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A redescription of the larva of *Porthmidius austriacus* (SCHRANK, 1781), with notes on the taxonomy and biology of the species* (*Coleoptera*: *Elateridae*)

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ABSTRACT. A detailed, illustrated redescription of the larva of *Porthmidius austriacus* (SCHRANK, 1781) is presented. The larva develops in sandy-clayey soil in sunny places in sparse deciduous forests; it is necrophgaous and predacious. The following synonymy has been established: *Elater austriacus* SCHRANK, 1781 = *Ectinus subaeneus* REDTENBACHER, 1842 sensu DOLIN and OSTAFITSCHUK, 1973 = *Sericoderma aenea* (REDT.) [sic!] DOLIN, 1988 [error typographicus!]. *Sericoderma* DOLIN, in DOLIN and OSTAFITSCHUK, 1973 is a junior synonym of *Porthmidius* GERMAR, 1847.

Key words: entomology, taxonomy, biology, larva, *Coleoptera*, *Elateridae*, *Physorhinini*.

To my Teacher and Friend,
Dr. Bolesław Burakowski

INTRODUCTION

Porthmidius austriacus (SCHRANK, 1781) is a member of a genus represented by 2 species in Europe and 4 in the world (PLATIA 1994). The genus *Porthmidius* GERMAR, 1847 is included in the tribe *Physorhinini*, subfamily *Elaterinae* (STIBICK 1979, GURJEVA 1979), in older literature treated often as a subfamily (*Physorhininae*). The group, comprising nearly 250 species, mostly Palaeotropical and Neotropical,

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classified in over 10 genera, is, according to the present knowledge, very heterogenous. The heterogeneity is the most pronounced with respect to larval stages (BUCHHOLZ 1987). Unfortunately, the knowledge of larvae of this taxon is very fragmentary. Till now larvae of only 8 species of the genera *Physorhinus* ESCHCHOLTZ (3), *Anchastus* LECONTE (1), *Podeonius* KIESENWETTER (1), *Astanchus* GURJEVA (1), *Chastanus* DOLIN et GURJEVA (1) and *Porthmidius* GERMAR (1), have been described. The existing descriptions are often laconic, enabling no broader taxonomical conclusions. Because of this, a more detailed approach to the larval morphology of the Physorhinini seems advisable, with a view of future correct systematic interpretation of the group.

The distribution area of *Porthmidius austriacus* comprises the southern and central parts of Europe, from France to the central Ukraine; it was also recorded from Asia Minor (BURAKOWSKI et al. 1985, DOLIN 1988, LIPP 1938). In the entire distribution range it was rather rarely recorded.

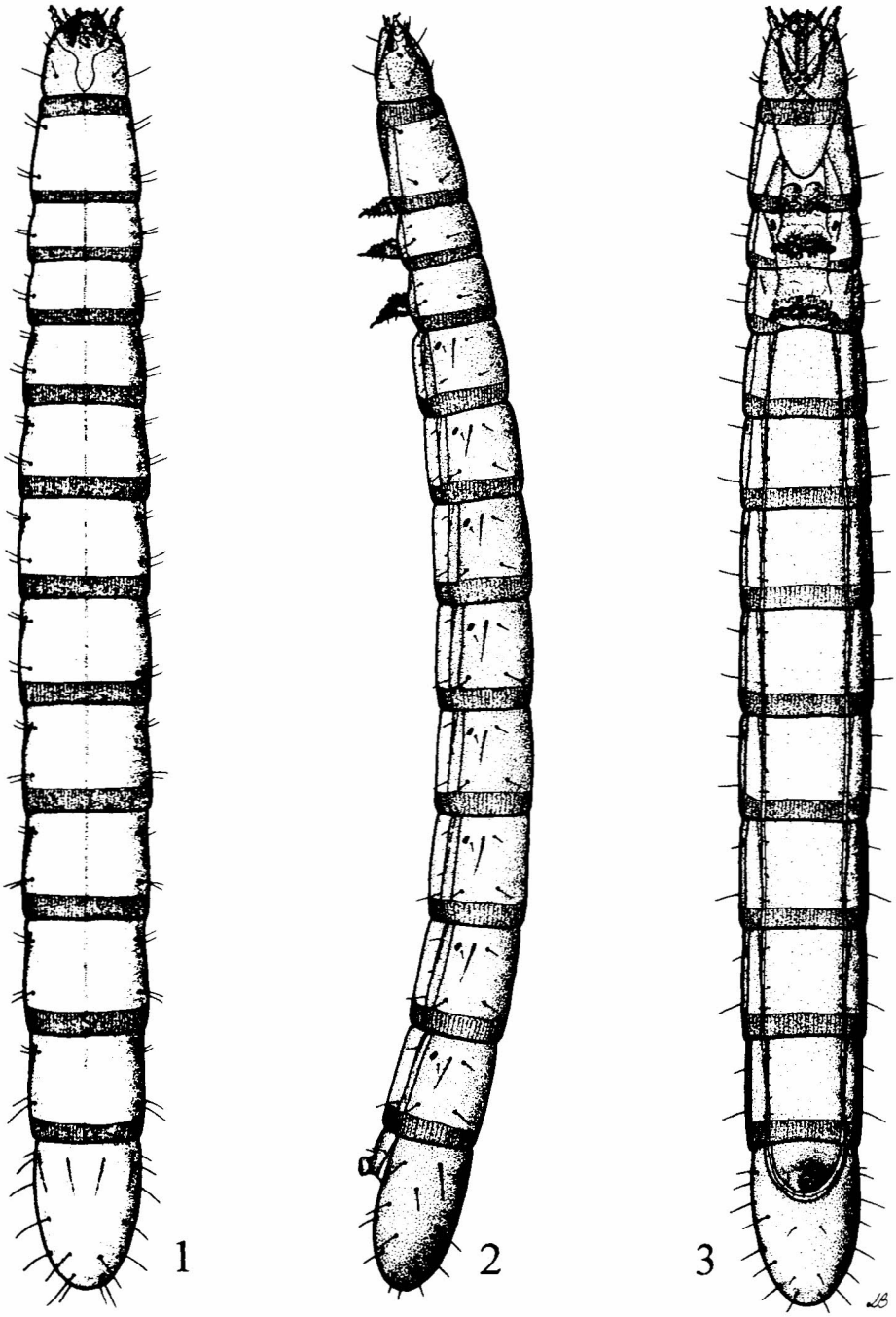
In May 1988, in the nature reserve "Bielinek", I found a rather abundant but very local appearance of imagines of *Porthmidius austriacus* (the locality of this species, discovered between the wars - HEDICKE 1937, LIPP 1938 - is till now the only locality of this species in Poland). As a result of two (May 29th, July 6th 1988) searches in the soil from several places in the locality, I found 7 elaterid larvae unknown to me, of the subfamily *Elaterinae*. After establishing that all represented the same species I preserved two of them and kept the rest alive in the laboratory. One of the larvae (all the remaining larvae died) metamorphosed on the same year, resulting in an imago of *P. austriacus* which, together with the exuvium of the last larval instar, I preserved for further studies.

Till my discovery of the larva of *P. austriacus*, the larva was regarded as unknown. It turned out however, that it had been described 15 years earlier by DOLIN and OSTAFITSCHUK (1973) as a larva of *Sericus subaeneus* (REDTENBACHER, 1842). In the paper cited above the authors proposed a new genus *Sericoderma* DOLIN et OSTAFITSCHUK for the larva, since morphologically it differed considerably from those of other members of the genus *Sericus* ESCHHOLZ [=ESCHSCHOLTZ]. Because of a considerable similarity between the imagines of *S. subaeneus* and other members of the genus, GURJEVA (1979) lowered *Sericoderma* to subgeneric rank. In his monograph of the *Elateridae* of Ukraine, DOLIN (1988) rectified the above error in a way that may easily be overlooked. In that paper, in the synonymy of *P. austriacus* (and only there) the erroneous name under which the larva was described, is listed, i.e. "*Sericoderma aenea* (RTB.)". This makes it difficult to associate the name with *Sericus subaeneus*.

The following synonymy results from the above considerations:

Porthmidius GERMAR, 1847: 7 = *Sericorderma* DOLIN, in DOLIN et OSTAFITSCHUK, 1973: 84 **(syn. nov.)**

Elater austriacus SCHRANK, 1781: 186 = *Ectinus subaeneus* REDTENBACHER, 1842: 12 sensu DOLIN and OSTAFITSCHUK, 1973 = *Sericoderma aenea* (REDT.) [sic!] DOLIN, 1988: 120 (error typographicus).



1-3. *Porthmidius austriacus* (SCHRANK), larva: 1 - dorsal view, 2 - lateral view, 3 - ventral view

The description of the larva of *P. austriacus* included in the monograph of Ukrainian elaterids (DOLIN 1988) is, like the first description (DOLIN and OSTAFITSCHUK 1973) very brief, illustrated by diagrammatic and inexact figures of hypostoma, frontoclypeal region and ventral view of IX abdominal segment, as well as with more exact figures of dorsal view of VIII and IX abdominal segments (the figures in both these papers are essentially identical). The characters presented in the description and in the figures, though they enable a correct species (or only genus) identification, do not make it possible to draw any further-reaching taxonomical conclusions. A possibility of such conclusions, for the reasons discussed in the introduction, may be very useful in the case of the genus *Porthmidius*. The necessity to prepare a detailed redescription of the larva of *P. austriacus*, and to provide information on the biology of this species, results also from the fact that two recently published monographs dealing with European elaterids (KLAUSNITZER 1994, PLATIA 1994) contain an information that the larva of *P. austriacus* is unknown (for unknown reasons the authors of both those publications ignored DOLIN's (1988) monograph). It is also necessary to rectify the information, widespread in literature and based on DOLIN and OSTAFITSCHUK's (1973) paper, on the larva of *Sericus subaeneus* (REDTENBACHER); actually, the larva of this species has not been described to date.

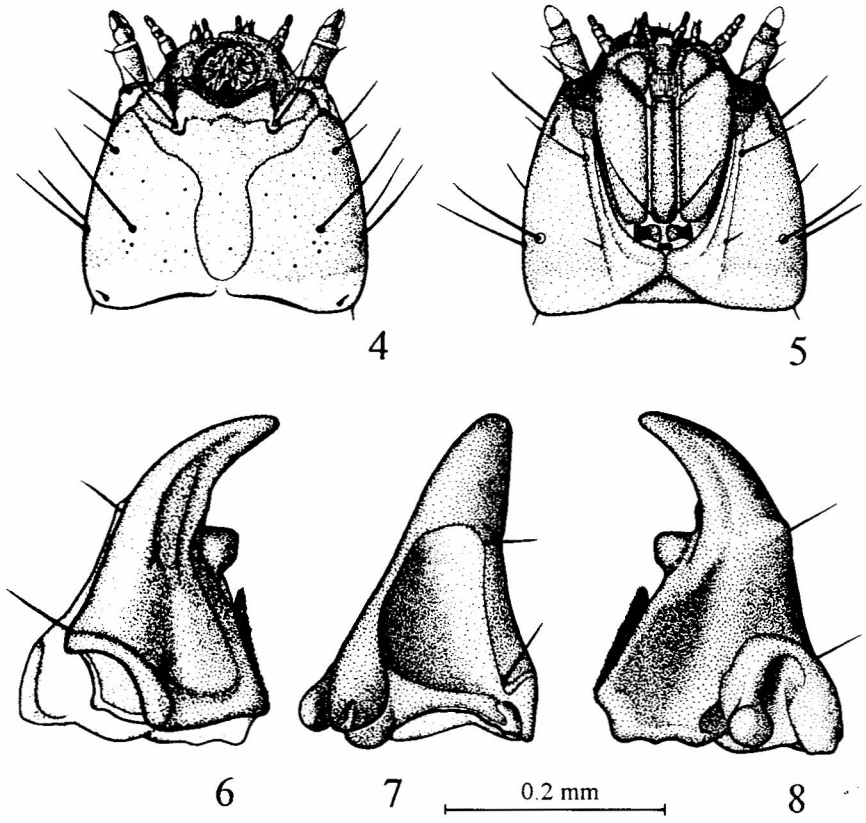
DESCRIPTION OF THE LARVA

Note. The total drawings of the larva (figs 1-3), its head (figs 4, 5) and thorax (fig. 15), and of IX abdominal segment (figs 20-22) were based on the larva collected on May 29th 1988 and preserved. The drawings of the antenna (figs 12, 13), hypostoma (fig. 14), leg (fig. 16) and of IV abdominal segment (fig. 17) were based on the larva collected on August 14th 1993, which died in the laboratory culture as a result of mechanical damage (preserved on September 10th 1993). Based on the size comparison between both the larvae mentioned above and the larva collected on July 6th 1988, and kept in the laboratory till the imaginal stage, it can be supposed that the first larva represented the last instar (pupation and emergence of imago would have probably taken place in the late summer of 1988), while the second represented the penultimate instar (the larval development would have been completed in the late summer of the next, 1994, year). The remaining figures of particular parts of the larva (figs 6-11, 18-19) were based on a larval exuvium taken out of pupal chamber of the larva collected on July 6th 1988 and kept in the laboratory till the imaginal stage.

Body length up to c. 13 mm, head width 0.90 mm, prothorax width 1.15 mm. Body (figs 1-3) almost cylindrical, slightly dorsoventrally flattened, moderately sclerified and very poorly sculptured. Dorsal side of body stronger convex than the ventral side.

Colour light, creamy yellow, ventral side somewhat lighter, intersegmental junctions of a pectinate structure, darker, head and legs light brownish yellow, nasale and mandibles dark brown; membraneous parts light creamy yellow.

Head (figs 4, 5) prognathic, epicranial suture poorly visible; frontoclypeal plate (fig. 9) separated from genae by a distinct suture, in its anterior part monodentate nasale and monodentate subnasale (fig. 10). Preimaginal eyes in shape of two dark spots situated below cuticle, on sides of genae, in their anterior part. Antennae (figs 12, 13) tri-segmented; the second segment with one large paraboloid sensory appendix, occupying whole anterior surface of the segment; third segment small, situated at the sinuately produced dorsal margin of the second segment and directed obliquely upwards; on its end setae. Mandibles (figs 6-8) very similar with respect to size and shape, broadly crescentic, with medium-sized retinaculum and two setae on the outer side. Maxillae (fig.14) with elongate stipes, each bearing in its anterior part three setae situated at the outer margin. Cardo built of two overlapping sclerites (forming disticardo and proxicardo); outer, smaller, partly hidden under the inner; stronger sclerified than the inner. Maxillary palps four-segmented. Galea two-segmented, lacinia covered with hairs forming a dense brush. Labium (fig. 14) built of two sclerites: prementum and postmentum, rather far apart, connected by a membraneous structure; prementum in shape of an elongate pentagon, with two

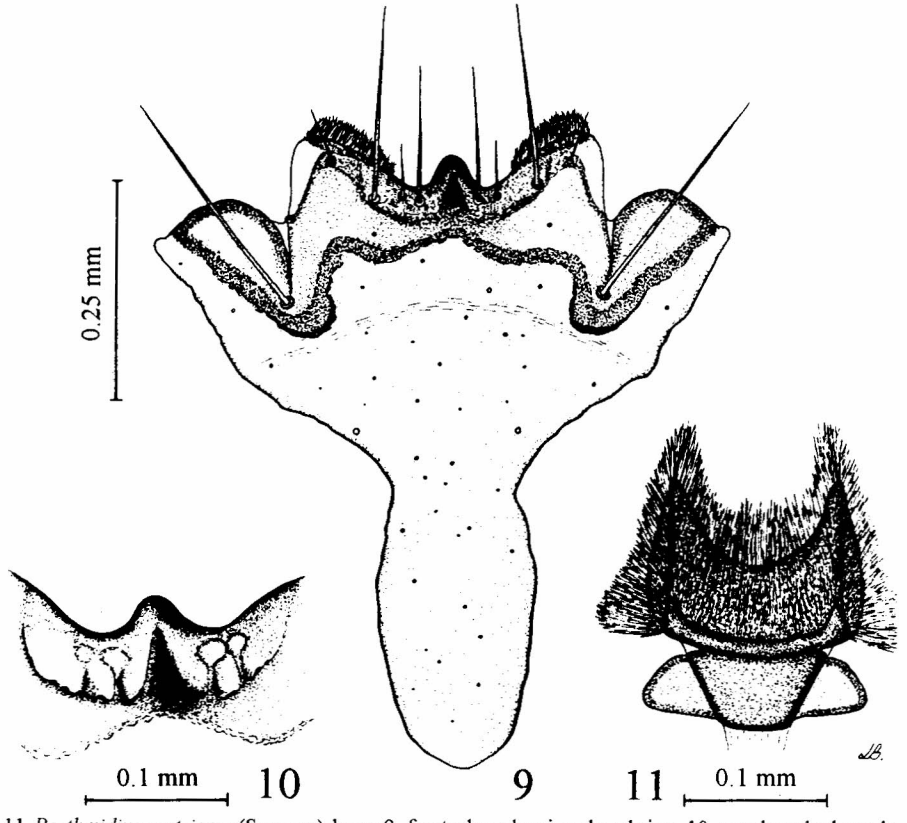


4-8. *Porthmidius austriacus* (SCHRANK), larva: 4 - head, dorsal view, 5 - head, ventral view, 6 - mandibula, dorsal view, 7 - mandibula, lateral view, 8 - mandibula, ventral view

pairs of setae: smaller on the anterior, produced margin, larger near the middle. Labial palps two-segmented; postmentum elongate, narrow, approximately parallelsided, provided with four setae: two smaller in the anterior, and two larger in the posterior part (fig.14). Hypocranial suture long, distinct; gula large, distinctly visible, broadly triangular (fig. 5).

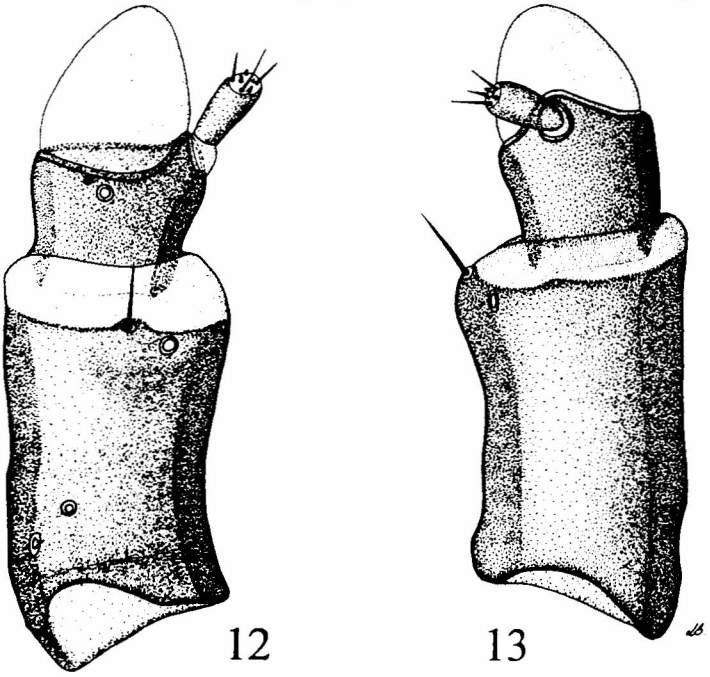
Prothorax length somewhat smaller than the combined length of meso- and metathorax; mesothorax slightly shorter than metathorax (fig. 15). Anterior surface and lateral edges of the inner side of legs with rather densely arranged, strong, bluntly terminated thorns; posterior surface of legs additionally with short, thick, sharply terminated setae (fig. 16).

Abdominal segments I-VIII slightly barrel-like, their anterior part narrower than the posterior, segment IX oval in outline, segment X in the form of a short anal funnel, somewhat convex in its mid ventral part; situated in the basal, ventral part of segment IX. Abdominal segments I-VIII of similar shape and structure (fig. 18), II-VII of approximately equal size, the fist somewhat shorter, the eight somewhat longer than the remaining ones (figs 1-3). Narrow pretergites (not limited from the



9-11. *Porthmidius austriacus* (Schrank), larva: 9 - frontoclypeal region, dorsal view, 10 - nasale and subnasale, ventral view, 11 - hypopharynx

mediotergite) of segments I-IX poorly sclerified, completely devoid of puncturation, mediotergites covered with very sparsely arranged, fine, poorly visible punctures (fig. 18A) (they appear to be smooth). Each mediotergite has a delicate but rather distinctly visible ridge situated in the lateral part, somewhat oblique relative to the mediotergite margin, and four setae: two smaller setae in the anterior, and two larger setae in the posterior part. Abdominal spiracula (fig. 19) light brown, their outline rectangular with broadly rounded angles, situated in the anterolateral part of the

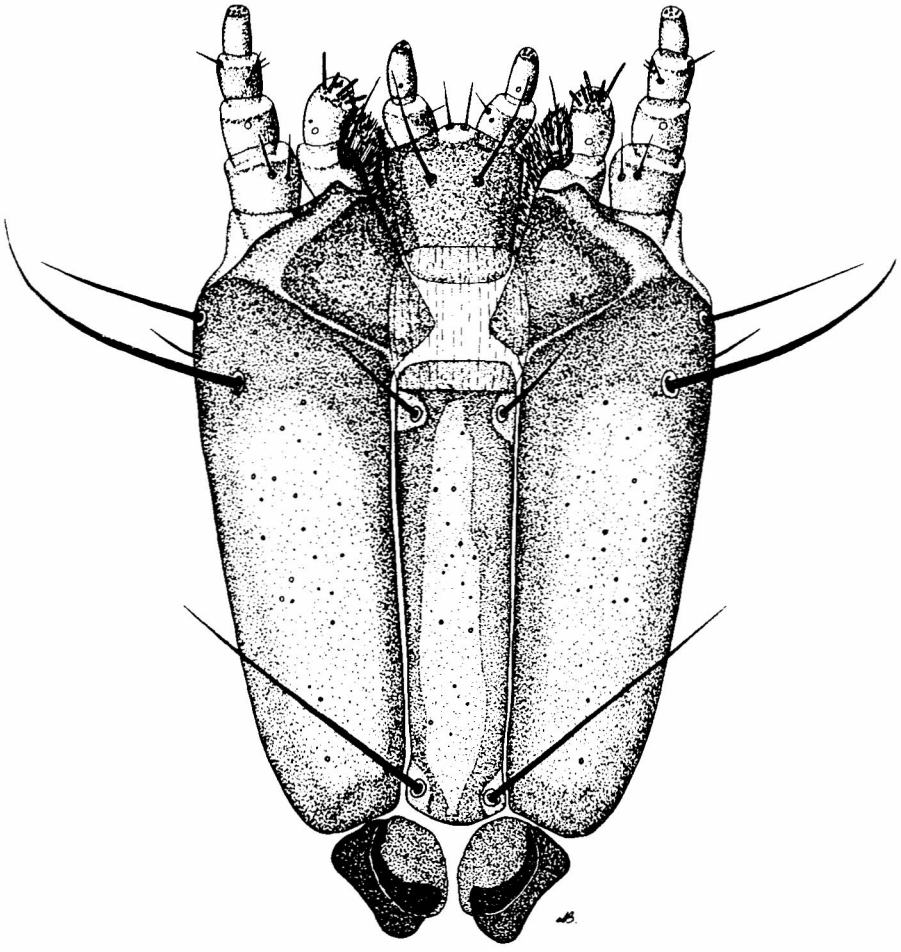


12, 13. *Porthmidius austriacus* (SCHRANK), larva: 12 - left antenna, lateral view, 13 - left antenna, dorsal view

mediotergites. Posttergites in the form of elastic pectinate belts forming intersegmental junctions; they occupy c. 0.25 segment length. Pleurites (lateral plates of abdominal segments) narrowly rectangular, longitudinally divided by a rather distinct suture; a narrowly-trapezial part adjoining the mediotergite (probably laterotergite) punctured like the latter, the wedge-like (probably pleurite) external part devoid of punturation. Abdominal sternites I-VIII even more delicately and sparser punctured than the mediotergites (fig. 18B), each with two pairs of well visible setae situtaed near lateral margins: one pair of smaller setae in the anterior, and one pair of larger setae in the posterior part; additionally at lateral margins of the sternites, between the anterior and the posterior pair of distinctly visible setae, a pair of very tiny setae, visible only under high magnification (fig. 17). Abdominal segment IX punctured like the mediotergites (appears smooth), in its anterodorsal part four longitudinal, delicate but well visible ridges; it is covered with setae arranged as in figs 20-22.

TAXONOMIC REMARKS

The morphological characters of the larva of *P. austriacus* presented above confirm the earlier suggestions on the exceptional heterogeneity of the tribe *Physorhinini* (BUCHHOLZ 1987). Comparing this larva with the larvae of members of the genera: *Podeonius*, *Astanchus*, *Physorhinus* and *Anchastus*, it is difficult to find a set of characters which would indicate a closer relationship between *Porthmidius* and any of the genera just named. There are, however, single characters, that place this genus close to *Podeonius* and *Astanchus*, both these genera being closely related to each other and showing a considerable similarity in the structure of larva (BUCHHOLZ 1987). The degree of similarity prompted DOLIN (1988) to transfer *Astanchus aquilus* (CAND.), the only member of *Astanchus* whose larva is known, to the genus *Podeonius*. The larval characters shared by *Porthmidius*, *Astanchus* and

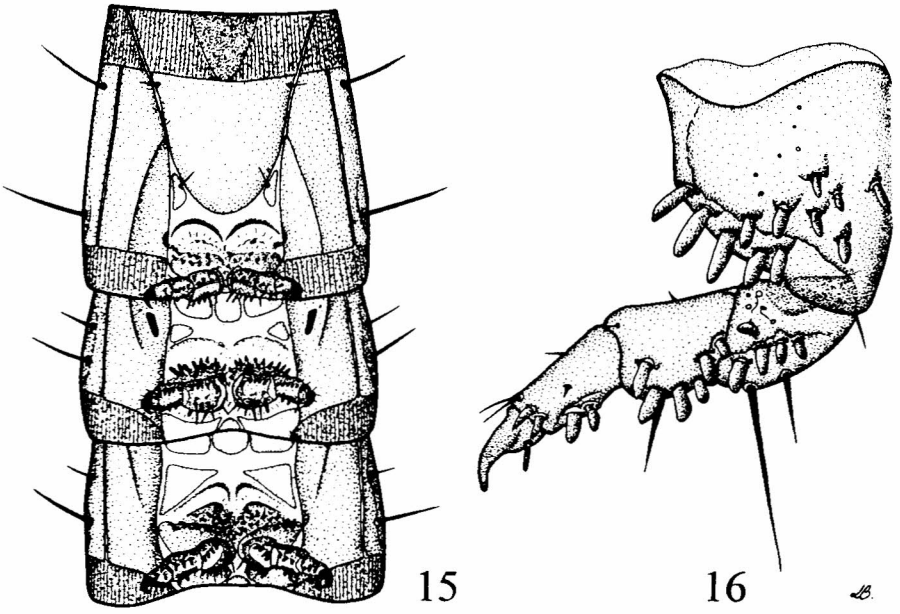


14. *Porthmidius austriacus* (SCHRANK), larva: hypostoma, ventral view

Podeonius are a very weak body puncturation and the general scheme of antennal and hypostomal structure. These characters, indicating probably some relationship, may support inclusion of *Porthmidius* in the same tribe as *Astanchus* and *Podeonius*.

NOTES ON BIOLOGY

The knowledge of the biology of *P. austriacus* is still fragmentary. From scattered literature data (GURJEVA 1979, KOCH 1989, LIPP 1938 and others) it can only be concluded that the species is stenoecious, thermophilous, associated with sparse, warm deciduous and mixed forests, and with xerothermic habitats overgrown with shrubs and some trees, where imagines were observed as a rule singly, on sunny, warm days, on leaves and flowers of trees and shrubs. More abundant



15, 16. *Porthmidius austriacus* (SCHRANK), larva: 15 - thorax, ventral view, 16 - right mesothoracic leg, anterior view

appearances were observed only locally. There is almost no literature information on the habitat of larval development of *P. austriacus*, and data that can be found are based only on guesses (e.g. information that the larvae develop in rotting wood). The only data based on observations are contained in the papers of DOLIN and OSTAFITSCHUK (1973) and DOLIN (1988). These authors state that the habitat of larval development is the soil in deciduous forests.

Because of the fragmentary and sometimes contradictory data on the habitat of larval development and biology of *P. austriacus*, I present my observations. I think that some of the literature information (e.g. suggested higrophilous nature of the larvae of this species; DOLIN 1988) may be based on observations made in atypical places, accidentally populated by the larvae, or else the authors describe ecological preferences of the species only with regard to some particular parts of its distribution range.

CHARACTERISTICS OF THE HABITAT OF *P. AUSTRIACUS*

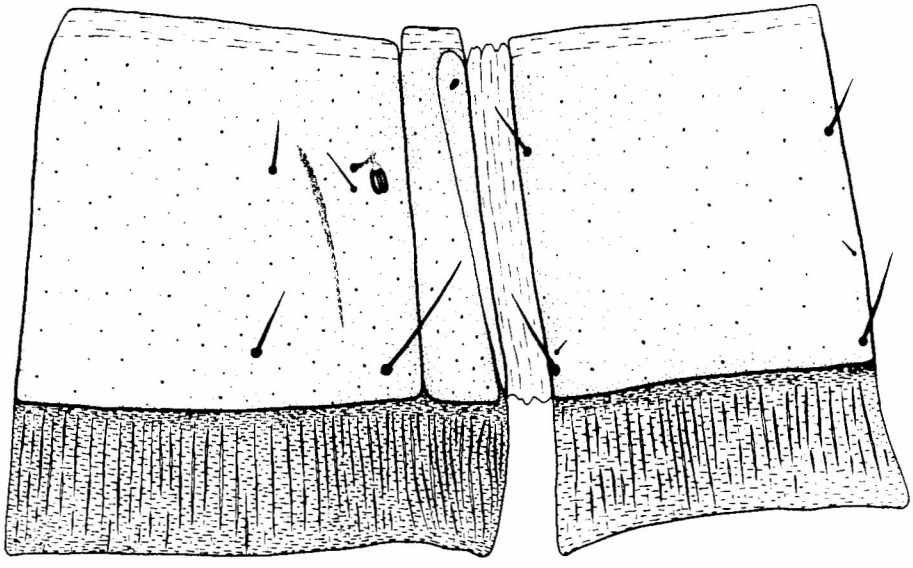
As was alreday mentioned in the introduction, the locality is situated in the nature reserve "Bielinek" (UTM: VU46), on the border between the physicogeographic mesoregions of the Lower Odra River valley and Pojezierze Myśliborskie Lakeland, in north-western Poland. The material of and observations on *P. austriacus* come from the western part of the reserve. The place where I observed a more abundant appearance of imagines and where in the soil I several times found larvae, is a fragment of a diluvium upland, on the border between a berm and a gorge (Wąwóz Storczykowy) (according to the forest grid division the locality is situated in division 39, on the border between sectors a, d and g). The total surface area of the place where I found the imagines and larvae was only about 300 metres square. It is noteworthy that all the remaining sites in the reserve "Bielinek", where I caught single specimens of *P. austriacus*, and the site recorded by LIPP (1938) are not further than 600 m from the above locality. Considering the above, it seems very likely that the habitat in that particular site is the optimum one for *P. austriacus* (at least with respect to the northernmost sites of the species).

CHARACTERISTICS OF THE HABITAT OF LARVAL DEVELOPMENT

Macrohabitat: an ecotone environment - an edge of an oak-beech forest, with admixture of other trees, mainly *Acer platanoides* L. and *Acer campestre* L., and a lush shrub layer consisting of young trees and *Clematis vitalba* L.; the forest passes into a rather sparse shrubbery of old and young specimens of *Q. sessilis* EHRH., *Acer campestre* and *Robinia pseudoacacia* L., in places entangled with *Clematis vitalba*. The herb layer is formed mainly of grasses. The place has a form of a narrow "peninsula", with two gorges on both sides (in the gorges there is a tall deciduous forest), and on one side there is a steep, xerothermic slope, covered with shrubs and sparse, low, mainly oak forest. In this place the soil surface on the side of the slope is much varied due to overgrown trenches of World War II. The soil surface is mostly well insolated, covered with herbaceous plants, mainly grasses, forming a compact turf. Shaded places occupy much less space; they are covered with tufts of herbaceous vegetation (between the tufts there are patches of deciduous litter).

Microhabitat. The soil originated on postglacial deposits, eroded to various degree, in the zone of drift sands and clays of the frontal moraine of the Blatic glaciation, in the border zone of the transition into the ice-marginal valley of the Odra River. The mineral part of the soil is a clayey or dusty sand, locally passing

into dusty clay, strongly sand-laden, with calcium carbonate content of a few to a dozen or so per cent. The humus layer of the soil, 5-10 cm thick, is of uneven thickness, very porous, of c. 2% humus content, and has a rich admixture of organic matter in the form of remnants of fragmented and mumified leaves, roots, twigs etc. The soil humidity is rather low.



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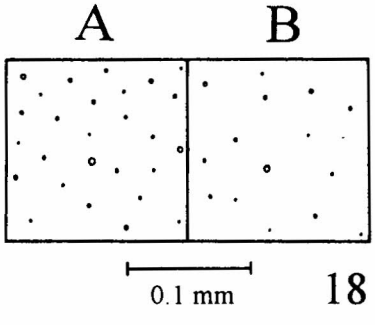

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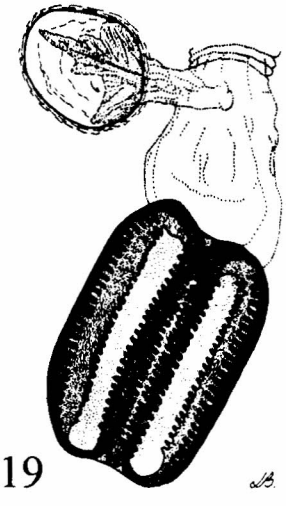

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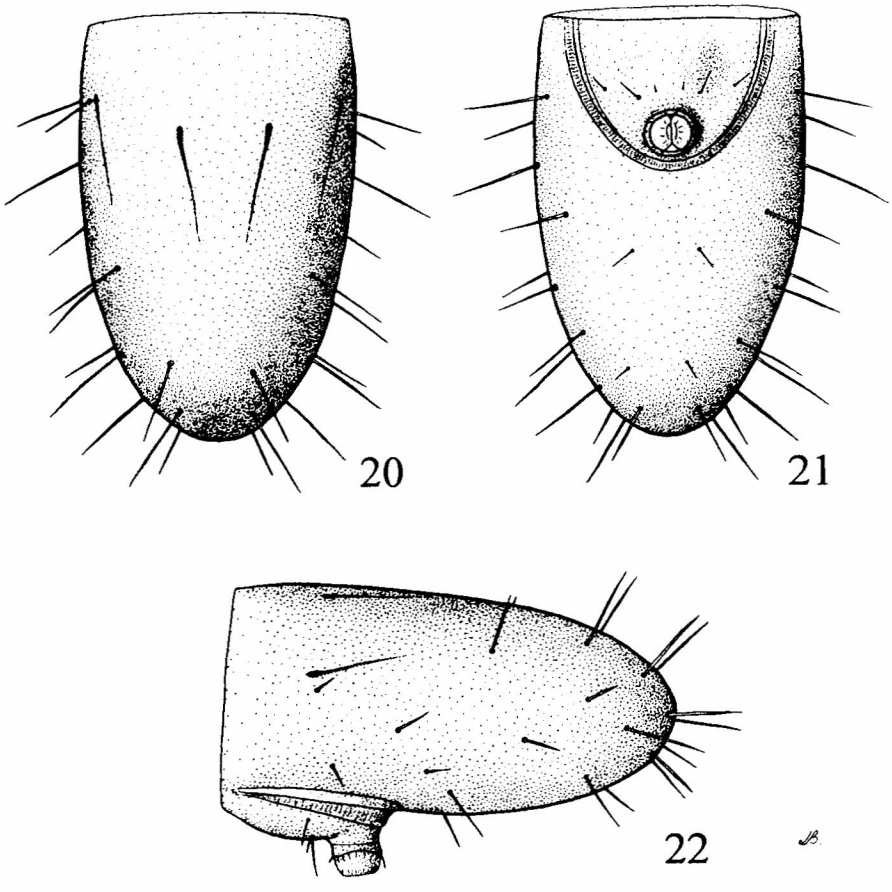
17-19. *Porthmidius austriacus* (Schrank), larva: 17 - IV abdominal segment, right mediotergite and sternite, 18 - puncturation of the mediotergites (A) and sternites (B), 19 - abdominal spiracle

In the above place I collected a total of 8 imagines of *P. austriacus* and 9 larvae of various instars. Most imagines (7 specimens) were caught in the entomological sweeper from tree and shrub branches, and also from herbaceous plants, on May 28th and 29th 1988; the weather was warm and sunny. I found a single female on July 6th 1988, on the soil surface in a slightly shaded place with sparse herbaceous vegetation; the female was most probably laying eggs. I found the larvae in soil samples taken to the depth of c. 20 cm, on May 29th and July 6th 1988, and August 14th 1993. The samples were taken from places to various degree covered with herbaceous vegetation and variously shaded. I searched the soil both in the site and in the laboratory. The total surface area of the soil thus searched did not exceed 2 metres square, and from this area I collected 9 larvae.



20-22. *Porthmidius austriacus* (SCHRANK), larva: 20 - IX abdominal segment, dorsal view, 21 - IX abdominal segment, ventral view, 22 - IX abdominal segment, lateral view

NOTES ON BIOLOGY

Larvae of *P. austriacus* develop in a rather dry, well-aerated, sandy-clayey, dusty soil, staying especially in its upper layer, overgrown with roots of herbaceous plants, containing humus and organic remnants in the form of decaying leaves, twigs etc. Based on the observation of the growth rate of larvae in the laboratory, it can be supposed that the period of larval development is at least 3 years. The larvae choose insolated places, sheltered from the wind, on which herbaceous plants, mainly grasses, form a more or less compact turf (in shaded places, under trees, in a soil devoid of at least patchy turf, I found no larvae). The larvae move in the soil very actively, boring distinct burrows. To moult or pupate they most often choose small fragments of rotting wood (twigs, roots etc.) buried in the soil, and there they make a chamber. Sometimes the chamber is built directly in the soil, through compacting it from the inside and strenghtening the wall with a secretion. In the laboratory culture, in one case I found such a chamber; the larva built it near the margin of the bottom of the container, thanks to which about half of the inner surface of the cell did not need compacting or strenghtening. Perhaps also under natural conditions, in the absence of wood fragments in the soil, the larvae may choose places for chamber building e.g. in a concavity of a stone. After moulting the larva stays in the cell until it is fully sclerified. The older larvae, observed in the laboratory, moult twice a year: in the early spring and late summer. Pupation takes place in the late summer, the pupa stage lasting c. 2 weeks. The formed imago stays in the pupal chamber built by the larva of the last instar till the next spring.

According to the observations made in the laboratory, the larvae of older instars are predacious and necrophagous (there are no observations on younger instars). The experiment aimed at explaining the feeding habits was the following. Two larvae collected on August 14th 1993 and placed in the same container were given a choise of food items buried c. 2.5 cm dep in the soil (on the artificial border between organic-rich and mineral soil). The food items were: a curculionid larva c. 8 mm long and damaged by piercing with a needle; a fragment of carrot root; a fragment of rotten willow wood. A boletid mushroom stem was placed just below the soil surface. After four days I found one of the larvae in already slightly decomposed curculionid larva, and the other in a chamber in the willow wood fragment (the larva was most probably preparing to moult). During the following several days, during which I added no new food, one of the larvae moved actively in the substratum, ignoring the plant food that was present in the container. The other larva stayed in its chamber. Twenty days from establishing the laboratory culture I found that the larva which had been staying in the willow wood was dead, mechanically damaged; it had probably been attacked by the other larva (the latter was still very active). Fragments of the carrot root and the mushroom remaining in the soil showed no traces of feeding of the larvae.

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