

# THE 5th STAGE NYMPH OF CERATOCOMBUS (CERATOCOMBUS) COLEOPTRATUS (ZETTERSTEDT, 1819) AND NOTES ON THE MORPHOLOGY AND SYSTEMATICS OF DIPSOCORIDAE (HETEROPTERA)

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## I. Introduction

The pre-imaginal developmental stages of the family Dipsocoridae are very unsatisfactorily known. Partial information can be obtained from Benick 1921, Butler 1923, Carayon 1949, Jordan 1941, 1951, Leston 1954, Leston & Scudder 1956, Spooner 1938 and Wygodzinsky 1952, 1953, 1955, but they are very incomplete and sometimes incorrect. No European species has been satisfactorily described and figured until now. We may expect that the investigations of pre-imaginal stages will furnish us with valuable auxiliary systematic characters and will help us in the understanding of the obscure morphology of the adult insects.

The 5th stage nymph of *Ceratocombus coleoptratus* (Zett.) described below was obtained from a sample of *Sphagnum* sp. (Czechoslovakia, South Bohemia, Velký Tisý, 28. 7. 1957, lgt. M. Kunst) treated by Tullgren's apparatus. Its conspecificity with *Ceratocombus coleoptratus* is undoubted—in this habitat there live, of the genus *Ceratocombus*, only *C. kunsti* Štys, 1958 and *C. coleoptratus* (Zett., 1819) (see Štys 1958a, b). The first mentioned species belongs to the subgenus *Xylonannus* Reut., but our nymph is—according to the chaetotaxy of the head and pronotum—a representative of the subgenus *Ceratocombus* Sign. In my material there are other *Ceratocombus* nymphs from various districts of Czechoslovakia, all obtained by treating the soil or moss samples by Tullgren's apparatus. The nymphs in question belong probably to the species *C. coleoptratus* (Zett.) also, but since they have not been collected together with the adults, and since they differ slightly in the chaetotaxy of the abdomen from the species described, they have not been included in this paper. We are yet not able to decide if the source of chaetotaxic differences ought to be ascribed to the individual variability of *Ceratocombus*-nymphs or to the presence of nymphs of undescribed species in our material. The description in detail of the relatively complicated chaetotaxy of the ventral side of the abdomen and the attempt to establish the serial homology between the setae of individual urites were not made for reasons

quoted above. That will be possible only after the examination of a greater amount of material of which the conspecificity is guaranteed. We may expect in the future a great advance in the exploitation of chaetotaxic characters in the systematic study of Dipsocoridae.

In the description of the nymph of *C. coleoptratus* (Zett.) (as follows in the next chapter) there are given various morphological observations of higher than specific importance (e.g. structure of propleura, respiratory system)—some of them are given more detailed consideration in chapter III.

## II. Description of *Ceratocombus* (*Ceratocombus*) *coleoptratus* (Zett., 1819), 5th stage nymph

### General shape

Long oval, slightly flattened in thoracic region, smooth and shining on sclerotized body areas. With long stout bristles.

### Colour

General colour "olivaceo-flavus"; extremities lighter ("melleus"). Imaginal eyes and ocelli showing through carmineously. Postero-lateral margins of pronotum and hind margins of meso- and metanotum (including hemelytral and alar lobes) dark "flavo-virens". Membraneous portions of abdomen "pallido-griseolus". (See the remark on Butler's description!)

### Measurements

(all made on unmounted and consequently undeformed specimen).

Total length: 1.72 mm. Head: length 0.15 mm.; width across the eyes 0.33 mm.; synthlipsis 0.30 mm. Pronotum: length 0.30 mm.; width across the anterior angles 0.32 mm.; width across the basal angles 0.43 mm. Mesonotum: length in the middle 0.33 mm.; maximal width 0.63 mm. Metanotum: length in the middle 0.15 mm.; maximal width 0.59 mm. Abdomen: length (without membraneous proctiger) 0.79 mm.; maximal width 0.60 mm. Rostrum: length 0.79 mm. (length of segment I, 0.12 mm.; II, 0.10 mm.; III, 0.28 mm.; IV, 0.28 mm.). Antennae: length of segment I, 0.07 mm.; II, 0.17 mm.; III, 0.28 mm.; IV, 0.37 mm. Lengths of femora: I, 0.41 mm.; II, 0.42 mm.; III, 0.50 mm. Lengths of tibiae: I, 0.38 mm.; II, 0.38 mm.; III, 0.58 mm. Lengths of tarsi (without claws): I, 0.19 mm.; II, 0.17 mm.; III, 0.27 mm.

### Structure

**Head** (Fig. 1, 2). In anterior direction obliquely inclined. Eyes small, with relatively large facets. Synthlipsis 5.64 times as wide as the width of one eye (measured in specimen mounted on slide). Anteclypeus distinctly divided from the postclypeus posteriorly. Epicranial sulcus well developed. Its stem short, very conspicuously developed medial parts of arms straight, the lateral portion of epicranial arms curved cephalad along the inner eye margin. Antenniferous tubercles weakly developed, distinguishable only anteriorly. Chaetotaxy as in the figures 1, 2.

**Antennae** (Fig. 1) four-segmented, without secondary subdivisions. Pseudosegments developed between individual joints. The 1st segment thick

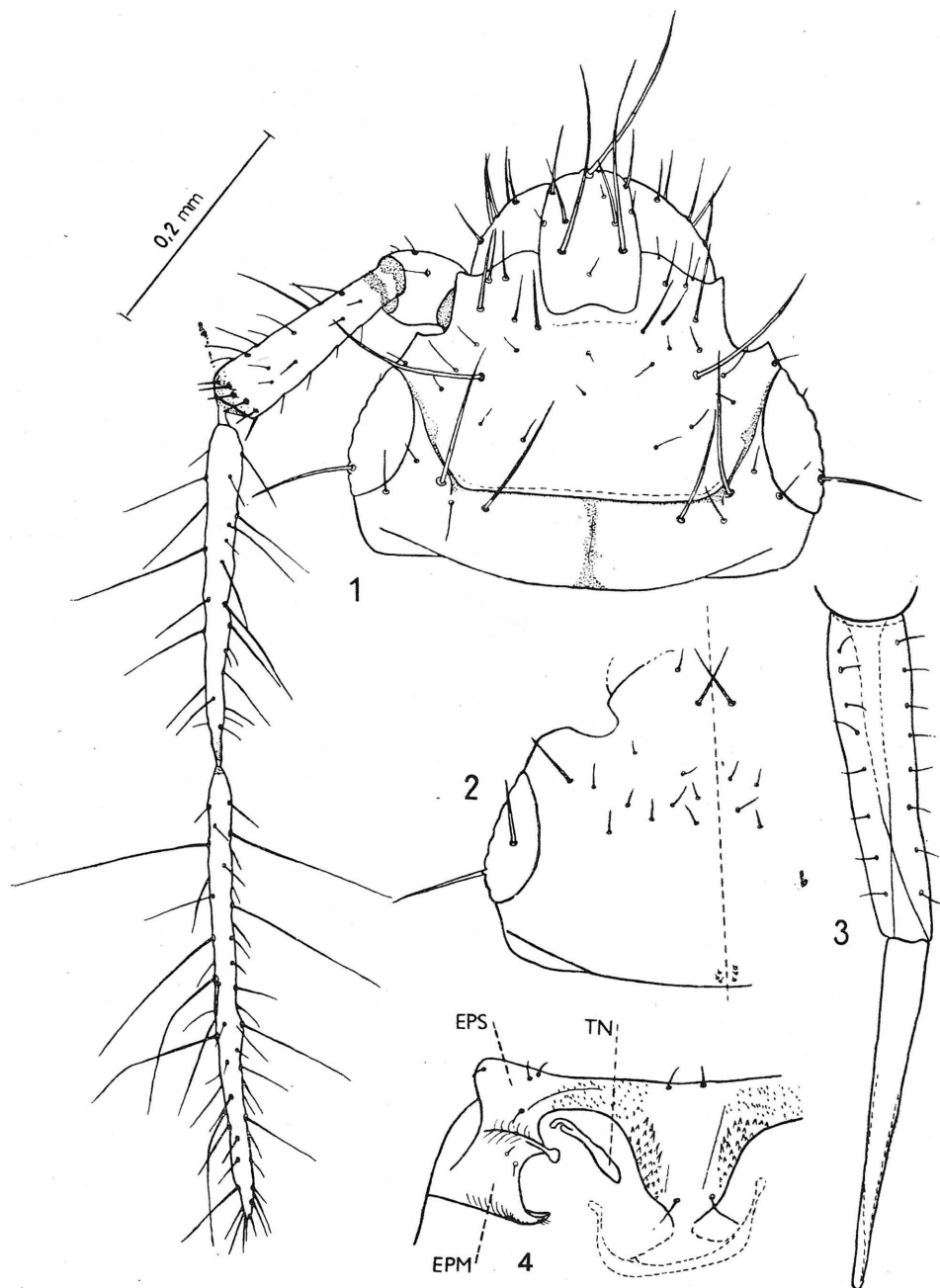


Fig. 1. Head and antenna. Fig. 2. Chaetotaxy of gular region of the head. Fig. 3. The fourth and third segments of rostrum. Seen from below. Fig. 4. Prothorax—ventral view. EPS=episternum, EPM=epimeron, TN=trochantine. The same scale for all the figures.

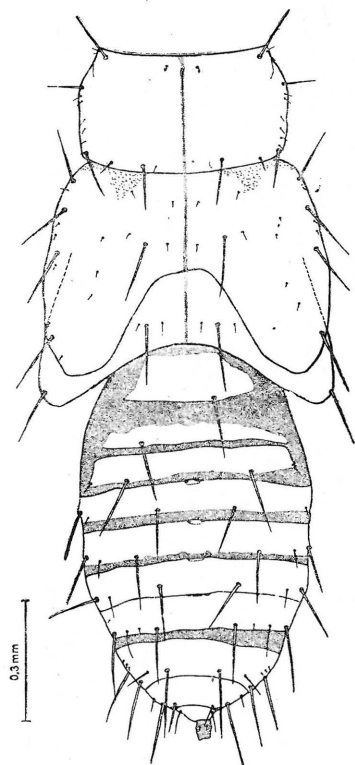


Fig. 5. Thorax and abdomen.

and short, pseudosegment very conspicuous. The 2nd segment long clubshaped, with conspicuous wreath of setae on its tip. Pseudosegment between 2nd and 3rd segment pedunculate. Thin and long 3rd and 4th segments provided with nearly perpendicular long and weak setae.

**Rostrum** (Fig. 3) relatively thin, laterally compressed (3rd joint very stout in side view). Four-segmented, basal segment swollen and weakly sclerotized. Segments I—III with regularly arranged microchaetae, segment IV bare. Rostrum reaching the tips of hind coxae.

**Thorax**—chaetotaxy as in the figures 4, 5. Ecdysial line as a middle dorsal desclerotized line on all three segments. Pronotum trapezoid, hind margin rounded. Collum clearly distinguishable laterally. Propleura (Fig. 4) divided into episternum and epimeron, postcoxale seems lacking. Trochantin well developed, coxa with both trochantinal and dorsal articulation. Xyphus laterally with small thick spinous setae. Prosternal furca very conspicuous and well visible. Hemelytral lobes do not reach the tips of alar lobes. Mesonotum posteriorly more deeply emarginate than metanotum. Anterior margin of mesonotum papillarily roughened laterally and sublaterally (on the places covered by the free posterior margin of pronotum).

**Legs** (Figs. 6—8). **Coxae** cardinate, the hind ones are the strongest. Setae concentrated at distal margins of coxae, only fore coxae with regular row of setae on hind margin. Lateral and posterolateral sides with numerous rows of very short ( $3.4\text{--}4.8\ \mu$  on the average, max. length  $6.8\ \mu$ ), but strong microchaetae. **Trochanters** of all pairs of legs seem two-segmented (Fig. 13). The first joint short, the 2nd one much longer, obliquely attached to the femur. Fore femora thickened. All femora with two parallel edges on their ventral side, femora excavated between them. All femora with rows of long setae, the strong dorsal praepical macrochaeta very conspicuous. Hind tibiae stick-shaped, middle and fore ones thickened to the tip. All tibiae densely haired, among relatively weak hairs stout spinous setae distributed. Fore tibiae on outer side with antenna cleaner (Fig. 10) consisting of two long, lateral setae and a medial row of cca 18 densely crowded short hairs, placed above the strongly sclerotized ridge. **Tarsi** two-segmented, fore and middle ones relatively short and thick, the hind ones long and thin. The 1st tarsite very short, obliquely attached to the 2nd one. **Prætarsus** (Fig. 9) with 2 narrow claws. Each claw provided with small basal tooth. Unguitractor considerably developed, unguifer process

of the 2nd tarsite very sclerotized. No membranous appendages of præ-tarsus developed.

**Abdomen** (Fig. 5). Dorsal slightly, ventral conspicuously vaulted. Tergites I—IX, annular Xth urite and membranous XIth urite clearly distinguishable. Tergites I—V membranously separated, tergite VI with VII and tergite VIII with IX firmly joined together. Tergites I and II anteriorly and laterally, tergites III—V posteriorly without clear delimitation. The Xth urite telescopically retracted into the urite IX. The XIth

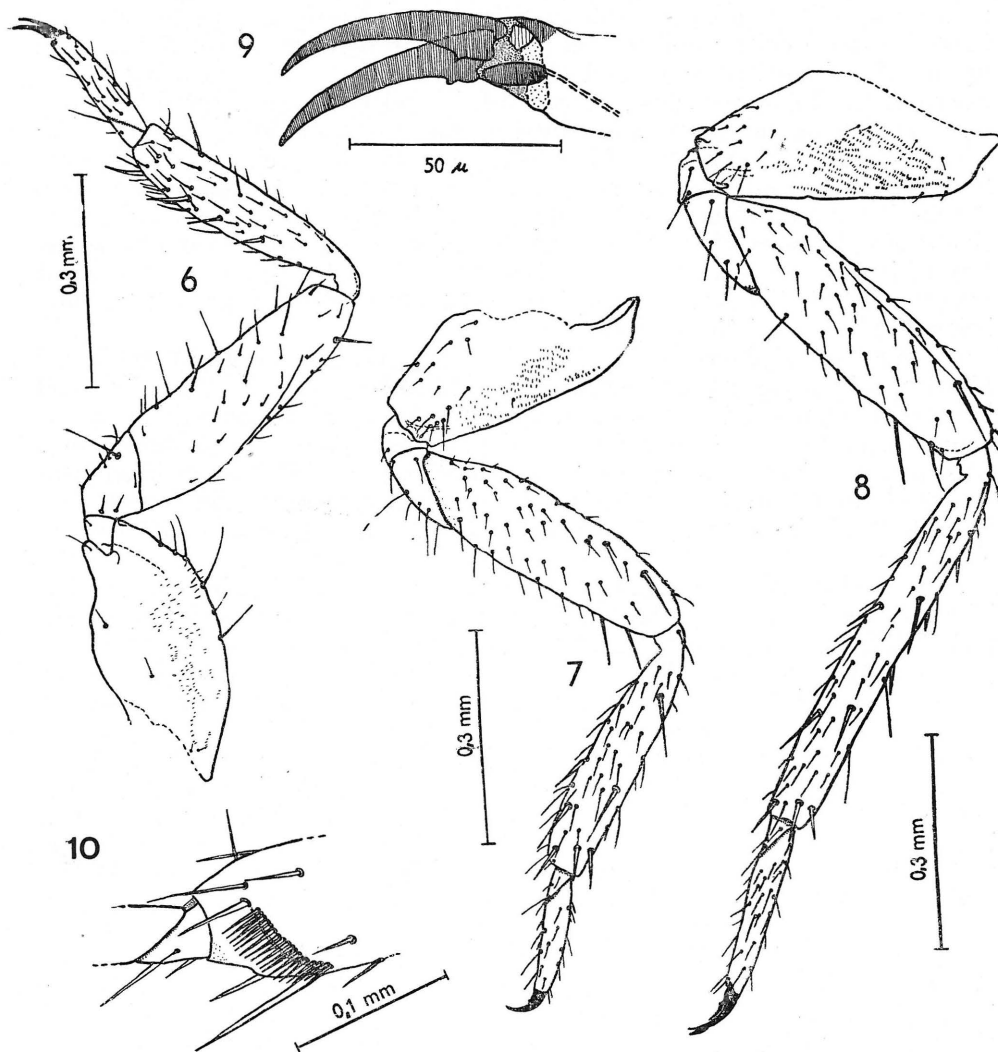


Fig. 6. Fore leg. Fig. 7. Middle leg. Fig. 8. Hind leg. All legs from mesal view. Fig. 9. Præ-tarsus of the fore leg. Fig. 10. Antenna cleaner.

urite all mebraneous, but with some microchætes. Without any laterotergites and without distinct connexivum. The VIIth—Xth zygosterna sclerotized ventrally, zygosternum VI divided into 2 in the middle widely separated sclerotized regions. The zygosternum V has undergone the same process of desclerotization, its sclerotized regions are still smaller, hardly distinguishable and similarly as in the urite VI not clearly delimited. Ventral parts of more anterior urites without any sclerotizations. Chætotaxy of abdominal tergites as in the fig. 5. Lateral and sublateral rows of macrochætæ conspicuous at the first glance. Ventral and lateral sides of individual urites also with regular chætotaxy. There are lateral groups of setæ (in the spiracular region) and medial groups separated from them there. The groups mentioned not separated on the last urites. The assymetry in the distribution of macrochætæ of targites I, II and IV of the figured specimen is anomalous as had been ascertained by the investigation of other *Ceratocombus*-nymph material (see Introduction!). In the specimen from Michalovce (N. Slovakia) the tergite I is provided with 1+1 sublateral macrochætæ, the macrochætæ are lacking on the tergite II. Abdominal microchætæ simple, macrochætæ with small apical or subapical projections, sometimes bifid on the tip. The main types are figured (Fig. 14). The most common type is that having two short, thin, sharp, spinous projections close below the narrowed tip of the seta.

**Dorsal abdominal glands** (Fig. 11, 12). 4 dorsal abdominal gland openings (on the anterior margins of the tergites IV, V and VI and between the jointed tergites VI and VII). All openings essentially of the same structure: a narrow transverse ramparted space. Its posterior wall with a wide tongue-shaped processus, which is projected into an inner concavity of the opening. The first three openings of nearly equal length (40, 35 and 42  $\mu$ ), the last opening greater (57  $\mu$ ) and somewhat different in shape.

**Respiratory system** opening by means of 8 pairs of spiracles. The 1st pair is on the prothorax, the 2nd one on the mesothorax, 3rd to 8th pairs situated in the lateral membranous regions of urites III—VIII.

**Remarks on the old descriptions.** The nymph of *C. coleoptratus* (Zett.) was twice extremely briefly described. Butler (1923) gave a good outline figure of the 5th stage nymph, but his notes on the chætotaxy of the abdomen, on the length and segmentation of the rostrum and on the identity of antennal structures in nymphs and adults (secondary annulation of 3rd and 4th antennal segment in imago!) are quite wrong. Butler's note on the reddish-testaceous general colour of this insect is correct, as the red pigmentation occurs very often in nymphs of European Dipso-coridæ. The amount of this pigmentation varies considerably in individual specimens, in some (as the specimen described e.g.) the red pigment is lacking. Jordan's (1941) five-line note on the nymph of the species considered is not accurate as to the openings of the dorsal abdominal glands (see the next chapter). Of the other *Ceratocombus* species only the head of 5th stage nymph of American species, *Ceratocombus (Xylonannus) vagans* McAtee & Malloch, 1925 was figured by Spooner (1938). It agrees with our species in all the principal features of the structure of the head capsule.

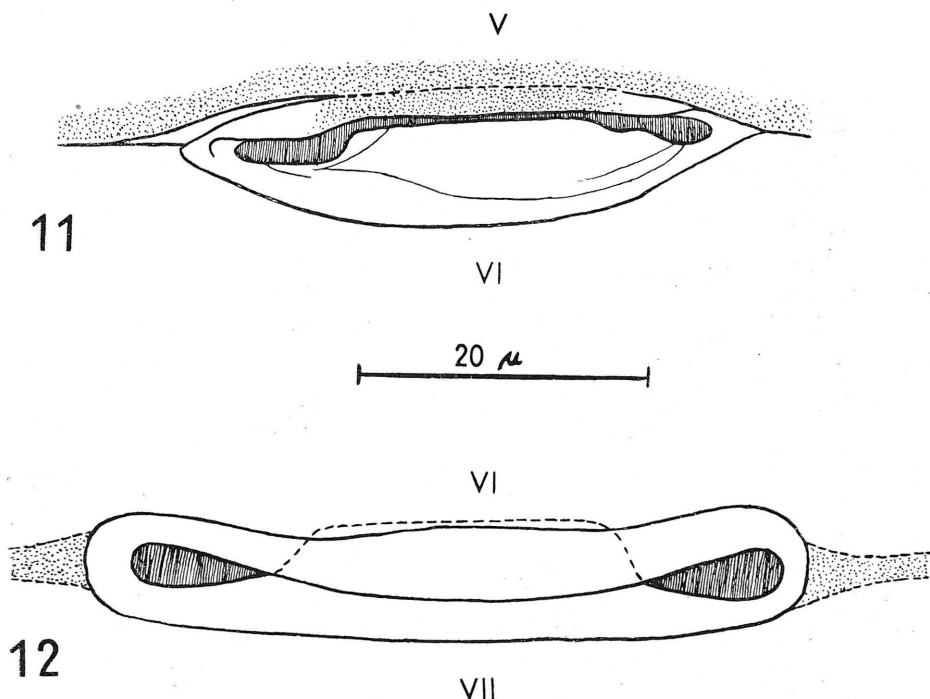


Fig. 11. Opening of the dorsal abdominal gland between the 5<sup>th</sup> and 6<sup>th</sup> tergites. Fig. 12. Opening of the dorsal abdominal gland between the 6<sup>th</sup> and 7<sup>th</sup> abdominal tergites.

### III. Systematic and morphological remarks

1) Some remarks on the nymphs of the genus *Pachycoleus* Fieber, 1860.

(*Pachycoleus*—synonymized tentatively with *Cryptostemma* H.-S., 1835 by Wygodzinsky 1950b!). Due to the questions considered below it is necessary to record here some features of the nymphs of both *Pachycoleus* species (the descriptions are in preparation): the openings of dorsal abdominal glands are placed between the urites III—IV, IV—V, V—VI and VI—VII. Præ-tarsus with long, narrow, pointed membraneous arolium, similar to those of nymphs of *Cryptostemma haywardi* Wyg., 1952 and *C. usingeri* Wyg., 1955.

2) Notes on the openings of the dorsal abdominal glands of the nymphs of Dipsocoridae.

There exist some confusions as to the number of openings. Jordan (1941) described the nymphs of the species *Pachycoleus walthi* Fieb., 1860 and *Ceratocombus coleoptratus* (Zett., 1819) as insects with 3 dorsal glands and corresponding openings. Similarly Jordan (1951) and Leston & Scudder (1956) classified Dipsocoridae into that group of heteropterous families having 3 dorsal abdominal glands. Leston (1954) found 4 pairs of orifices (the

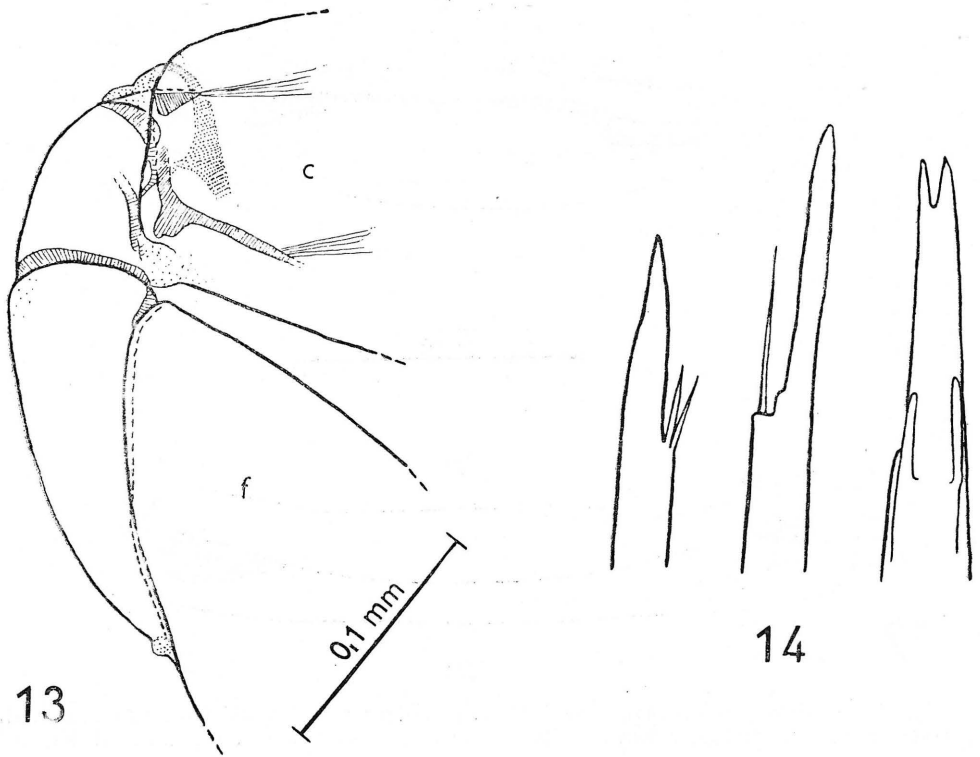


Fig. 13. Trochanter of the fore leg. Inner apodemes shaded. The hairs are omitted. C = coxa, F = femur. Fig. 14. Various forms of the tips of long abdominal setae. Under high magnification, without scale.

posterior without glandular sac) in the nymph of *Cryptostemma alienum* H.-S., 1835. Wygodzinsky (1953) did not find any openings in nymphs of *Trichotonannus dundo* Wyg., 1953. The same author described (1952) the nymph of *Cryptostemma haywardi* Wyg., 1952 as having 4 openings of dorsal abdominal glands, but without glandular sac in the last opening. Similar conditions exist in the nymphs of *Cryptostemma usingeri* Wyg., 1955, but this insect possesses "an additional small gland opening between abdominal tergites VII and VIII" (Wygodzinsky 1955). Carayon (1949) had written on Dipsocoridæ: "Il existe chez les larves 4 glandes abdominales médio-dorsales (la postérieure nettement plus réduite que les 3 précédentes qui sont également développées)". (This statement may be valid, perhaps, as a generalized rule for most Dipsocoridæ s. str., but certainly not for Schizopteridæ—considered as a subfamily in the Carayon paper mentioned—as can be seen by Wygodzinsky 1950a). The present author showed the number of abdominal gland openings in *Pachycoleus*-species and in *Ceratocombus coleoptratus* (Zett.) as to be four.



We can summarize: the nymphs of the genera *Ceratocombus* Sign., 1852 and *Pachycoleus* Fieb., 1860 possess 4 openings of dorsal abdominal glands (regardless of the functional or functionless state of the gland, regardless of the paired or unpaired aperture). They are placed (if we accept a hypothesis on their intersegmentary origin and position) between the tergites III—IV, IV—V, V—VI and VI—VII. The same conditions can be found in the nymphs of the genus *Cryptostemma* H.—S., 1835; however, the nymph of *Cryptostemma usingeri* Wyg., 1955 possesses probably a 5th opening between the tergites VII—VIII. No openings developed in the nymphs of *Trichotonannus* Reut., 1891.

The abdomen of nymphs of the most closely allied family Schizopteridæ is provided with paired apertures of dorsal gland openings between the Vth and VIIth tergites in the genera *Machadonannus* Wyg., 1950, *Luachimonnannus* Wyg., 1950, *Vilhenannus* Wyg., 1950 and *Humpatanannus* Wyg., 1950; no openings present in *Seabranannus* Wyg., 1950 (Wygodzinsky 1950a). The nymphs of the superfamily Cimicoidea, in which the Dipsocoridæ were sometimes placed, possess 3 dorsal abdominal gland openings in Cimicidæ, Microphysidæ, Anthocoridæ and Nabidæ, one opening in Miridæ and Isometopidæ and no opening in Polycetenidæ.

The dorsal abdominal glands of the nymphs of Heteroptera are — whatever their homology or origin may be — serially homologous and metamERICALLY arranged organs. Consequently we may assume that the greater number of their openings (without, of course, counting the secondarily (?) developed paired openings on the same intersegmentary region) indicates a more generalized condition. Dipsocoridæ belong apparently to the most primitive heteropterous families in this respect. This fact, together with the appearance of the tendency to reduce these openings within the same family, the extreme specialization of Dipsocoridæ on one hand, and presence of both cimicomorphan and pentatomomorphan characters on the other hand, suggests Dipsocoridæ as to be descendants of separate developmental line of Geocorisæ, allied to both main developmental stems—pentatomomorphan and cimicomorphan. (Leston [1957] studying the stridulatory mechanisms of terrestrial Heteroptera came to a similar conclusion.)

3) Distinguishing characters between the nymphs of European Anthocoridæ and Dipsocoridæ.

The superficially similar nymphs of European species of Anthocoridæ (esp. Lyctocorinæ) can be easily distinguished from the nymphs of European Dipsocoridæ as follows:

- 1 (2) Three dorsal abdominal gland openings (between tergites III—IV, IV—V, and V—VI). The second antennal segment longer than the 3rd, or subequal. Relatively flattened species . . . . . **Anthocoridæ**
- 2 (1) Four dorsal abdominal gland openings (between tergites III—IV, IV—V, V—VI and VI—VII). The second antennal segment considerably shorter than the 3rd. Un-flattened species . . . . . **Dipsocoridæ**

4) Notes on the systematics of Dipsocoridæ.

The relationships among the genera of Dipsocoridæ have remained obscure up to the present time. The observations of Carayon (1949, 1950),

McAtee & Malloch (1925), Wygodzinsky (1952, 1955) and the present author exhibit, however, such essential differences between *Ceratocombus* Sign., 1852 on the one hand and *Cryptostemma* H.-S., 1835 and *Pachycoleus* Fieb., 1860 on the other, that the division of Dipsocoridae into 2 subfamilies would seem well justified. (Carayon [1950] also emphasized the great difference between *Ceratocombus* and *Cryptostemma* on the basis of the study of ovarioles.)

*Ceratocombus*: Cuneal fracture short, interrupting the marginal hemelytral vein only. The male abdomen symmetrical, the male genitalia nearly so. Female with well developed ovipositor. Ovaria with 6 ovarioles. Præ-tarsus of nymph without membranous arolium.

*Cryptostemma* and *Pachycoleus*: Cuneal fracture deep, reaching the medial vein. Male abdomen and genitalia highly assymetrical. Female with reduced ovipositor. Ovaria with 5 ovarioles. Prætarsus of nymph with long and pointed membranous arolium.

It is possible that the genera mentioned above represent different developmentary trends within the family. Unfortunately, most of genera are very unsatisfactorily known and in no genus (except for 3 genera mentioned) have all the considered characters been investigated. Until now we cannot judge of the phylogenetic significance of those characters, but by analogy with other heteropterous groups they all seem to be of a higher importance. The *Ceratocombus*-characters are undoubtedly more generalized. The genera *Leptonannus* Reut., 1891, *Mutianvuaia* Wyg., 1953 and *Issidomimus* Popp., 1910 seem to be allied to *Ceratocombus*, while in *Trichotannus* Reuter, 1891 the characters of both groups appear.

#### 5) Trochanters of *Ceratocombus coleoptratus* (Zett.).

The trochanters of all pairs of legs of both nymph and adult insect seem at first glance two-segmented (Fig. 13). If more carefully examined, complicated endoskeletal apodemal structures may be found on the distal end of the coxa and on the base of the "1st trochanter" and an apodemal ring may be seen on the base of the "2nd trochanter". It is possible, that two-segmented trochanter (as in Odonata) or trochanter and basal subdivided part of femur (as in most Hymenoptera) or simply a trochanter only seemingly divided by a ridge (corresponding to the interne ring-apodeme) is involved. As the data on the musculature are lacking, I refrain, for the time being, from entering into a discussion of the matter. If two joints developed in fact, then they must be very firmly joined.\*)

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\*) Southwood [1953, *Trans. Roy. Ent. Soc. Lond.* 104 (11): 415—449] ascertained a similar condition in the genus *Orthotylus* Fieb. (Het., Miridae). His investigations, supported by the study of musculature, have shown that the first segment is a true trochanter, whereas the second segment represents only a subdivision of the femur (a prefemur as in Hymenoptera). That is also in all probability the case of *Ceratocombus coleoptratus* (Zett.).

## Summary

- 1) The 5th stage nymph of *Ceratocombus coleoptratus* (Zett., 1819) is described and figured in detail.
- 2) This nymph possesses a regular chætotaxy, 4 openings of dorsal abdominal glands and prætarus without long pointed arolium.
- 3) Some remarks on the morphological characters of *Pachycoleus*-nymphs are given.
- 4) The literary data on dorsal abdominal glands of Dipsocoridae are reviewed and in this respect the generalized condition of Dipsocoridae is emphasized.
- 5) The distinguishing characters between the nymphs of European species of Dipsocoridae and Anthocoridae are pointed out.
- 6) Some notes on the relationships within the family are given and the genera *Cryptostemma* H.-S. and *Pachycoleus* Fieb. on the one hand and *Ceratocombus* Sign. on the other hand are compared.
- 7) Some features of the peculiar structure of trochanters of *Ceratocombus coleoptratus* (Zett.) are mentioned.

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