

## The Position of *Trochiliphagus* Carriker within the Ricinidae (Insecta: Phthiraptera)

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**Abstract.** Two forms of the Ricinidae (Mallophaga, Phthiraptera) that live on Trochilidae have independently developed piercing mouthparts. The one (*Trochiloecetes*) is obviously an ancient inhabitant of hummingbirds, whereas the other has settled these birds rather recently. CARRIKER (1960) established a new genus "*Trochiliphagus*" for the second one. It is demonstrated that these lice belong to *Ricinus* de Geer, 1778, a genus with normal biting mouthparts which is widespread on Passeriformes. *Trochiliphagus* Carriker, 1960 is placed as a junior synonym of *Ricinus* and all species described till now should be named *Ricinus jimenezi*. Within *Ricinus* these hummingbird-dwelling lice are best placed in the *dolichocephalus* species-group. Obviously mouthparts have a high plasticity and are not good for diagnostic characters.

**Keywords.** *Ricinus jimenezi*, piercing mouthparts, secondary settlement.

### 1. INTRODUCTION

CLAY (1949) detected that among lice with biting mouthparts (= Mallophaga) the members of the genus *Trochiloecetes* Paine & Mann, 1913 that live on hummingbirds have developed piercing mouthparts independent of the Anoplura. She described details of the mouthparts that emerged from the hypopharynx and the ligular sclerites. According to CLAY the mandibles are reduced.

Rather incidentally CLAY mentions that on hummingbirds there are also members of the genus *Ricinus* de Geer, 1778 that have also lost the typical mouthparts of Mallophaga, though the changes are not as far-reaching as in *Trochiloecetes*. She continues: "The *Ricinus* species on the Trochili are typical of the genus apart from the modified mouthparts, and this modification, therefore, must have taken place in the *Ricinus* species of the Trochili after the morphological characters of the genus *Ricinus* had been established; *Trochiloecetes*, closely related to *Ricinus* and restricted to the Trochili, must be a later derivative from a *Ricinus*-like ancestor."

CARRIKER (1960) revised this group of lice, but created many problems. For example, he established a new family (Trochiliphagidae) for the two genera parasitizing hummingbirds. However, he designated *Trochiloecetes* as genotype. Thus the correct family spelling should be Trochiloecetidae (s. EICHLER 1963). CARRIKER, too, transferred the *Ricinus*-like mallophaga (s. CLAY) to a new genus *Trochiliphagus*.

CARRIKER (1960) believed that *Ricinus* is the progenitor for both, *Trochiloecetes* and *Trochiliphagus*. He ignored

that *Ricinus* itself digests blood and not feathers and concluded that both on hummingbirds living genera developed the sucking apparatus because of lack of suitable feathers. CARRIKER was not aware that the piercing mouth parts of *Trochiloecetes* and *Trochiliphagus* have developed independently. In his mind the change from biting to piercing mouthparts is so essential that it justifies the separation into a new family.

In his monograph EICHLER (1963) presents a system for "Mallophaga" within which the "superfamilia" Laemobothrioidea includes two "interfamilias": Laemobothriiformia and Riciniformia. Within the latter he defines two families, Ricinidae (with the genus *Ricinus*) and Trochiloecetidae (with the genera: *Trochiloecetes* and *Trochiliphagus*). More recently, PALMA (1996) in the Zoological Catalogue of Australia placed all three mentioned genera in the family Ricinidae, as did PRICE et al. (1993) in the last World Checklist. I will follow this decision here.

Members of *Ricinus* have biting mouthparts and feed on blood of species of Passeriformes s. lat., whereas those of *Trochiloecetes* and *Trochiliphagus* have sucking mouthparts and feed on blood of hummingbirds (Trochilidae).

An earlier paper (RHEINWALD 1968) contained a revision of the Old-world species of *Ricinus* and established four species-groups. NELSON (1972) revised the New-world species and established eight species-groups, of which three are identical with the old-world groupings. Therefore six species-groups are recognized with altogether 54 species.

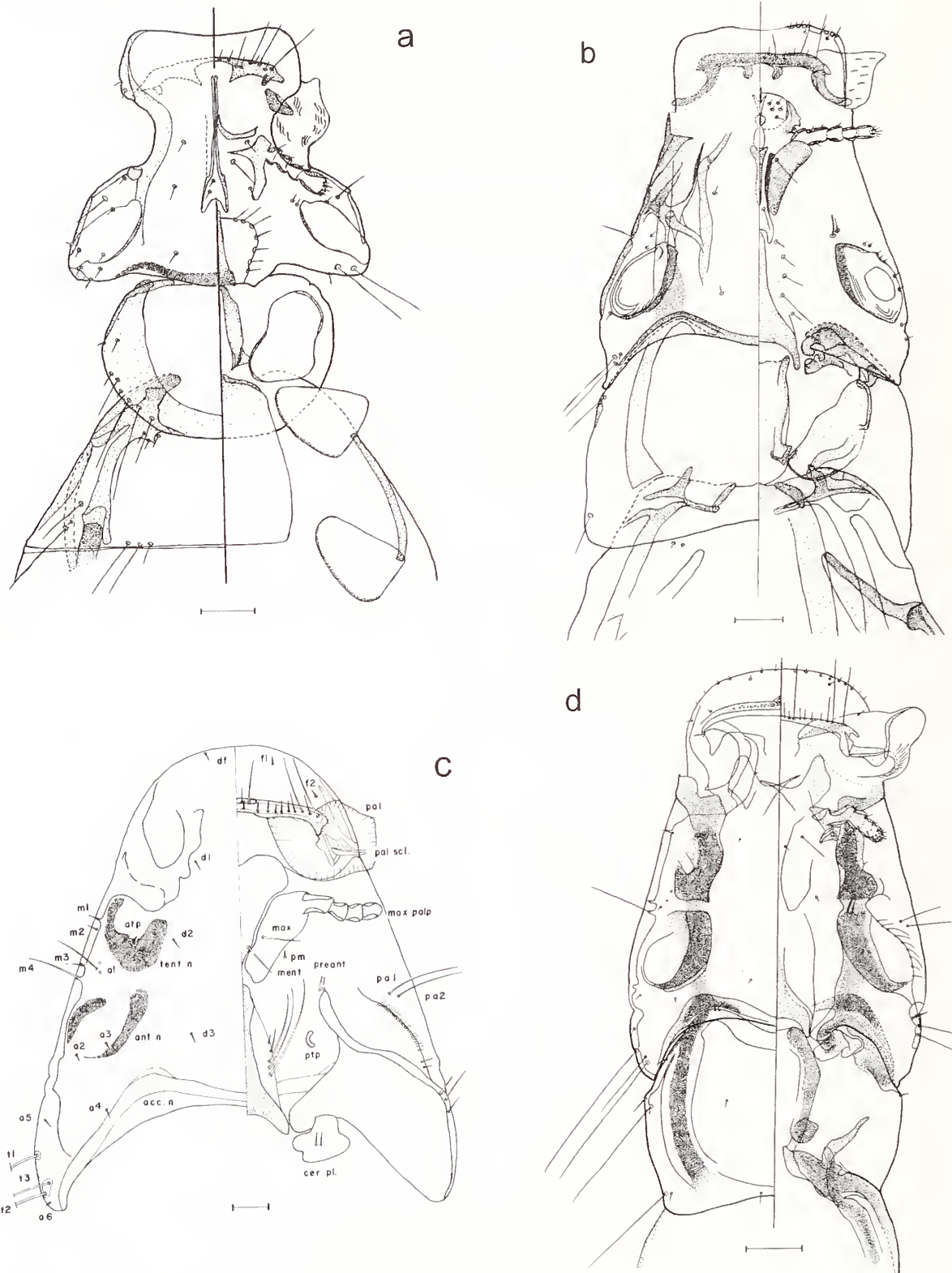


Fig. 1. Head and prothorax of females a: *Trochiloecetes ochoterenai?*, b: "*Trochiliphagus*", c: *Ricinus brevicapitatis* (from NELSON 1972, plate 2), d: *R. dolichocephalus* (from RHEINWALD 1968, Fig. 13). Left from dorsal, right from ventral. Scale bar 0.1 mm.

CARRIKER (1960) identified at least ten species of *Trochiliphagus* based on minimal size differences and minute changes in shape of the clypeus and prothorax, these differences are often an artefact due to preparation. Generally he says (1960: 331): "There is a generic conformity in the general shape of the head and in the absence of darker markings, following the type of *Ricinus microcephalus*<sup>1</sup> Kellogg, except that the head is longer and usually narrower in the temples."

Nearly all specimens of *Trochiliphagus* which are deposited in US collections were collected by M. A. CARRIKER. Most of these specimens from a large number of hosts were loaned and studied by Dr. J. Willis-Oniki (Rio Claro, Brasilia) and me in Bonn. Here I noticed the enormous similarity between *Trochiliphagus* and *Ricinus*.

It is the aim of this paper to clarify the position of *Trochiliphagus* within the Ricinidae as far as this is possible with conventional methods.

## 2. MATERIALS AND METHODS

Drawings were made and measurements taken from the specimens listed in the Appendix. Usually lice are killed and conserved in 70 % ethanol. For mounting on slides they first are hydrated, then treated with weak KOH to resolve the non-chitinized parts of the inside and then embedded in resin. The resolution of the inner parts is necessary; otherwise details of the chitinized skeleton will not be visible. But that means that all characters we know are features of the chitinized skeleton, upon which all species descriptions are based exclusively. For a detailed study of the mouthparts of *Trochiloecetes* and *Ricinus* we possibly also need histological sections.

In my revision of *Ricinus* I figured head and prothorax of every species as well as the terminal segments of the female in dorsal and ventral views. Additionally mandibles, labium and cardo-stipes, gular sclerite and the sternites of pro- and metathorax as well as the male genitalia were presented. NELSON (1972) also followed this format. Therefore I will present here for comparison just these parts in the same view. Additionally claws and limbs of the third leg of a female are measured and drawn.

## 3. RESULTS

### 3.1. Head and prothorax

In Figure 1 the head and prothorax of *Trochiloecetes ochoterenai*?, "*Trochiliphagus*", *Ricinus brevicapitatis* Carriker (from NELSON 1972, Table 2) and *R. dolicho-*

*cephalus* (Scopoli) are presented in the same arrangement. *Ricinus brevicapitatis* is the typical species parasitizing Cotingidae – a bird family close to the base of the Passeriformes. If the classification in EICHLER (1963) is accepted, then *Trochiliphagus* and *Trochiloecetes* should be most similar. However, as Figure 1 shows, the highest similarity exists between *R. dolichocephalus* and "*Trochiliphagus*". A special feature of "*Trochiliphagus*" and some species of the *dolichocephalus*-group is that the maxillary palpi exceed far beyond the sides of the head, whereas in all other species the palpi do not reach the border of the head. Additionally, the dorsal lamina of the occiput is well developed.

### 3.2. Mandibles (Fig. 2)

The only clearly visible feature of the mandible is the articulation. If we follow the sclerites from the articulation further we find in *Trochiloecetes* the structure which CARRIKER (1960) called the "collar", but it is most likely the remaining portion of the mandible. The mandible of CARRIKER appears to be part of the basal limb of the palpus. In (b) ("*Trochiliphagus*") homologizing the "mandibles" is highly interpretable. Section series would be necessary to clarify these structures.

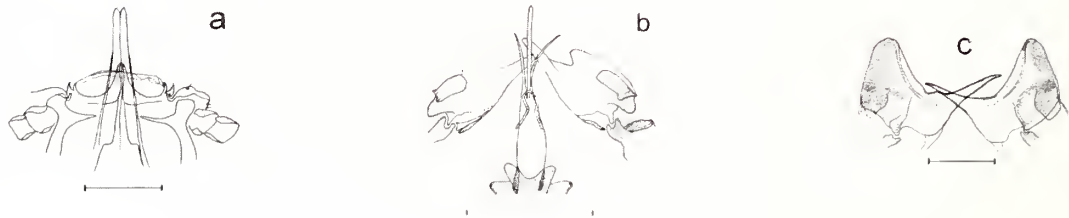
### 3. Gular plate, prosternite and metasternite (Fig. 3)

When we compare again the same forms, *Trochiliphagus* differs significantly from *R. brevicapitatis* and *Trochiloecetes* especially in the form of the gular plate and the prosternite. On the other hand, the agreement between "*Trochiliphagus*" and *R. dolichocephalus* is great, even in details in the form of the gular plate and the form of the sclerites in the pro- and metasternite. In RHEINWALD (1968), all species of the *dolichocephalus*-group (Figs 13–21, each no. d) generally show the same type as "*Trochiliphagus*", while the species of the *rubeculae*-group (Figs 22–33, each no. d) differ to some degree.

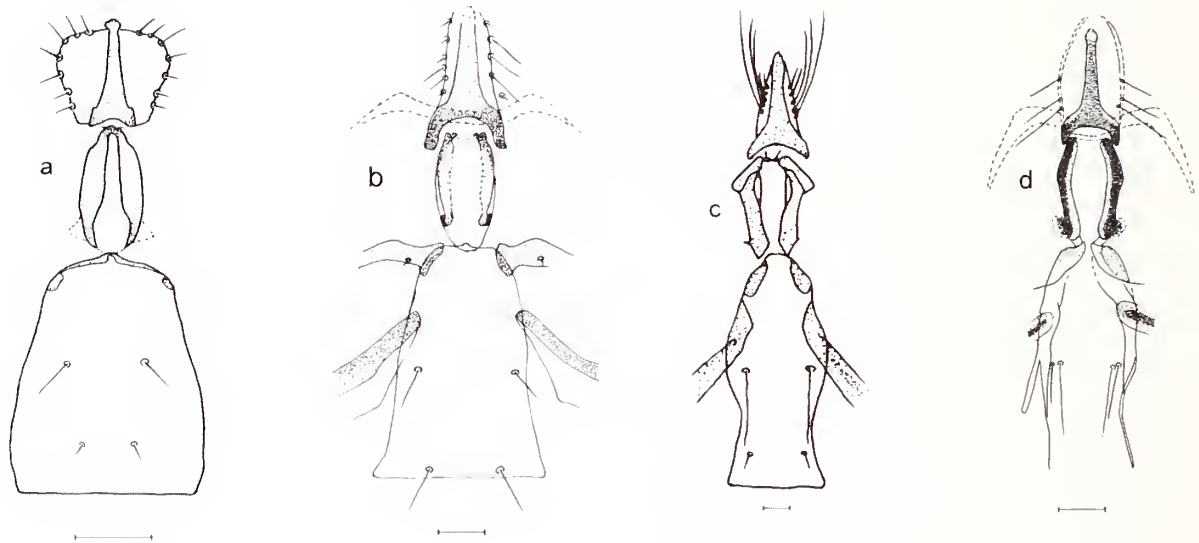
### 3.4. Labium and cardo-stipes (Fig. 4)

As the figures show, the labium is very uniform in all Ricinidae and therefore contributes little to the systematics of the group. But obviously the cardo-stipes in *Trochiloecetes* and "*Trochiliphagus*" assists considerably the stiletto in its function (see also Fig. 1). The plates behind the labium (cardo-stipes) in *Trochiloecetes* (a) have a rectangular form and in that differ considerably from *Ricinus*. As Figure 1 shows, the ligular sclerite of *Trochiloecetes* is connected directly with the stiletto and

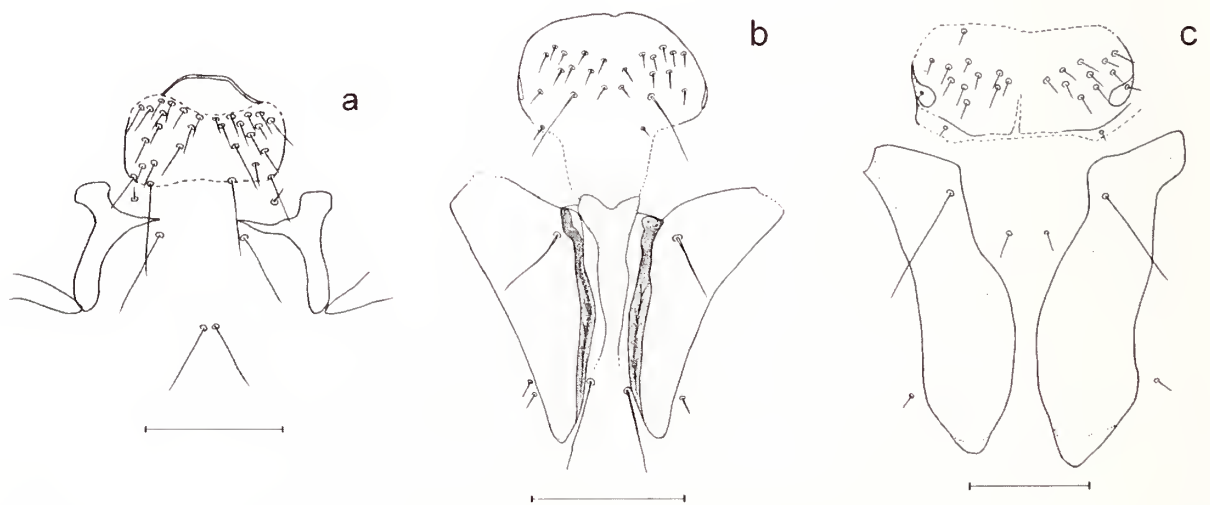
<sup>1</sup> Which according to my experience (s. RHEINWALD 1968) belongs to *R. fringillae*.



**Fig. 2.** Mouthparts of a: *Trochiloecetes ochoterenai?*, b: "*Trochiliphagus*", and c: *R. dolichocephalus* (from RHEINWALD 1968, Fig. 13). Scale bar 0.1 mm.



**Fig. 3.** Gular plate, prosternite and metasternite of a: *Trochiloecetes ochoterenai?*, b: "*Trochiliphagus*", c: *Ricinus brevicapitatis* (after NELSON 1972, combination from plate 2 and 3) and d: *R. dolichocephalus* (from RHEINWALD 1968, Fig. 13). Scale bar 0.1 mm.



**Fig. 4.** Labium and cardo-stipes (= maxillar plate according to NELSON 1972) of a: *Trochiloecetes ochoterenai?*, b: "*Trochiliphagus*", and c: *R. dolichocephalus* (from RHEINWALD 1968, Fig. 13). In b) an additional intermediate plate. Scale bar 0.1 mm.

at its protruding edges a muscle appears to be attached which stretches well forward (dashed line); obviously the stileto is bored into the skin by the ligular sclerite. The cardo-stipes is not enlarged, nor sclerotized.

In "*Trochiliphagus*" (b) the ligular sclerite appears not to be connected with the stileto, but the plate between the cardo-stipes is lengthened into a long, well sclerotized plate. The cardo-stipes in general has the form that is found in all *Ricinus* species (see NELSON 1972; RHEINWALD 1968) but it is enlarged and the inner margin is thickened. Obviously the short stileto of "*Trochiliphagus*" is moved by these plates and bored into the skin of the host. Though it is very difficult to see the single parts of the stileto in both forms with this preparation method, it seems to be rather clear that the stiletos are moved absolutely differently, which underlines the meaning that the two stiletos have developed convergently.

### 3.5. Female postabdomen (Fig. 5)

*Trochiloecetes* differs most; lacking pigmented sternal plates, having well pigmented pleurites to segment VI only and a very small anal tergite (cf. RHEINWALD 1968). Arrangement and relative length of setae differs in many respects from that of *Ricinus* species. *Ricinus brevicapitatis* (c) has, like all *Ricinus* species, pigmented sternites, pleurites up to segment VIII and a fringe of small setae at the well-developed anal tergite. "*Trochiliphagus*" and *R. dolichocephalus* are nearly identical, both having the anal tergite surpassing the margin of segment XI and by that the tip of the abdomen, and in the arrangement and the relative length of the tergal and sternal setae.

### 3.6. Male genitalia (Fig. 6)

In the three species of *Trochiloecetes* the general form is rather simple. The basal plate (cf. RHEINWALD 1968, Fig. 1g) is not pointed, the parameres are short and rounded and the genital sclerite is a simple, more or less rectangular structure without significant ornamentation. In *Ricinus arctuatus* (Kellog & Mann) (from Tyrannidae, plate 5 of NELSON 1972) and in other species-groups of *Ricinus* we find many peculiarities in the form of the mesosomal plate, the length of the parameres, the form and ornamentation of the genital sclerite. We find high agreement between "*Trochiliphagus*" and *R. dolichocephalus*. This is especially true in the form of the mesosomal plate and the length of the parameres; in all species of the *dolichocephalus*-group and in "*Trochiliphagus*" the preputial-sac is ornamented with fine structures which are missing in other species-groups.

### 3.7. Tarsus (Fig. 7)

In my revision of the genus *Ricinus* (RHEINWALD 1968) I did not investigate the tarsus. When studying more carefully members of the genus *Trochiloecetes* I noticed that they have huge claws on the last tarsal limb. Thereupon I compared the tarsi of *Trochiloecetes*, "*Trochiliphagus*" and several species-groups of *Ricinus*.

Some general remarks can be made: Obviously within a species the tarsi are morphologically identical, which means that besides individual differences which derive from mounting (as position, angle of the limbs to one another, wrinkles, shrinkages) and bad recognition deriving from the smallness of the object, a series of elements are species-specific. That is especially true for the form of the claws, the form of the outer sclerite at the second tarsal limb, position and size of the two "stonelets" (the homology of which is not clear to me). The form of the inner (second) tarsal limb is species-specific too, even when it is in most cases hard to see and by the position of the outer limb (the angle between outer limb and tibia) as a consequence of mounting is often heavily deformed.

As far as I have material, the species within a species-group of *Ricinus* (*fringillae*- and *rubeculae*-group) appear to correspond in the proportions of the tarsal limbs, the proportions of the claw, the form of the outer sclerite at the tarsal limbs and the tibia as well as in the length of the four large setae at the tip of the inner tibia. That means that members of *Ricinus* and *Trochiloecetes* are well distinguishable by their tarsi. But within the genus *Ricinus* there are also group-specific differences. On the one hand these are the lengths of the claw and the second tarsal limb relative to the total length. On the other hand the form of the outer sclerites of the second tarsal limb and the tibia and the position of the "stonelets" are group-specific.

In connection with the questions in this paper it is of main interest whether "*Trochiliphagus*" shows similarities to *Trochiloecetes* or to *Ricinus*. Table 1 shows that *Trochiloecetes* is separated from all other forms as well by the relative length of the claw as by the relative length of the tarsus. The form of the lateral sclerites of the second tarsal limb and tibia are also clearly different. The tarsus of *Ricinus rubeculae* (Schrank) appears also autapomorphic. It has the relatively smallest claw, the shortest tarsus, and the form of the lateral sclerite differs distinctly.

In opposite to *Ricinus rubeculae*, "*Trochiliphagus*" shows much conformity in the form of the sclerites with *R. fringillae* and *R. dolichocephalus*. While the relative length of the claw agrees well with *R. fringillae* and *R. dolichocephalus*, the relative length of the tarsus differs and appears to be mid-way between *Trochiloecetes* and

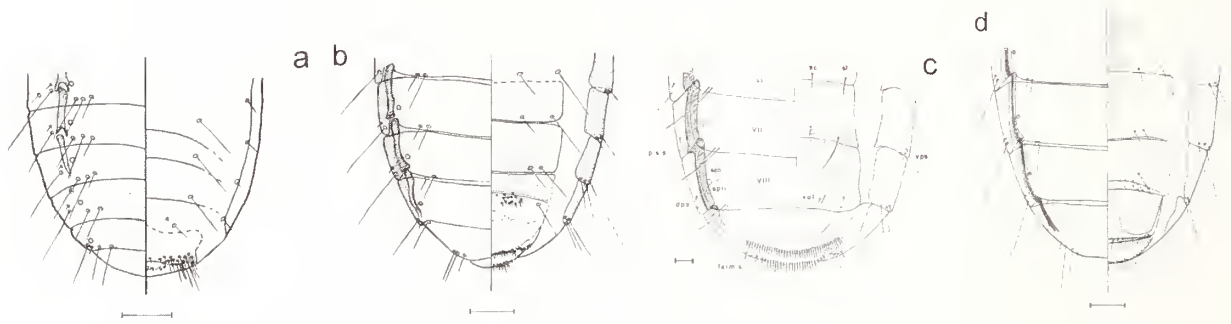


Fig. 5. Abdominal segments and the terminal plates of a: *Trochiloecetes ochoterenai*?, b: "*Trochiliphagus*", c: *Ricinus brevipitatis* (after NELSON 1972, plate 3) and d: *R. dolichocephalus* (from RHEINWALD 1968, Fig. 13). Left from dorsal, right from ventral. Scale bar 0.1 mm.

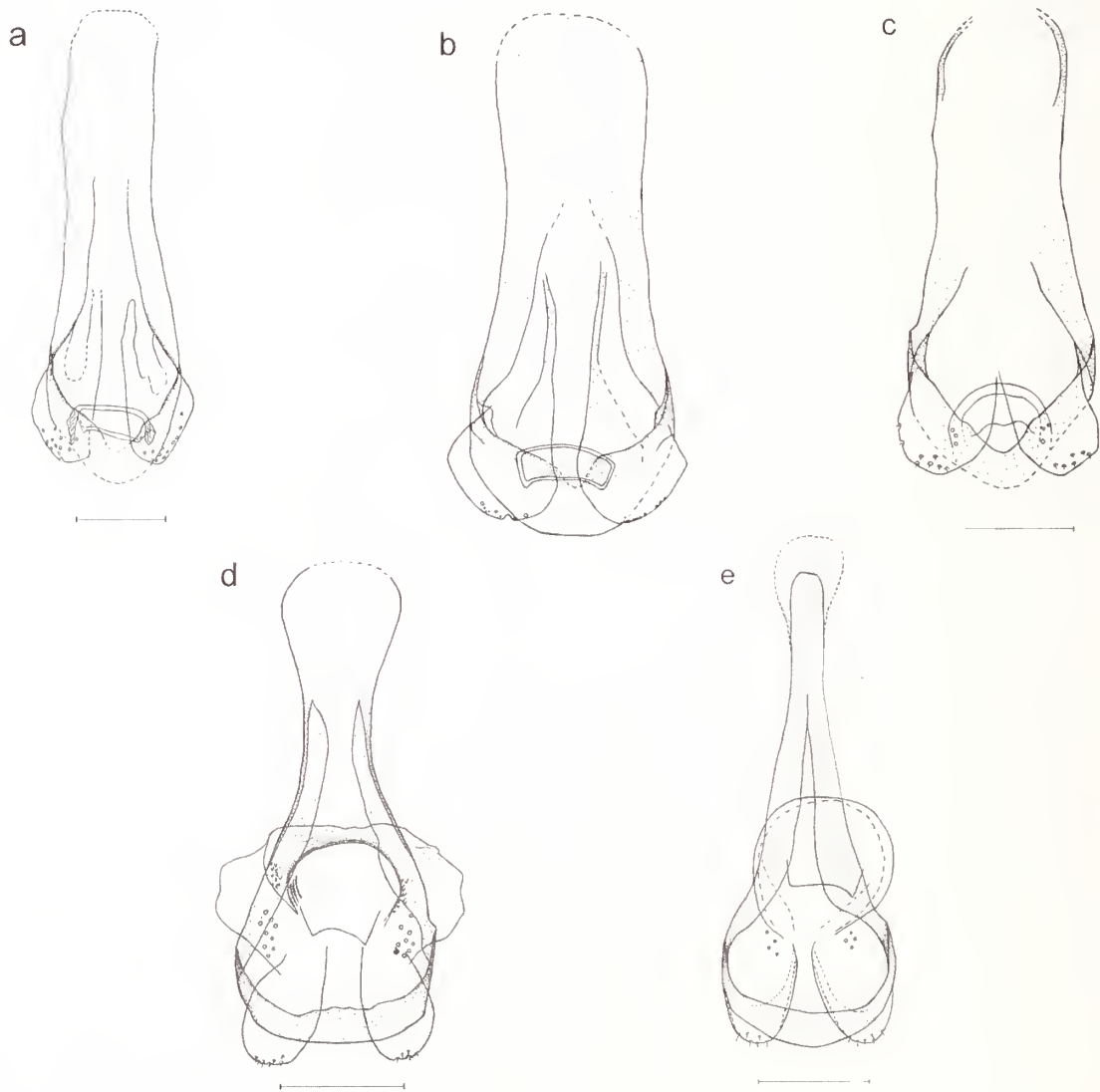
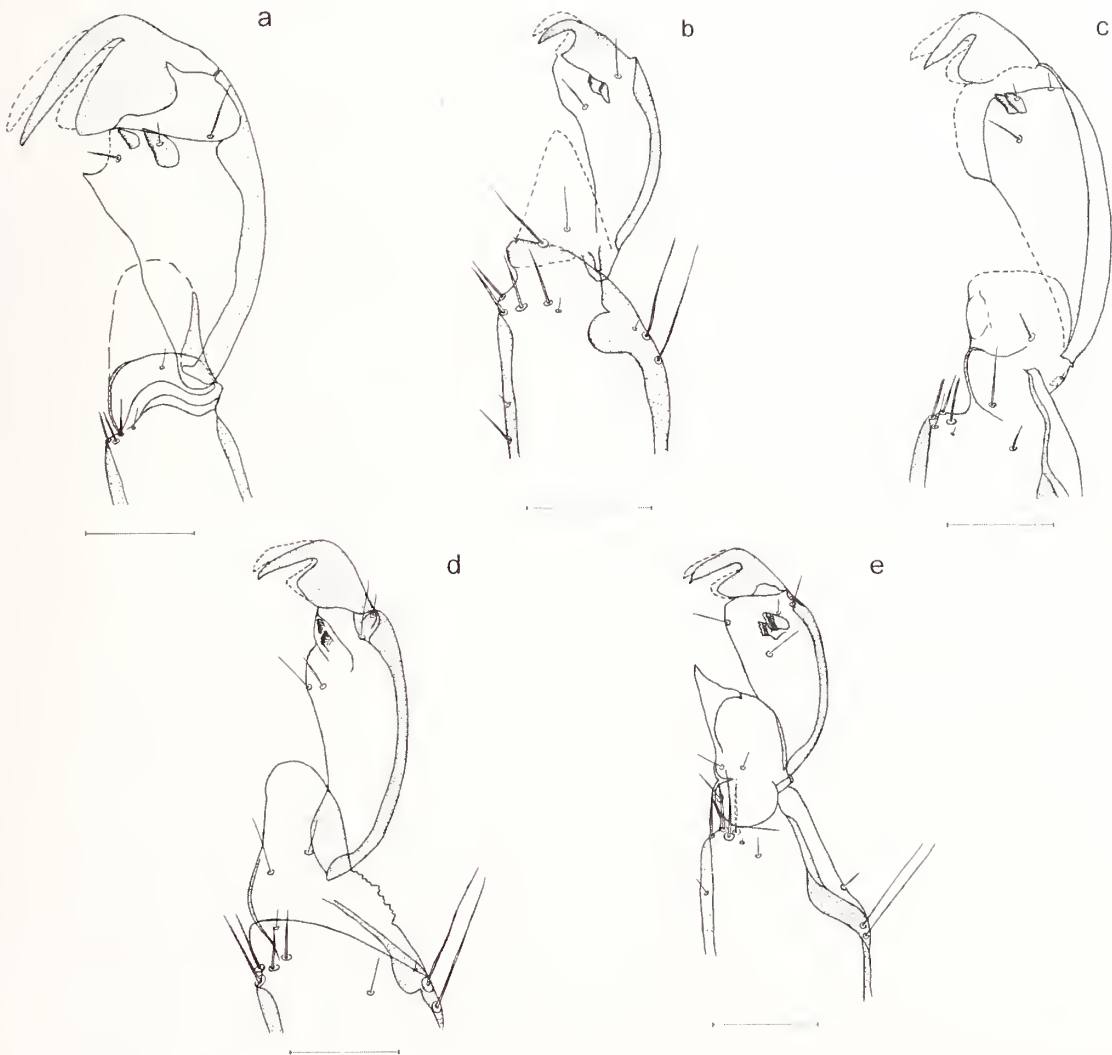


Fig. 6. Male genitalia a: *Trochiloecetes rumpumuni*, b: *T. insularis*, c: *T. ochoterenai*, d: "*Trochiliphagus*", e: *Ricinus dolichocephalus* (from RHEINWALD 1968, Fig. 13). Scale bar 0.1 mm.

**Table 1.** Length of the second tarsal limb and claw, and its relative length in relation to the total length of the two members of Ricinidae living on hummingbirds and of some *Ricinus* species.

	<i>Trochiloecetes</i>	" <i>Trochiliphagus</i> "	<i>R. rubeculae</i>	<i>R. fringillae</i>	<i>R. dolichocephalus</i>
total length [mm]	2.18	3.35	3.32	3.02	4.70
length of tarsus [mm]	0.338	0.322	0.178	0.203	0.305
length of the claw [mm]	0.159	0.076	0.038	0.063	0.079
relative length of tarsus	0.155	0.096	0.056	0.067	0.065
relative length of claw	0.073	0.023	0.011	0.021	0.016

**Fig. 7.** Claws, two tarsal limbs and tip of tibia of a: *Trochiloecetes ochotereuai*?, b: *Ricinus rubeculus*, c: "*Trochiliphagus*", d: *R. dolichocephalus*, and e: *R. fringillae*. Scale bar 0.1 mm.

*Ricinus*. One may well suppose that similar to the mouthparts, the tarsi have adapted to the same host-group – the hummingbirds – possibly convergently.

#### 4. DISCUSSION

##### 4.1. Position of “*Trochiliphagus*” within the Ricinidae

For an outgroup comparison members of the family Laemobothriidae seem to be optimal since together with Ricinidae it forms the subclass/superfamily Laemobothriformia. *Laemiobothrion maximum* (Scopoli) recently was investigated by PEREZ et al. (1995) with SEM. But comparable studies in *Trochiloecetes* and *Ricinus* do not exist. SYMMONS (1952) studied the Mallophagan head and also presented figures and descriptions of *Laemiobothrion* and description of *Ricinus*. But polarities can not be derived from this. Larger series of *Laemiobothrion maximum* were examined, but I was unable to homologize the different parts of the head to derive evolutionary trends. Therefore the question of the polarity between *Trochiloecetes* and *Ricinus* and within *Ricinus* remains unsolved.

Mallophaga as a rule live strictly host-specific, a fact that led to the rule of NITZSCH-KELLOGG. Hummingbirds and songbirds, according to the accepted classifications (e.g., SIBLEY & MONROE 1990) belong to different orders (resp. superorders) that are not closely related. Therefore one should expect that the many species that live on Passeriformes and till now are combined in the genus *Ricinus* should be differentiated significantly in their morphology from those living on Trochiliformes (*Trochiloecetes*, *Trochiliphagus*). As demonstrated in the figures this is true for *Trochiloecetes*. Not knowing the polarity, these characters can be understood as autapomorphic for *Trochiloecetes*.

In the opposite “*Trochiliphagus*” and *Ricinus* can not be separated from each other. As CLAY (1949) observed, these animals are part of the genus *Ricinus*. The cladistic analysis of MARSHALL (2003), based on 147 morphological characters, supports this idea. Within *Ricinus* all specimens of “*Trochiliphagus*” are best placed within the *dolichocephalus* species-group. If somebody wants to split up the genus *Ricinus* then these separations have to occur along the species-groups that were described by NELSON (1972) and RHEINWALD (1968) earlier. The differentiations of these species-groups relative to the *dolichocephalus*-group are so essential, that the small deviations that accompanied the development of the stiletto and the reduction of the mandibles in “*Trochiliphagus*” appear rather insignificant.

Herewith I place the genus *Trochiliphagus* Carriker, 1960 as a junior synonym of *Ricinus* De Geer, 1778. As much as I have seen in the different collections from a variety of hosts there are no consistent morphological differences between these populations. All appear to belong to one morpho-species.

This species should be named *Ricinus jimenezi* Carriker, 1903, though CARRIKER (1960) made *T. lazulus* Carriker 1960 the type-species of *Trochiliphagus*. There exists an older name: *Physostomum lineatum* Osborn, 1896 from *Trochilus colubris* (= *Archilochus colubris*). According to CARRIKER (1960) the three specimens on which the description was based no longer exist. The description makes clear that this is not a *Trochiloecetes*. If the host is correct this should be a “*Trochiliphagus*”, though the piercing mouthparts are not mentioned. Under these circumstances the name “*lineatus*” in the family Ricinidae should be suppressed. An application was directed to the International Commission for Nomenclature.

##### 4.2. Primary or secondary?

According to MARSHALL (2003) Laemobothriidae are not close relatives to Ricinidae and therefore not their ancestors. The whole amblycercan louse-family Ricinidae is restricted to Trochilidae and Passeriformes. The differences between *Trochiloecetes* and *Ricinus* fit well in the usual ideas of the relations between Trochilidae as part of the Apodiformes and the Passeriformes. Since the possession of mandibles is symplesiomorphic within the Amblycera, the piercing mouth parts of *Trochiloecetes* is an autapomorphy. If this relation is correct, then *Ricinus jimenezi* must have colonized the Trochilidae secondarily.

##### 4.3. Origin of the secondary colonization

The host-shift onto Trochilidae must have been from a songbird of the families Oriolidae, Meliphagidae, Nectariniidae, Rhipidurinae, Muscicapidae which are the host-families of the *dolichocephalus* species-group. But these bird families all occur exclusively in Africa or Asia. How could it happen that a *Ricinus* from the African-Asian realm colonized a hummingbird in South America? Colonization from an American family of Passerines would be much more likely. But then *Ricinus jimenezi* must show relations to species-groups of *Ricinus* established by NELSON (1972). I could not detect any agreement there.



#### 4.4 Are the Trochilidae a monophyletic taxon?

I do not believe that this is a relevant question, though theoretically it might be that some hummingbirds (the hosts of *Trochiloecetes*) are swift-relatives while others (the hosts of *Ricinus jimenezii*) are songbirds. But CARRIKER (1960) said that he had collected both forms from the same host.

#### 4.5. The development of piercing mouthparts

Hummingbirds have an extremely thick skin. Since the size of the parasites relative to the size of the host is limited, blood-feeding Ricinidae could not grow bigger as they are today. On the smaller hummingbirds these parasites are accordingly smaller. CARRIKER (1960) noted for *Trochiloecetes* a maximal body length of 2.54 mm (see Table 1), while according to his information females of "*Trochiliphagus*" reach 2.57 to 3.8 mm. With this body size the length of the mandibles is not sufficient to open the skin. If therefore a member of Ricinidae were to survive on hummingbirds it had to develop piercing mouthparts. This should be a plausible explanation for the convergent occurrence of two members of Ricinidae with piercing mouthparts on hummingbirds.

For *Trochiloecetes* this explanation may be evident. Because these are the original parasites, they should have evolved on hummingbirds since their separation from swifts and could gradually evolve a stylet to in addition to the mandibles; as soon as this stylet was completely functional the mandibles could be reduced.

For the secondary settler, *Ricinus jimenezii*, great obstacles must have arisen. When it moved from songbirds to hummingbirds it had mandibles and certainly no stylet because it did not need it for living on songbirds. But with its mandibles it could not pierce the skin of a hummingbird. Therefore it should have starved and a secondary infestation would not have happened. If it would have found thinner parts of skin where it may have survived some time why should it then evolve a stylet?

Even when the membership of "*Trochiliphagus*" to *Ricinus* and here to the *dolichocephalus* species-group seems to be evident, it is absolutely unclear how we can imagine the procedure of this secondary colonisation. The question of the offspring of *Ricinus jimenezii* and therefore its relations to *Ricinus* and perhaps the reconstruction of the history of its development might be a fascinating case for the application of modern enzymatic or DNA-techniques. The biggest problem here may be the procurement of relevant Mallophaga which in no case are abundant and in many cases are known to science just by one specimen.

Normally the eggs of *Ricinus* at the bases of the feathers of neck and anterior breast are so conspicuous that with some experience it is easy to detect those birds where it is worth while searching for adults.

#### 4.6. Plasticity of the mouthparts

The occurrence of biting and piercing mouthparts within the genus *Ricinus* throws new light on the question what value mouthparts have as characters for phylogenetic discussions. It is meanwhile common sense that Ischnocera and Anoplura are sister-groups (BARKER et al. 2003; HOPKINS 1949; WEBB 1946). In the Anoplura sucking mouthparts developed for the first time in the Phthiraptera. In the other large group of the Phthiraptera, the Amblycera, a stylet evolved twice, both within the Ricinidae. On the one hand in *Trochiloecetes*, which obviously is the characteristic Ricinidae of the Trochilidae, and on the other hand within *Ricinus* when one of its members secondarily colonised Trochilidae. That means that piercing mouthparts evolved at least three times within Phthiraptera.

But if such fundamental alterations are in principle possible, what general value has mouthparts as a phylogenetic feature? We have examples from other animal classes, such as birds, in which alterations in the mouthparts within small taxonomic units are of similar dimensions. As a consequence in future we should leave out features of the mouthparts in our data sets for the analysis of phylogeny.

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## APPENDIX

### Investigated material

#### The Natural History Museum, London

- |   |  |
|---|--|
| <i>Trochiliphagus hirsutus</i> Carriker<br>♂ Paratype       | <i>Glaucis hirsuta</i> , Aripo Valley, Trinidad, 14.IV.1960, TRVL. 4505, Brit. Mus. 1963–351                                   |
| <i>Trochiliphagus hirsutus</i> Carriker<br>♀                | <i>Glaucis hirsuta</i> , Aripo Valley, Trinidad, Aitken coll. Brit. Mus. 1963–351  |
| <i>Trochiloecetes rupumuni</i> Carriker<br>♀                | <i>Phaethornis superciliosus</i> (AMH 36), Belize, Aguacate, 4.V.1979, C. Lyal and A. Hutson                                   |
| <i>Trochiloecetes rupumuni</i> Carriker<br>♀, ♂             | <i>Phaethornis superciliosus</i> , 42984, Mosqueiro Ferry, Bencvides, Brazil, 25.X.1968, T. Aitken, ML.17, Brit. Mus. 1970–726 |
| <i>Trochiloecetes insularis</i> Carriker<br>♂ Paratype      | <i>Glaucis hirsuta</i> , Aripo Valley, Trinidad, 5.VII. 1960, TRVL. 4622, Brit. Mus. 1963–351                                  |
| <i>Trochiloecetes insularis</i> Carriker<br>3 larvae        | <i>Glaucis hirsuta</i> , Aripo Valley, Trinidad, 5.VII. 1960, TRVL. 4622, Brit. Mus. 1963–351                                  |
| <i>Trochiloecetes insularis</i> Carriker<br>♀, 1 larva      | <i>Glaucis hirsuta</i> , Aripo Valley, Trinidad, 17.III. 1961, T. Clay, No. 194, Brit. Mus. 1963–351                           |
| <i>Ricinus dolichocephalus</i> (Scopoli)<br>3 ♀ Neoparatype | <i>Oriolus. o. oriolus</i> , N.E. Poland, VIII 1935, 4190, Brit. Mus. 1951–171   |

### Personal material

- |   |   |
|---|---|
| <i>Trochiloecetes ochrotereni</i> ?<br>1 ♀, 1 ♂ | <i>Selasphorus rufus</i> , Nationalpark Desierto de los Leones, 30 km w. von Mexico City, VIII 1971, leg. Poley |
| <i>Trochiloecetes</i> spec.<br>1 ♀              | <i>Eugenius fulgens</i> , Nationalpark Desierto de los Leones, 30 km w. von Mexico City, VIII 1971, leg. Poley  |
| <i>Ricinus rubeculae</i> (Schrank)<br>1 ♂, 3 ♀  | <i>Luscinia svecica cyanecula</i> , Modracek, Pakvice, CSR, 4.IV.1955, leg. F. Balat                            |
| <i>Ricinus fringillae</i> De Geer<br>1 ♀        | <i>Fringilla coelebs</i> , Obergurgl, Ötztal, Österreich, 1.IX.1968, leg. A. Aichhorn                           |

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