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Morphology and systematic position of the larvae of *Cryptocephalus octacosmus* and *C. semiargenteus* with special reference to the age variation of *Cryptocephalus* larvae
(Coleoptera: Chrysomelidae: Cryptocephalinae)

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ABSTRACT. The article includes original descriptions of the last instars of *Cryptocephalus octacosmus* BEDEL and *C. semiargenteus* REITTER, and a redescription of the first instar larva of *C. octacosmus*. The larva of *Cryptocephalus octacosmus* is close to *C. decemmaculatus* and *C. janthinus* and the larva of *C. semiargenteus* is close to *C. undulatus*. Keys to species are provided and the age variation of morphological details in the larvae of *Cryptocephalus* is discussed.

Key words: entomology, morphology, larvae, *Coleoptera*, *Chrysomelidae*, *Cryptocephalinae*, *Cryptocephalus*.

MATERIAL

The specimens used in this study were collected in part by M. Ja. ORLOVA-BIENKOWSKAJA and the author, in part obtained from Dr. O. G. VOLKOV (All-Russian Institute of Plant Quarantine, Moscow), and in part from the collection of the Zoological Institute of the Russian Academy of Sciences, St.-Petersburg. All balsam slides were mounted by the author and remain in the author's collection. Terminology for the structural details and the description plan follow LESAGE (1986).

ACKNOWLEDGEMENTS

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Marine Station (near Novorossijsk) and to the Dr. L.M. MUKHAMETOV (the Leader of the Station) for the possibility to carry out the field work, and to my wife, M.Ja. ORLOVA-BIENKOWSKAJA, for help in collections. I gratefully acknowledge the Dr. A. ELŻANOWSKI, who made many linguistic corrections in the manuscript.

***Cryptocephalus octacosmus* BEDEL, 1891**

(figs. 1-8, 9-11)

DESCRIPTION OF THE LAST INSTAR LARVA

Frons (fig. 1). Width 0.92-0.94 mm (male), or 1.02-1.07 mm (female). Frons with 6 pairs of frontal setae and 2 sensillae. Setae fs1-3 clavate and serrate. Microsculpture irregular, granulate, forming somewhat curved rows occupying the whole frons.

Epicranium (fig. 1) with distinct keel behind frontal suture. Anterior portion (in front of keel) with 4-5 simple setae and microsculpture along frontal suture similar to those of the frons, posterior portion with 25-29 setae and rugate microsculpture.

Clypeolabrum (fig. 2) with one pair of simple clypeal setae (cs), 3 pairs of long labral setae (ls) and 2 pairs of labral sensillae. Suture between frons and clypeus and between clypeus and labrum indistinct. Anterior emargination of clypeolabrum with a wide triangular projection.

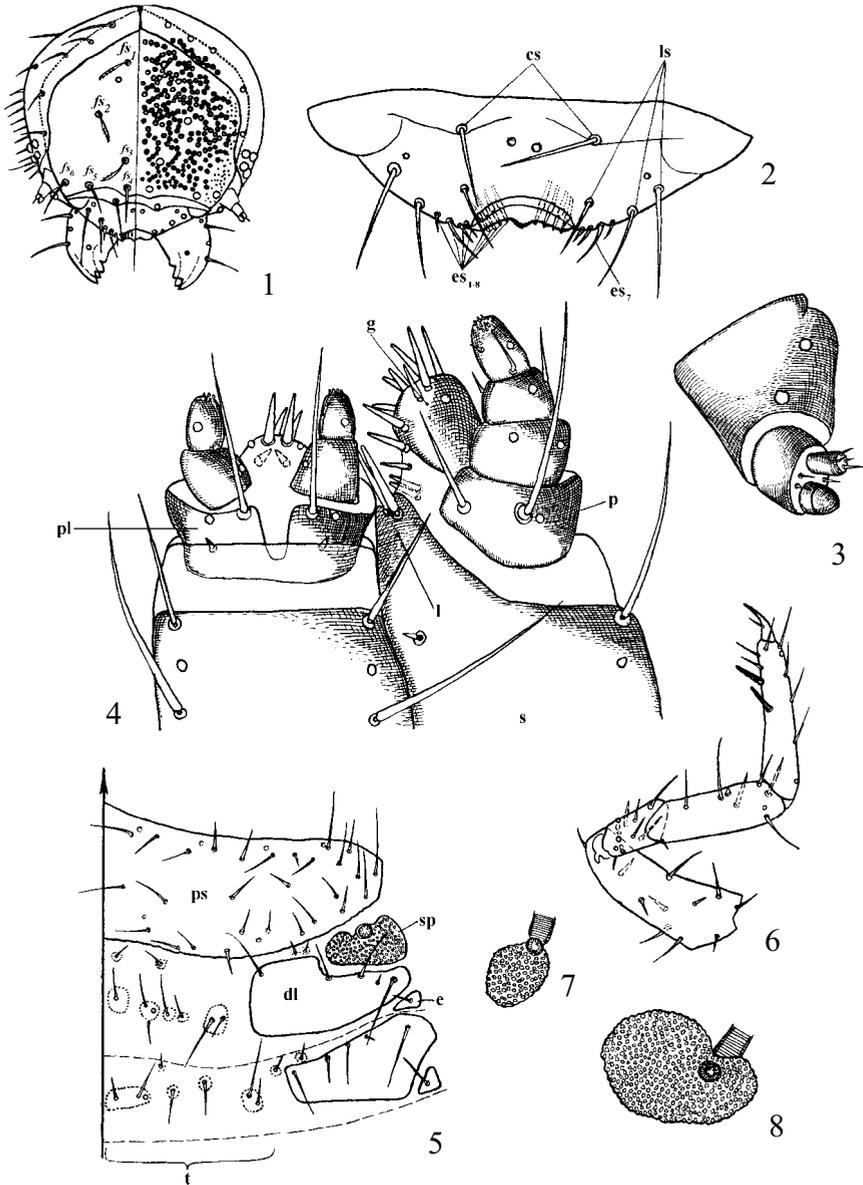
Epipharynx with 4 pairs of marginal and 4 pairs of submarginal setae (fig. 2 es1-8), es7 two times longer than others. Anterior epipharyngeal cluster of 10 sensillae.

Antenna (fig. 3) relatively small. Segment 1 with 2 sensillae, segment 2 with 3-4 minute setae and a large conical sensory papilla sclerotized at the base, segment 3 with 1 large and 2-4 minute setae at the apex.

Mandible (fig. 1) 4-toothed, with 3 apical teeth and 1 at the apex of the inner cutting edge; with 2 setae and 2 sensillae at the dorsum and 1 sensilla at the face.

Maxilla (fig. 4). Cardio with 1 seta. Stipes (fig. 4 s) with 1 large outer marginal seta, 1 minute inner apical seta, 1 large outer apical seta, 1 outer apical sensilla, and numerous lateral spinules. Galea (fig. 4 g) well-sclerotized, with a membranous portion at the base of the inner side, separated from the stipes, with 12 setae and 1 sensilla. Lacinia (fig. 4 l) fused with the stipes, well sclerotized, with an elongate process at the inner apical corner of stipes, and 2 apical setae. Maxillary palp 3-segmented (or 4-segmented with the palpifer (fig. 4 p) counted as a segment), palpifer with 1 sensilla and 2 large setae, one of which reaches the apex of palp, segment 1 with 2 sensillae, segment 2 with 2 setae and 1 sensilla, segment 3 with 1 large seta appressed onto it, 1 minute seta and 1 sensilla at side, and a group of minute apical sensillae.

Labium (fig. 4). Postmentum with 3 pairs of setae, 1 pair at the base and 2 at the apex, and 1 pair of sensillae at the apex. Palpifer (fig. 4 pl) with 2 (1 large and



1-8. *Cryptocephalus octacosmus*, last instar larva: 1 - Head (fs1-6 - frontal setae): chaetotaxy (left side) and microsculpture (right side); some setae of back part of epicranium are not shown; 2 - Clypeolabrum (cs - clypeal setae, ls - labral setae, es1-8 - epipharyngeal setae); 3 - Antenna; 4 - Apical part of labium and left maxilla (g - galea, l - lacinia, s - stipes, p - maxillar palpifer, pl - labial palpifer); 5 - Dorsal side of pro-, meso- and metathorax (ps - pronotal sclerite, dl - dorso-lateral sclerite, e - epipleural sclerite, sp - spiracular plate, t - tergal area); 6 - Leg; 7 - Spiracular plate of the abdominal segment 1; 8 - Spiracular plate of the abdominal segment 7

1 minute) setae and 1 sensilla. Left and right palpifers fuse at base. Apex of prementum produced into a membranous ligula with 3 pairs of setae and 1 pair of sensillae. Labial palps 2-segmented, each segment with 1 lateral sensilla and a group of minute apical sensillae.

Prothorax. Pronotal sclerite (fig. 5 ps) well sclerotized, with simple setae of variable length (25-36 along the anterior margin, 22-29 along the posterior margin, 7-10 at the disc) and 12 sensillae (8 along anterior, 4 along posterior margin). Microsculpture of the pronotal sclerite feebly rugate almost on the whole surface, but granulate along the anterior margin. Epipleural sclerites absent.

Meso- and metathorax (fig. 5). Tergal area (fig. 5 t) with 1 sensilla and 6-7 setae distributed in an irregular transverse row at disc and 1-2 minute setae along anterior margin on each side. Bases of setae convex, sclerite-shaped, but not sclerotized. Dorso-lateral and epipleural sclerites weakly sclerotized. Dorso-lateral sclerite (fig. 5 dl) with 3 long, 1 shorter, and 1 minute seta in a transverse row. 2 minute setae located in front of the dorso-lateral sclerite. Mesothoracic spiracle with a large, kidney-shaped spiracular plate (fig. 5 sp). Plate bearing granules of irregular shape, very minute granulated in interstices. Spiracular opening located at the anterior margin of spiracular plate. Epipleural (fig. 5 e) and hypopleural sclerites with 1 each, sternal sclerite with 4 setae.

Legs (fig. 6). Spiniform setae present only on tibiotarsus. Coxa with 11-13 setae. Trochanter with 5-6 setae and 6-8 sensillae. Sensillae in a row around trochanter. Femur with 7-9 setae and 2 sensillae. Tibiotarsus with 4 simple setae and 2 sensillae on the upper side, 2 spiniform and 3 simple setae on the lower side. Unguis without pulvillus, with 1 seta on the lower side.

Abdomen. Segments without sclerites, with sparse setae. Spiracles present on segments 1-8. Spiracular plates similar to the mesothoracic ones, but smaller, kidney-shaped on segments 1-4 (fig. 7), ovate with spiracular opening at the outer margin of plate on segments 5-8 (fig. 8).

Microsculpture absent on thorax and the anterior abdominal segments, represented by minute spinules at the apex of abdomen.

Larval case. Length 6.0 mm (male) or 7.3 mm (female), width 3.0 mm (male) or 3.4 mm (female). Case with 3 longitudinal crests at dorsum. Middle crest higher than others, runs from the posterior end to the anterior 1/3 or 1/4 of the length, lateral crest runs from the posterior end to mid-length of case.

DESCRIPTION OF THE FIRST INSTAR LARVA

Frons (fig. 9). Width 0.23-0.24 mm, with 6 pairs of clavate and serrate setae and 2 sensillae. Microsculpture regular, granulate; granules of irregular shape, separated by distances approximately equal to their diameters. Anterior part in front of setae fs3-fs5-fs6 without microsculpture.

Epicranium (fig. 9) without a distinct keel behind frontal suture. Anterior portion with granulate microsculpture along the frontal suture, with 5 setae and 1

sensilla; 4 setae clavate and serrate, 1 largest simple. Posterior portion with granulate microsculpture, with 5 simple setae.

Clypeolabrum (fig. 9) with 1 pair of simple clypeal setae, 3 pairs of labral setae, and 2 pairs of sensillae. Sutures between frons and clypeus and between clypeus and labrum moderately developed. Anterior depression of clypeolabrum with a wide triangular projection.

Epipharynx with 4 pairs of marginal setae and 4 pairs of submarginal ones.

Antennae similar to those of last instar, but relatively larger (cf. figs. 1 and 9), segment 2 only with 2 setae.

Mandibles similar to those of last instar.

Maxillae. Cardo and lacinia similar to those of last instar. Stipes with 2 large setae, 1 sensilla, and numerous lateral spinules. Galea well sclerotized, with a membranous portion at the inside of the base, separated from stipes, with 8 setae and 1 sensilla. Maxillary palps 3-segmented (or 4-segmented with the palpifer counted as a segment), similar to that of the last instar.

Mentum. Postmentum and labial palps similar to that of the last instar. Palpifer with 1 large and 1 minute seta and 1 sensilla. Left and right palpifers fuse at base. Apex of prementum produced into membranous ligula bearing 2 pairs of setae and 1 pair of sensillae.

Prothorax (fig. 10). Pronotal sclerite well sclerotized, with 10 large setae, 2 minute setae and sensillae, which alternate with the large setae along anterior margin; 10 large setae, 2 minute setae and 2 sensillae along posterior margin; 2 setae at disc; and without microsculpture. Epipleural sclerites absent. Hypopleural sclerite with 1 seta.

Meso- and metathorax (fig. 10). Inner tergal area (fig. 10 it) with 1 large and 3 minute setae distributed in a transverse row at each side. Lateral tergal sclerite (fig. 10 lt) convex, well sclerotized, with 1 large, 1 minute seta, and 1 sensilla. Dorso-lateral sclerite with 2 large and 1-2 minute setae. Mesothoracic spiracle with a large, oval, granulate spiracular plate; spiracular opening near the anterior margin of plate. Epipleural and hypopleural sclerites with 1 seta each; sternal sclerite with 4 setae.

Legs. Spiniform setae present only on tibiotarsus. Coxa with 2 setae. Trochanter with 5 setae and 7 sensillae. Sensillae in a row around trochanter. Femur with 7 setae. Tibiotarsus with 4 simple setae and 2 sensillae on upper side, 2 spiniform and 3 simple setae on the lower side. Unguis similar to that of the last instar.

Abdomen (fig. 10). Segments with moderately convex, colourless sclerites. Inner tergal sclerite with 1 large and 1 minute seta. Lateral tergal sclerite with 1 minute seta. Dorso-lateral area (fig. 10 dl) with 4 minute setae. Spiracular plates similar to the mesothoracic ones, but smaller; spiracular opening located at the outer margin of plate. Epipleural and hipopleural sclerites with 1 large and 1 minute seta each. Parasternal sclerite with 1 seta. Sternal sclerite with 2 large and 2 minute setae.

Microsculpture represented by tubercles on thorax and abdomen, minute spinules at the apex of abdomen.

Larval case (fig. 11) consists of the egg case and the anterior part constructed by the larva. Egg case with longitudinal or oblique rows of short crests. Length 1.65 mm, width 0.95 mm.

REMARKS

MEDVEDEV and ZAITSEV (1977) briefly described the first instar larva of *C. octacosmus*. My specimens mostly matches their description but differ by having a wide triangular projection in the anterior emargination of clypeolabrum. The case of the last instar larva was recently described by DUHALDEBORDE (1994).

SYSTEMATIC POSITION

C. octacosmus belongs to a species group in which the anterior portion of epicranium has 4-5 setae on each side; mesothoracic and abdominal spiracular plates are very large, oval or kidney-shaped, 4-6 times wider than spiracle diameter; femur bears only simple setae; tibiotarsus has 4-5 setae on the lower side, and differs from other species of this group with the following key:

- 1(2) Dorso-lateral sclerite of mesothorax with 6 (3 large and 3 minute) setae. Frontal microsculpture irregular, forming curved rows; all frontal setae serrate.
 *C. decemmaculatus* (LINNAEUS, 1758) (first and last instars).
 (after OGLOBLIN and MEDVEDEV 1965, and MEDVEDEV and ZAITSEV 1977).
- 2(1) Dorso-lateral sclerite of mesothorax with 3-5 setae.
- 3(4) Dorso-lateral sclerite of mesothorax with 2 large and 1-2 minute setae (fig. 10). Frontal microsculpture regular; all frontal setae serrate (fig. 9)
 *C. octacosmus* BEDEL, 1891 (first instar).
- 4(3) Dorso-lateral sclerite with 5 (3 large, 1 shorter and 1 minute) setae. Frontal microsculpture irregular, forming curved rows; setae fs5-6'4 '0simple.
- 5(6) Posterior portion of epicranium with 25-29 setae on each side. Pronotal sclerite with 25-36 setae along anterior margin (fig. 5).
 *C. octacosmus* (last instar).
- 6(5) Posterior portion of epicranium with 18-20 setae on each side. Pronotal sclerite with 22 setae along anterior margin
 *C. janthinus* GERMAR, 1824 (last instar).

MATERIAL EXAMINED

C. octacosmus. Last instar. Balsam slides: 4 exuviae from cases containing adults. Kazakhstan: Alma-Ata reg., Bakh-Bakty, Ili river bank, 1 case on grass, 21.6.1989, O.G. VOLKOV leg. (adult female emerged on 3.7.1989); Ukraine: Poltava, 1 case with emerged adult female, 1937, D.A. OGLOBLIN leg.; Russia: Krasnodar Terr., near Novorossiysk, Abrau, meadow near a pond, 2 cases on *Poaceae*, 19.5.1995, M.Ja. ORLOVA-BIENKOWSKAJA, A.O. BIENKOWSKI leg. (adults males emerged before 5.6.1995).

First instar. Balsam slides: 3 larvae reared from adult female. Ukraine: Poltava, 16.7.1936. D.A. OGLOBLIN leg.

C. janthinus. Last instar. Balsam slide: 1 exuvium from case containing adult. Russia: Krasnodar Terr., near Novorossijsk, Abrau, pond bank, larva on *Lythrum* (?), 14.5.1995, M.Ja. ORLOVA-BIENKOWSKAJA leg. (larva was reared in a cage and fed leaves of its host plant, adult emerged on 16.6.1995). Available specimen matches the description by MEDVEDEV and ZAITSEV, 1977, but differs by the well-developed epicranial keel and simple epicranial setae.

HABITS OF *C. octacosmus*

Despite the fact that *C. octacosmus* is a widely distributed and relatively abundant, its larvae were hitherto not found at their habitat. Only the larval cases attached to grasses were found (DUHALDEBORDE 1994, and Dr. O.G. VOLKOV's and author's observations in Kazakhstan, Krasnodar Terr., and Saratov reg.). I soaked and cut into pieces one of larval cases (collected in Abrau), and studied it under the microscope at 70 X magnification. Besides the unidentified material (larval excrements ?) and pieces of plant tissues, numerous small sands of different sizes were found. This indicates that the larvae live on the ground. The use of mineral materials for case construction was noted by MEDVEDEV (1962) for *Clytra quadripunctata* (LINNAEUS, 1758).

***Cryptocephalus semiargenteus* REITTER, 1894**

(figs. 12-17)

DESCRIPTION OF LAST INSTAR LARVA

Frons (fig. 12). Width 1.18 mm. Available specimen have 15 frontal setae including one aberrant seta near fs1 on right side and 2 sensillae. All frontal setae simple. Microsculpture fine, irregular, granulate. Anterior margin without microsculpture.

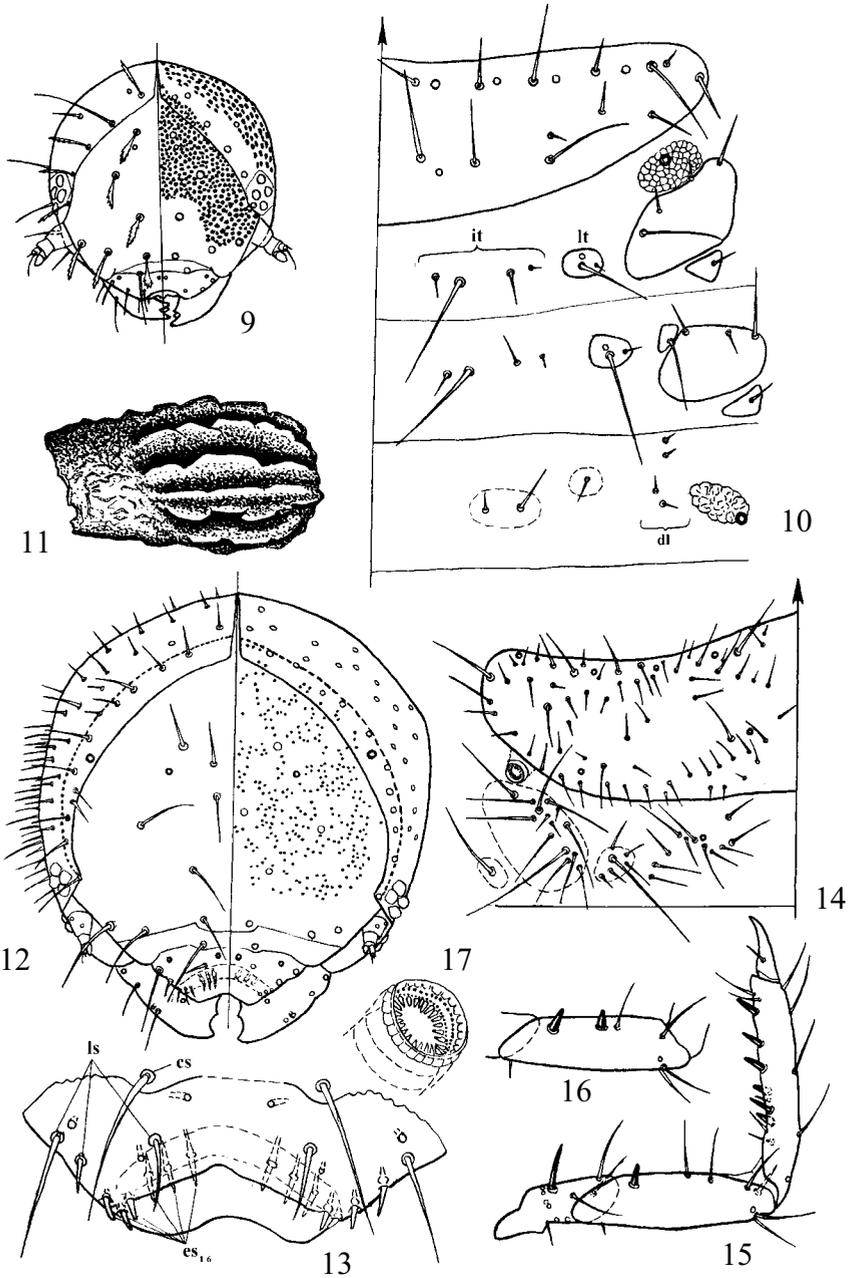
Epicranium (fig. 12) with a distinct keel behind the frontal suture. Anterior portion (in front of the keel) bears 11-12 simple setae and 1 sensilla; microsculpture similar to that of the frons. Posterior portion with 47-54 setae of variable length.

Clypeolabrum (fig. 13) with one pair of clypeal setae (cs), 3 pairs of labral setae (ls) (2 large and 1 minute), and 3 pairs of labral sensillae. Sutures between frons and clypeus and between clypeus and labrum indistinct. Anterior emargination of clypeolabrum without a projection.

Epipharynx with 3 pairs of marginal setae and 3 pairs of submarginal setae (fig. 13 es1-6). Anterior epipharyngeal cluster of 10 sensillae.

Antennae relatively small. Segment 1 with 2 sensillae, segment 2 with 3 minute setae and large conical sensory papilla sclerotized at the base, segment 3 with 1 large and 3 minute setae at the apex.

Mandibles (fig. 12) with 2 rounded teeth (teeth probably ground off), 2 setae and 2 sensillae at the dorsum and 1 sensilla at the face.



9-11. *Cryptocephalus octacosmus*, first instar larva: 9 - Head; 10 - Pro-, meso-, metathorax and abdominal segment 1, dorsal side (it - inner tergal area, lt - lateral tergal sclerite, dl - dorso-lateral area); 11 - Larval case. 12-17. *C. semiargenteus*, last instar larva; 12 - Head; 13 - Clypeolabrum; 14 - Pro- and mesothorax, dorsal side; 15 - Fore-leg (coxa is not shown); 16 - Femur of mid-leg; 17 - Spiracular plate of the abdominal segment

Maxillae. Cardo with 1 seta. Stipes with 1 large outer marginal seta, 1 minute inner apical seta, 1 large outer apical seta, 1 outer apical sensilla, and numerous lateral spinules. Galea well-sclerotized, with a membranous portion at the inside of the base, separated from stipes, with 11 large thick and 2 minute setae and 1 sensilla. Lacinia fused with stipes, well sclerotized, with an elongate process bearing 2 apical setae at the inner apical corner. Maxillary palp 3-segmented (or 4-segmented if the palpifer is counted as a segment), palpifer with 2 large setae and 1 sensilla, segment 2 with 2 setae and 1 sensilla, segment 3 with 1 large seta appressed onto segment, 1 minute seta and 1 sensilla at side, and a group of minute apical sensillae.

Labium. Postmentum with 3 pairs of setae, 1 pair at the base and 2 at the apex, and 1 pair of sensillae at the apex. Palpifer with 2 (1 large and 1 minute) setae and 1 sensilla. Left and right palpifers fuse at base. Apex of prementum produced into a membranous ligula bearing 3 pairs of setae and 1 pair of sensillae. Labial palps 2-segmented.

Prothorax (fig. 14). Pronotal sclerite well sclerotized, with simple setae of variable length (80 along the anterior margin, 73 along the posterior margin, 6 at the disc), and 12 sensillae (8 along the anterior and 4 along the posterior margin). Microsculpture of the pronotal sclerite slightly rugate at almost the whole surface, granulate along the anterior margin. Epipleural sclerites absent.

Meso- and metathorax (fig. 14). Inner tergal area with 11 setae and 1 sensilla, lateral tergal, dorso-lateral, and epipleural sclerites with respectively 6, 14, and 1 seta. Dorso-lateral sclerite moderately sclerotized, others slightly sclerotized. Mesothoracic spiracle with a very small, ring-formed spiracular plate.

Legs. Trochanter (fig. 15) with 4 simple and 1 spiniform setae and 6 sensillae. Femur with 1 minute simple seta on the upper side near the base, 3-4 large simple setae and 1 sensilla at the apex, and 3 setae on the lower side (1 spiniform and 2 simple on the fore-femur (fig. 15), 2 spiniform and 1 simple on the other femora (fig. 16)). Tibiotarsus (fig. 15) with 4 simple setae and 1 sensilla on the upper side, 6 spiniform and 4-5 simple setae on the lower side. Unguis (fig. 15) without pulvillus, with 1 seta on the lower side.

Abdomen. Segments without sclerites, with sparse setae. Spiracular plates very small, ring-formed (fig. 17).

Microsculpture absent on the thorax and anterior abdominal segments, represented by minute spinules at the apex of abdomen.

Larval case without crests. Length 8 mm, width 3.5 mm.

SYSTEMATIC POSITION

Larva of *C. semiargenteus* is similar to that of *C. undulatus* SUFFRIAN in having 11-12 setae at each side of the anterior part of epicranium, small, ring-formed spiracular plates, spiniform setae on the femur and 6 spiniform setae on the tibiotarsus, but differs from it in the following points:

1(2) Frons with 12 simple setae. Anterior emargination of clypeolabrum shallow, with a weak projection. Dorso-lateral sclerite of mesothorax with 9-10 setae. Larva on *Tamarix* sp.

..... *C. undulatus* SUFFRIAN, 1854 (elder instar).

2(1) Frons with 14 simple setae. Anterior emargination of clypeolabrum deep, without a projection. Dorso-lateral sclerite of mesothorax with 14 setae. Larva on *Calligonum microcarpum*.

..... *C. semiargenteus* REITTER, 1894 (last instar).

MATERIAL EXAMINED

C. semiargenteus. Last instar. Balsam slide: 1 exuvium from a case containing adult. Uzbekistan: 140 km NW Shafrikan, larva on *Calligonum microcarpum*, 14.5.1972, FALKOVICH leg. (adult female emerged on 6.7.1972).

C. undulatus. Elder instar. Balsam slide: 1 larva. Kazakhstan: Kara-Tau, larva on *Tamarix* sp., associated with adult, 5.1936, F. LUKJANOVICH leg. Available specimen mostly corresponds to the description by MEDVEDEV and ZAITSEV (1977) and differs with the simple frontal setae and 11 setae on anterior portion of epicranium at each side.

MORPHOLOGICAL AGE VARIATION IN *Cryptocephalus* LARVAE

Age variation of structural details in the *Cryptocephalus* larvae remains insufficiently studied. MEDVEDEV and ZAITSEV (1973) investigated differences between the newly hatched and 2 months old larvae of *C. mannerheimi* GEBLER and *C. ochroloma* GEBLER. These differences are in the form of the frontal, epicranial and labral setae, and in the microsculpture of the pronotal sclerite. LESAGE (1986) noted the distinguishing characters of the first instar larvae of the American species *C. quadruplex* NEWMAN and *C. venustus* FABRICIUS: presence of the egg bursters on meso- and metathorax, papillate setae on the head, and 2 pairs of spiniform setae on the tibiae. The numbers of spiniform setae on the tibiae and of clubbed setae on the pronotum increase in the succeeding instars.

The first and last instar larvae of *C. octacosmus* show a number of morphological differences (see above). Some diagnostic characters such as the form of frontal and epicranial setae and the form of the epicranial keel change during the larval development, but the form of the anterior margin of clypeolabrum, chaetotaxy of the tibiotarsus, and structure of spiracular plates remain invariable.

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