platform of equal size; median papillae of terminal platform with 5 conical, well-developed appendages; spines on dorsal side of segment VI obtuse, distinctly larger behind median papillae than before them. Median papillae of segments V and VI rather short, with 2 or 3 appendages of subequal length. Length of spiracular tube no more than 4 times its basal width.

Notes. The larvae develop in standing birch trunks and those rather fresh, laying on the ground; the trunks are covered by a reddish fuscous bast and inhabited by Lymexylonidae. The larvae usually move along the horizontal tunnels in the upper layers of alburnum, which are free of larvae of locust borers, frequently occur together with larvae of the genus *Libnotes* Westw. (Limoniidae) also inhabiting locust-borer tunnels. Syrphid and limoniid larvae frequently occur in new and old tunnels of locust borers, filled with a liquid mucus. This liquid is a fermented sap or excretions formed as a result of the activity of microscopical ambrosian fungi. The last instar larvae usually collect in the tunnels perpendicular to the surface in the bast thickness. In addition to birches, the larvae were recorded on aspens, poplars, and elms.

***Brachyopa insensilis* Collin (Fig. 1, 4–6)**

Material. 3 larvae, Khust, Transcarpathia, Ukraine, 17.VII.1963, no. 151, beech trunk (N. Krivosheina).

Description. Larva. Body length 6 mm, width 2.5 mm. Body appearing dark brown in dorsal view because of presence of numerous dark plates densely covering surface of tergites. Lateral lobes, bounding mouth opening, with pale hairs, without dark tapered spines. Carina, bounding antennal-maxillary complex, with 4 weakly separated tubercles covered with large pale spines turning on dorsal side into smaller spines reaching median papillae. Posterior median papillae situated nearly at level of prothoracic spiracles. Dorsal

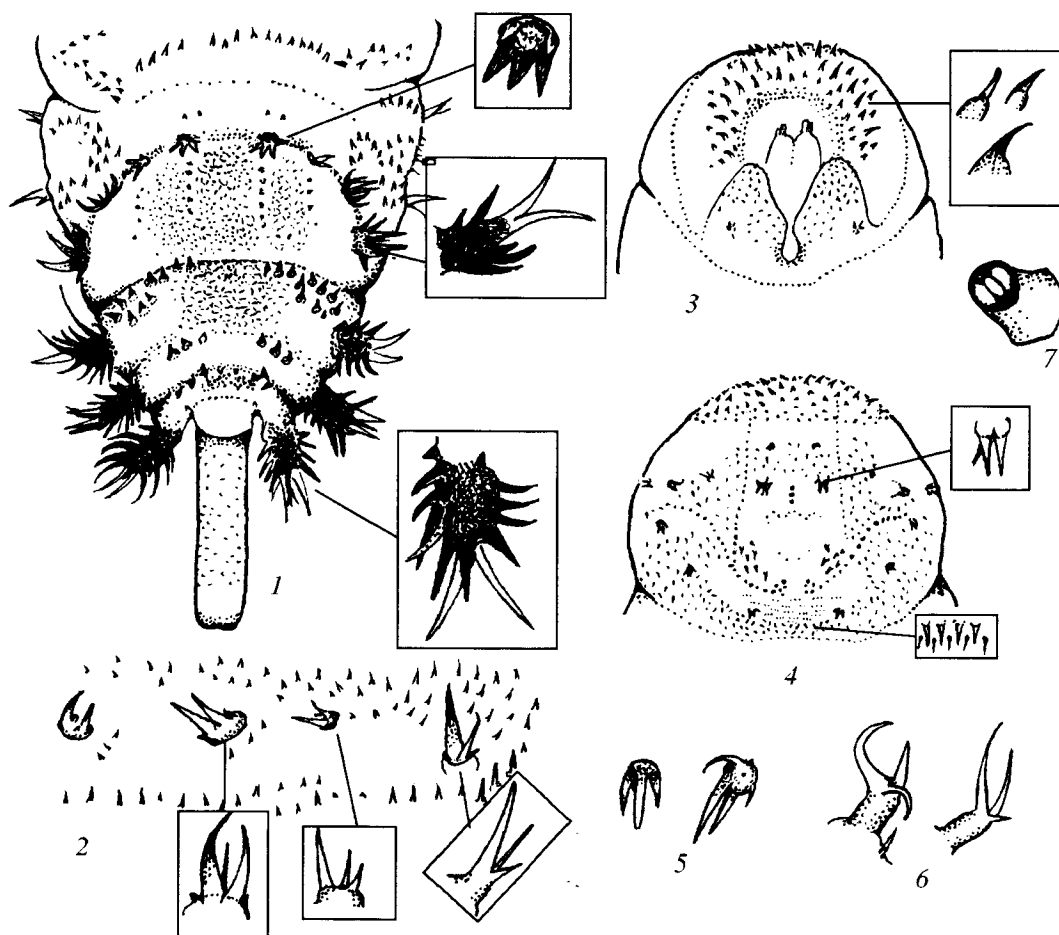


Fig. 4. *Brachyopa panzeri*, larva: (1) end of body, dorsal view; (2) median, intermediate, and marginal papillae of abdominal tergite VII; (3) anterior end of body, ventral view; (4) pro- and mesothorax, dorsal view; (5, 6) median and marginal papillae of abdominal tergites; (7) anterior spiracles.

papillae of prothorax large, presented by short tubercle with 5 thick short appendages. Mesothorax darkest before median papillae, sclerotized plates on this area densely adjoining one another. Median area between meso- and metathorax with several dark plates and 3 conical tubercles at each side. Dorsal papillae of abdominal segments with 2 long and 2 short (segments I-IV) or 3 or 4 long thick baculiform appendages (segments V-VI); 4 or 5 thick dark conical tubercles lying at borders between segments. In addition to dark plates, several elongate separated conical or baculiform tubercles present before median and intermediate papillae and along posterior margins of segments. Terminal platform widely rounded anteriorly and narrowed posteriorly; 2 pairs of anterior papillae smallest, equal in size to papillae on segment VI. Five pairs of marginal papillae elongate, cylindrical, with numerous branches; 3rd and 4th pairs of papillae approximate

and situated at one level. Surface of platform with dark polygonal plates denser in anterior 1/3. Posterior part of platform with rows of dark obtuse cylindrical tubercles. Ventral side of segments with numerous, rather uniformly situated, dark plates and tubercles. Latero-ventral surface of segments with row of dark, arcuately situated tubercles turning on abdominal sternites IV-VI into thick elongate tapered spines. Anal opening with usual set of papillae. Anterior spiracles oblong-cylindrical, 3 times as long as wide, slightly widened in upper part. Spiracular tube long, at least 6 times as long as wide, slightly wider and densely covered with dark oval plates in basal 2/3, then pale, almost uniformly colored, slightly narrowed and darkened along short distance before apex.

Differential diagnosis. The larva is most similar to *B. stackelbergi* in appearance, but its spiracular tube longer and not uniformly colored; dorsal side of body

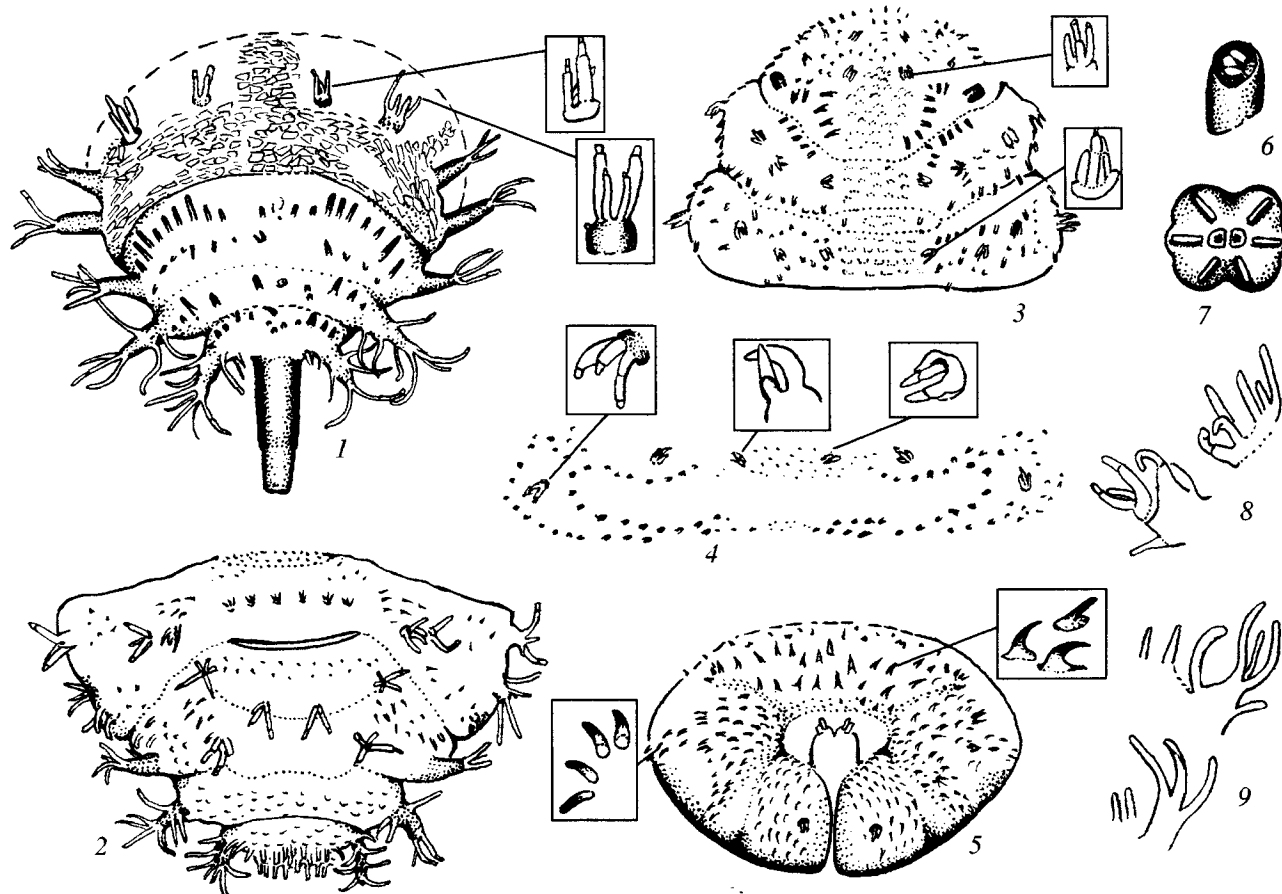


Fig. 5. *Brachyopa paradoxa*, larva: (1) end of body, dorsal view; (2) end of body, ventral view; (3) thoracic segments, dorsal view; (4) cuticular structures of abdominal tergite III; (5) anterior end of body, ventral view; (6) anterior spiracles; (7) posterior spiracles; (8) lateral papillae of thorax; (9) lateral papillae of abdominal tergite IV, ventral view.

bearing, in addition to flat dark plates, elongate separated conical or baculiform tubercles; and terminal platform with separated obtuse tubercles.

Notes. The larvae are common in sap accumulations on trunks of various trees: *Quercus*, *Aesculus*, *Ulmus*, *Betula*, and *Acer* (Hartley, 1961; Krivosheina and Mamaev, 1967; Rotheray, 1991, 1996).

***Brachyopa panzeri* Goffe (Fig. 4)**

Material. Ukraine: 6 larvae, Kvasy, Transcarpathia, 15.IV.1963, no. 51, 18.IV.1963, no. 67, larvae in fir stub (N. Krivosheina).

No adult was reared from larvae of this species. However, as the larvae have been found in a fir stub together with larvae of *B. vittata* Zett., and adult of only these two species have been recorded in the area, I refer these larvae to *B. panzeri*.

Description. Larva. Body length 10 mm, width 2 mm. Lateral lobes, bounding mouth opening, with

very fine dark spines in anterior part and with pale hairs in posterior one. Carina, bounding antennal-maxillary complex, separated into 4 tubercles with large, arcuately curved spines situated on widened, rather flat bases. Prothorax with 2 rows of median papillae, among which posterior pair largest and situated slightly before level of anterior spiracles. Papillae with 2 large thick tapered appendages varying in length and also with 1 additional appendage half as long as them. Small area, situated behind median papillae and bounded by longitudinal grooves, glabrous, only with several spines near boundary with mesothorax. Rest of surface before median papillae and between anterior spiracles and posterior margin of tergite with long large spines. Largest spines situated near median papillae along longitudinal grooves bounding them. Boundary between prothorax and mesothorax with simple row of dark plates separated in middle part. Area of mesothorax between median papillae with double row of spines. On mesothorax, intermediate dorsal papillae situated more closely to marginal

than to median ones. Entire surface of metathorax with fine spines turning into hairs near lateral surface. Dorsal surface of abdominal segments I-IV with dense hairs over entire surface, except for narrow stripe behind median papillae; hairs on abdominal segment V darker and larger. Areas between median and intermediate papillae, and also transverse depression behind median papillae glabrous. Dorsal papillae with 2 large appendages of unequal length and with 1 or 2 small appendages. Dorsal surface of abdominal segment VI with distinct dark plates and with dark large tapered spines situated along anterior margin before papillae; several obtuse tubercles forming row immediately behind median papillae. Groups of large spines also situated behind marginal papillae. Posterior margin of segment without spines. Median and intermediate papillae with 2 or 3 flat conical appendages widened at base, marginal papilla with 1 large appendage thickened at base and also with 2 appendages. Posterior lateral papillae with 3 appendages varying in length. Dorsal surface of segment VII with 1 or 2 spines situated symmetrically at sides of median line of body and with group of large spines near lateral surface. Terminal platform oval, slightly widened forwards; 2 median papillae wide and flat, with 5 short and wide appendages; 5th and 6th pairs of papillae not longer than wide; lateral appendages of papillae short, narrowed at apex; apical appendages paler and longer. Terminal platform with row of tapered tubercles at anterior margin of median secondary segment; tubercles separated along median line and at anterior margin of 3rd secondary segment. Spiracular tube dark, uniformly colored; its length 4.5 times width and slightly exceeding width of median secondary segment of terminal platform.

Differential diagnosis. The larvae are similar in the structure to larvae of *B. dorsata*. The larvae are characterized by the following features: size large; lateral appendages of papillae, surrounding terminal platform, short, mainly straight, conical, tapered at apex, distinctly shorter than papilla; 2 apical appendages long, wide, and pale; prothorax bounded posteriorly by distinct row of elongate dark plates; glabrous area between median papillae and longitudinal grooves bounding them without rows of spines; abdominal segment VI with tapered spines of equal size before and behind median papillae; length of spiracular tube nearly 4.5 times its basal width; dorsal papillae of abdominal segments V and VI elongate, with appendages varying in length; median papillae of terminal platform usually with 3 wide conical appendages, occasionally also with 2 shorter additional ones.

Notes. The larvae were found in a damp bark of fir stubs together with larvae of *B. vittata* Zetterstedt.

Brachyopa paradoxa Krivosheina (Fig. 2, 12, 13; 5)

Material. 2 larvae, 2 puparia, environs of Dzhilikul, Tajikistan, 27.III.1986, no. 11, sap under bark of turanga (N. Krivosheina).

Description. Larva. Body length 9 mm, width 3 mm. Head without projecting mouth hooks. Lateral lobes, bounding mouth opening, rather densely covered with dark elongate spines reaching their posterior margin. Antennal-maxillary complex with dark paired sensilla. Apical tubercle bearing sensillum separated by shallow emargination. Carina, surrounding antennal-maxillary complex, divided by grooves into 6 tubercles: two median ones weakly separated, with large dark elongate and obtuse spines; lateral ones with smaller spines. Dorsal side of prothorax with distinct groups of papillae presented by tubercle bearing 3 or 4 thick appendages. Second pair of dorsal papillae situated slightly before level of anterior spiracles. Meso- and metathorax with polygonal fine dark plates forming mosaic pattern. Long, obtuse, dark spines situated near median papillae and spiracles. Anterior spiracles in the form of small tubercles narrowed toward apices and beveled on posterior surfaces, situated on lateral surfaces of prothorax. Distance between median papillae of abdominal segments I-VI nearly 1.5 times distance between median and intermediate papillae. Marginal pair shifted slightly backwards; distance from it to intermediate papillae nearly twice distance between median and intermediate papillae. Dark obtuse spines forming loop between intermediate and marginal papillae. Terminal platform with rather large, dark, polygonal plates in anterior part. Posterior half of platform pale, with transverse rows of obtuse, campaniform, dark tubercles. Median papillae in the form of small tubercles each bearing two 2-segmented appendages; intermediate papillae larger than median ones, each bearing 4 rather long appendages. Lateral surface with 5 pairs of long dark conical papillae, 3 first pairs with 2 or 3 pale baculiform apical appendages. Two terminal pairs of papillae with lateral appendages, in addition to apical ones. Ventral surface of meso- and metathorax glabrous in middle part, with ill-defined polygonal plates and 2 small papillae. Lateral surfaces of sternites densely covered with long dark spines. Ventral surface of abdominal segments I-VI with 3 transverse rows of dark obtuse spines, posterior row with 3 pairs of small flat pale papillae each bearing 3

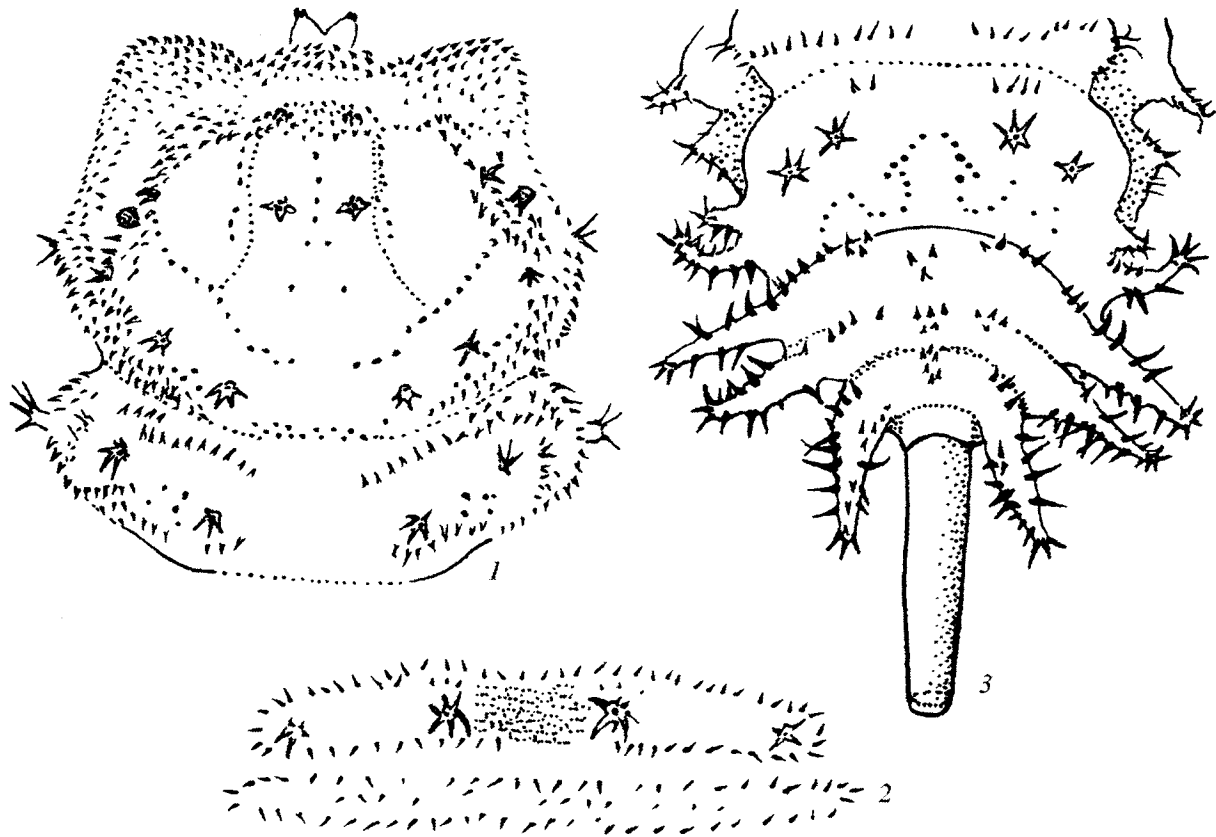


Fig. 6. *Brachyopa pilosa*, larva: (1) thoracic segments, dorsal view; (2) cuticular structures of abdominal tergite III; (3) end of body, dorsal view.

or 4 short appendages. Marginal papillae with 2 long pale baculiform appendages. Dark obtuse spines varying in size situated around papillae, 3–5 spines larger than others. Anal opening narrow and slit-shaped, 6 pale papillae situated near it. Four considerably larger papillae (each bearing 2 appendages) forming semicircle bounding anal opening posteriorly. Four papillae, each bearing 4 long baculiform appendages, situated at level of anal opening. Three lateral papillae in the form of small tubercles each bearing 3 or 4 appendages; only upper papilla on segment VI much larger than others, conical, and dark. Spiracular tube slightly narrowed toward apex, 3 times as long as wide, slightly wrinkled in basal 2/3, smooth and shining in apical 1/3.

Puparia flat on lower side, convex on upper side, yellowish brown; thick black conical erect spines in anterior part of body forming transverse rows; dorsal and lateral papillae black, cylindrical. Puparial spiracles elongate, cylindrical, without spiracular openings in basal 2/3. Apical 1/3 narrowed apically and bearing distinct 8 spiracular tubercles. Surface of puparial spiracles covered with minute tubercles.

Differential diagnosis. The larva is similar in general to larvae of *B. bicolor* and other species developing in beads of a wood sap. The larva is characterized by the following features: terminal platform not elevated above surface of body and not darkened; dorsal side of segments rather sparsely covered with elongate obtuse black tubercles forming simple loop-shaped row near lateral surfaces of abdominal segments; same obtuse elongate tubercles situated in posterior half of terminal platform. It should be noted that 2nd pair of papillae of terminal platform not smaller, but larger than median papillae, in contrast to those in larvae of other species. Spines, surrounding antennal-maxillary complex varying in size; median spines distinctly larger than lateral ones.

Notes. The larvae were found in a deep slit in a living turanga trunk under the bark and in accumulations of the loose bast at the place of a broken-off twig. The larvae collected in a dark semi-fluid substance in the lower part of the slit.

Brachyopa pilosa Collin (Figs. 2, 7, 8, 10; 6)

Material. Russia: 3 larvae, Nikol'skoe, Ust'-Kubenskii Distr., Vologda Prov., 11.VI.1983, no. 193,

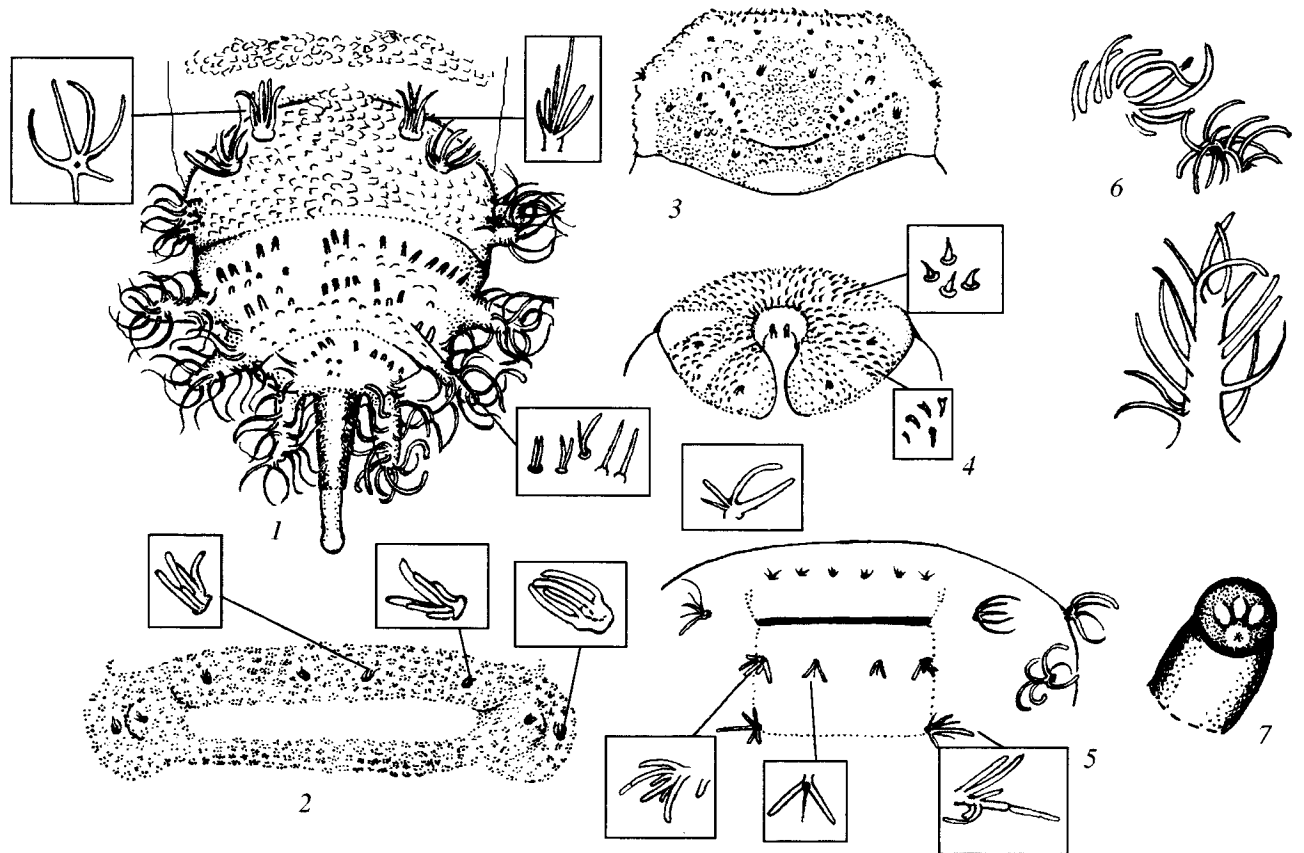


Fig. 7. *Brachyopa stackelbergi*, larva: (1) end of body, dorsal view; (2) cuticular structures of abdominal tergite III; (3) pro- and mesothorax, dorsal view; (4) anterior end of body, ventral view; (5) anal opening and papillae surrounding it; (6) lateral papillae of abdominal segments; (7) anterior spiracles.

birch stub; 1 larva, Kadnikovskii, Vologda Prov., 16.VII.1962, aspen trunk laying on the ground; 1 larva, Ishti-Khem, environs of Shagonar, Tuva, 8.VIII.1973, nos. 57 and 58, 15.VII.1974, no. 345, sap bead on birch stub (N. Krivosheina). Ukraine: 1 larva, Khust, Transcarpathia, 17.VII.1963, sap bead on beech trunk (N. Krivosheina).

Description. Larva. Body length 6 mm, width 2.5 mm. Body white yellow, with transverse rows of dark tapered spines. Lateral lobes, adjoining mouth opening, with fine spines in anterior part and with tufts of hairs on inner surface. Anterior end of body with short tapered spines strongly widened at base. Dorsal papillae of prothorax with wide base and 5 short conical tapered appendages. Second pair of median papillae situated slightly before level of anterior spiracles. Rounded dark plate forming simple longitudinal rows bounding median papillae. Similar plate forming transverse arcuate rows at boundary between pro- and mesothorax. Longitudinal rows of tapered spines situated at level of anterior spiracles. Metathorax with

several rounded black plates between median and intermediate papillae. In addition, margins of segments with transverse rows of tapered spines. Dorsal surface of abdominal segments I–VI with large papillae each bearing at least 5 conical tapered appendages. Median and intermediate papillae situated in one row at equal distance from each other; marginal papillae shifted backwards, distance between them and median papillae 1.5 times that between median papillae. Tapered brownish spines, distinct against pale background of segments, forming transverse rows bounding median and intermediate papillae; in addition, 2 or 3 (in places) rows of spines situated along posterior margin of tergites. As a whole, rows loose; their spines not approximate, situated at equal distance from one another. Lateral surfaces of segments with numerous tapered spines at level of marginal papillae. Terminal platform oval, pale; its anterior 1/3 with dark plate forming 2 arcuate longitudinal rows in middle part and 2 short transverse rows laterally. Two other secondary segments with groups of conical tapered spines in

middle part and near lateral surface. Two pairs of anterior papillae in the form of small tubercles bearing 6 rather long, tapered appendages; median papillae slightly larger than succeeding pair. Others 5 pairs of papillae elongate, slightly narrowed toward apex, pale, flattened, bearing straight tapered brownish lateral appendages only slightly longer than wide and 0.3 times as long as papillae. Lateral papillae of abdominal segments of same kind, but smaller. Ventral side of body with fine, hardly noticeable pale spines. Anterior spiracles in the form of wide cylindrical tubercle. Spiracular tube slightly narrowed toward apex; its length 5.5 times its width, subequal to distance between papillae of median secondary segment of terminal platform. Surface of tube with fine transverse striation along its greater part, but appearing shining; apical 1/4 of tube smooth.

Puparium. Puparial spiracles slightly narrowed at apex, with spiracular tubercles along apical 2/3. Spiracular tube slightly narrowed before apex.

Differential diagnosis. The larva is similar to that of *B. bicolor* in the structure of the cuticular formations, differs from it in a paler coloration of the body and in the finer and sparser dorsal spines forming transverse rows.

Notes. According to Krivosheina and Mamaev (1967) and Rotheray (1991, 1996), the larvae develop in a sap in the bark of *Populus*, *Quercus*, *Aesculus*, and *Ulmus* and in a damp dust in the bast of *Fagus* trunks laying on the ground. The larvae were found in a sap on birch stubs, they occurred immediately in a fermenting sap on the surface of a stub usually together with larvae of Amsopodidae. The last-instar larvae collected in slivers of stubs and under the bark near a sap bead, usually along the border with a fresh bark. The larva were also recorded in beads of a having fermented sap on beech trunks, in accumulations of mucus under the epidermis of the aspen trunk laying on the ground and in willow trunks infected by Siricidae. In aspen trunks, the larvae lived together with larvae of *Mycetobia* Meigen (Mycetobudae) and *Sphegma* Meigen (Syrphidae).

Brachyopa stackelbergi Krivosheina (Fig. 7)

Material. 2 larvae, 2 puparia, Ramit, Tajikistan, 8.VI.1978, no. 343, sap bead on poplar (M. Danilevskii).

Description. Larva. Body length 7 mm, width 2.3 mm. Body oval, pale, with rather pale papillae.

Antennal-maxillary complex with 2 pairs of elongate cylindrical sensilla at apex. Apical segment, bearing sensilla, divided by emargination. Lateral lobes, adjoining mouth opening, with numerous fine tapered spines in anterior part and with numerous pale hairs on inner side. Carina of anterior part of prothorax, surrounding antennal-maxillary complex, with superficial grooves separating median part and two lateral parts at each side; carina covered along entire length with tapered dark spines equal in size and approaching median papillae on dorsal side.

Dorsal surface of thoracic segments densely covered with polygonal dark plates along nearly entire length. Second pair of median papillae of prothorax situated nearly at level of anterior spiracles. Narrow oblique pale areas, bearing no dark plate, extending from prothoracic spiracles toward median line of body. Oval pale area, nearly free of dark plates, lying on meso- and metathorax behind median papillae. Middle part of ventral side of meso- and metathorax with numerous microstructures forming transverse rows. Mesothorax with 2 small distinct median papillae, metathorax with distinct 4 median and intermediate papillae. Ventral side of lateral surfaces of thoracic segments with long, rather dense, dark spines and also with pale hairs and 2 papillae.

Dorsal surface of abdominal segments I–VI with numerous polygonal dark plates, without conical spines or elongate tubercles. Median and intermediate dorsal papillae separated from marginal ones by superficial groove. All papillae rather large, presented by short tubercle bearing mainly 5 rather long baculiform appendages, occasionally also with 1 or 2 smaller appendages. Two pairs of anterior papillae on terminal platform rather small, but larger than those on segment VI; 3rd and 4th pairs of papillae approximate, with wide cylindrical base and numerous long appendages. Three pairs of posterior lateral papillae of terminal platform long, subcylindrical, only slightly narrowed toward apex, with numerous pale long appendages over entire surface. All marginal papillae of terminal platform with fine pale serpentine apical and lateral appendages. Anterior part of platform with numerous dark polygonal plates, without spines or tubercles. Posterior part with sparser dark plates and long conical dark tubercles resembling thick spines and forming 3 transverse rows more closely to lateral surface.

Abdominal segments I–VI densely covered on ventral side with fine dark plates and microspines, also bearing 3 transverse areas of dark conical spines each

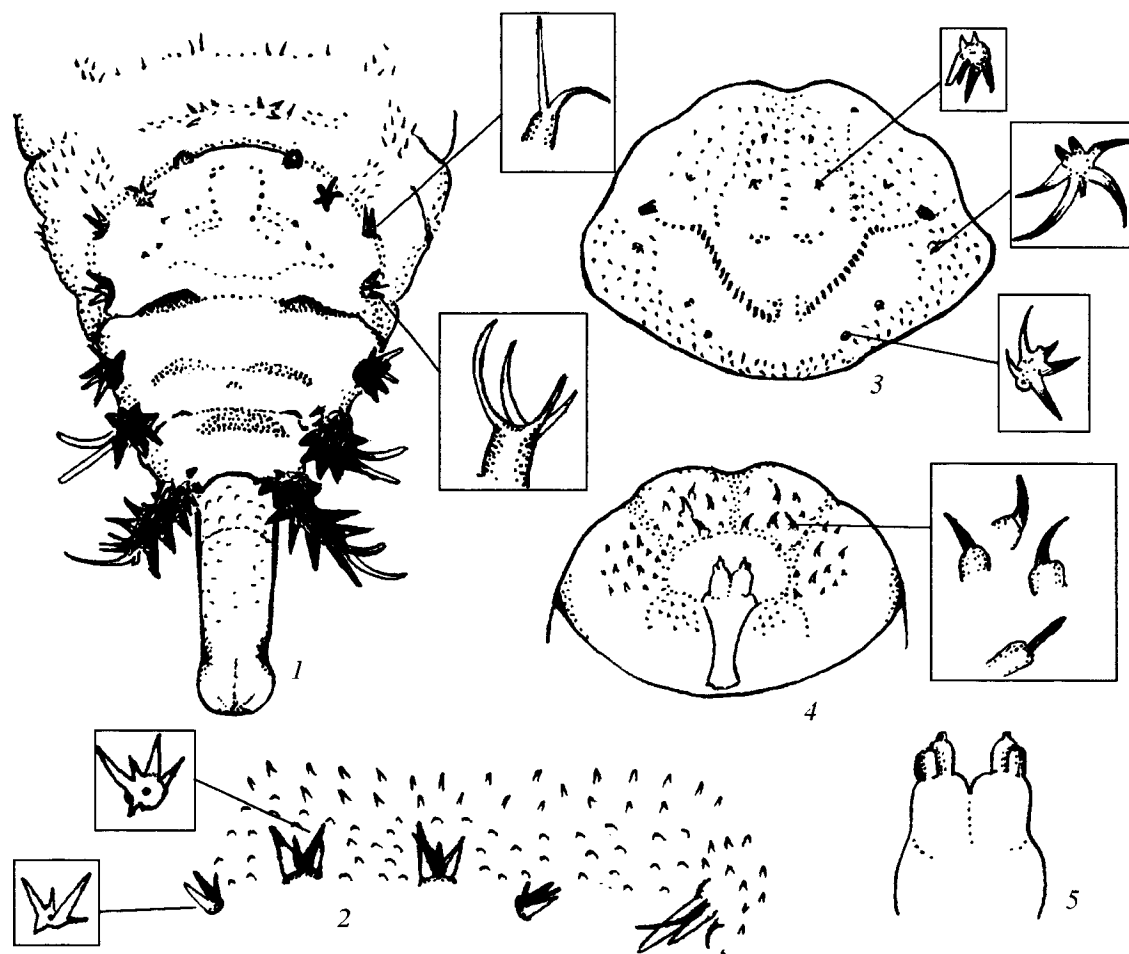


Fig. 8. *Brachyopa vittata*, larva: (1) end of body, dorsal view; (2) cuticular structures of abdominal tergite VI; (3) pro- and mesothorax, dorsal view; (4) anterior end of body, ventral view; (5) antennal-maxillary complex.

forming 2 or 3 indistinct rows; these areas bounded laterally by longitudinal rows of long tapered spines. Six small sternal papillae, bounding at posterior margin by transverse area of spines, situated more closely to posterior margin of sternites. Lateral surfaces of sternites with 1 latero-ventral papilla and with longitudinal row of long tapered thick setae before it. Ventral surface of segments VII and VIII with numerous fine microspines and plates. Slit-shaped anal opening bounded anteriorly by 6 papillae equal in size to sternal papillae of preceding segment: 4 larger papillae bounding anal opening posteriorly and 2 smaller papillae situated behind them, more closely to lateral surface. In addition, 1 large papilla present at each lateral margins of anal opening. Each segment with 3 lateral papillae at each side: upper one, presented by small tubercle bearing 7 or 8 long baculiform apical appendages, shifted to posterior margin of segment; two others situated at one level on lateral surface. Length of

papillae increasing toward end of body, papillae of ultimate segments conical and bearing numerous branches along entire length. Prothoracic spiracles narrow, subcylindrical, with 3 spiracular slits. Spiracular tube wrinkled, smooth at apex, slightly constricted in apical part; length of tube 0.25 times its basal width and 0.7 times width of median secondary segment of terminal platform.

Puparium pale, yellowish brown, with dark polygonal plates forming 2 distinct transverse areas on each segment. Puparial spiracles slightly narrowed before apical part, with dark tubercles in basal 3/5; apical 2/5 pale, but also tuberculate, except for apex. Posterior spiracles surrounded with long plumose hairs, length of these hairs not less than width of tube.

Differential diagnosis. The larva is most similar to the larva of *B. insensilis* in the shape of the cuticular structures, but differs in the absence of elongate cylin-

dricul or conical tubercles. The larva is characterized by the following features: dorsal side of body only with flat, occasionally indistinct cuticular plates; posterior part of terminal platform with rows of conical and tapered (instead of wide and obtuse) tubercles; spiracular tube slightly narrowed before apex, uniformly colored, only 4 times as long as wide.

***Brachyopa vittata* Zetterstedt (Figs. 2, 4–6, 8)**

Material. Russia: 2 larvae, 1 puparium, Peshki, Solnechnogorsk Distr., Moscow Prov., 16.IX.1970, no. 218, in tunnels of *Lymexylonidae* in fir stubs, 1 larva, 1 puparium, Nakhabino, Moscow Prov., 12.V.1964, under bark in fir stub, 2 larvae, Nikol'skoe, Ust'-Kubenskii Distr., Vologda Prov., 28.V.1983, no. 25, 31.V.1983, no. 62, under bark in fir stub (N. Krivosheina), 3 larvae, Berezovka, Tuva, 5.V.1973, no. 352, fir trunks (V. Kovalev), 1 larva, Ishtikhem, Tuva, 16.VI.1974, under bark of larch stub (N. Krivosheina). Ukraine: 5 larvae, Kvasy, Transcarpathia, 18.VI.1963, no. 67, under bark of fir stub (N. Krivosheina)

Description. Larva. Body length 10 mm, width 2.5 mm. Body elongate, cylindrical, pale, covered in anterior and posterior parts with numerous fine oval pale plates turning into fine pale hairs on middle tergites. Lateral lobes, bounding mouth opening, with fine spines in anterior part; hairs on inner side poorly developed. Carina around antennal-maxillary complex divided into 4 tubercles each with 7 or 8 large spines arranged in 2 rows and also with several fine spines. Prothorax bordered at posterior margin by arcuate row of elongate dark plates. Median dorsal papillae varying in size, second row usually with larger papillae shifted forwards from level of anterior spiracles at distance equal to distance between median papillae. Each papilla presented by small tubercle bearing 3 large, and 2 or 3 smaller appendages. Area of prothorax between median papillae and posterior margin of segment smooth, glabrous, with longitudinal and transverse short rows of oval dark plates along median line. Rest of surface of segment with fine pale spines and hairs. Mesothorax with hairs and spines along posterior margin of segment. Papillae without tubercles, with 3 large, and 2 or 3 fine appendages. Surface of metathorax with fine spines and hairs. Dorsal papillae of abdominal segments small, nearly sedentary, with flat base, consisting of 2 or 3 longer appendage varying in length and 2 or 3 very short appendages. Dorsal surface of abdominal segments I–III densely covered with fine pale spines. Transverse depression behind median

papillae glabrous or with very fine spines. Papillae on segments IV and V of similar structure, but larger. No hair and spine present between median and intermediate papillae. Intermediate papillae of segment VI shifted backwards and situated at level of marginal ones. Median papillae of segment VI with 2 wide conical and 1 very small appendages, intermediate papillae with fine appendages varying in length. Most part of segment VI without hairs or fine spines, but with distinct polygonal plates. Short black spines situated near median line at anterior and posterior margins. Continuous area of spines surrounding marginal papillae. Dorsal side of segment VII with 5 small separated spines in middle part and with group of 12 or 13 spines near lateral surface. Terminal platform oblong-oval, elevated above surface of segments, sclerotized, darker than preceding segments. Four first pairs of papillae distinctly smaller than others, in the form of small tubercles bearing accordingly 2–3, 3, 4, and 5 short appendages. Five to seven pairs of papillae in the form of flat tubercles present; two first ones as long as, or slightly longer than wide, papillae of last pair 2.0–2.5 times as long as wide. Lateral appendages of papillae wide and conical, their length not exceeding width of papillae at base. In apical part, 2 or 3 appendages half as thick and twice as long as others. Posterior papillae of terminal platform, including appendages, half as long as spiracular tube. Surface of terminal platform with occasionally indistinct polygonal plates. Darker oval plate forming 2 longitudinal simple rows at level of median papillae and 2 shorter transverse rows at level of intermediate papillae. Median and posterior secondary segments with dark oval plates and occasionally with singular obtuse black tubercles deepened into transverse folds. Lateral surfaces of segment VIII with numerous dark plates along terminal platform. Ventral side of body with fine spines prevailing in middle parts. Anal opening with usual set of papillae, surface of body around it with numerous transverse rows of microspines. Length of spiracular tube at most 3.5 times its width and slightly exceeding width of median secondary segment. Spiracular tube slightly narrowed before apex, its surface weakly tuberculate.

Puparium. Puparial spiracles 3.5 times as long as wide. Spiracular tubercles situated in apical half. Spiracular tube wide, large, parallel-sided, mainly coarsely wrinkled.

Differential diagnosis. These larvae are similar to larvae of *B. dorsata* and *B. panzeri* in the structure of the body. In contrast to the two species described

above, the larva of *B. vittata* is characterized by the following features: terminal platform narrower, with less strongly developed marginal papillae; 4 first pairs of papillae very fine, resembling tubercles; only terminal papilla elongate, distinctly longer than two preceding papillae. The larva described under the name *B. conica* Panzer (Krivosheina and Mamaev, 1967) is referred to *B. vittata*. Earlier, two species appeared in the literature under the name *B. conica* Panzer: *B. vittata* Zetterstedt and *B. panzeri* Goffe (= *B. conica* Panzer) (Thompson, 1980), and this circumstance brought some confusion in the species diagnostics not only for adults, but also for larvae.

Notes. The larvae develop in standing trunks and stubs of firs, not only in the overground, butt part, but also under the bark on the roots; they collect on damp areas. The larvae inhabit the bark, following representatives of Ipidae and Lymexylonidae, occurring in fresh and old tunnels. Probably, they can make tunnels in a thickness of the bark. Before pupation, the larvae usually collect immediately in the bark, in the tunnels perpendicular to the surface.

A Key to Larvae of Species of the Genus Brachyopa

1. Terminal platform oblong-oval, usually darker than other segments, bounded by black flat papillae; its margins slightly elevated above surface of segments of body. Body with dense spines turning into hairs on lateral surface 2.
 - Terminal platform conical or baculiform, of same coloration as other segments of body; its margins not elevated above surface of body. Body without spines or not entirely covered with spines 4.
2. Terminal platform oblong-oval, rather narrow; its length at least 1.5 times its width in middle part. Marginal papillae of terminal platform small, tuberculate; 2 last pairs distinctly larger, penultimate one half as long as ultimate one. Lateral appendages of papillae short and conical, apical ones long and fine. Spiracular tube large, slightly narrowed before apex, no more than 3.5 times as long as wide. Terminal platform only with several tubercles in middle part of anterior secondary segment. Transverse rows of spines absent. Intersegmental folds and depressions with rows of oval and round dark plates behind median papillae. Segments III–VI with glabrous areas surrounding median and intermediate papillae *B. vittata* Zetterstedt.
 - Terminal platform oval, rather wide, only slightly longer than wide. At least 3 or 4 pairs of marginal papillae of platform well developed. In addition to tubercles in middle part of anterior secondary segment of platform, distinct transverse rows of tubercles present in anterior part of secondary median and terminal segments 3.
3. Fifth and sixth marginal papillae of terminal platform not longer than wide, only 7th pair 1.5 times as long as wide; 3rd and 4th pairs of papillae distinctly smaller than succeeding ones, with very short lateral appendages and with 2 long pale apical appendages. Lateral appendages of terminal papillae dark, rather short, conical and straight, shorter than papillae. Pale apical appendages of marginal papillae of terminal platform wider and longer than lateral ones. Prothorax glabrous between median papillae and longitudinal grooves bounding them. Dorsal surface of abdominal segment VI with obtuse spines varying in size; largest spines lying along posterior margin of tergite. Surface of tergites with tubercles behind median papillae and with transverse row in middle part of posterior fold *B. panzeri* Goffe.
 - Three last papillae of terminal platform longer than wide. Third and fourth pairs of papillae of terminal platform not differing sharply in size from succeeding ones. All papillae with long curved appendages occasionally longer than papillae. Prothorax between median papillae and longitudinal grooves (bounding them) with 2 longitudinal rows of spines reaching posterior margin of prothorax. Dorsal surface of abdominal segment VI with tapered spines of equal size. Dark spines situated before median papillae and in middle part of posterior fold *B. dorsata* Zetterstedt.
4. Body on dorsal side with numerous polygonal dark plates, occasionally also with single obtuse tubercles, without spines or hairs 5.
 - Body on dorsal side with numerous spines or hairs in addition to polygonal plates sclerotized to varying degree 6.
5. Dorsal side of body only with polygonal flat plates. No elongate sclerotized obtuse tubercle present at boundary between segments. Terminal platform on 2nd and 3rd secondary segments with rows of tapered conical spines. Most part of spiracular tube uniformly colored and distinctly narrowed before apex, weakly wrinkled; length of tube 4 times its width

- and equal to width of median secondary segment of terminal platform *B. stackelbergi* Krivosheina.
- Dorsal side of body, in addition to polygonal sclerotized plates, with obtuse single tubercles at boundary between segments in middle part and at posterior margin of tergites. Terminal platform on 2nd and 3rd secondary segments with large obtuse dark tubercles distinct against background of fine polygonal and oval plates. Spiracular tube with numerous dark plates in basal 2/3; apical part not narrowed, smooth, and pale. Apex of tube slightly darker. Length of tube 6 times its width and 1.5 times width of median secondary segment of terminal platform *B. insensilis* Collin.
6. Abdominal segments with simple row of dark tubercles forming symmetric loops immediately behind dorsal papillae and also symmetric simple transverse rows along posterior margin of tergites. Terminal platform, in addition to 2 pairs of small short anterior papillae, with 5 pairs of dark baculiform papillae bearing tuft of appendages at apex. Anterior secondary segment of terminal platform with polygonal approximate plates, two succeeding segments with 3 transverse rows of elongate obtuse tubercles *B. paradoxa* Krivosheina.
- Dorsal side of abdominal segments with numerous tapered spines forming 2 parallel rows along posterior margin. Terminal platform, in addition to 2 pairs of small short anterior papillae, with 5 pairs of conical pale fuscous papillae; among these, at least two last ones with appendages along entire length 7.
7. Median and intermediate papillae of abdominal segments with 5 appendages: usually 3 large and 2 small ones. Dorsal side of abdominal segments with tapered fine spines forming simple row before and behind dorsal papillae, and with 2 or 3 rows along posterior margin. On terminal platform, anterior secondary segment with rather pale polygonal plates and with two longitudinal median rows and groups of lateral dark rounded plates occasionally visible against this background. Spiracular tube long; its length 6 times its width and nearly 1.5 times width of median secondary segment of terminal platform. Terminal marginal papillae of terminal plate pale, with rather short straight lateral branches, length of which usually not exceeding basal width of papillae. Length of 5th marginal papilla exceeding length of terminal papilla and no less than 5 times exceeding its width *B. pilosa* Collin.
- Median and intermediate dorsal papillae of abdominal segments with 2 or 3 large appendages; marginal ones with 3 large and 2 small appendages. Dorsal side of abdominal segments with densely situated polygonal plates and with thick spines; spines strongly widened at base, tapered at apex, bordering median and intermediate papillae, and forming 2 parallel rows along posterior margin of tergites. Spines in these rows densely situated and approximate at base with one another. Terminal platform only with polygonal dark plates on anterior secondary segment, black oval plate absent. Two other segments with 4 rows of large, black, tapered spines. Terminal lateral papillae of terminal platform with arcuately curved lateral appendages occasionally as long as papillae. Length of spiracular tube 6 times its width and 1.5 times width of median secondary segment of terminal platform. Length of 5th marginal papilla equal to length of terminal one, 4 times its basal width *B. bicolor* (Fallén).

In general, larvae of the genus are rather similar in the morphology of most of their structures. The basic specific distinctions used earlier are the length and structure of the spiracular tube and structure of the cuticular formations of the segments. However, it should be noted that the structure of the papillae and length of the spiracular tube are not very convenient for definition of a species of larvae. The structure of the papillae, especially, the number and length of the appendages rather widely vary even between the symmetrically arranged papillae. The spiracular tube may be partly deepened in the terminal segment of the body. The coloration of the cuticular plates varies with the age and state of a larva, especially in the prepupal phase. In the course of studying the morphological structures, I have established that the structure and arrangement of the papillae, bounding the terminal platform on the dorsal side of abdominal segment VIII, are of great importance for the diagnostics of larvae. The structure of the most terminal platform and morphology of its papillae have been found to depend on the mode of life of larvae. As a result, larvae of the genus can be distinctly subdivided into two groups on the basis of ecology and morphology. The first group includes inhabitants of sap beads, they possess an ill-defined terminal platform; the second group comprises inhabitants of tunnels of various insects, mainly Lymexylonidae; they are characterized by a distinctly separate, rather strongly sclerotized terminal platform.

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