On the Problem of Homology of the Clypeus and Labrum in Coccids (Homoptera, Coccina)

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Received January 10, 2022; revised March 20, 2022; accepted March 20, 2022

Abstract—Arguments by P. Pesson and S. Singh on the homology of the clypeus and labrum in Coccina are supported. The labrum rudiment at the apex of the anteclypeus in coccids and reduction of lora in Margarodidae s. l. are considered.

Keywords: Homoptera, Coccina, homology of the clypeus, lora, labrum

DOI: 10.1134/S001387382203006X

From the earliest works (Weber, 1930; Silvestri, 1934) up to modern times (Koteja et Liniowska, 1978), the anteclypeus of coccids has been interpreted as the labrum, although its correct homology was established already by Pesson (1944) and Singh (1971); the rudiment of the true labrum has remained unrecognized until the publication of Singh (1971). The homology of facial structures can be correctly assessed by comparing the cephalic sclerotization in coccids with that in their sister or, more precisely, parental taxon, i.e., aphids (Shcherbakov and Popov, 2002).

Aphids possess all the basic elements of facial sclerotization characteristic of Rhynchota (Silvestri, 1934; Singh, 1971), namely the clypeus subdivided into post- and anteclypeus, the lora (mandibular plates), and the typical narrow, elongate-conical labrum. These elements are represented in the clearest and most typical (archetypical) form in the 1 instar nymph of the black peach aphid Brachycyclus persicaeniger Smith, illustrated by Silvestri (1934, fig. 408) (see Fig. 2, 1, 2).

Aphids retain a fairly mobile lifestyle and a normally separated head; unlike coccids, they have a well-developed rostrum and no crumena. “Den normalen Funktionalstyp, der zweifellos für Hemipteren relativ ur sprunglich ist, verkörpert zum Beispiel die Aphiden” (Weber, 1930: 60).

All the Rhynchota possess a specific “rhynchotal” piercing-sucking rostrum, in which the maxillae (their laciniae) and mandibles have been transformed into stylets and enveloped by a modified tubular labium; at the same time, the labrum has become smaller and narrower, so that it covers only the basal portion of the dorsal labial cleft distad to the clypeus (Fig. 2).

A small but distinct, elongate-conical labrum is present in Aphidina (Weber, 1930: 212; Silvestri, 1934: 398; Singh, 1971), Psyllina (Weber, 1930: 198, 200, 201, 386; Silvestri, 1934: 373), Peloridiina (Myers and China, 1929), Heteroptera (Weber, 1930: 186, 198, 386; Silvestri, 1934: 205, 245, 262, 265), and Auchenorrhyncha (Silvestri, 1934: 311, 336, 337, 363, 367; Anufriev and Emeljanov, 1988: 13), its homology raising no doubt in any of the above cases. The labrum of Aleurodina (Fig. 2, 5–7) is also distinct and separated from the anteclypeus by a constriction, but strongly reduced in size (Weber, 1930: 212). This element was also clearly illustrated by Silvestri (1934: 394, 402, 409) but not mentioned in description since, unlike H. Weber, F. Silvestri erroneously regarded the anteclypeus as the labrum (see below).

Due to reduction of the rostrum proper, i.e., the labium (but not the stylets) in Coccina (Fig. 2, 4), the labrum has also been reduced to a tiny ledge on the
distal margin of the anteclypeus. This element is very evolutionarily stable and present in most coccids (see numerous illustrations in Koteja and Liniowska, 1978). This small ledge at the tip of the anteclypeus was apparently overlooked by researchers, including H. Weber, so that the anteclypeus was misinterpreted as the labrum. In their extensive work on facial sclerotization of coccids, Koteja and Liniowska (1978) also regarded the anteclypeus as a labrum, which they called the clypeolabral shield. However, the labrum of Rhynchota is never flanked by the lateral parts of the clypeus and is never shaped as a broad blunt plate that could be confused with anteclypeus; on the contrary, it is the basal part of the anteclypeus that is always located between the tips of the lora, as in aphids (Silvestri, 1934: 443). It should be noted that the works of Pesson (1944) and Singh (1971) escaped the attention of most researchers and were not usually cited or commented on in reviews. An exception was the monograph on the insect head by R. Matsuda (1965), but he did not discuss the homology of the clypeus and labrum in coccids.

As can be seen in the drawings of H. Weber (1930: 213), the rostrum of the mealybug *Pseudococcus adonidum* Geoffroy = *Ps. longispinus* (Targioni Tozzetti) in the working state is positioned at a right angle to the anteclypeus (designated as the labrum: OL by the cited author); in this case the normally developed labrum would also be flexibly articulated with the anteclypeus. The clypeolabral shield of coccids should be more correctly called clypeoloral, since it incorporates the lora while the labrum is reduced.

The boundary between the lora and the anteclypeus is well defined in coccids, but the boundary between the lora and the postclypeus is nearly always absent (Fig. 1, 1, 2; Fig. 2, 4); it is partly discernible only in *Phenacoleachia* (Phenacoleachiidae, Archaeococcida) (Koteja and Liniowska, 1978, fig. 1, 1) and probably also in *Dactylopius* sp., *Cerococcus punctiferus* (Green), and some Neococcida (Koteja and Liniowska, 1978, fig. 7, 1, 4).

Unfortunately, the material of Archaeococcida considered by Koteja and Liniowska (1978) was insufficient and incomplete: some families (Ortheziidae, Phenacoleachiidae) were represented only by adults, others (Margarodidae, with a single exception of *Gueriniella* Fern.), only by the I instar nymphs, and none of the species was represented by both the I instar nymph and the adult. Since the adult clypeolabral shield of *Gueriniella* is quite different from the nymphal shields, which are all very uniform, the shield structure seems to change during the final molt to the adult. For this reason, it is
not clear how the “clypeolabrum” is transformed. At least with respect to Neococcida, it can be stated that no major transformations of the shield occur at the final molt.

Apart from Orteziidae and Phenacoleachiidae, resembling Neococcida in their facial shield (“clypeolabrum”) morphology and showing the smallest deviation from the plesiomorphic variant typical of aphids, the Archaeococcida also include the vast group Margarodidae s. l. with a very peculiar narrow facial shield, which lacks sclerotization in the loral area at least in the nymphs, i.e., the entire shield consists essentially of the clypeus. The epistomal suture in these taxa adjoins the boundary with anteclypeus.

Two ways leading to this condition can be imagined: extension (instauration) of the postclypeoloral carina up to its connection with the epistomal edge (suture) and simultaneous desclerotization of the lora, or gradual

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Fig. 2. Morphology of the facial region in Homoptera: (1, 2) Aphidina, 1 instar nymph of Brachycaudus persicaeniger Smith: (1) total ventral view; (2) enlargement of facial region; (3) Auchenorrhyncha, adult of Xestocephalus freyi Lindb. (Cicadellidae); (4) Coccina, Icerya purchasi Mask. (Margarodidae); (5–7) Aleyrodina: (5, 6) Auleurolabus olivinus Silv.: (5) head in antero-ventral view; (6) enlargement of anteclypeus and labrum; (7) Bemisia tabaci Gem., head in lateral (left) view. 1, 2, 3–7 after Silvestri, 1934; 3 after Anufriev and Emeljanov, 1988; 4 modified after Pesson, 1944. acl, anteclypeus; fcl, frontoclypeus; lbr, labrum; lor, lorum; mxp, maxillary plates; pcl, postclypeus; pclr, postclypeoloral suture. Original designations used by F. Silvestri in (3): B, labrum; D, mandible [= lorum]; E, maxilla [= maxillary plate]; F, labium [= proboscis]; S, mandibular and maxillary setae [= stylets; misprinted as “gonapophyses” in the original Russian text.—Author.
reduction of the lora and their shift toward the ante-
clypeoloral carina up to their complete disappearance.
The distal portion of the postclypeoloral carina (suture) 
in some neococcids reaches the level of the lateral edges 
of the clypeal part of the epistomal suture, e.g., in Ceroputo 
pi losella e Šulc and Dactylop i us sp. (Koteja and 
Liniowska, 1978, fig. 3, 5, fig. 7, 2); the only remaining 
step would be joining of the two sutures.

The structure of the facial shield in Margarodidae s. l. 
suggests that this family is a deviated lineage branching 
off the basal part of the Coccina tree.

ACKNOWLEDGMENTS

I am sincerely grateful to D.E. Shcherbakov (Paleontologi-
cal Institute of the Russian Academy of Sciences, Moscow) 
for his help in finding the literature.

FUNDING

This work was carried out within the framework of the 
State Research Assignment 122031100272-3 at the Zoologi-
cal Institute of the Russian Academy of Sciences.

COMPLIANCE WITH ETHICAL STANDARDS

Statement on the welfare of animals. All the applicable 
international, national, and/or institutional guidelines for the 
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