

Key to the New World subfamilies of the family Braconidae (Hymenoptera: Ichneumonoidea)

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Abstract

This is an updated key to the 36 subfamilies of Braconidae found in the New World (Western Hemisphere). This includes Greenland and the Caribbean Islands. It is a revision of the key by Sharkey, (1997) found in the manual of the New World genera of the family Braconidae (Wharton et al., 1997). The key is fully illustrated and is meant to facilitate use by non-specialists; the online version additionally follows web accessibility standards and is usable on desktop and mobile devices. This represents the first of a series of publications, the rest of which will focus on each braconid subfamily. Each of these publications will include an overview of a subfamily, an illustrated key to its genera, and one or several pages dedicated to each genus with extensive illustrations. As each of these 36 keys is published, the online version of this publication will be updated with links to lead readers to the appropriate subfamily publication.

Sharkey, M.J. 1997. Key to the New World subfamilies of the family Braconidae, pp. 39-63, In: Wharton, R.A., Marsh, P.M., & Sharkey, M.J. (eds). Manual of the New World genera of Braconidae (Hymenoptera). Special Publication of the International Society of Hymenopterists, 439 pp.

Wharton, R.A., Marsh, P.M., & Sharkey, M.J. (eds). 1997. Manual of the New World genera of Braconidae (Hymenoptera). Special Publication of the International Society of Hymenopterists, 439 pp.

Published online October 18 2023

Introduction

Literature Background

Wharton et al. (1997) published the “Manual of the New World Genera of the Family Braconidae”. This was updated in 2017 and published with Amazon (Wharton et al. 2017; link in References). This latter version includes an addendum at the end of each subfamily chapter that updates the subfamily treatment with new literature citations and changes in taxonomic nomenclature, e.g., new genera, changes in subfamily composition. The present publication, treating the Braconidae as a whole, is the first of a series of publications that will completely revise the Manual.

Diversity

The Hymenoptera are a diverse order of insects, and

probably the most diverse order after Diptera (Hebert et al. 2016), despite arguments suggesting that Hymenoptera is the most diverse (Forbes et al., 2018). For example, Figure 1 shows the relative number of species of insects (estimated by COI barcodes) by order captured by Malaise traps in the Área de Conservación de Guanacaste (ACG), in northwestern Costa Rica (Janzen & Hallwachs, 2011, 2019). Although beetles may be underrepresented in Malaise traps it seems clear that Diptera are the most diverse order followed by Hymenoptera, Coleoptera, and Lepidoptera.

Within the Hymenoptera there are four higher taxa with similar species diversity in the same area, Chalcidoidea, Ichneumonoidea, Platygastroidea, and Aculeata (Fig. 2). Together these constitute more than 70 percent of all

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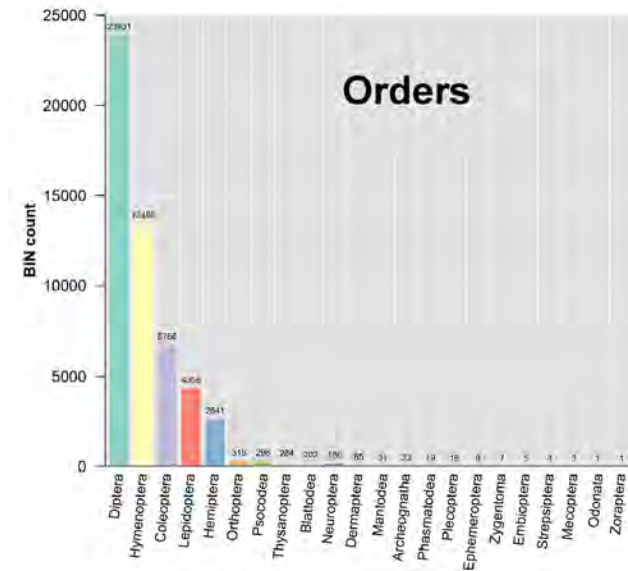


Figure 1. Bar graph of the estimated number of species in insect orders captured by Malaise traps in Área de Conservación de Guanacaste. BIN = Barcode Index Number; a BIN represents an operational taxonomic unit that closely corresponds to a species. Data from Barcode of Life Database (<https://v3.boldsystems.org>), accessed February 2022.

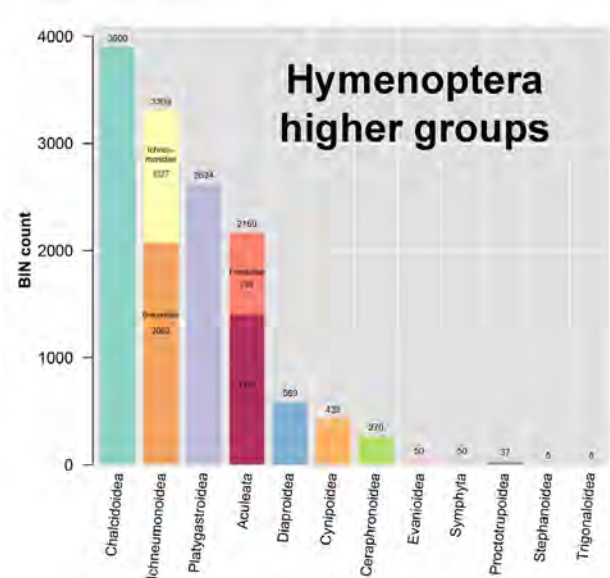


Figure 2. Bar graph of the estimated number of species in higher taxa of Hymenoptera captured by Malaise traps in the Área de Conservación de Guanacaste. Data from Barcode of Life Database (<https://v3.boldsystems.org>), accessed February 2022.

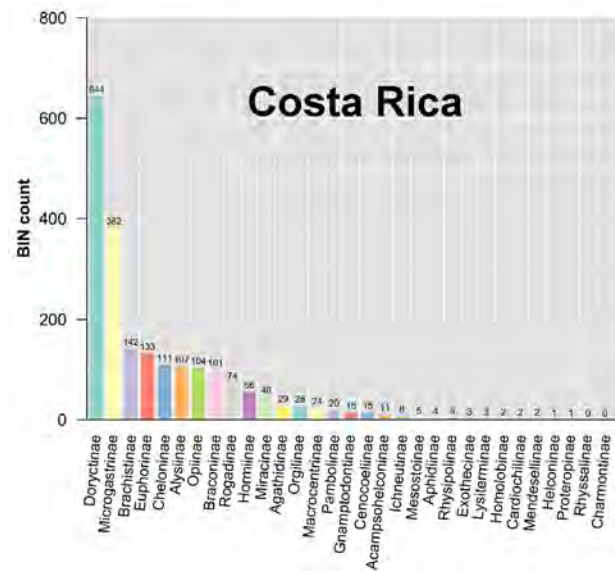


Figure 3. Bar graph of the estimated number of species in the subfamilies of Braconidae captured by Malaise traps in the Área de Conservación de Guanacaste, Costa Rica. Data from Barcode of Life Database (<https://v3.boldsystems.org>), accessed February 2022.

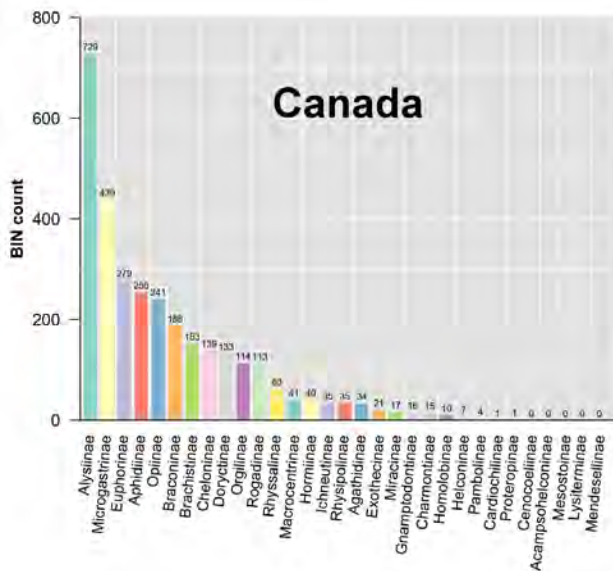


Figure 4. Bar graph of the estimated number of species in the subfamilies of Braconidae captured by Malaise traps in Canada. Data from Barcode of Life Database (<https://v3.boldsystems.org>), accessed February 2022.

Hymenoptera surveyed in the ACG. Amongst the families of Hymenoptera, the Braconidae are the most diverse in ACG with 1,742 species, followed by the Ichneumonidae with 1,113 species. Data from other areas may differ from ACG but, based on worldwide data on BOLD, there is little question that braconid parasitoid wasps are among the most species-rich groups of Hymenoptera.

Here we treat the braconid subfamilies that occur in the New World (North, Central and South America).

These vary greatly in their species richness. Figure 3 is a bar graph of the number of species of the subfamilies in ACG, and Figure 4 presents a bar graph of the number of species of the subfamilies captured in Malaise traps in Canada (Hebert et al. 2016). In Costa Rica the Doryctinae are the most species-rich, whereas in Canada they are in a distant ninth place. Conversely in Canada (Fig. 4) the most species-rich subfamily by far is the Alysiinae. In both areas the Microgastrinae are in second place, and

it may be the most species-rich subfamily overall. These diversity statistics are probably similar across northern temperate and tropical areas in the Americas and are worth noting when attempting an identification.

Biology

The message of the numbers detailed above is that Braconidae is an extremely diverse family in terms of species richness (Jones et al., 2009). They are also diverse in their biologies. Most are parasitoids of other holometabolous insects and of these most are attacked in the larval stage. However, there are numerous exceptions to these generalizations. Paurometabolous insects in adult or nymphal stages may act as hosts (e.g., for Aphidiinae and some Euphorinae), and egg (e.g., for Cheloninae, some Brachistinae, and a few Microgastrinae) or adult (e.g., most Euphorinae) stages may be attacked. Those that attack the egg stage delay their own development until the host larva is well developed; there are no true egg parasitoids. Even stranger, there are several independent developments of phytophagy within Braconidae (Samacá-Sáenz et al., 2022). There are also rare examples of hyperparasitoids, i.e., parasitoids of parasitoids, e.g., some Alysiniinae that attack Tachinidae. Parasitoid braconids, the vast majority of braconids, are classified as either idiobionts or koinobionts. Idiobionts begin their development immediately after the egg is laid whereas koinobionts delay their feeding and development allowing the host to grow to an appropriate size or stage. Parasitoids are also classified as endo- or ectoparasitoids. Those that feed on the host internally are endoparasitoids and those that feed externally are ectoparasitoids. All of these biological traits and more will be discussed in detail in the subfamily and generic treatments in future publications. Details of braconid biology can be found in publications by Mark Shaw and Tom Huddleston (Shaw and Huddleston 1991), Bob Wharton (Wharton 1993) and Donald Quicke (Quicke 2015).

Classification

There have been a number of recent works on the phylogeny of the Braconidae (Jasso-Martínez et al. 2022, and references therein) and these have resulted in changes in classification at the subfamily level. Here we recognize 36 subfamilies as occurring in the New World, which are listed in Table 1. In the manual of New World Braconidae (Wharton et al., 1997) 34 subfamilies were recognized. The differences are the result of the following changes. The subfamilies Adeliinae, Betylobraconinae, Blacinae, Histeromerinae, Meteorinae, Neoneurinae and Ypsistocerinae have lost their subfamily status and have been placed in other subfamilies from which they are derived. The following list includes the parent subfamily in parenthesis: Adeliinae (Cheloninae), Betylobraconinae (Rogadinae), Blacinae (Brachistinae), Histeromerinae (Rhyssalinae), Meteorinae (Euphorinae), Neoneurinae

(Euphorinae) and Ypsistocerinae (Doryctinae). There are also new subfamilies introduced or more generally accepted since 1997, i.e., Brachistinae, Charmontinae, Exothecinae, Lysiterminae, Mesostoinae, Pambolinae, Rhyssalinae, Rhyssalinae. Most of these come from the breakup of the formerly polyphyletic Hormiinae. Finally, the subfamily name Gnamptodontinae has been changed to Telengaiinae.

There are several informal groups in the Braconidae. Amongst these are the cyclostoma (or cyclostomes), orthostoma (or orthostomes), endodont braconids, and exodont braconids. Images of these are in Figure 6.

Table 1. List of subfamilies of Braconidae recognized as occurring in the New World.

Agathidinae	Lysiterminae
Alysiinae	Macrocentrinae
Aphidiinae	Masoninae
Apozyginae	Mendesellinae
Brachistinae	Mesostoinae
Braconinae	Meteoridiinae
Cardiochilinae	Microgastrinae
Cenocoeliinae	Microtypinae
Charmontinae	Miracinae
Cheloninae	Opiinae
Dirrhopinae	Orgilinae
Doryctinae	Pambolinae
Exothecinae	Proteropinae
Euphorinae	Rhyssalinae
Helconinae	Rhyssalinae
Homolobinae	Rogadinae
Hormiinae	Sigalphinae
Ichneutinae	Telengaiinae

Catalogues and Other Resources

There are numerous catalogues dealing with the Braconidae, all of which are outdated. Yu et al. (2016) created an electronic database that incorporated data on the Ichneumonidae and Braconidae. Unfortunately, there have been no updates since 2016. The Yu et al. (2016) database can be obtained from most of the authors of this publication and certainly by senior author Sharkey (msharkey@uky.edu). On the bright side, the internet has become increasingly effective as a taxonomic resource. Google Scholar and the Biodiversity Heritage Library (<https://www.biodiversitylibrary.org>) are invaluable. Ghahari et al. (2006) published a bibliography of the Braconidae that deals with literature from 1964 through 2003. A link to this is given in the references.

Identifying New World Braconidae

Only the largest specimens of Braconidae can be

pinned in the conventional manner, i.e., with the pin pierced through the thorax. All other specimens should be point-mounted to permit identification. For larger specimens, the tip of the paper point may be angled downward to provide more surface area.

The keys in this publication and the subfamily treatments that will follow in the near future will allow for the identification of braconids to the levels of subfamily and genus. Beyond that we will be presenting a list of published keys for each genus. Unfortunately, we estimate that fewer than a quarter of the northern temperate New World species and less than 3% of the tropical and southern temperate species are described. Moreover, the literature containing descriptions and keys is often oversimplified. In short, the task of identifying a braconid to species is usually an impossible one. Despite this state of affairs, one tool has revolutionized identifications: Barcode Of Life Data Systems (BOLD) (Ratnasingham and Hebert 2007). To obtain an identification using BOLD, one simply obtains a COI sequence for the specimen and submits the sequence as a query at the following URL: http://www.boldsystems.org/index.php/IDS_OpenIdEngine. Presently, this will give the user the generic name of about 80% of New World braconids, and almost all of the common genera, but few species names. There is a serious initiative to barcode the type specimens in many major museums and we suspect that in less than a decade BOLD will be dense with barcodes associated with species names. This will almost certainly be the method of choice for braconid identification in the future. It will be interesting to see if there will be any value in the future for the key presented

here and those at the generic level that will follow over the next months. In any case, they have been a joy and an intellectual challenge to create and the database at BOLD would not have been created without keys such as these. In cooperating with BOLD, we as taxonomists do not mind committing partial intellectual suicide. With the advent of artificial intelligence, many enterprises such as the work associated with this publication will, no doubt, become archaic. Readers may consider this a depressing thought, but it need not be. In an ideal future, naturalists will be able to collect braconid specimens in their back yards and create inventories in days. Laypersons will be able to identify braconids and other insects to the species level and appreciate, to a much greater degree, the treasures under their protection.

Morphology and Terminology

Every attempt has been made to illustrate each character in the key such that laypersons can use the key without a knowledge of specialized jargon such as vein RS, pronotum, first tergum, etc. Nonetheless, we include a few images from the morphology chapter in the 1997 manual (Sharkey and Wharton, 1997) for those readers interested in having a more comprehensive understanding of braconid morphological terminology (Figs 5-9). There is also an online resource, the Hymenoptera Anatomy Ontology Portal (Seltmann et al. 2012), available at: <http://portal.hymao.org/projects/32/public/ontology/>. Here you can enter a morphological term and select it from a picklist. This will direct you to the definition and an illustration of an example of the character.

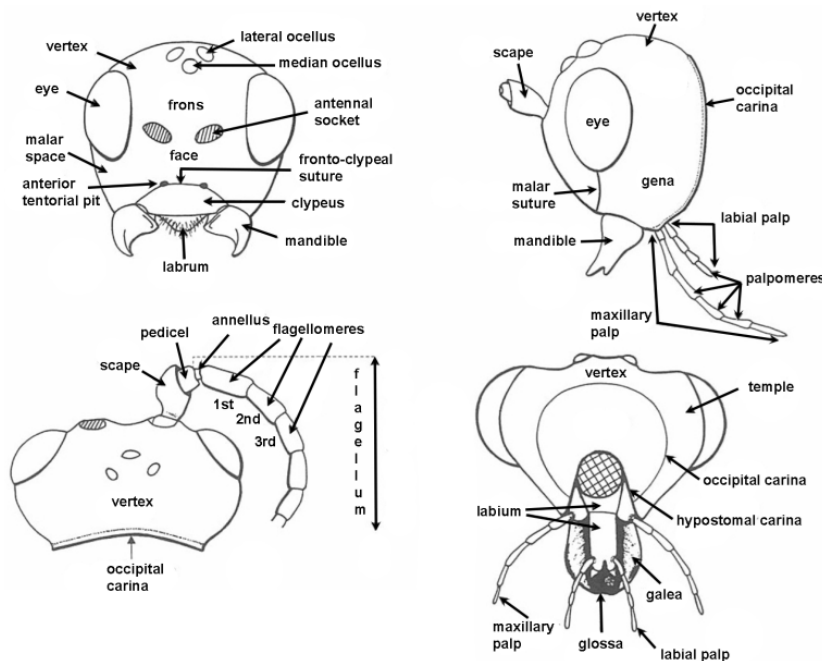


Figure 5. Head structures.

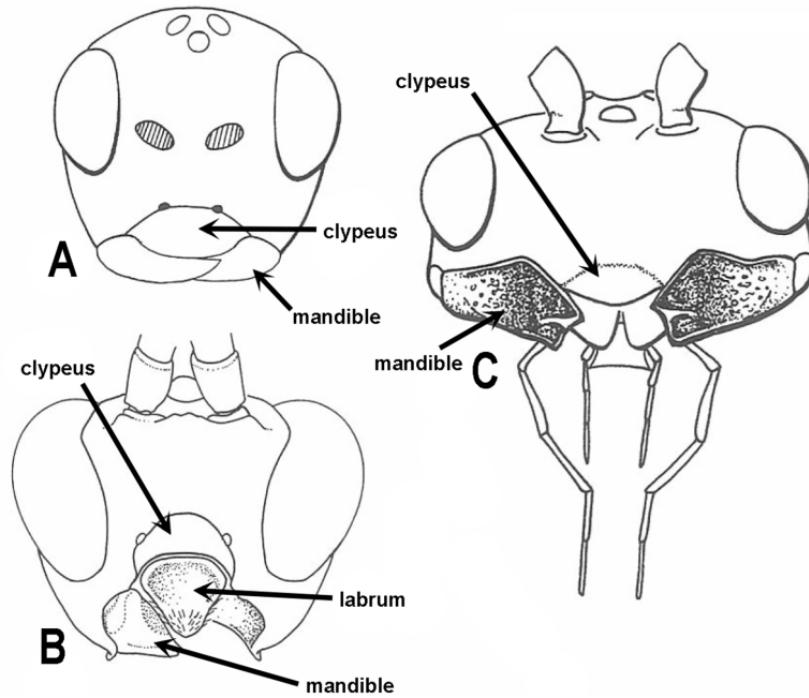


Figure 6. Major informal groups of Braconidae are based on mouth morphology. **A.** Non-cyclostome or orthostome braconid (the labrum is hidden by the clypeus or if visible it is not concave and it is setose, i.e., with hair/setae). **B.** Cyclostome braconid (the labrum is visible between the clypeus and mandibles and its medial surface is usually glabrous [lacks setae]). **C.** Exodont braconid (the mandibles do not meet when closed and the teeth of the mandibles face outward). This last condition is found in all Alysiinae and rarely in members of a few other subfamilies. Contrastingly, the mouthparts in A and B are referred to as endodont because the teeth of the mandibles face inward.

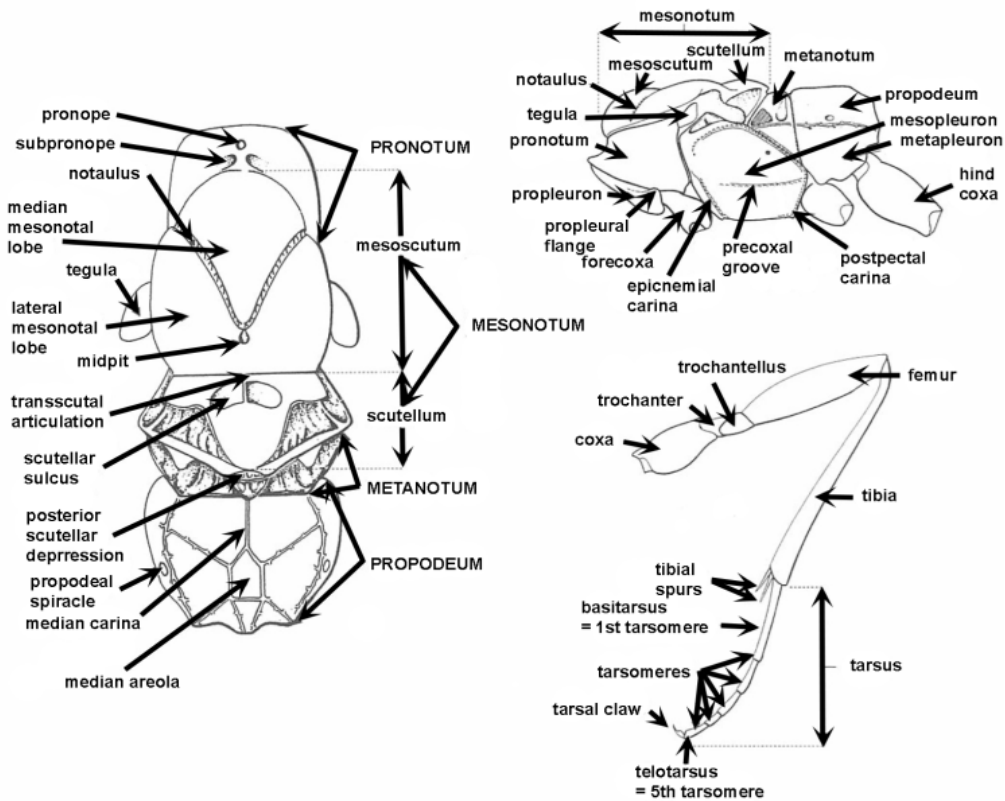


Figure 7. Mesosomal and hind leg structures.

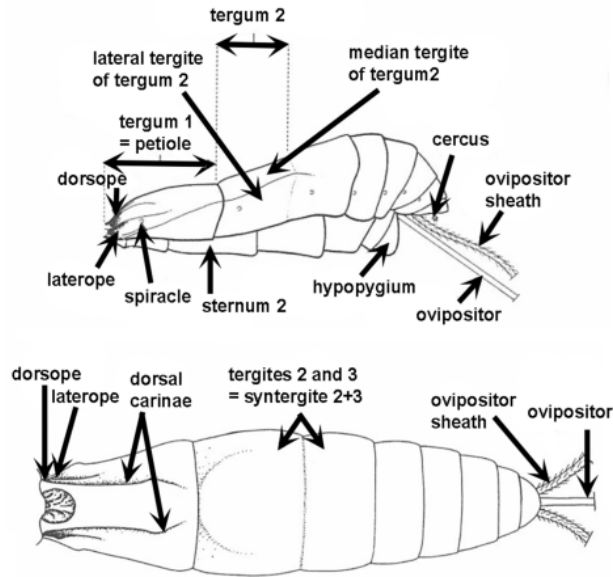


Figure 8. Metasomal structures.

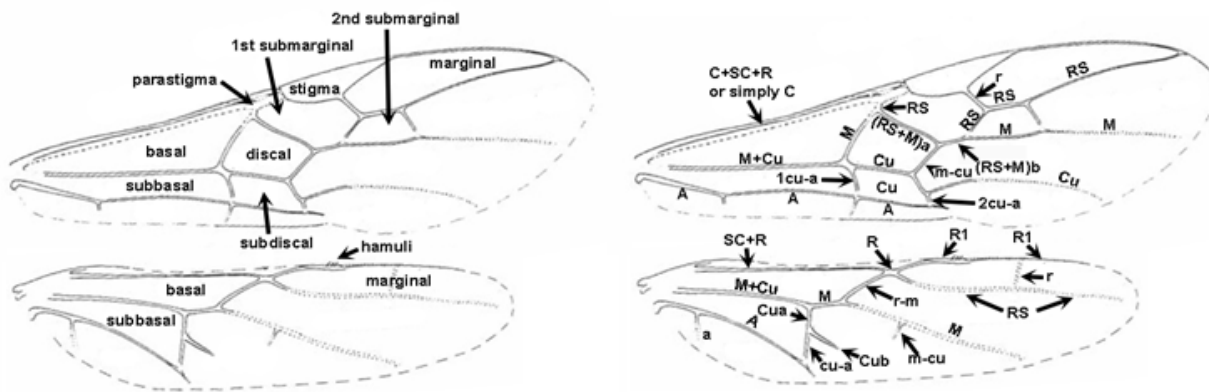


Figure 9. Wing cells and wing veins.

The Key

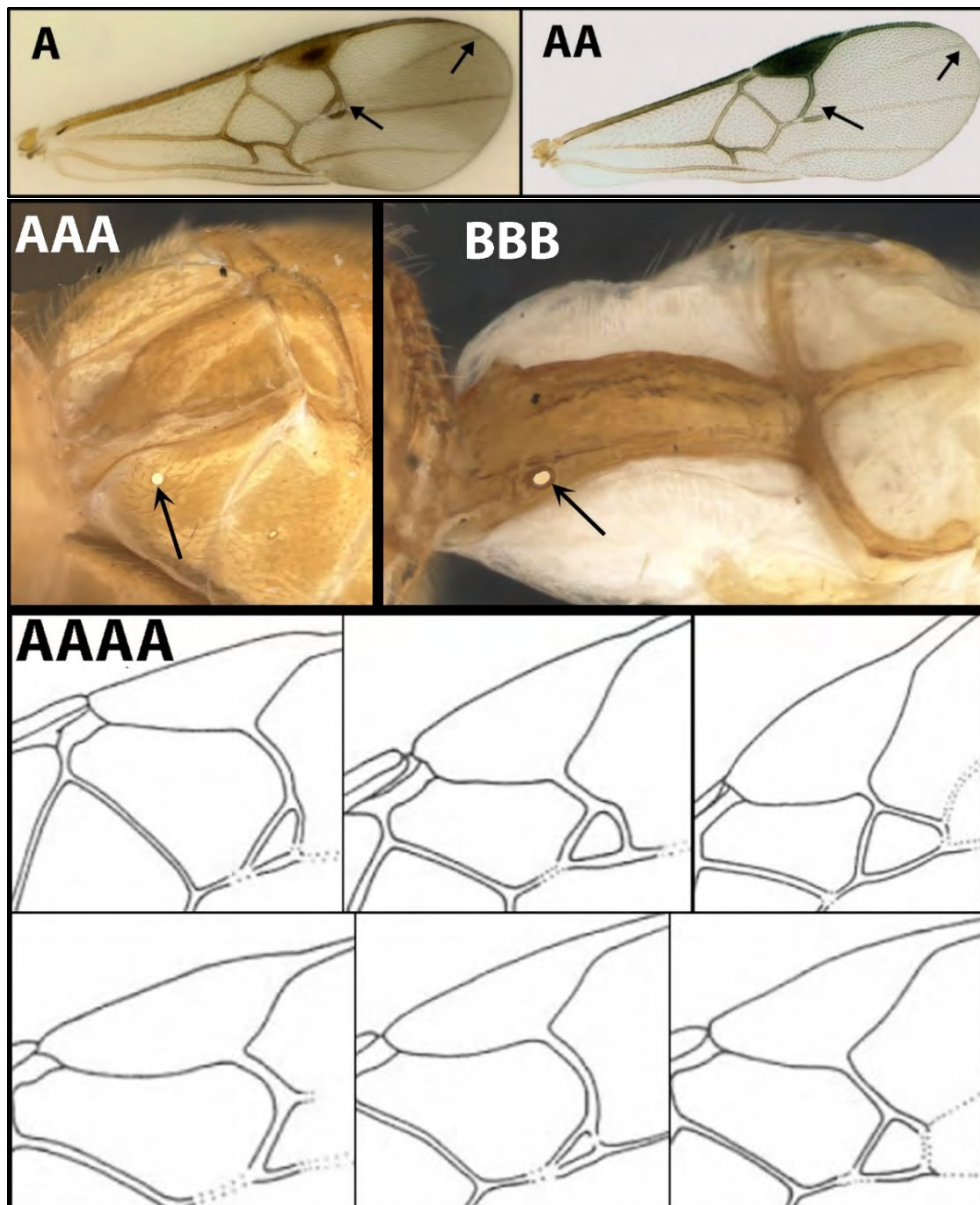
We have made every effort to make this key as simple as possible without sacrificing accuracy; however, so as not to make the key unduly long and complicated, some rare species are not included. We have illustrated the key so that it is not necessary to have a thorough knowledge of braconid morphology. This is a key to subfamilies with the exception of a few cyclostome subfamilies. This is in part because there are a few cyclostome genera for which subfamily placement is uncertain, e.g., *Allobracon*. There is also a handful of cyclostome subfamilies for which there is disagreement about which genera should be included (e.g., Sharanowski et al., 2011; Quicke et al., 2020; Chen & van Achterberg, 2019; Jasso-Martínez et al., 2022). For this reason, and for the fact that many do not have unequivocal morphological synapomorphies, these wasps are referred to as “OTHER CYCLOSTOMA” in the key. These subfamilies and genera (*Allobracon*, *Exothecinae*,

Hormiinae, *Lysitermiinae*, *Mesostoinae*, *Pambolinae*, *Rhyssinae*, and *Rhysipolinae*) will have a collective chapter that will key all genera together and speculate on their subfamily placement. Over the coming months and perhaps years, as subfamily chapters are published, there will be links added to the online version of this subfamily key to take readers directly to the appropriate genus-level key: the names that will have direct links are in all capital letters, e.g., **AGATHIDINAE** and when these have an active link, they will be set in bold font and underlined, e.g., **AGATHIDINAE**, **OTHER CYCLOSTOMA**. The online version of this key is designed to be responsive (i.e., usable on desktop, mobile, and other devices) and to follow web accessibility standards, meaning it can be used with a screen reader or other assistive technologies. Both the online and PDF versions can be navigated by clicking on the couplet numbers to move forward and backward through the key.

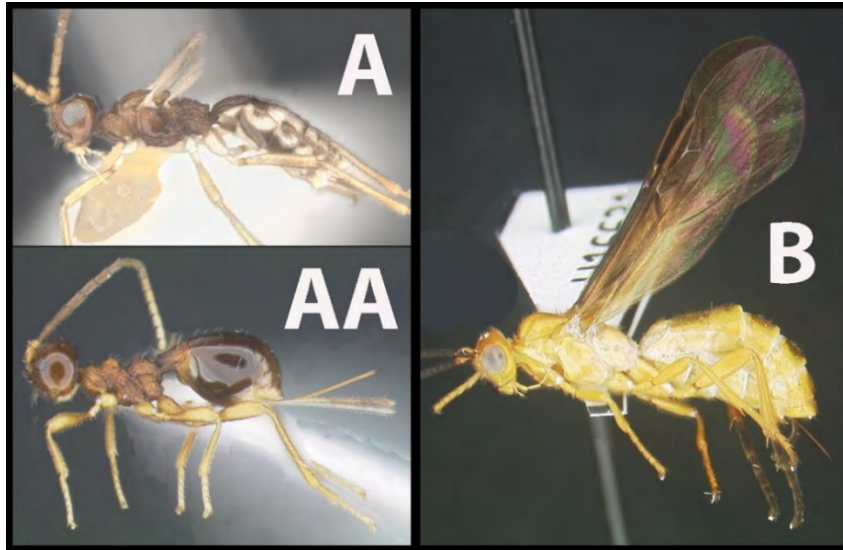
3(1). **A.** Antenna with 16 flagellomeres. RS of forewing not reaching wing margin as a tubular vein; second submarginal cell of forewing small or absent, usually triangular, rarely quadrangular, forming a small areolet as in A, or if second submarginal cell absent, then forming an inverted 7-like shape (as in AA). **AAA.** Spiracle of metasomal segment 1 on lateral tergite. Figure AAAA shows some of the variations found in the forewing venation of the subfamily. Very common. Widespread.....**MICROGASTRINAE**

- **B.** Antenna rarely with 16 flagellomeres. RS vein of forewing variable. **BBB.** Spiracle of metasomal segment 1 usually (90%) on median tergite.**4**

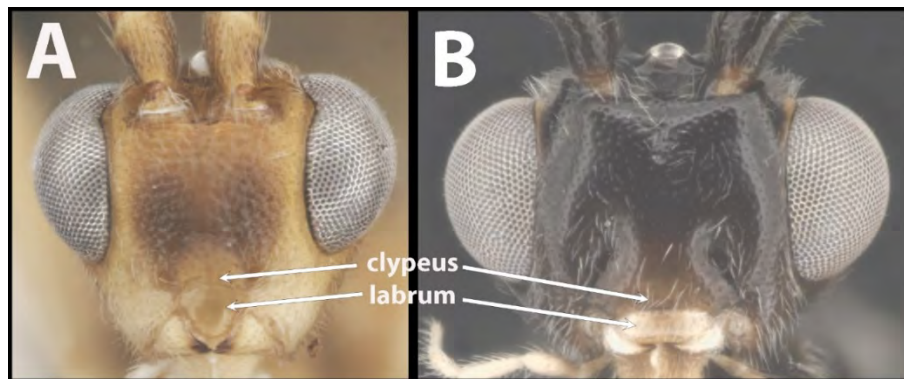
Note. The spiracle on the lateral tergite of microgastrines may be very difficult to see. It is often obscured by the hind coxa or hidden because the lateral tergite is folded under the metasoma. It is perhaps better to simply look for a spiracle on the median tergite. If it is present on the median tergite, Microgastrinae may be ruled out.



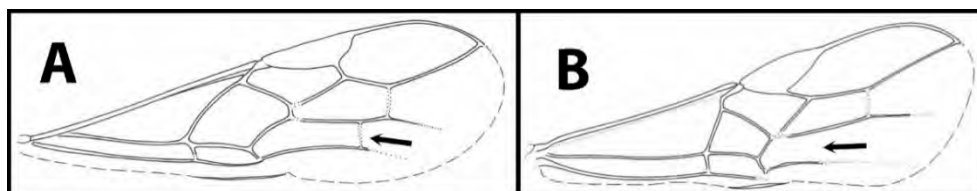
- 4(3). **A.** Wings greatly reduced (brachypterous) usually not extending beyond the first metasomal tergum when directed posteriorly. Rarely wings longer but then compressed on their longitudinal axes such that the venation is not fully developed, or AA wings absent.78
- **B.** Wings present and extending well beyond the first metasomal tergum when directed posteriorly.5



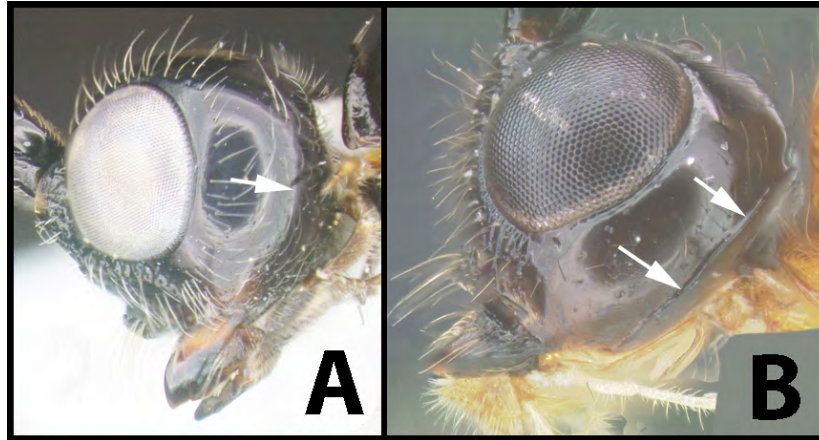
- 5(4). **A.** Labrum exposed and concave or exposed and set back (more interior) from surface of clypeus. Labrum lacking setae medially. Spiracle of tergum 2 usually (80%) on median tergite.6
- **B.** Labrum completely concealed by clypeus, or if visible flat, not set back from surface of clypeus, and not concave. Labrum often with setae on medial surface. Spiracle of tergum 2 usually (95%) on lateral tergite. .33



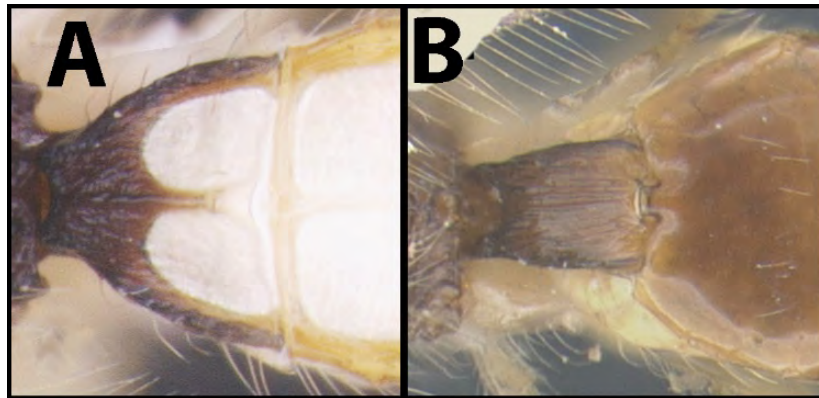
- 6(5). **A.** Crossvein 2m-cu of forewing present. Rare. Chile.APOZYGINAE
- **B.** Crossvein 2m-cu of forewing absent. Common. Widespread.7



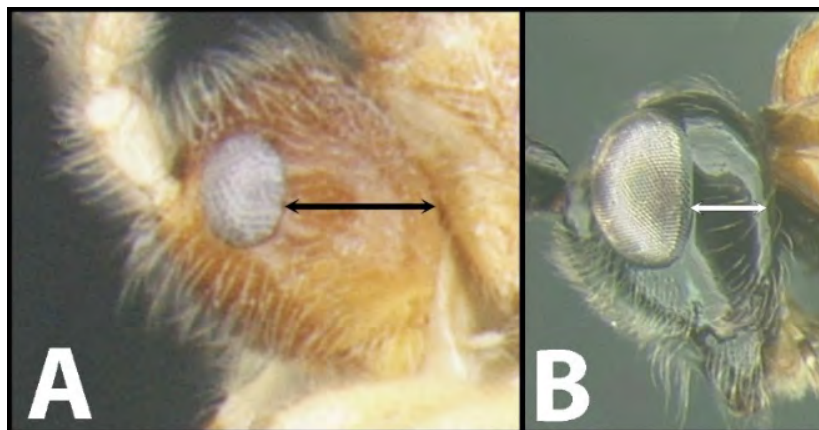
- 7(6). A. Occipital carina completely absent. [8](#)
- B. Occipital carina present at least partly. [13](#)



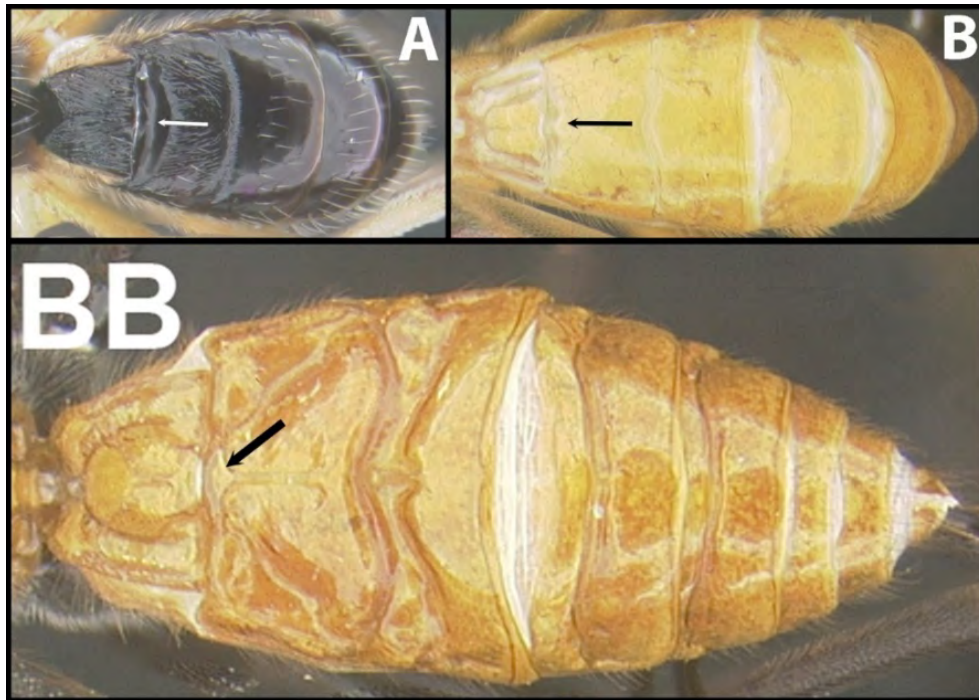
- 8(7). A. Median tergite 1 of metasoma membranous apically. Neotropical.
 **OTHER CYCLOSTOMA (*Allobracon*)**
- B. Median tergite 1 of metasoma evenly sclerotized. Widespread..... [9](#)



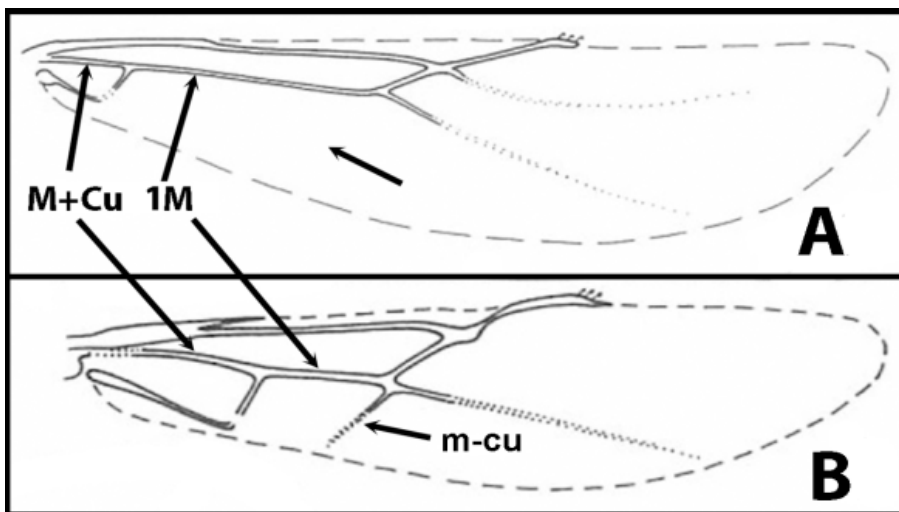
- 9(8). A. Gena longer than eye width. Strange looking braconids with short antennae and associated with termites. Neotropical. Rare. **a few DORYCTINAE (*Termitobracon*)**
- B. Gena shorter than eye width. Normal braconids with long antennae. Widespread. Common..... [10](#)



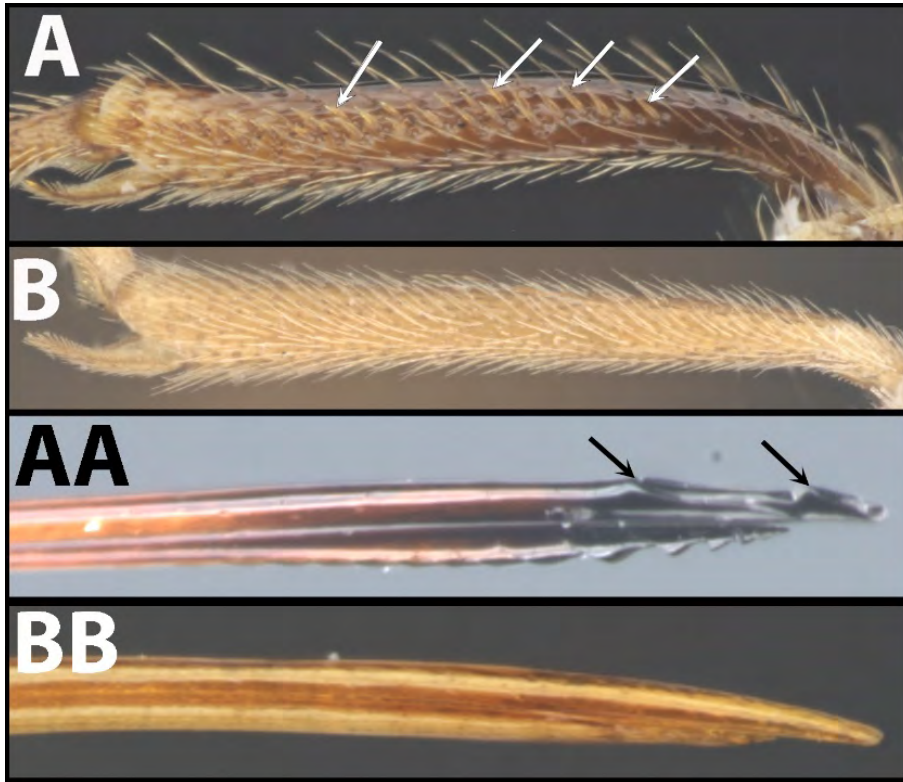
- 10(9). **A.** Median tergite 2 with raised transverse area anteriorly that has a rounded posterior margin extending across the entire tergum. Body length usually less than 3 mm. in length.**some TELENGAIINAE (formerly Gnamptodontinae)**
- **B.** Median tergite 2 without raised transverse area anteriorly, or **BB.** With a raised anterior area with a sharp median angle on the posterior margin. Body length often longer than 3 mm.[11](#)



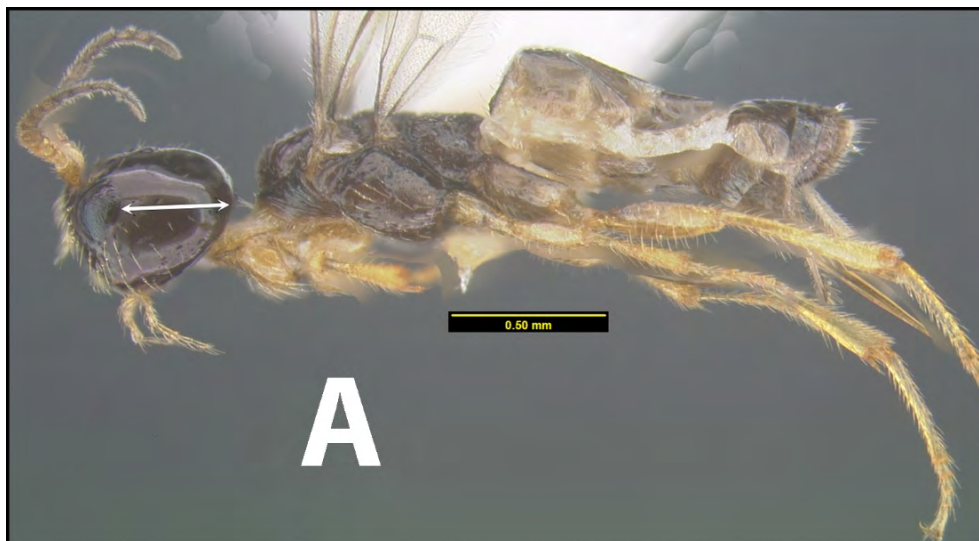
- 11(10). **A.** Vein M+Cu of hind wing less than 1/3 length of vein M. Crossvein m-cu absent **BRACONINAE**
- **B.** Vein M+Cu of hind wing more than 1/3 length of vein M. Crossvein m-cu often present.[12](#)



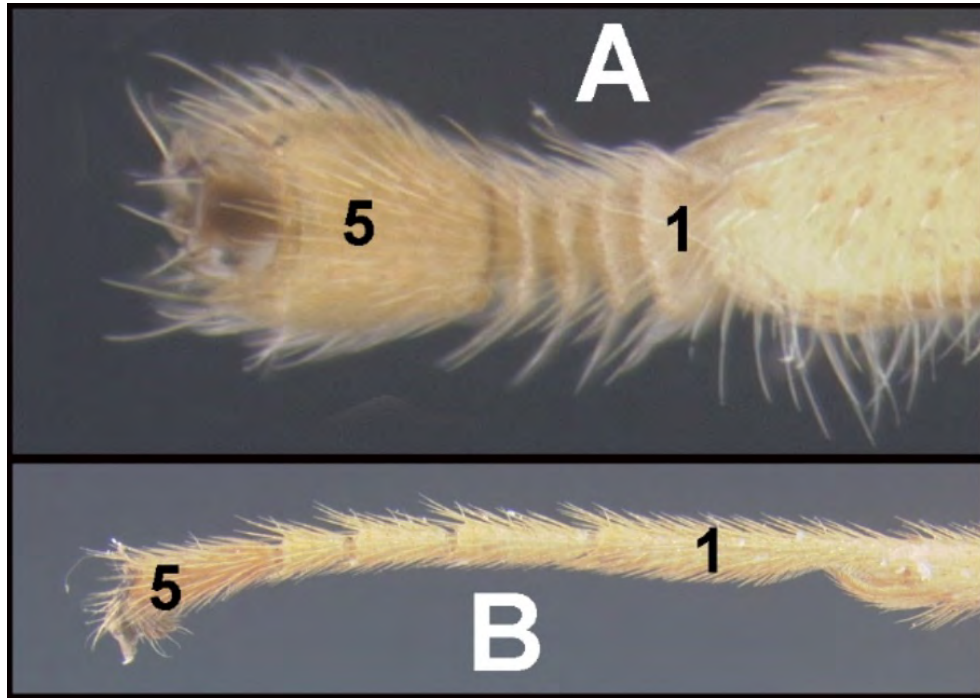
- 12(11). **A.** Longitudinal row of spines on medial anterolateral surface of foretibia present. **AA.** Dorsal valve of ovipositor usually with two nodes, rarely with one. Tip of ovipositor usually (95%) melanic.....
 **a few DORYCTINAE**
- **B.** Longitudinal row of spines on anterolateral surface of foretibia absent. **BB.** Dorsal valve of ovipositor lacking nodes. Tip of ovipositor concolorous with basal portions. **some OPIINAE**



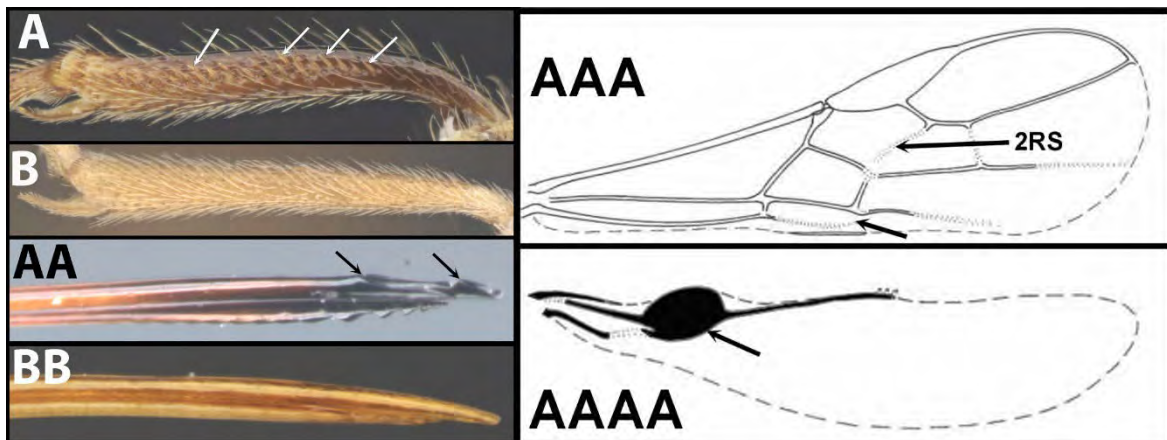
- 13(7). **A.** Small specimens less than 3mm.in length. Antenna very short. Distance between eye and occiput much greater than eye length. Habitus as in A. Nearctic. .. **OTHER CYCLOSTOMA (Rhyssalinae Histeromerus)**
- **B.** Not combining all the above. Widespread..... [14](#)



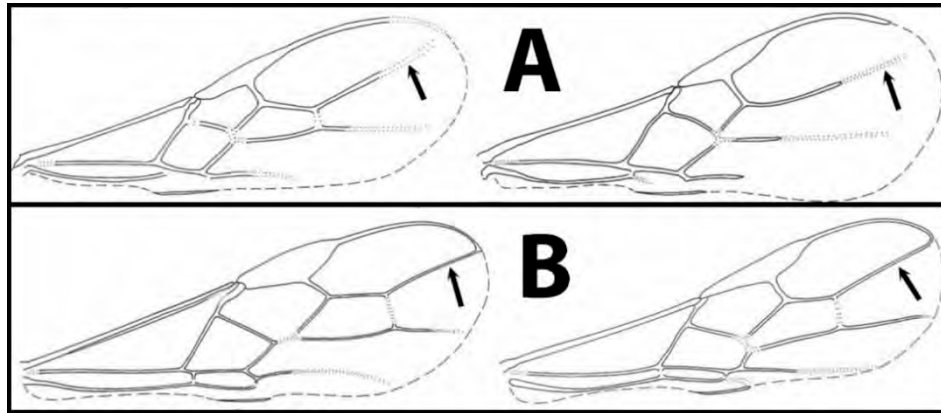
- 14(13). **A.** Apical tarsomere (5) as long as the four basal tarsomeres combined.....
 **some ROGADINAE (many *Yelicones*)**
- **B.** Apical tarsomere (5) normal, not longer than the four basal tarsomeres combined. **15**



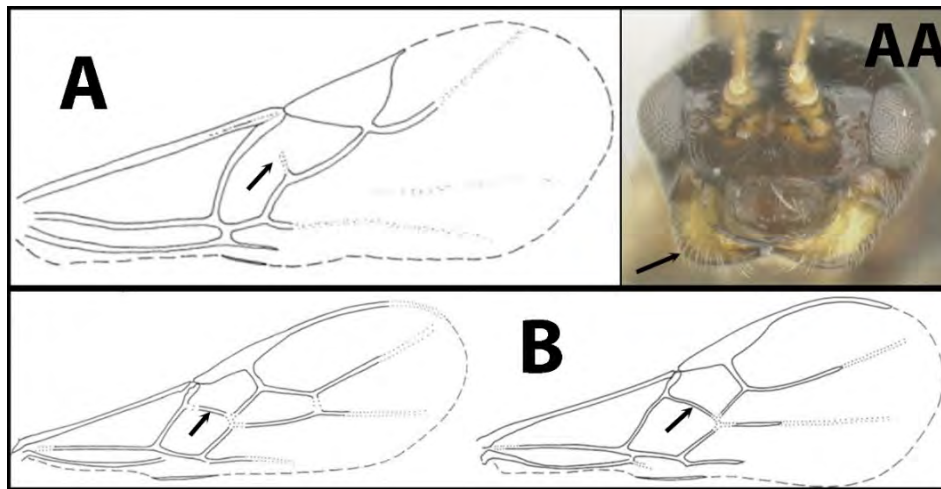
- 15(14). **A.** Spines on medial surface of foretibia present. **AA.** Dorsal valve of ovipositor with two nodes. Tip of ovipositor usually (95%) melanic. Some smaller specimens especially in the very common genus *Heterospilus* have inconspicuous spines but these can be identified with venation as in AAA, in which vein 2RS is incomplete or absent and the subdiscoidal cell is not closed because crossvein cu-a is absent. Males of this genus and its allies have a swollen pseudostigma in the hind wing as in AAAA. **most DORYCTINAE**
- **B.** Spines on medial surface of foretibia absent. **BB.** Dorsal valve of ovipositor lacking nodes. Tip of ovipositor concolorous with basal portions. Wing venation not as in AAA and AAAA. **16**



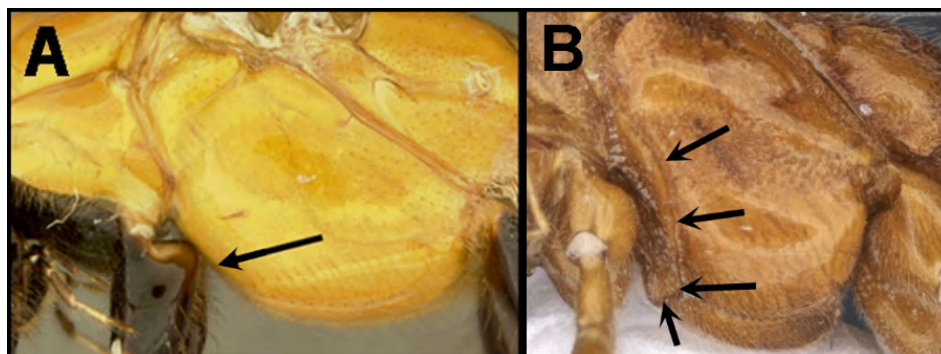
- 16(15). A. Vein RS of forewing not reaching wing margin as a tubular vein.17
- B. Vein RS of forewing reaching wing margin as a tubular vein.18



- 17(16). A. Vein (RS+M)a of forewing absent or represented as a short stub. AA. Mandibles massive.
 a few EUPHORINAE (*Cosmophorus*)
- B. Vein (RS+M)a of forewing present and complete or nearly so. Mandibles normal.
 OTHER CYCLOSTOMA (Rhyssalinae: *Acrisis* and *Proacrisis*)



- 18(16). A. Epicnemial carina absent.19
- B. Epicnemial carina present.25



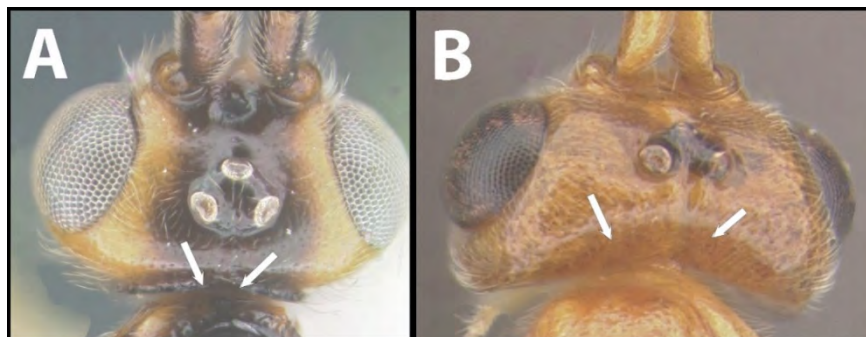
- 19(18). **A.** Metasomal terga 2+3 mostly desclerotized with sclerotized margins.
OTHER CYCLOSTOMA (e.g., *Parahormius*)
- **B.** Metasomal terga 2+3 entirely sclerotized.20



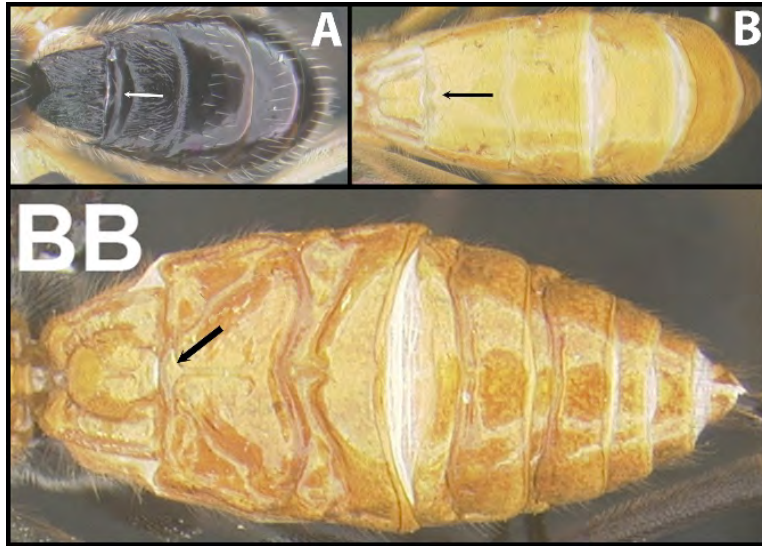
- 20(19). **A.** Face rugose at least medially.a few DORYCTINAE (*Monitoriella*)
- **B.** Face not rugose.21



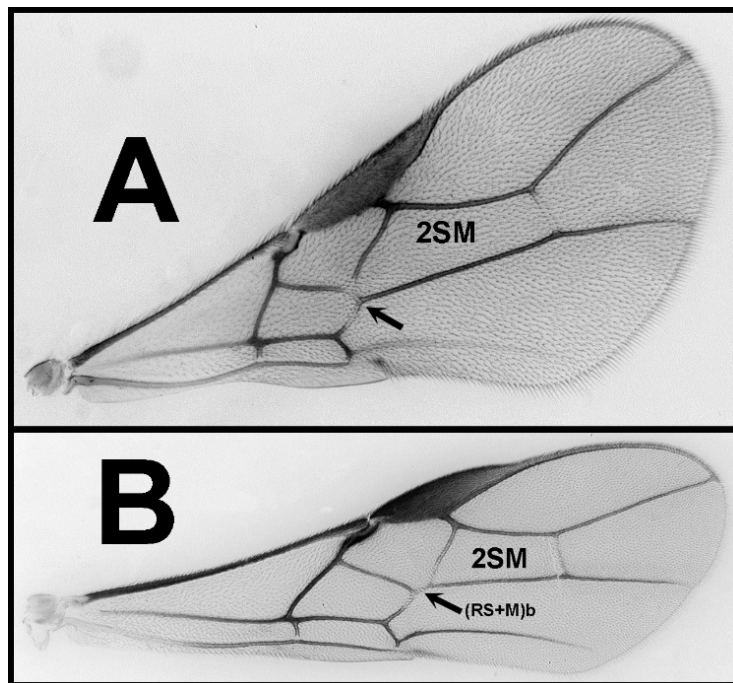
- 21(20). **A.** Occipital carina complete dorsally, or almost complete, with only a small break medially.....
OTHER CYCLOSTOMA (e.g., Exothecinae: *Xenosternum*, *Colastes*)
- **B.** Occipital carina broadly absent dorsally.22



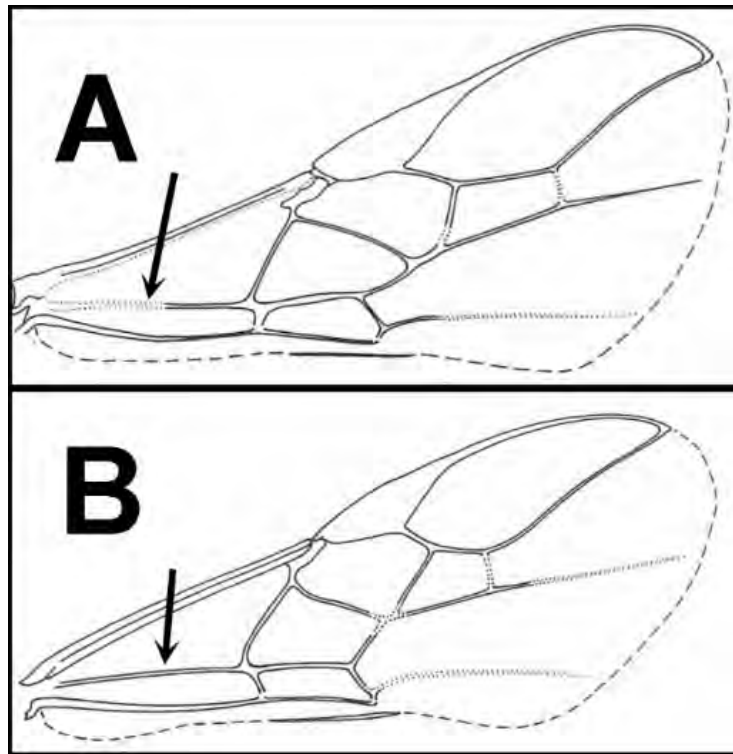
- 22(21). **A.** Median tergite 2 with raised transverse area anteriorly that has a smooth, rounded posterior margin.
..... **most TELENGAIINAE (formerly Gnamptodontinae)**
- **B.** Median tergite 2 without raised transverse area anteriorly, or **BB.** raised anterior area present with sharp angles on its posterior margin.[23](#)



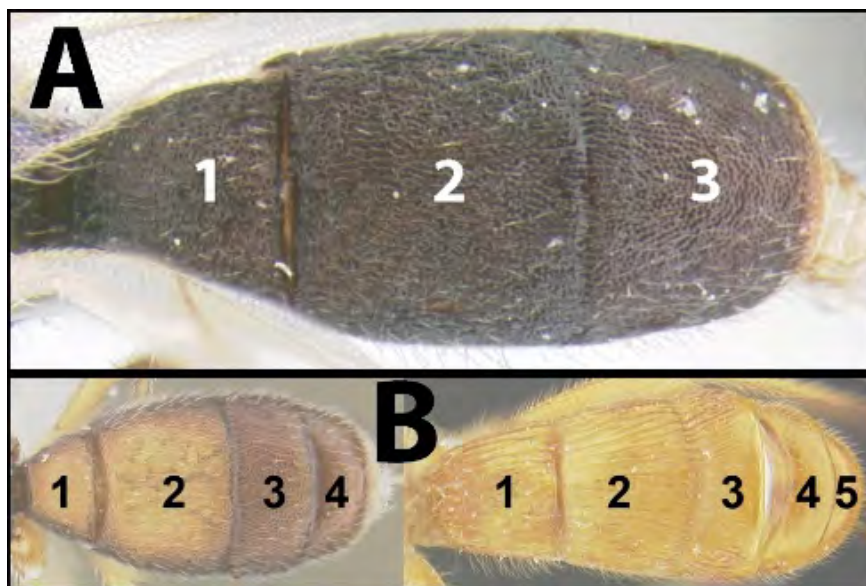
- 23(22). **A.** Forewing vein (Rs+M)b absent causing the 2SM cell to have five sides. **some OPIINAE**
- **B.** Forewing vein (Rs+M)b present causing the 2SM cell to have 4 sides.[24](#)



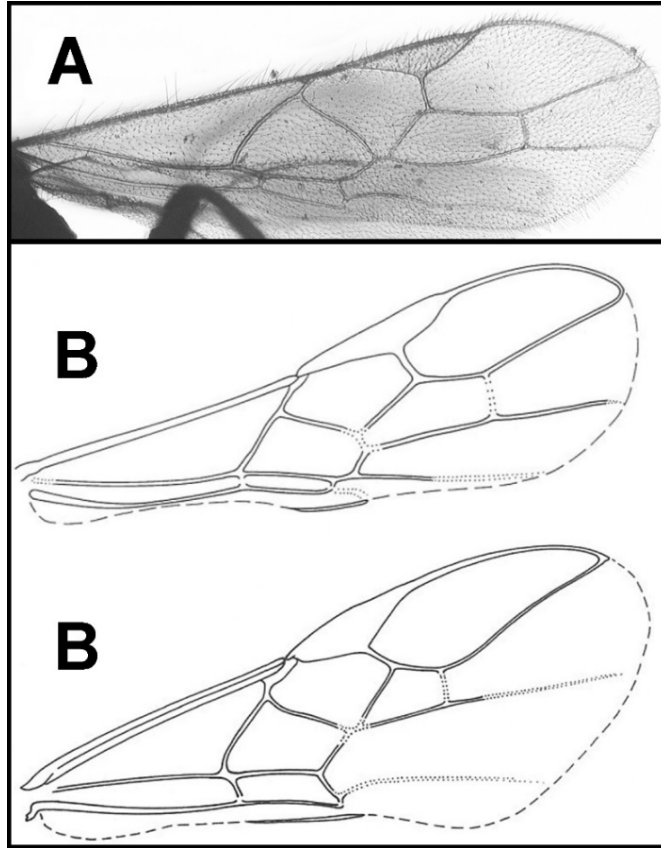
- 24(23). **A.** Forewing vein M+Cu not tubular in basal half or more. **some OPIINAE**
 - **B.** Forewing vein M+Cu mostly or entirely tubular.
 **OTHER CYCLOSTOMA** (some Exothecinae, e.g., *Xenarcha*, *Shawiana*)



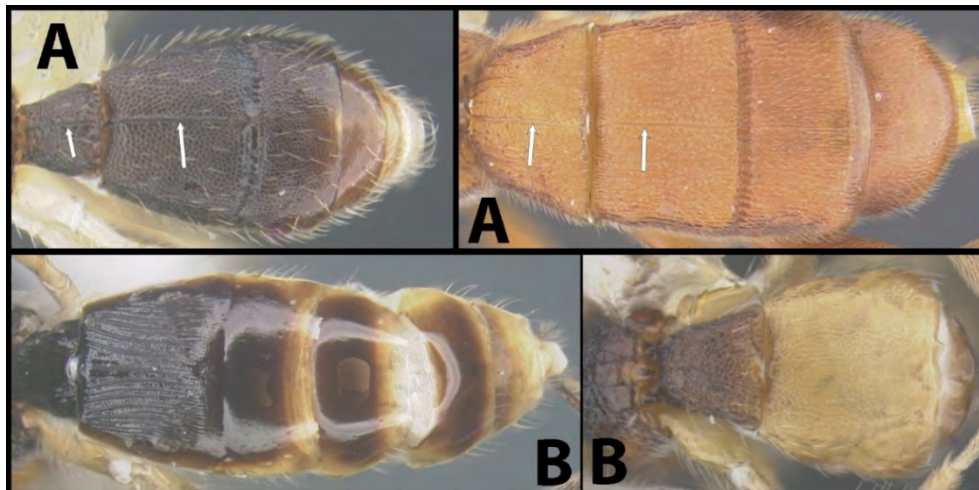
- 25(18). **A.** Metasomal terga in the form of a 3-segmented carapace, heavily sculptured throughout. [26](#)
 - **B.** Metasomal terga heavily sculptured or not, but always with at least four terga visible in dorsal view. [27](#)



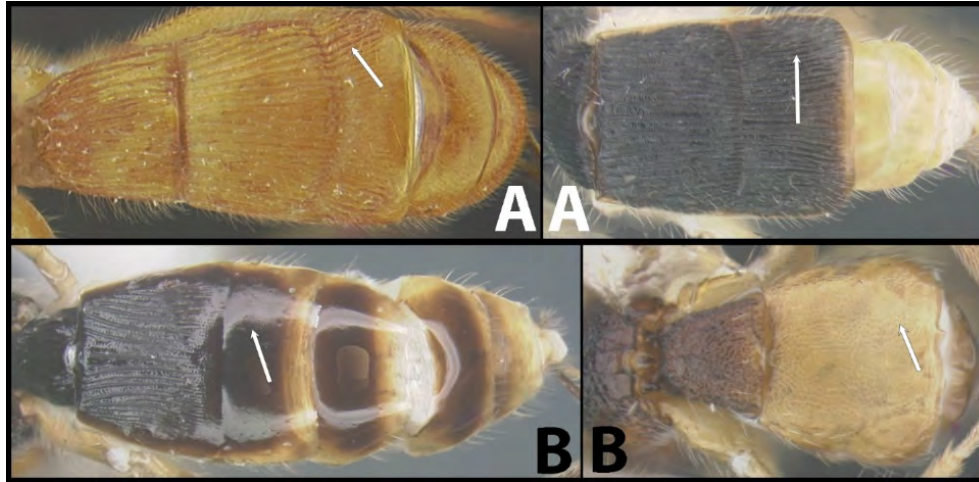
- 26(25). **A.** Forewing exactly as in A. Chile.some **ROGADINAE** (*Gondwanocentrus*)
- **B.** Forewing variable but not as in A. Two examples are given in figure B. Widespread.....
 **OTHER CYCLOSTOMA** (e.g., *Lysitermus* and some *Lysitermoides*, *Sagarana*, and *Oncophanes*)



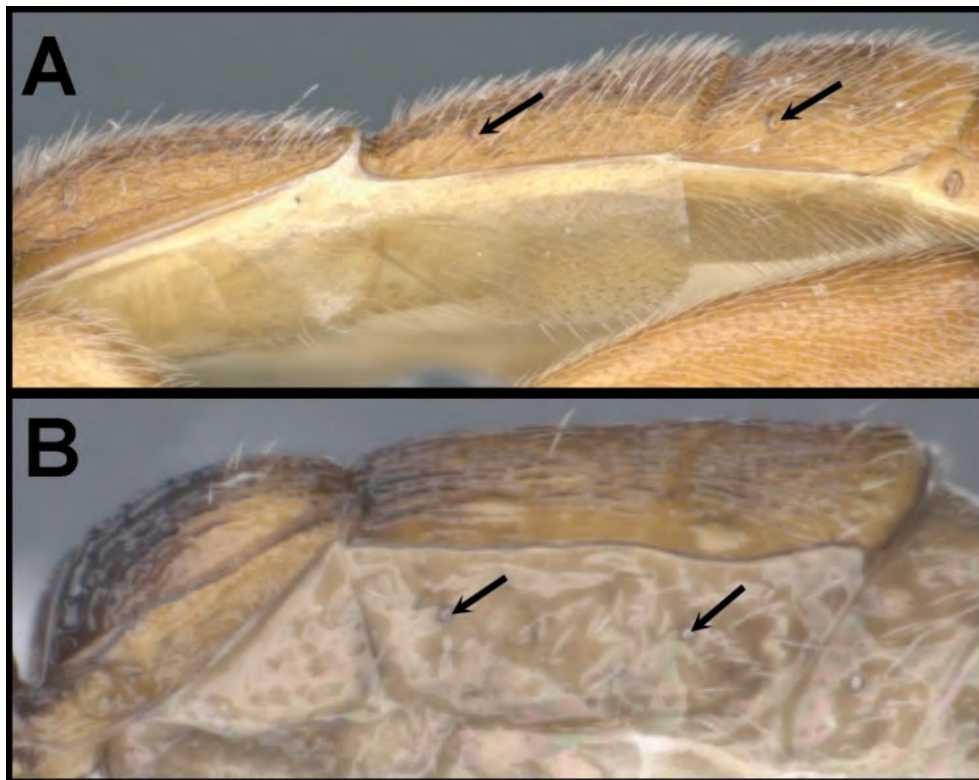
- 27(25). **A.** Metasomal terga 1 and/or 2 with a median longitudinal carina.most **ROGADINAE**
- **B.** Metasomal terga 1 and 2 without a median longitudinal carina.[28](#)



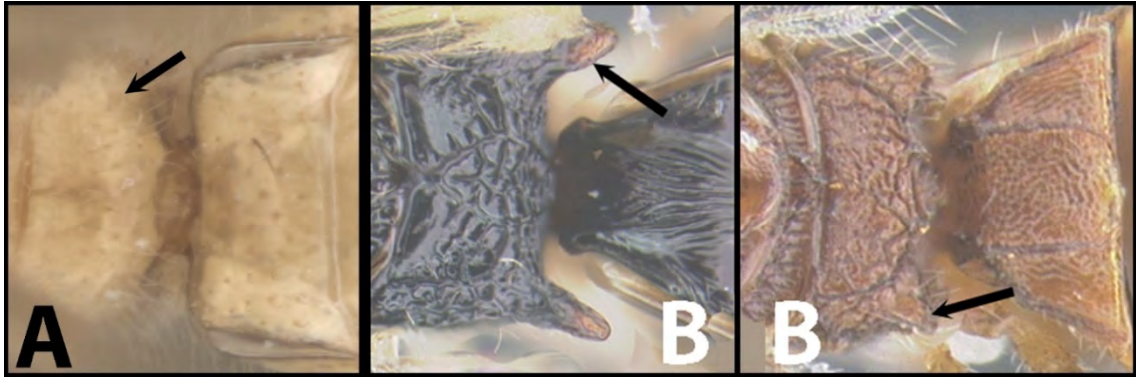
- 28(27). A. Metasomal tergum 3 with some longitudinal striae.29
- B. Metasomal tergum 3 without longitudinal striae, smooth or otherwise sculptured.30



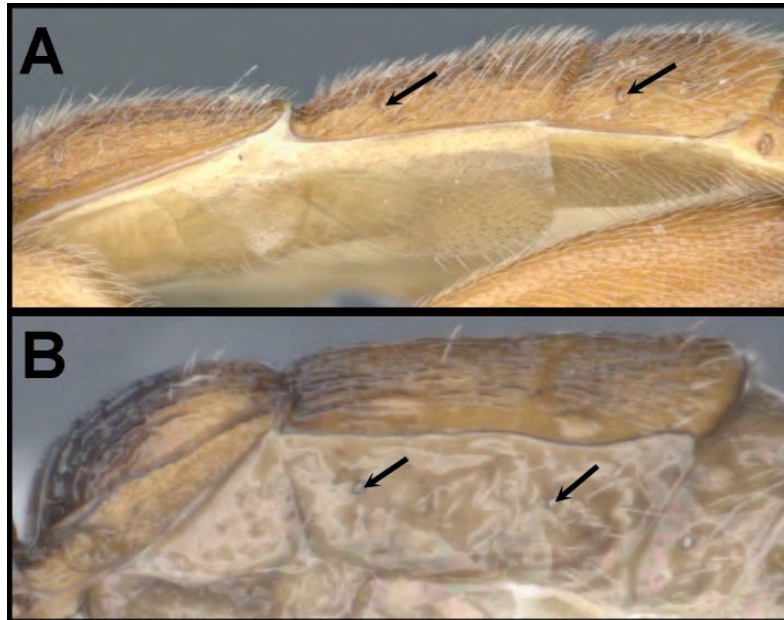
- 29(28). A. Spiracles of metasomal segments 2 and 3 on dorsal tergites. some **ROGADINAE**
- B. Spiracles of metasomal segments 2 and 3 on lateral tergites.
..... **OTHER CYCLOSTOMA** (e.g., some *Onchophanes* and *Lysitermoides*)



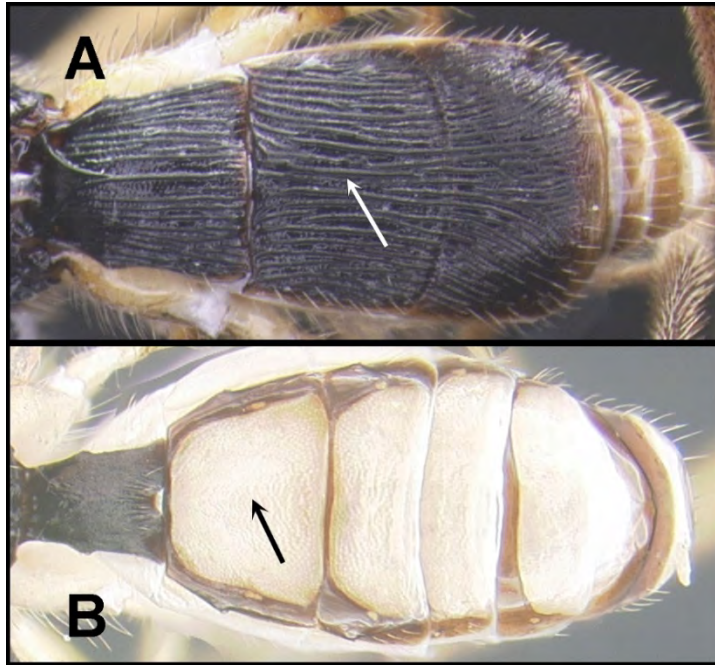
- 30(28). A. Propodeum without posterolateral projections.31
- B. Propodeum with posterolateral projections. OTHER CYCLOSTOMA (*Chremylus* and *Pambolus*)



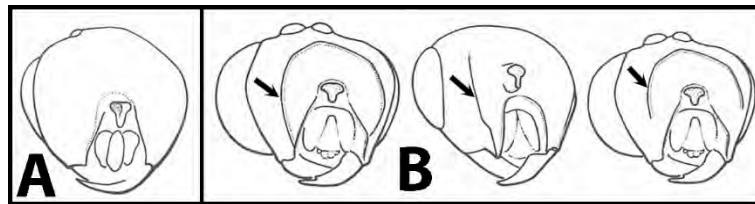
- 31(30). A. Spiracles of metasomal segments 2 and 3 on dorsal tergites.32
- B. Spiracles of metasomal segments 2 and 3 on lateral tergites. OTHER CYCLOSTOMA (e.g., *Hydrangeocola*, *Andesipolis*, *Apilodemon*, *Rhysipolis*, *Rhysalus*, *Dolopsidea*, *Cantharoctonus*, *Pseudorhysipolis*)



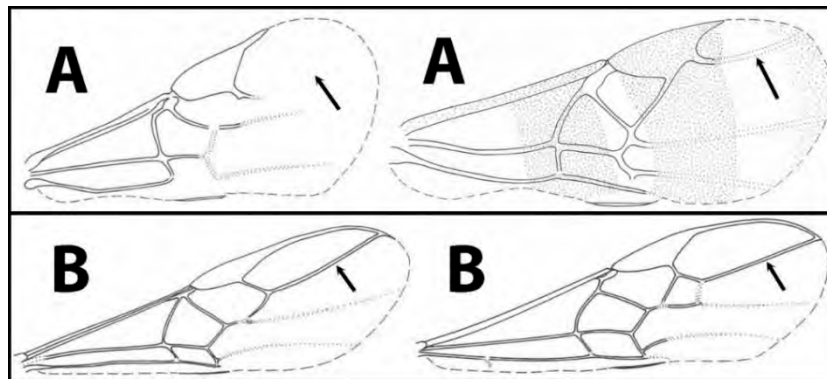
- 32(31). **A.** Tergum 2 well sclerotized and sculptured.
some **ROGADINAE** (*Jannya*, and some *Choreborogas* and *Clinocentrus*)
- **B.** Tergum 2 weakly sclerotized and smooth or almost smooth.
**OTHER CYCLOSTOMA** (some *Pseudorhysipolis*, *Rhysipolis*, and *Hormius*)



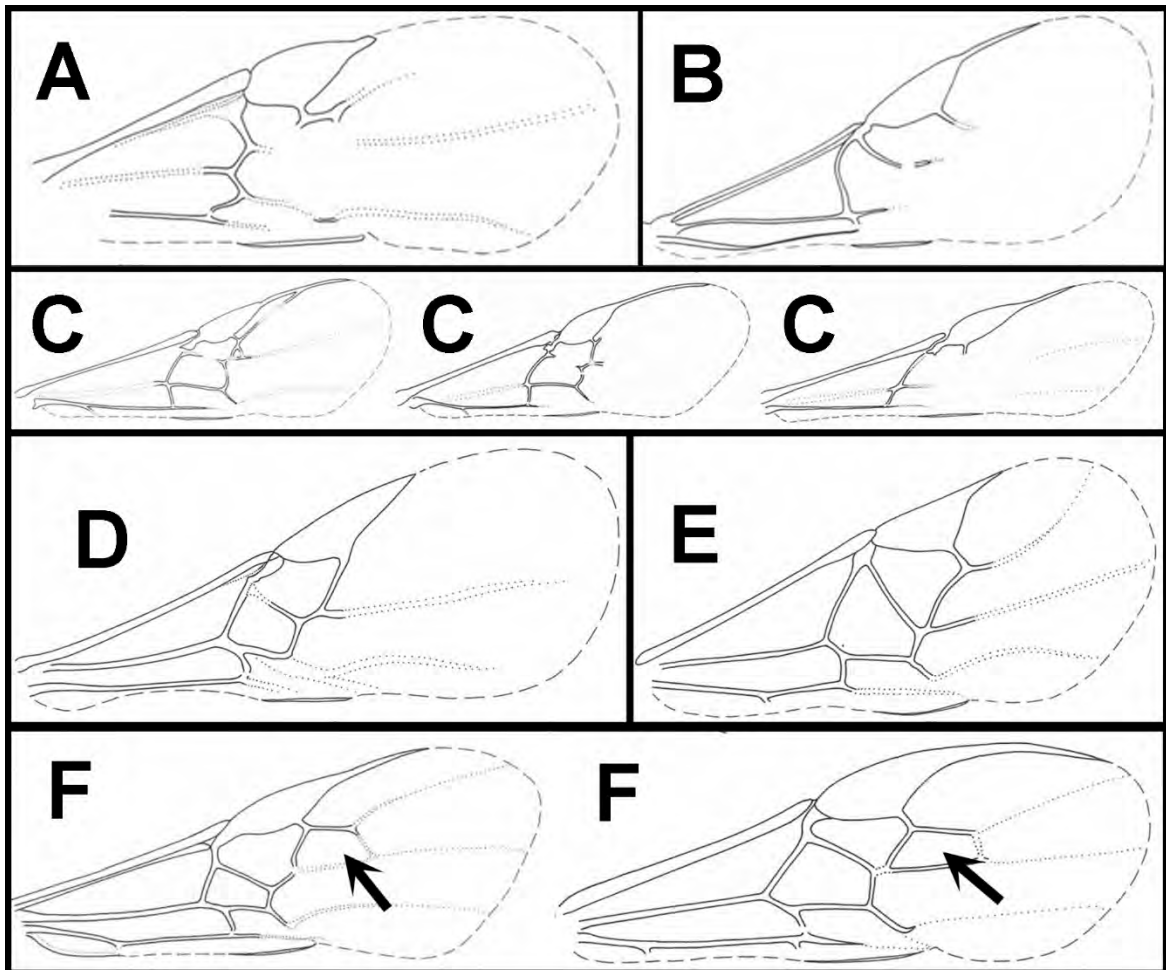
- 33(5). **A.** Occipital carina completely absent.[34](#)
- **B.** Occipital carina present and complete or incomplete dorsally or ventrally.....[37](#)



- 34(33). **A.** Forewing vein RS not reaching wing margin as a tubular vein.[35](#)
- **B.** Forewing vein RS reaching wing margin as a tubular vein.[37](#)

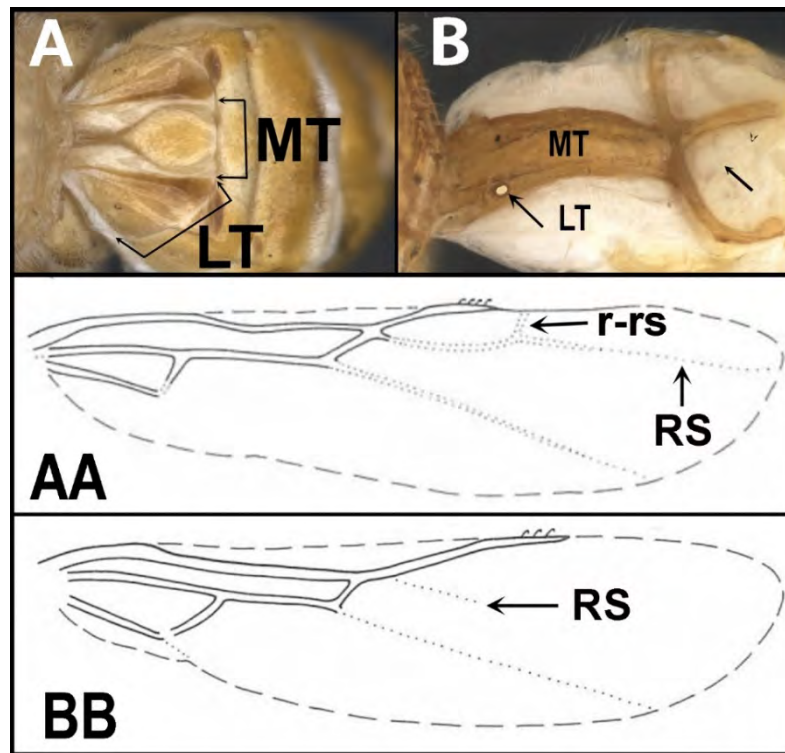


- 35(34). A. Forewing venation as in A. **some EUPHORINAE (some Neoneurini)**
- B. Forewing venation as in B. **some ICHNEUTINAE**
 - C. Forewing venation similar to those in C. **a few AGATHIDINAE**
 - D. Forewing venation as in D. **MIRACINAE**
 - E. Forewing venation as in E. **DIRRHOPINAE**
 - F. Forewing venation unlike those in A-E, and quite similar to those in F which have a weakly defined second submarginal cell. **36**

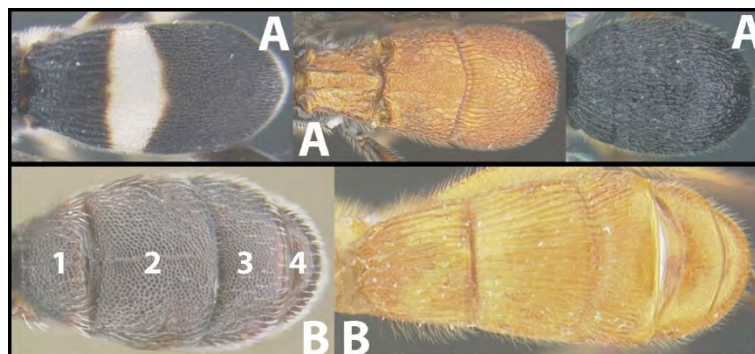


- 36(35). **A.** Spiracle of first metasomal segment on lateral tergite (LT). **AA.** Hind wing vein RS reaching wing margin as a nontubular vein, or almost so; and usually with an adventitious (non-tubular) crossvein r-rs present and approaching anterior margin of wing. Moderately common. Widespread. **CARDIOCHILINAE**
- **B.** Spiracle of first metasomal segment on median tergite (MT). **BB.** Hind wing vein RS not nearly reaching wing margin as a nontubular vein, and without an adventitious (non-tubular) r-rs crossvein reaching margin of wing. Rare. Neotropical. **MENDESELLINAE**

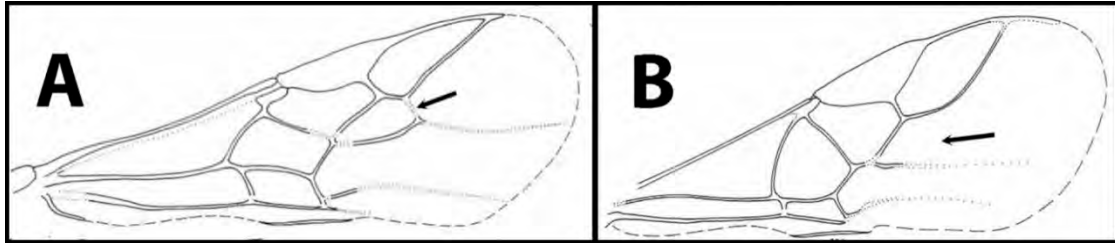
Note. The spiracle on the lateral tergite of cardiochilines may be very difficult to see. It is often obscured by the hind coxa or hidden because the lateral tergite is folded under the metasoma. It is perhaps better to simply look for a spiracle on the median tergite. If it is present on the median tergite, it is Mendesellinae, if it is absent on the median tergite it is Cardiochilinae. The first median tergite (MT) of cardiochilines can be very narrow.



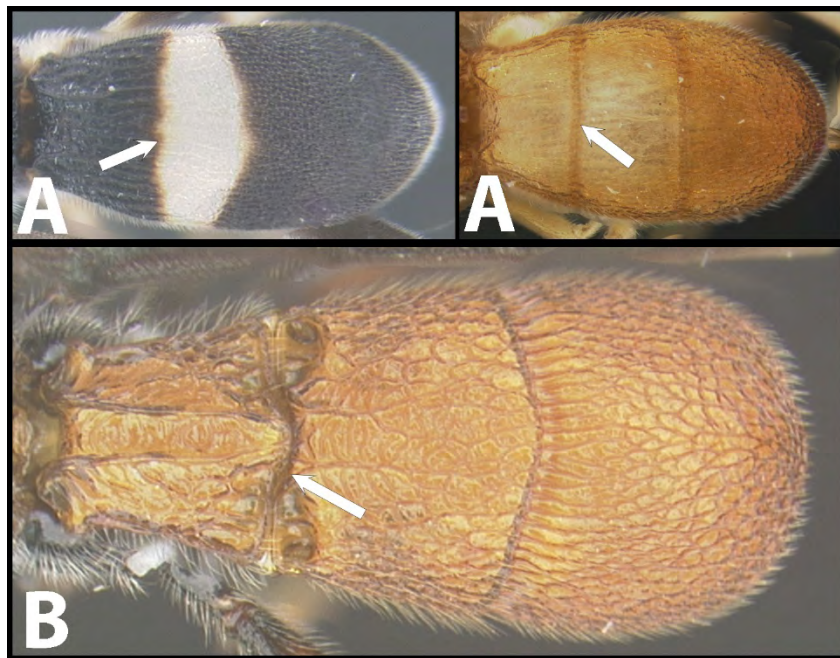
- 37(33, 34). **A.** First three metasomal terga forming carapace covering all other terga; divisions between the terga may not be apparent. **38**
- **B.** First three metasomal terga not forming carapace covering all other terga. **41**



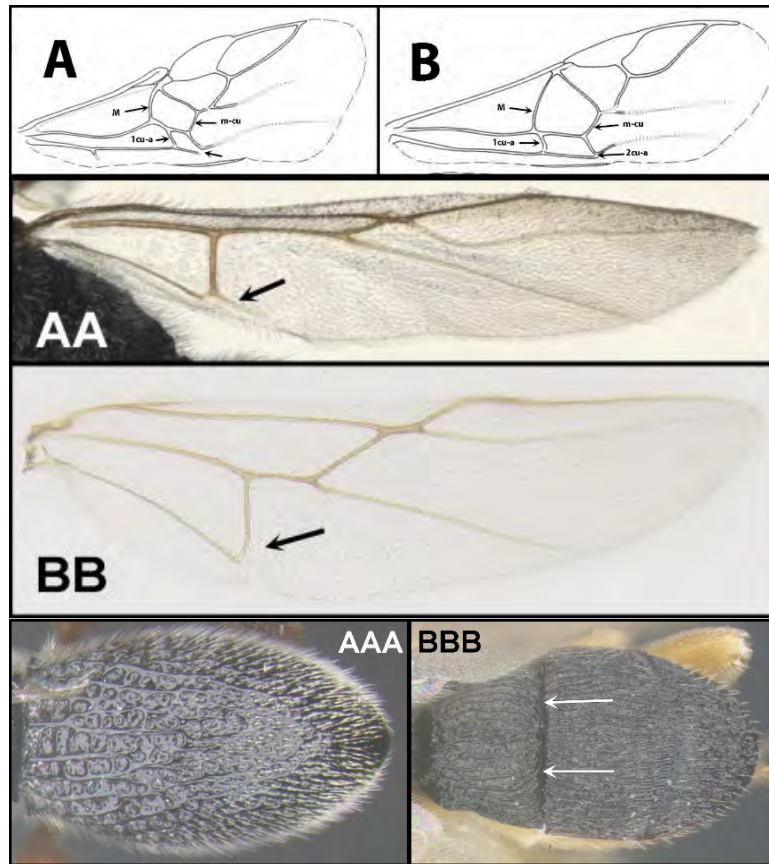
- 38(37). **A.** Forewing crossvein r-m present (though not always tubular and complete), thus second submarginal cell closed distally.39
- **B.** Forewing crossvein r-m absent, thus second submarginal cell open distally.40



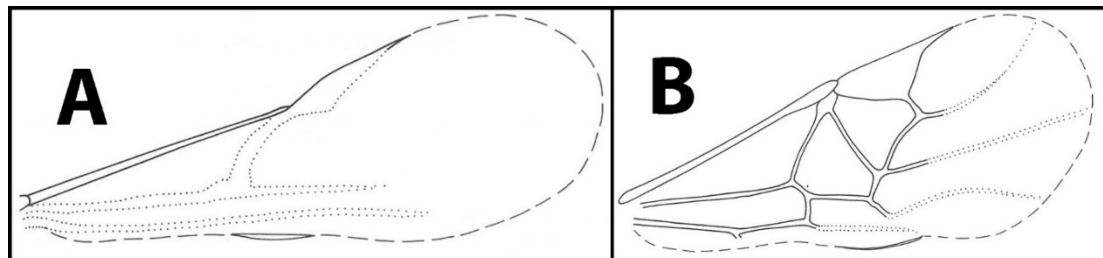
- 39(38). **A.** Metasomal terga 1 and 2 fused, not capable of articulation. Common. **most CHELONINAE**
- **B.** Metasomal terga 1 and 2 not fused, capable of articulation. Rare.
..... **most SIGALPHINAE (*Sigalphus* and *Minanga*)**



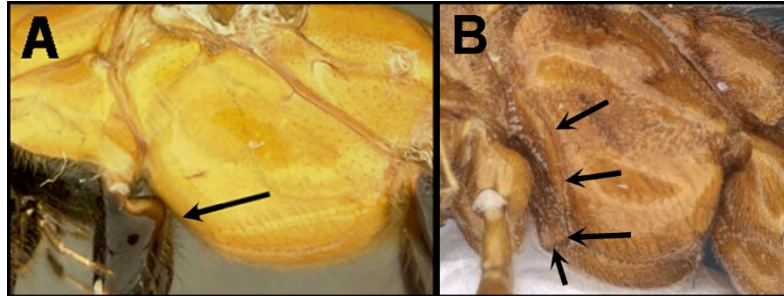
- 40(38). **A.** Forewing crossvein 1cu-a positioned midway between M and m-cu. 2cu-a absent. **AA.** Vein Cub of hind wing present but often weak and difficult to see. **AAA.** Metasomal terga 1 and 2 fused, not capable of articulation.**ACAMPSOHELCONINAE (Urosigalphus)**
- **B.** Forewing crossvein 1cu-a usually positioned much closer to M than to m-cu. Vein 2cu-a usually (90%) present. **BB.** Cub of hind wing absent. **BBB.** Metasomal terga 1 and 2 variable fused as in AAA or not fused and capable of articulation. **many BRACHISTINAE**



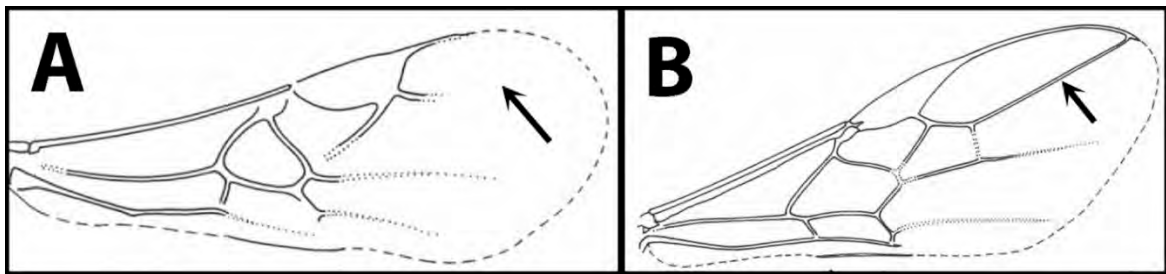
- 41(37). **A.** Forewing lacking tubular veins. Extremely small specimens, less than 2mm.in length. Rare..... **a few MASONINAE**
- **B.** Forewing with tubular veins. Specimens almost always more than 2mm in length.[42](#)



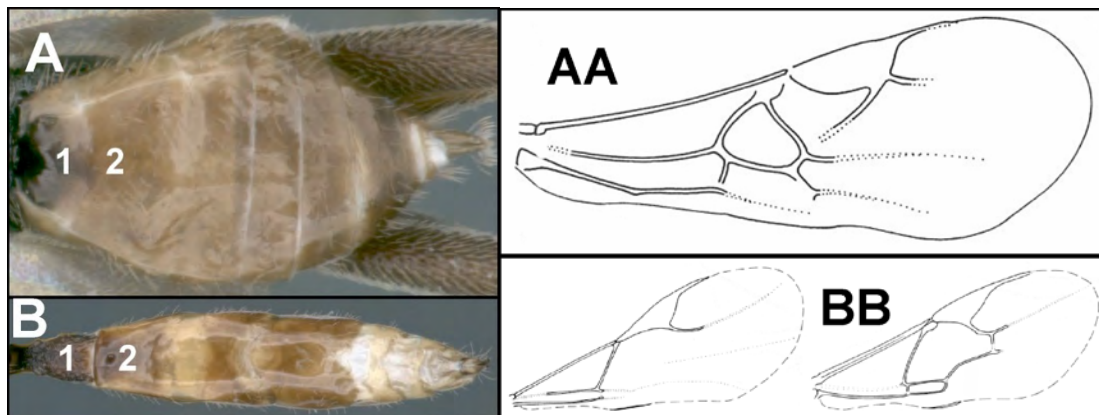
- 42(41). A. Epicnemial carina absent. 43
- B. Epicnemial carina present. 48



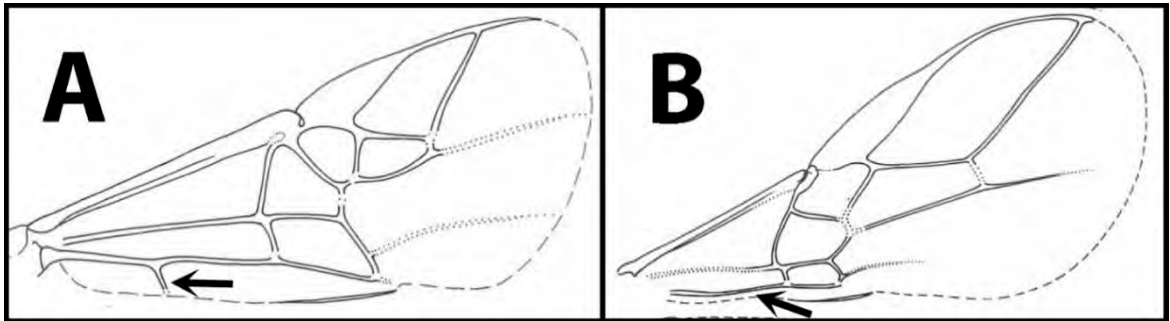
- 43(42). A. Forewing vein 3RS not reaching wing margin as a tubular vein. 44
- B. Forewing vein 3RS reaching wing margin as a tubular vein. 45



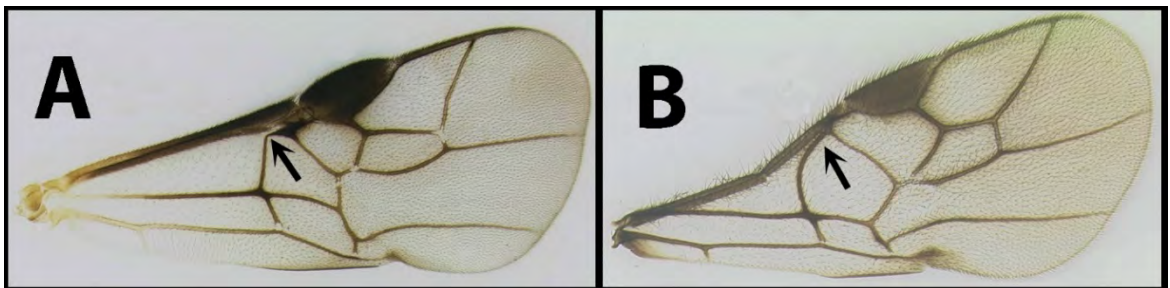
- 44(43). A. Metasomal terga 1 and two fused. AA. Forewing venation as in image AA. some CHELONINAE (*Adelius* and *Paradelius*)
- B. Metasomal terga 1 and 2 articulating. BB. Forewing venation variable but not as in AA. Two examples are given in BB. some APHIDIINAE



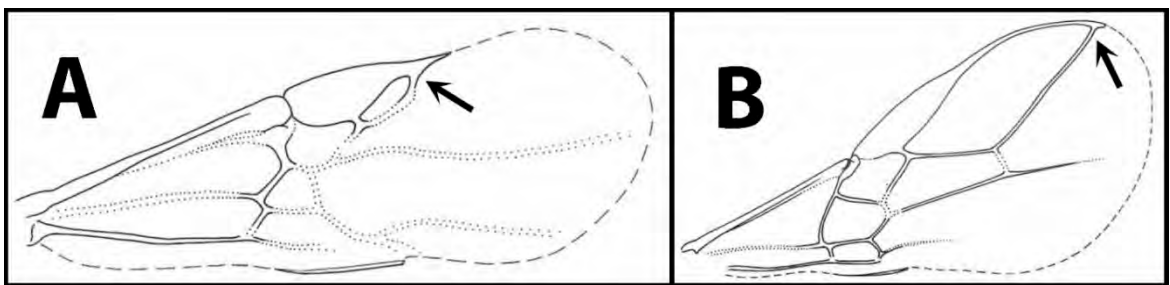
- 45(43). **A.** Forewing with anal cross vein present. This cross vein may be very short and weak.46
 - **B.** Forewing lacking anal cross vein.47



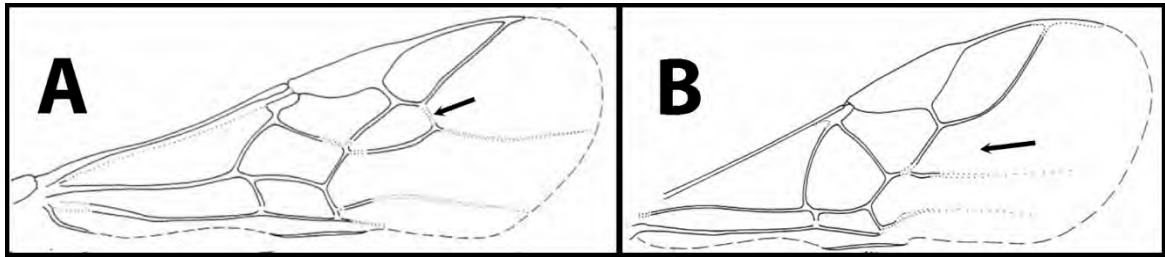
- 46(45). **A.** Forewing vein M with a sharp curve near intersection with parastigma. Nearctic.
 many **ICHNEUTINAE** (*Ichneutes* and *Pseudichneutes*)
 - **B.** Forewing vein M with evenly curved or relatively straight throughout its length. Widespread.
 most **PROTEROPINAE**



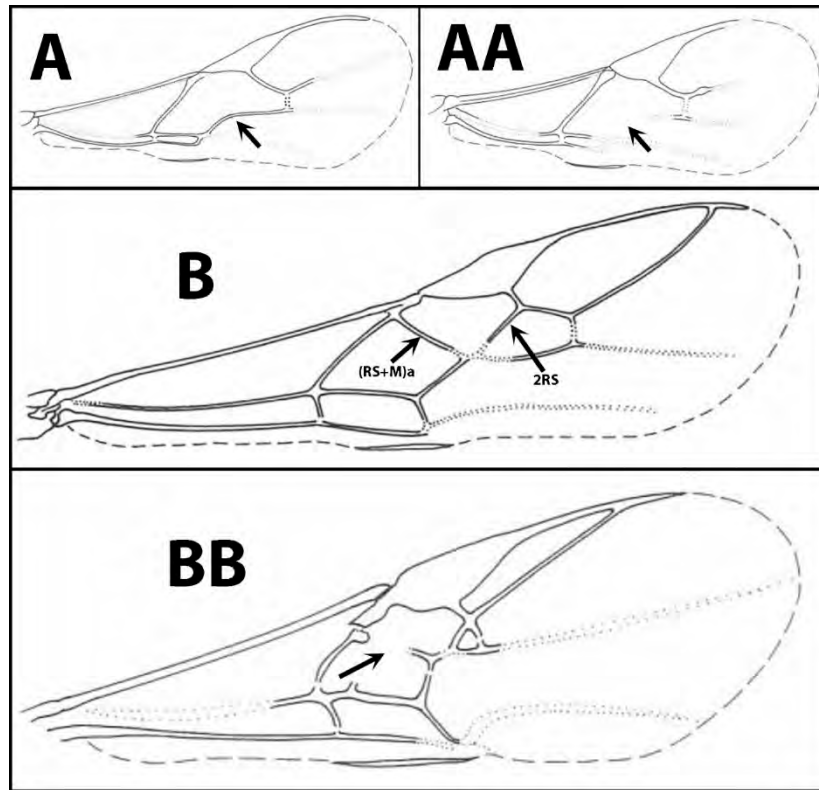
- 47(45). **A.** Forewing vein RS meeting wing margin near stigma. Nearctic. Relatively rare.
 some **EUPHORINAE** (*Neoneurus*)
 - **B.** Forewing vein RS meeting wing margin near apex of wing, far from stigma. Widespread. Common.
 many **OPIINAE**



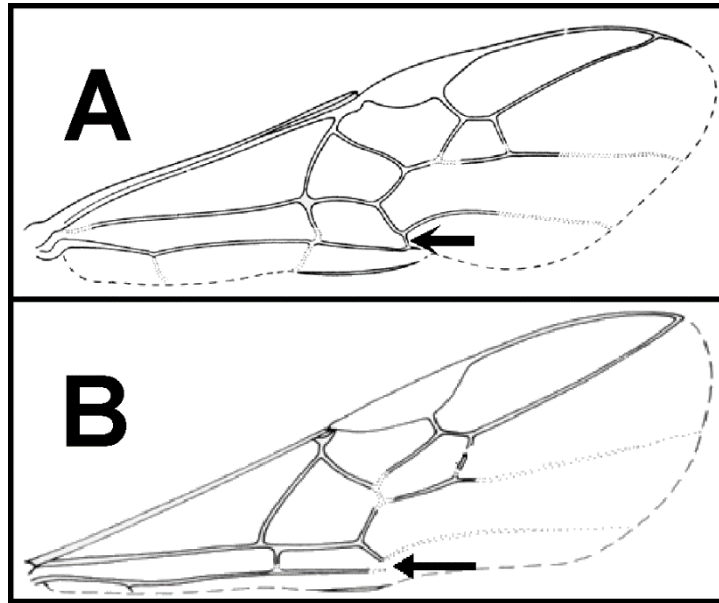
- 48(42). **A.** Forewing crossvein r-m present (though not always tubular and complete), thus second submarginal cell closed distally.[49](#)
- **B.** Forewing crossvein r-m absent, thus second submarginal cell open distally.[69](#)



- 49(48). **A, AA.** Veins 2RS and (RS+M)a of forewing absent, creating a single confluent cell in the middle of wing. This cell (1st submarginal + 2nd submarginal + 1st discal) may be completely closed, as in A, or partially open posteriorly as in AA.**some APHIDIINAE**
- **B, BB.** Forewing without a large confluent cell as described above; vein 2RS always present, thus second submarginal cell closed basally. **BB.** vein (RS+M)a partly or completely absent in most Agathidinae.[50](#)

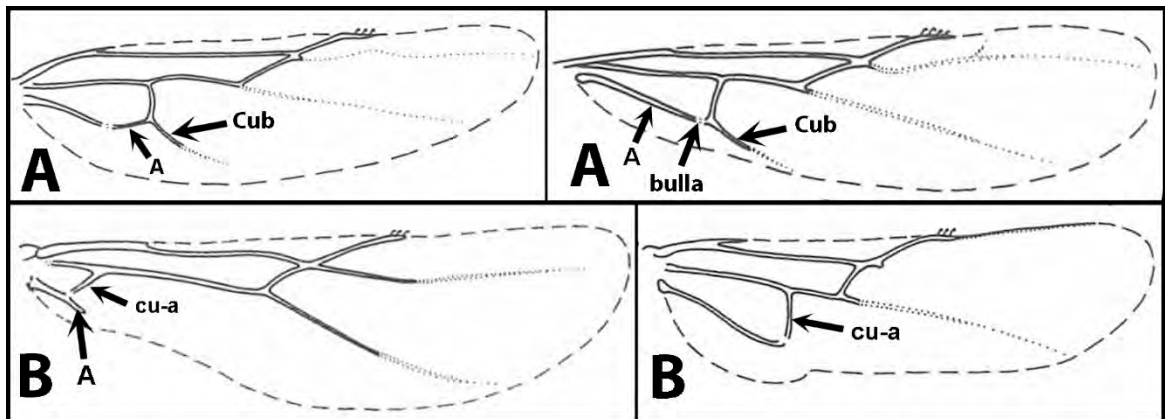


- 50(49). A. Forewing crossvein 2cu-a present. Subdiscoidal cell closed or almost closed distally.51
- B. Forewing crossvein 2cu-a absent. Subdiscoidal cell open distally.57

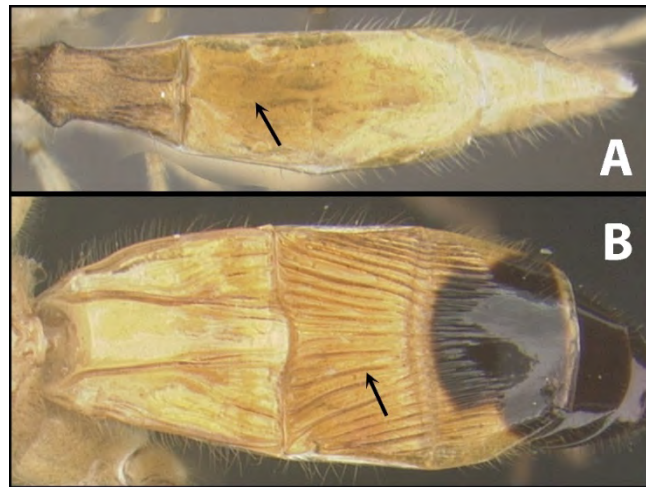


- 51(50). A. Hind wing vein Cub present. Rare.52
- B. Hind wing vein Cub absent. Common.53

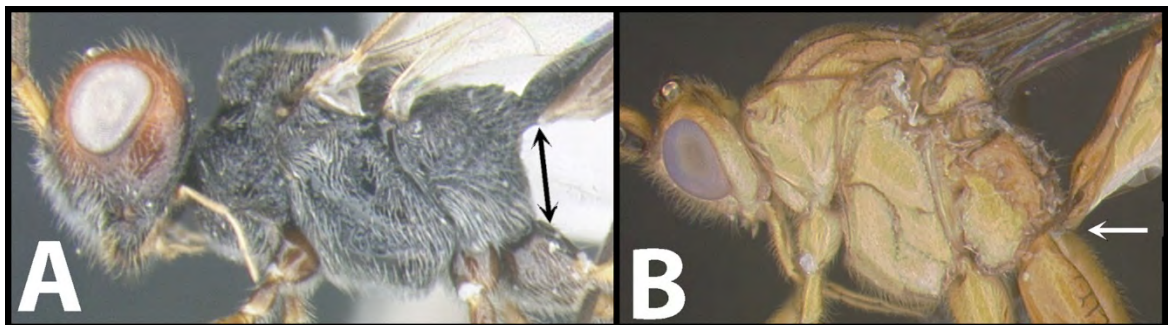
Note: This character is sometimes difficult to interpret because vein Cub may be very posterior in position (as in the right-hand figure A below) and therefore appear to be vein part of vein A (anal vein). A typical position for vein the distal part of vein A is illustrated in the left-hand figure B below. The best way to distinguish the two characters is as follows: if there is a break (bulla) on vein A it is the distal vein is Cub (A figures below), and if there is a break (bulla) on crossvein cu-a it is the distal portion of vein A (B figures below).



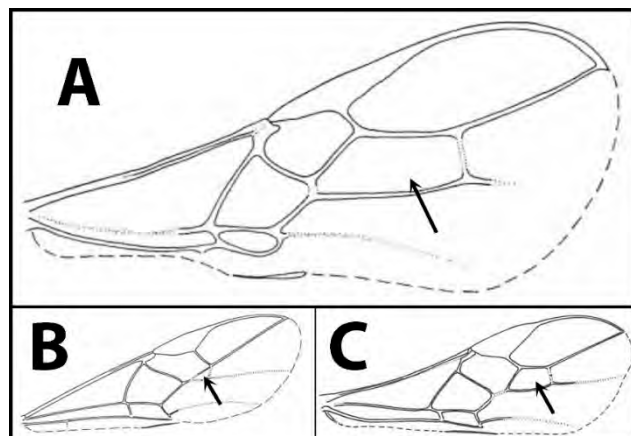
- 52(51). A. Metasomal terga 2 and 3 smooth, unsculptured or nearly so, never striate. Widespread. Rare.....
 METEORIDEINAE
- B. Metasomal terga 2 and 3 striate. Neotropical. Rare.some SIGALPHINAE (*Pselaphanus*)



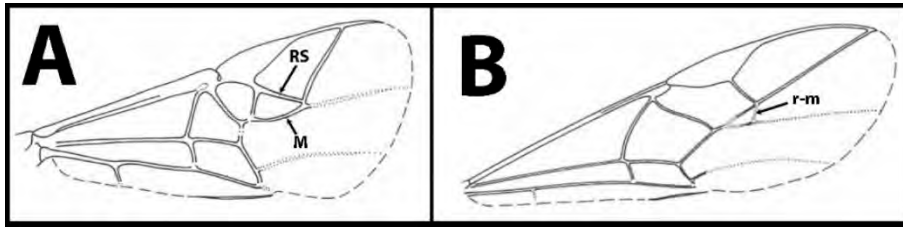
- 53(51). A. Metasoma attached to propodeum well above hind coxal cavities. CENOCOELIINAE
- B. Metasoma attached to propodeum directly above hind coxal cavities 54



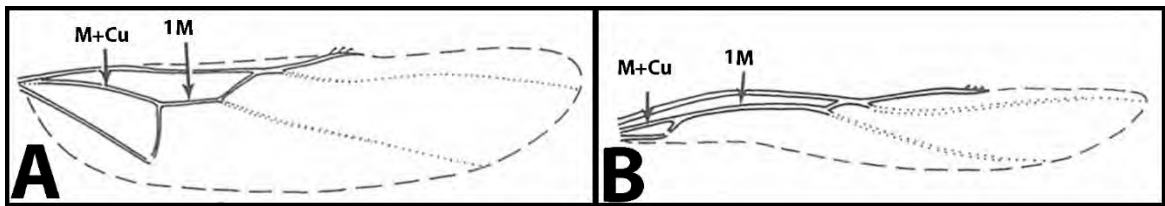
- 54(53). A. Second submarginal cell of forewing pentagonal.some APHIDIINAE
- B. Second submarginal cell of forewing triangular. 55
- C. Second submarginal cell of forewing quadrangular. 57



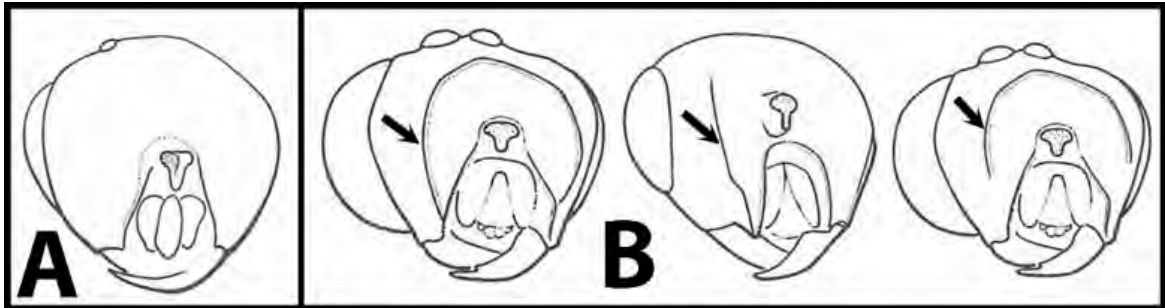
- 55(54). A. Forewing crossvein r-m very short or absent, thus M and RS meeting distally or nearly so.
some ICHNEUTINAE (a few *Ichneutes*)
 - B. Forewing crossvein r-m crossvein distinct, veins M and RS not meeting distally.56



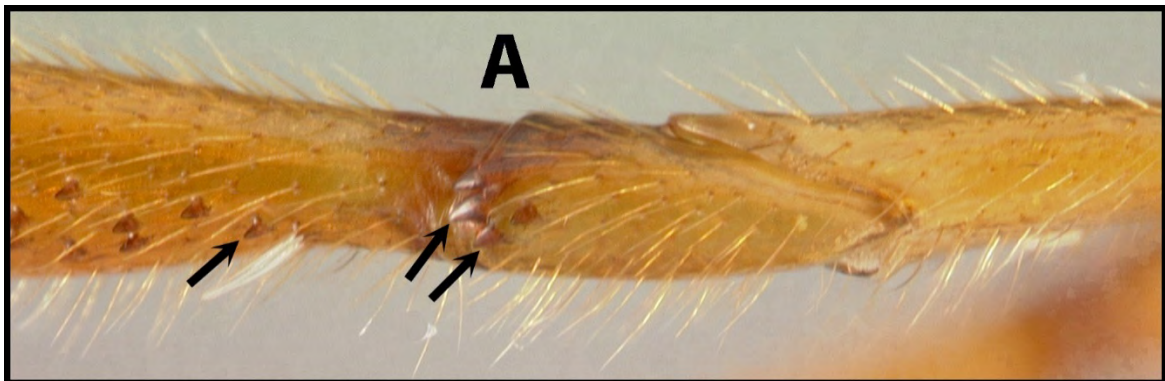
- 56(55). A. Hind wing vein M+Cu longer than 1M.MICROTYPINAE
 - B. Hind wing vein M+Cu much shorter than 1M.some ORGILINAE



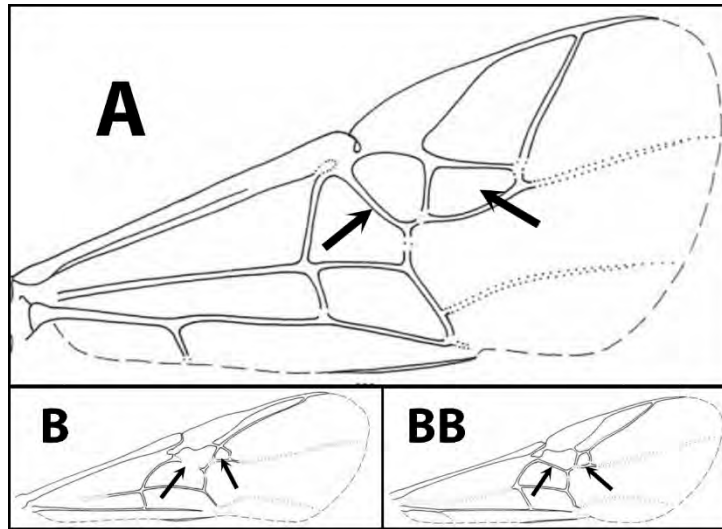
- 57(50, 54). A. Occipital carina completely absent.58
 - B. Occipital carina present, at least in part.60



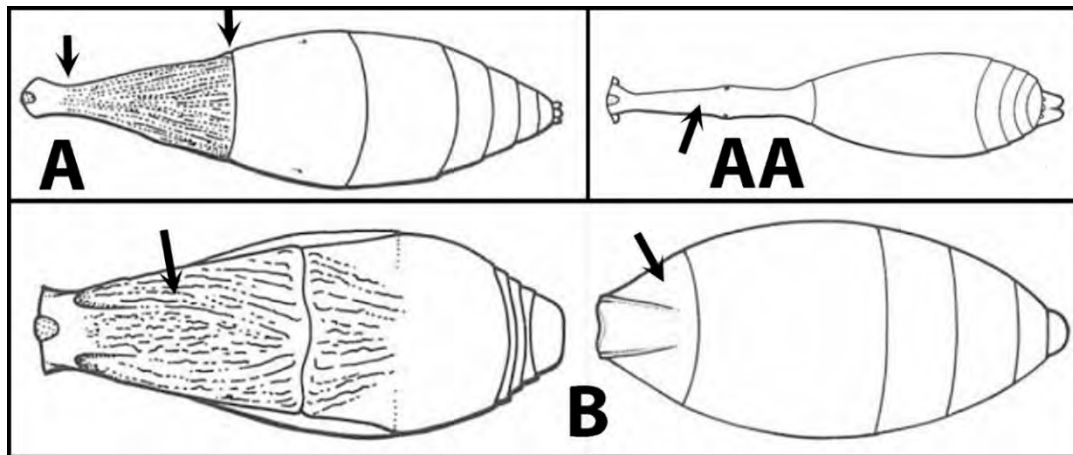
- 58(57). A. Apex of trochantellus of hind leg, and often base of hind femur, with spines. MACROCENTRINAE
 - B. Trochantellus and base of femur of hind leg without spines.59



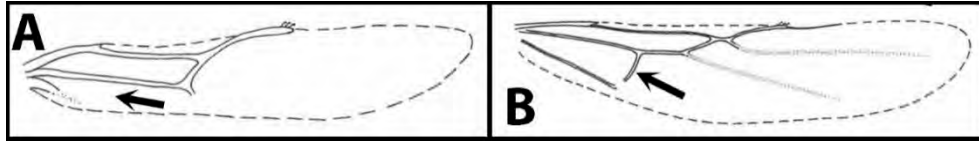
- 59(58). **A.** 2nd submarginal cell of forewing large, wider than high, and quadrangular. Vein (RS+M)a complete and tubular.many **ICHNEUTINAE**
- **B.** 2nd submarginal cell of forewing small, triangular or BB quadrangular; if quadrangular then not much wider than high. Vein (RS+M)a usually (95%) weak or absent (as in B), rarely complete and tubular (as in BB).most **AGATHIDINAE**



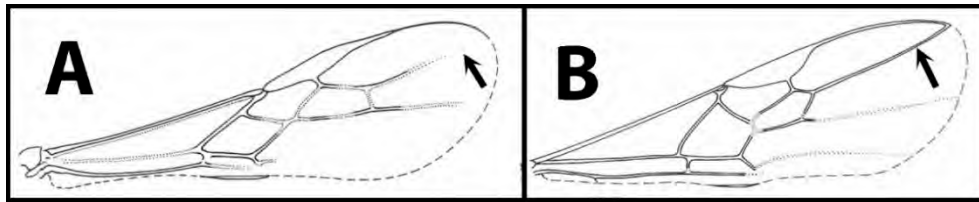
- 60(57). **A.** Tergum 1 at least 2.5 times wider at posterior margin than at narrowest point. Or **AA.** Tergum 1 more than 4 times longer than apical width.some **EUPHORINAE**
- **B.** Tergum 1 less than 2.5 times wider at posterior margin than at narrowest point and much less than 4 times longer than apical width.[61](#)



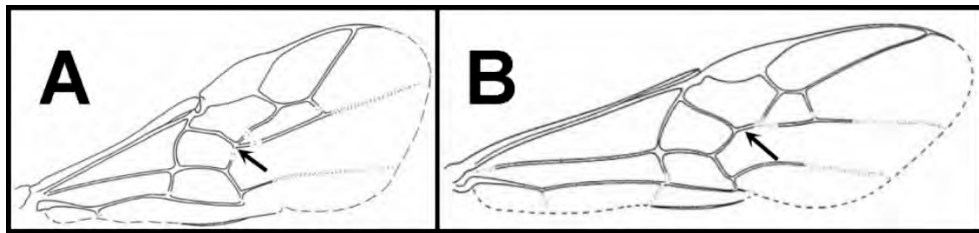
- 61(60). A. Hind wing crossvein cu-a absent.a few APHIDIINAE
 - B. Hind wing crossvein cu-a present.62



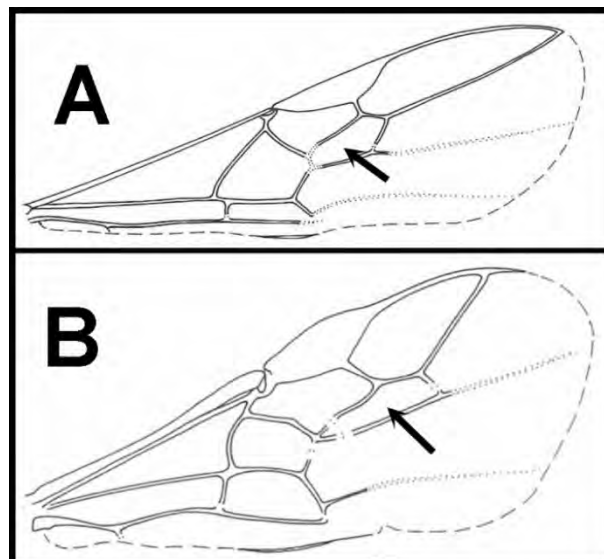
- 62(61). A. Forewing vein RS not reaching wing margin as a tubular vein. Rare. a few OPIINAE (*Ademon*)
 - B. Forewing vein RS reaching wing margin as a tubular vein.63



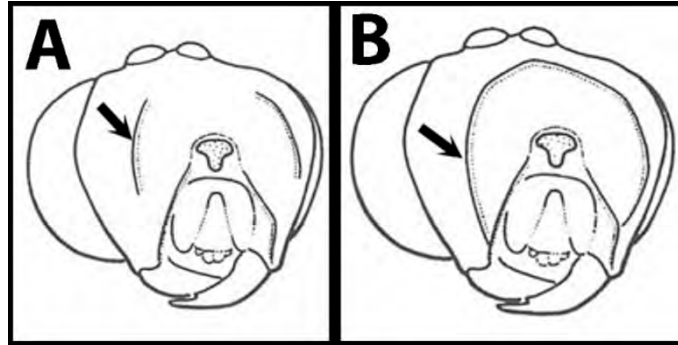
- 63(62). A. Forewing vein (RS+M)b absent. Rare.64
 - B. Forewing vein (RS+M)b present. Relatively common.65



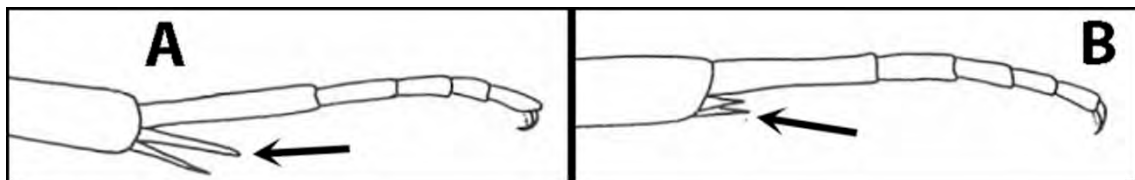
- 64(63). A. Second submarginal cell of forewing pentagonal. Rare. Nearctic. BRACHISTINAE (*Dyscoletes*)
 - B. Second submarginal cell of forewing quadrangular. Neotropical; rare.
 a few PROTEROPINAE (some *Helconichia*)



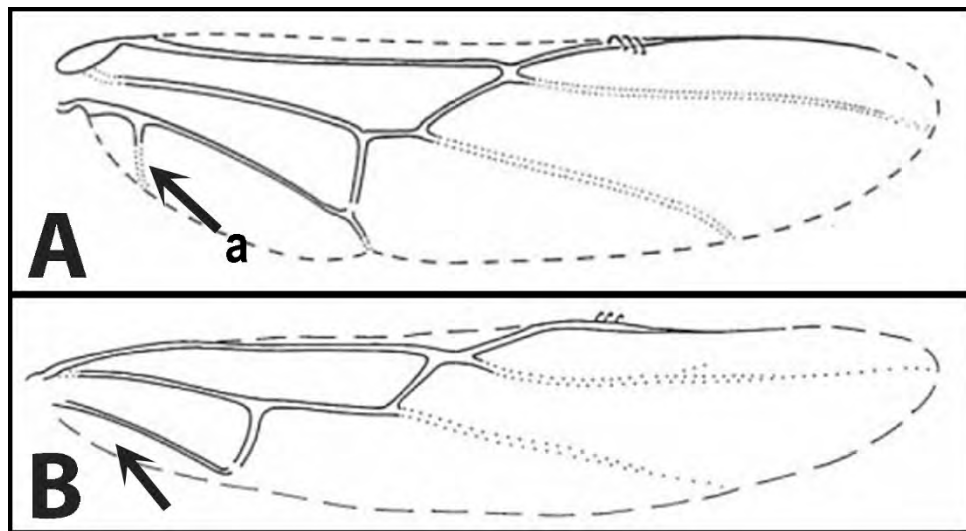
- 65(63). **A.** Occipital carina incomplete, present only laterally, absent dorsally and ventrally. Rare. Chile. **some ORGILINAE (*Antestrix*)**
 - **B.** Occipital carina complete, present dorsally and ventrally. **66**



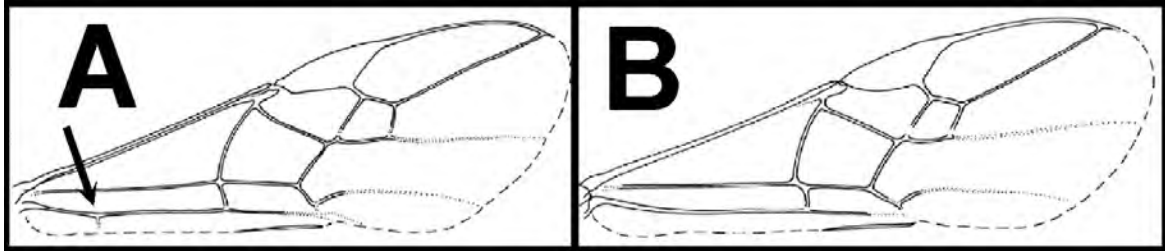
- 66(65). **A.** Longest spur of hind tibia almost as long as or longer than half length of basitarsus..... **HOMOLOBINAE**
 - **B.** Longest spur of hind tibia distinctly shorter than half length of basitarsus. **67**



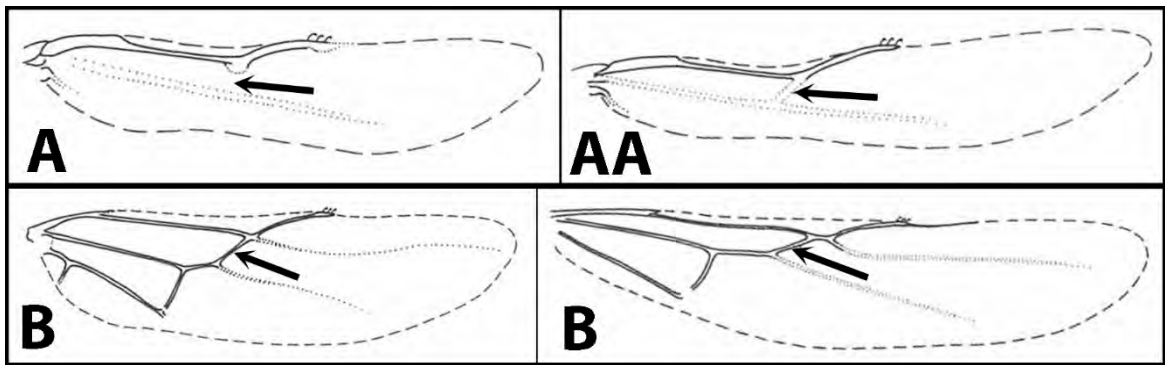
- 67(66). **A.** Anal crossvein (a) of hind wing present. **HELCONINAE**
 - **B.** Anal crossvein of hind wing absent. **68**



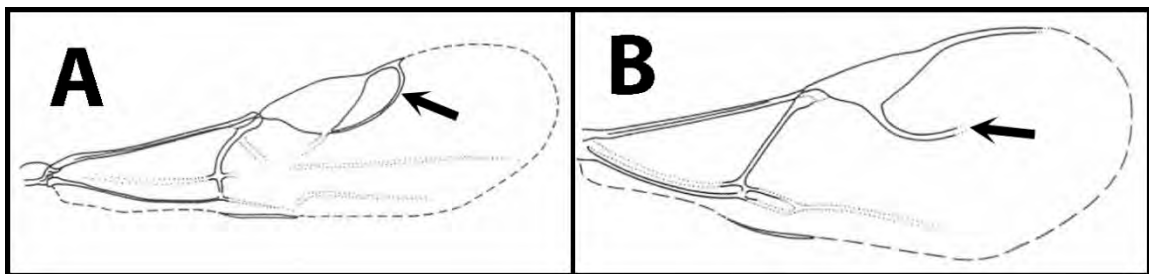
- 68(67). A. Forewing with one or two anal crossveins.some **BRACHISTINAE** (some **Diospilini**)
 - B. Forewing lacking anal crossveins.some **EUPHORINAE** (some **Meteorini**)



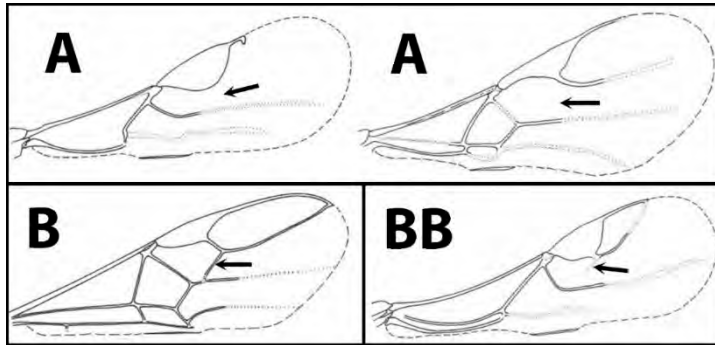
- 69(48). A. Hind wing crossvein r-m absent, or AA if present not tubular.**70**
 - B. Hind wing crossvein r-m present and tubular.**71**



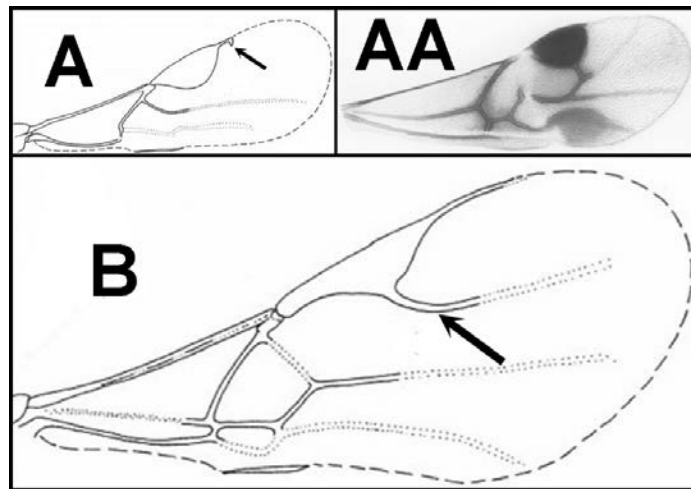
- 70(69). A. Forewing vein RS curved sharply towards anterior margin of wing.some **EUPHORINAE**
 - B. Forewing vein RS not curved sharply towards anterior margin of wing.some **APHIDIINAE**



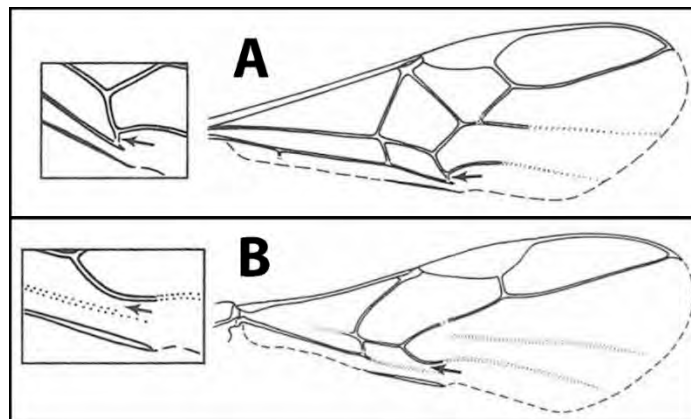
- 71(69). A. Forewing vein 2RS absent.72
- B. Forewing vein 2RS present at least weakly as in BB.73



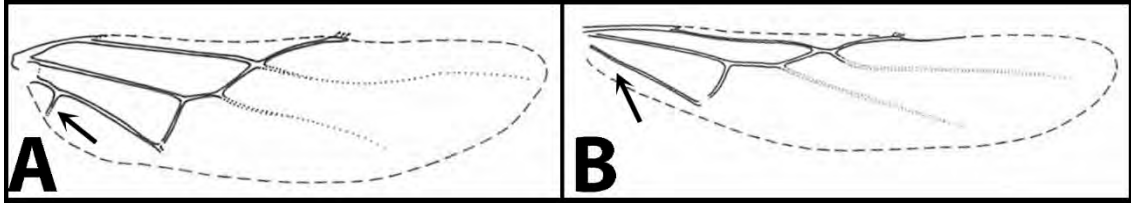
- 72(71). A. Forewing venation very similar to A or AA.
 some EUPHORINAE (*Euphoriella* (A) and *Betelgeuse* (AA))
- B. Forewing not as in A or AA; forewing vein RS arising from stigma and not reaching wing margin; one example is given. some APHIDIINAE



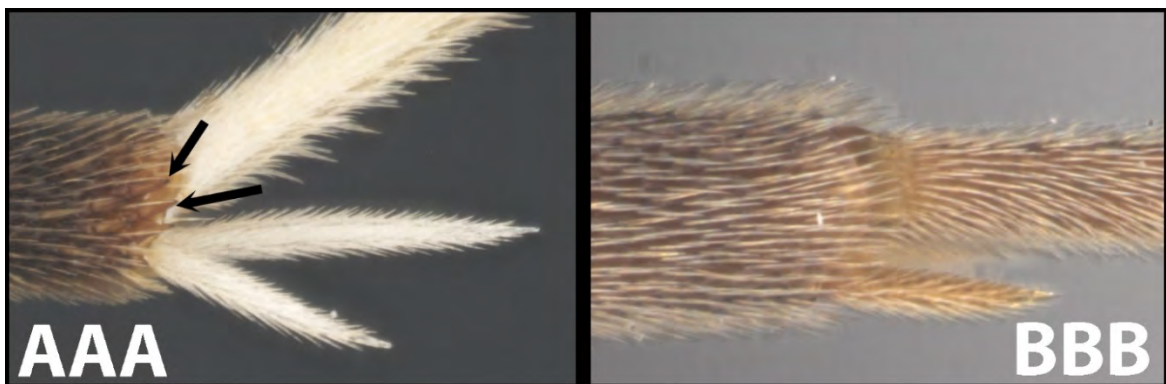
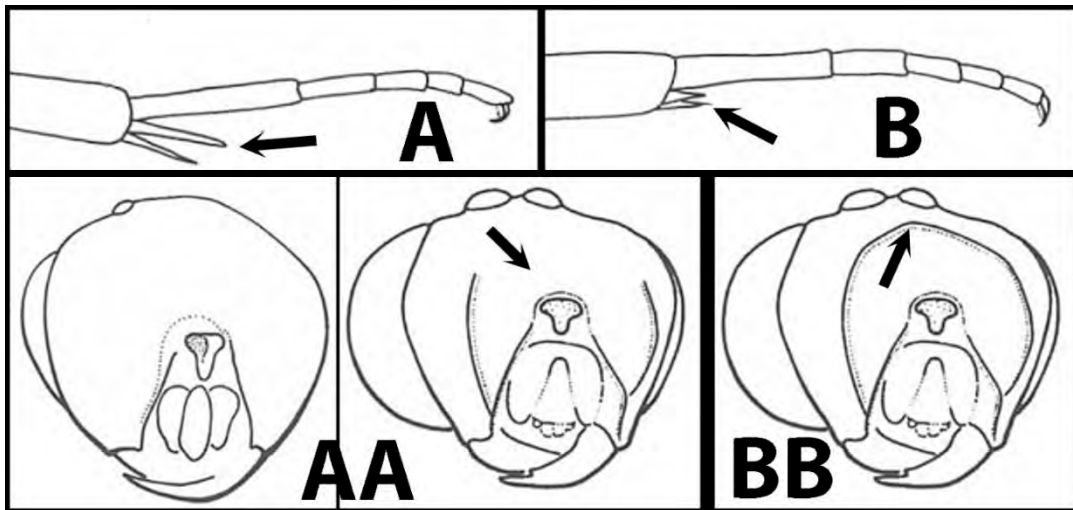
- 73(71). A. Forewing crossvein 2cu-a present.74
- B. Forewing crossvein 2cu-a absent.76



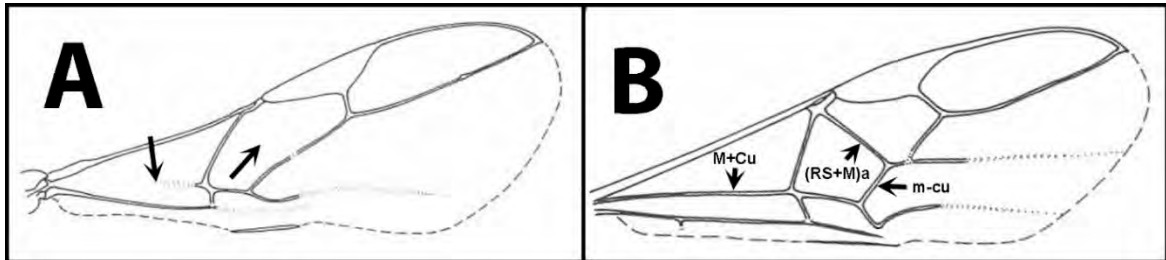
- 74(73). **A.** Hind wing anal cross vein present.**CHARMONTINAE**
 - **B.** Hind wing anal cross vein absent.**75**



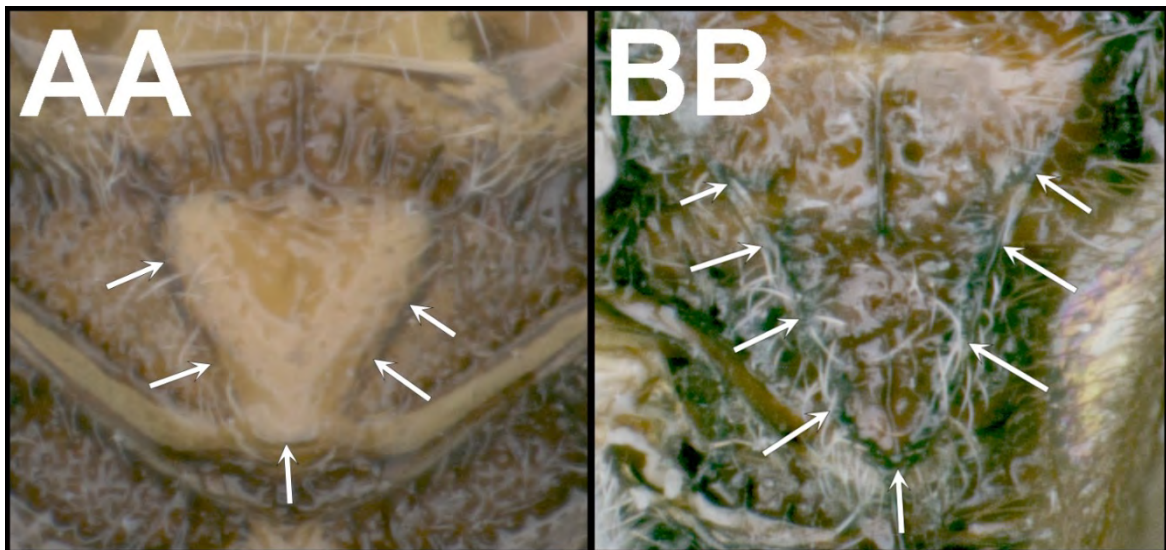
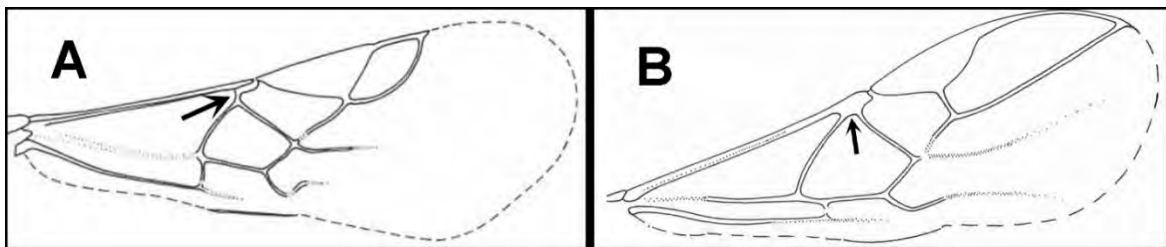
- 75(74). **A.** Longest tibial spur of hind leg often more than one third as long as basitarsus. **AA.** Occipital carina usually absent mid-dorsally (85%) or completely absent(5%). **AAA.** Hind tibia usually (90%) with apical spines.**some ORGILINAE**
 - **B.** Longest tibial spur of hind leg usually (80%) less than or equal to one third length of basitarsus. **BB.** Occipital carina complete dorsally. **BBB.** Hind tibia without apical spines.**some BRACHISTINAE**



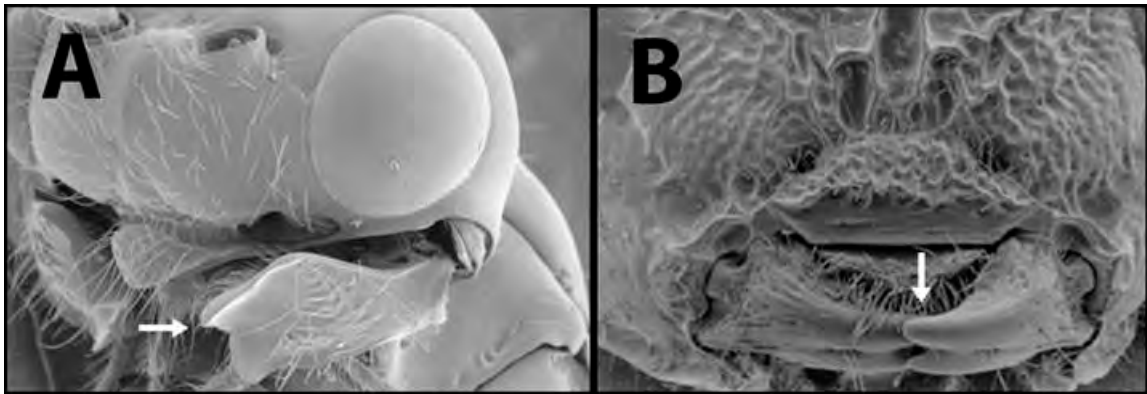
- 76(73). **A.** Forewing with one or more of the following veins and crossveins incomplete, absent, or not tubular: (RS+M)a, m-cu, at least basal three-fourths of M+Cu. **some EUPHORINAE**
- **B.** Forewing with vein (RS+M)a and crossvein m-cu tubular and complete, and at least the apical three-fourths of vein M+Cu tubular. **77**



- 77(76). **A.** Forewing vein 1RS present, though short. Vein RS length variable. **AA.** Scutellar triangle not bordered by carinae. **some EUPHORINAE**
- **B.** Forewing vein 1RS usually absent, rarely very short. Vein RS extending to near apex of wing. **BB.** Scutellar triangle bordered by carinae that is often produced into a spine at the posterior of the scutellum. **some BRACHISTINAE (most Blacini)**



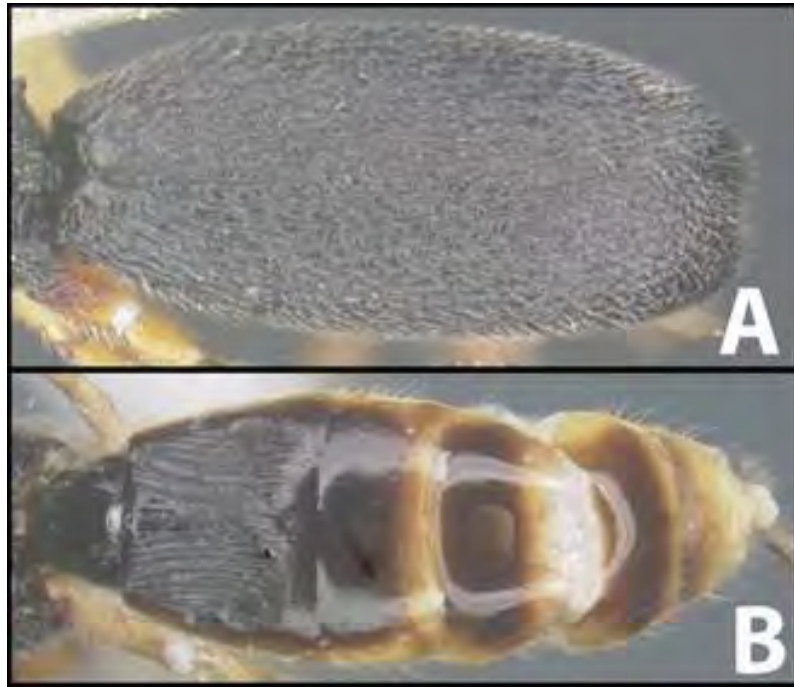
- 78(4). **A.** Exodont, mandibles not touching or overlapping when closed, and with 3 or more teeth facing outwardly.**some ALYSIINAE**
- **B.** Endodont, mandibles touching and usually overlapping when closed, and usually with two teeth, rarely one tooth, facing inwardly.[79](#)



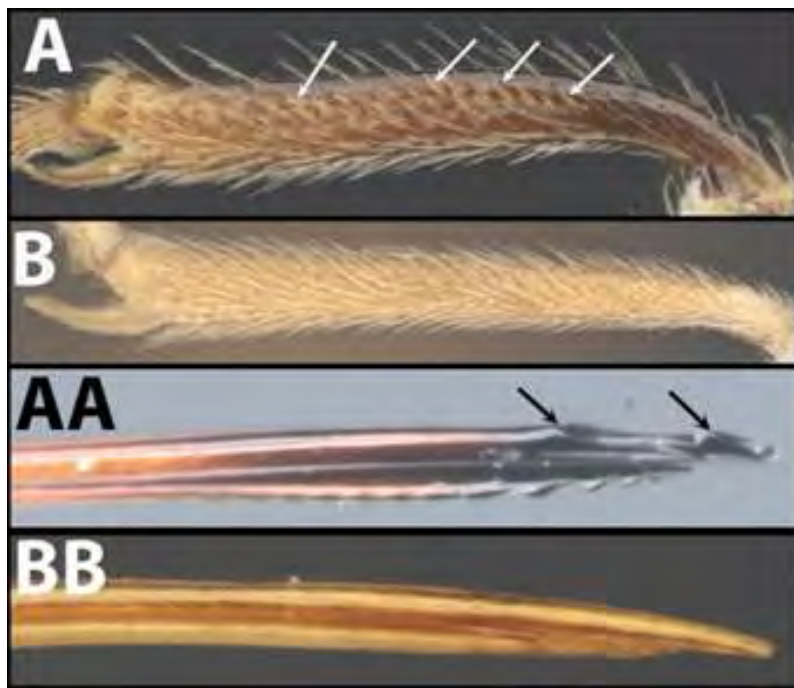
- 79(78). **A.** Metasomal terga 2+3 mostly desclerotized, with lateral margins more heavily sclerotized.**OTHER CYCLOSTOMA (some *Hormius* and *Parahormius*)**
- **B.** Metasomal terga 2+3 evenly sclerotized.[80](#)



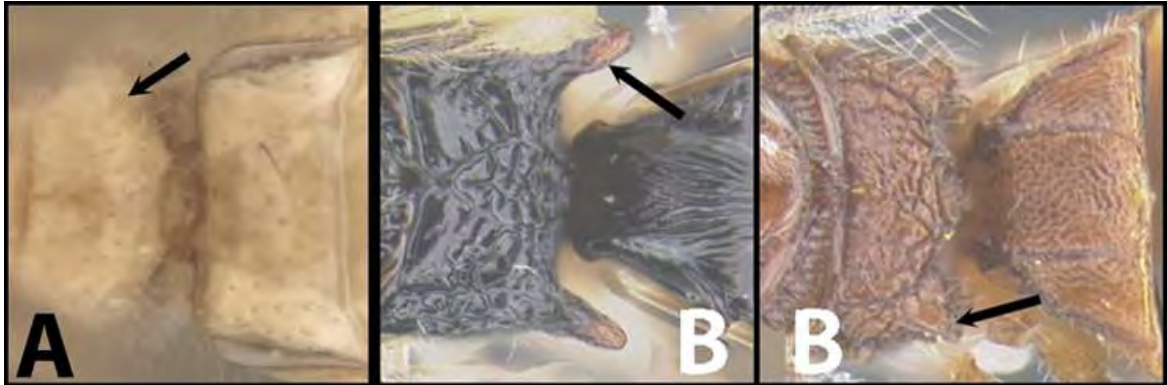
- 80(79). **A.** Metasoma carapace-like.....some **BRACHISTINAE** (a few *Triaspis*)
- **B.** Metasoma not carapace-like.[81](#)



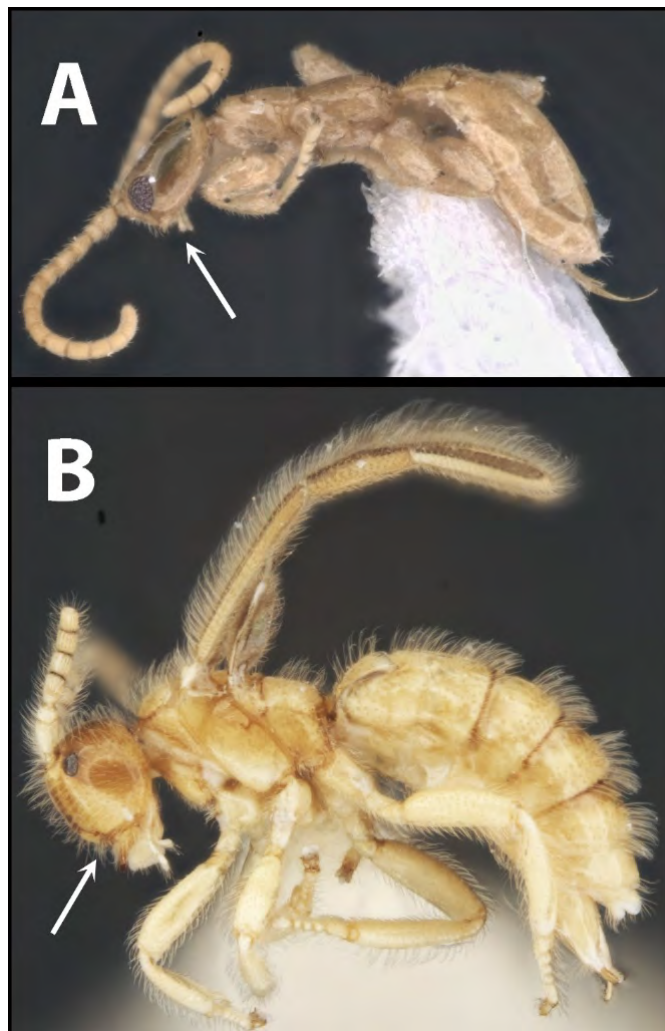
- 81(80). **A.** Spines on medial surface of foretibia present. **AA.** Dorsal valve of ovipositor with two nodes. Tip of ovipositor usually (95%) melanic.**a few DORYCTINAE**
- **B.** Spines on medial surface of foretibia absent. **BB.** Dorsal valve of ovipositor with one node or lacking nodes. Tip of ovipositor usually (95%) concolorous with basal portions.[82](#)



- 82(81). A. Propodeum without posterolateral projections.83
- B. Propodeum with posterolateral projections.OTHER CYCLOSTOMA (e.g., *Pambolus*)



- 83(82). A. Head elongate and dorsoventrally flattened. some MASONINAE
- B. Head of normal dimensions. Associated with termites..... some DORYCTINAE (*Termitobracon*)



Acknowledgements

Thanks to Steve Marshall for allowing us to use his fine photograph of *Histeromerus* sp., to Julia Stigenberg and Abigail Martens for reviewing earlier drafts, and to Heather Proctor for carefully and expertly reviewing the final manuscript.

Conflicting Interests

At the time of publication, Spencer K. Monckton was the Technical Editor for the Canadian Journal of Arthropod Identification. His inclusion in the list of authors recognizes his important contributions to the structure and appearance of this article's interactive online identification key, and we are not aware of any impact on the review process or handling of this article's publication. The remaining authors have no conflicts of interest to disclose.

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