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SOME IMPORTANT MORPHOLOGICAL FEATURES OF THE CHALCIDINI (HYMENOPTERA: CHALCIDIDAE) AND THEIR IMPLICATIONS IN THE CLASSIFICATION OF THE TRIBE

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ABSTRACT. A detailed morphological study of an extensive material revealed some important features of the Chalcidini and, within the tribe, of Spilochalcis. The main characters are: Malar sulcus, foraminal cavity, precapical carina of scutellum, dorsellum, propodeum, mesopleuron, prepectus, procoxae bristles, abdominal petiole, and the male genitalia. Among the described genera of Chalcidini, three are regarded as valid: Chalcis Fabricius (type species Sphex sispes Linné, 1761), Spilochalcis Thomson, 1876 (type species Chalcis xanthostigma Dalman, 1820), and Melanosmicra Ashmead, 1904 (type species Melanosmicra immaculata Ashmead, 1904). A phylogenetic tree is suggested. Synapomorphies for twenty-three groups of Spilochalcis are given. The following genera are synonymized under Spilochalcis: Thaumatus Kirby, 1883 (type species Smicra decora Walker, 1871), Epinaeus Kirby, 1883 (type species Smiera dux Walker, 1881), Metadontia Ashmead, 1888 (type species Smicra montana Ashmead, 1887), Ceratosmica Ashmead, 1904 (type species Ceratosmica petiolata Ashmead, 1904), Xanthomelanus Ashmead, 1904 (type species Chalcis dimidiata Fabricius), Psychidomica Blanchard, 1935 (type species Psychidomica australis Blanchard, 1935), Mixochalcis Blanchard, 1935 (type species Mixochalcis sibinecola Blanchard, 1935), and Eterochalcis Burks, 1939 (type species Smiera maculipennis Cameron, 1884). Platychalcis Cameron, 1904 (type species Platychalcis flavicolis Cameron, 1904) is synonymized under Melanosmicra.

Introduction

The Chalcidini comprise several hundred described species, but the taxonomy of the tribe is rather poorly understood. Attempts were made by Walker (1864 and 1871), Sichel (1865), Cresson (1872) and Ashmead (1904) to provide keys to the species, but these keys included only a small number of them, mainly those described by the authors themselves.

Ashmead's key to genera (1904) has most often been used to distinguish the various taxa. Burks (1940) revised the Nearctic species, which constitutes only a small part of the whole fauna of the group.

The objective of the present study, started four years ago, was to (1) assess the limits of the genera and propose a revised classification of the Chalcidini through a character analysis based on the examination of an extensive material, (2) look for synapomorphies defining natural groups within Spilochalcis Thomson, (3) update the nomenclature of the species after examining the type material.

The original confusion made by the earlier authors concerning the genus Chalcis Fabricius, 1787 and the fact that the genus Spilochalcis Thomson (1876) was established rather late, doubtless explain that, in the nineteenth century, most species of the tribe were described under Smiera or Smicra. The distinction between Chalcis and Spilochalcis appeared clearly for the first time in Thomson (1876) and in
Ashmead's key for the Chalcididae (1888). Later, Ashmead (1904) established several new genera, mainly on the basis of the metafemoral teeth. Most of them were, however, synonymized under Spilochalcis by Burks (1940).

The present study is based on a survey of about 400 species of Spilochalcis, among which 215 described species, 10 Chalcis, 7 Melanosmicra, 335 types and more than 4000 specimens. The male genitalia of 90 species of Spilochalcis belonging to 25 natural groups were also studied. The same was also studied in 4 species of Chalcis and 3 of Melanosmicra.

The Chalcidini may be recognized from other Chalcididae by the following combination of characters: Antenna inserted in the middle of the head, never immediately above the mouth; metatibia obliquely truncate at the end and bearing one apical spur; and gaster with a distinct petiole having a basal lamina and never bearing strong longitudinal grooves or keels.

In the present study all available species are treated disregarding their previous generic separation. Among the described genera of the tribe only three of them, Chalcis Fabricius, 1787, Spilochalcis Thomson, 1876 and Melanosmicra Ashmead, 1904 (better known by its junior synonym Platychalcis Cameron), are recognized.

A new genus will be probably necessary to include S. corumbicola Ashmead, 1904. I do not know Schizosmicra Blanchard, 1943 including its type species, S. tucumana Blanchard, 1943. It is not discussed further.

The three valid genera are characterized as follows:

Chalcis: Male hypopygium enlarged and posteriorly emarginate (Fig. 114); female hypopygium posteriorly protruding in its median part (Fig. 111); no apical spur on the mesotibia or apical spur fine and short (Fig. 105); male claws strongly pectinate and bifid at apex (Fig. 73); female claws unarmed (Fig. 72); claws only little curved in both sexes.

Melanosmicra: Female hypopygium densely pubescent at apex (Fig. 112); female metafemur with a strong and curved inner basal tooth (Fig. 62); apical spine of metatibia long and curved (Fig. 60); mandibles either 2-3 with the upper teeth longer than the other (Fig. 77) or 2-2 and fine, with the lower teeth longer than the upper (Fig. 78); in the latter case thorax strongly flattened and very sparsely punctured, with interspaces smooth and shiny; claws normally curved, similar in both sexes; apical spur always present on mesotibia; mouth never very broad.

Spilochalcis: Apical spur nearly always present on mesotibia (Fig. 106); claws normally curved, similar in both sexes (Fig. 107); hypopygium normal in both sexes (Fig. 113 and 115); metafemur sometimes with an inner tooth, but the latter never strong; if mandibular formula 2-3, then upper teeth not longer than the lower; if mandibular formula 2-2, then thorax never strongly flattened and sparsely punctured with interspaces smooth.

The tribe Chalcidini is mainly Neotropical. The distribution of the genera is summarized in Table I below:
The character analysis is based not only on the examination of an extensive material belonging to the Chalcidini, but also to other groups of Chalcididae: Brachymerini, Cratocentrini, Phasgonophorini, Haltichellinae, Dirhininae and Epitraininae. I tried to determine the polarity of the character states mainly by the outgroup method, i.e., by comparing their distribution within the family, then within the whole Chalcidini + Brachymerini, within the Chalcidini, and finally, within the genus Spi lochalcis. If no contradiction appeared, I considered the character states exhibited by the largest number of groups within Chalcididae or species groups of Spi lochalcis as primitive or plesiomorphic. In this reasoning, attention has been paid mainly to the species belonging to Brachymeria. On the other hand, character states evidently correlated with other ones, otherwise viewed apomorphic or derived, or resulting of a specialization were also considered as apomorphies.

However, it must be remembered that the polarity of a character must be considered within a grade. For example, a synapomorphy of the Chalcidini within the Chalcididae is a plesiomorphy for the species groups of Spi lochalcis within the genus.

**General features of Spi lochalcis**

Reversibility of characters states is one of the typical features exhibited by Spi lochalcis; its makes the character analysis and the evolution of the genus difficult to understand. For example, most species of the *mariae* and *femorata* groups have the mandibles 2-3; most of those of the *pygmaea* group are of the 2-2 formula and different subgroups within the *nigricornis* and *xanthostigma* groups are of the 2-3 formula. The analysis of other characters showed that all these groups are rather far apart from each other. However, I know one species of the *mariae* group with the

1. Some species are found in the Neartic and Neotropical regions.
2. 362 described species but about 280 still valid after examination of the type material.
3-3 mandibular formula and so are some species of the *femorata* and the *pygmaea* groups, and a subgroup of species within the *nigricornis* and *xanhostigma* groups. Many other cases may be quoted. This fact proves that, a character state though not visible in the phenotype of a species, is present in its genotype and might be expressed in other close species. It appears to establish the genetic unity of the genus.

The development of carinae or keels, which emphasizes structures and sculpture, is another typical feature of *Spilochalcis*. It includes carinae bordering the gena and the mandible, on the top of the interantennal projection, bordering the malar furrow, pronotal carina, preapical carina of the scutellum, transverse carina of the mesopleuron, ventral metapleural keels; apical carinae of pro- and metacoxae which cover the articulations with the trochanters and femora. These carinae are often expanded into foliaceous laminae.

**Mandibular formula**

This is the number of teeth in left and right mandibles; thus mandibles 2-3 means that the left mandible bears two teeth and the right one three teeth. Five character states were observed:

a - Mandibles 2-3: Considered plesiomorphic because of general occurrence within the Chalcididae and Chalcidini (Fig. 85).

b - Mandibles 3-3: Apomorphic but mostly without significance because noted in isolated species within various species groups of *Spilochalcis* (Fig. 81, 84 and 86).

c - Mandibles 2-2: Apomorphic and significant although appears four different times within the Chalcidini (Fig. 78, 82, 87 and 88).

d - Mandibles 2-2(+1): Apomorphic; intermediate between states a and c: a small tooth is hardly visible on the right mandible between the two other ones (Fig. 89).

e - Mandibles 3(+1)-3(+1): Apomorphic; a distinctive character state supported by species of the *maculipennis* group (Fig. 90).

In fact the mandibular formula must be used with other characters - mandible length, mandible shape, presence or absence of lower carina - to define synapomorphies.

**Malar sulcus**

We must here take into account the depth and breadth of the malar furrow, and the expansion of the carinae bordering it. The following states were observed:

a - Malar furrow deep but narrow, bordered by a distinct external carina and a weaker internal one (Fig. 17): in most *Spilochalcis* of the *oiketicus* group; some species of the *mariae, fulvomaculata* and the *nigricornis* groups.
b - Malar furrow present but superficial, the external carina quite distinct, the internal one absent or visible towards the mouth (Fig. 18): in Spilochalcis of the mariae, fulvomaculata, blanda, biannulata and nigricornis groups; some species of the xanthostigma and oiketicus group; some Melanosmicra.

c - Malar furrow very shallow and internal carina absent or virtually absent, only or mostly the external carina present (Fig. 19): Spilochalcis of the apaiis and rufodorsalis groups; some species of the xanthostigma and blanda groups.

d - Malar furrow very narrow and superficial, arched, not bordered by carinae (Fig. 20): Spilochalcis of the rufoscutellaris and debilis groups; some species of the fulvomaculata group; some Melanosmicra.

e - Neither malar furrow nor carina (Fig. 21): all Spilochalcis of the side group; some species of the debilis and the rufoscutellaris groups.

f - Malar furrow narrow, rather deep and arched, with the internal carina distinct the external one present only towards the mouth (Fig. 22): Spilochalcis of the maculipennis group.

g - Malar furrow broad and deep, bordered by two strong carinae (Fig. 23): Spilochalcis of the dimidiata, transitiva, N, discolor, alienata, pygmaea, hollandi, referator, flava and femorata groups; some species of the blanda group.

The presence of a distinct malar furrow is the groundplan of the Melanosmicra + Spilochalcis complex, because it can be seen only here within the family. I consider states d, e, and f as apomorphic because they occur in a minority of species groups of Spilochalcis. I consider also state g as apomorphic because before the malar furrow could be expanded, it must have been present; so state g evidently follows one of the states a or b. States a, b and c represent a transformation series, the polarity of which is not evident. Moreover two different states are sometimes observed within a natural group, i.e., states a and b within the mariae group, states b and c within the xanthostigma group.

However, from the distribution of state c within the tribe, there is little chance that it would be the plesiomorphic one.

As I could not decide with certainty between the two other states (a or b), I consider them equivalent and not significant for the character analysis.

Antennal scrobe and interantennal projection

The form of the antennal scrobe and the interantennal projection in the Chalcidini are characteristic and may represent the groundplan of the tribe. Generally in the other members of the family the scrobe is either shallow and little distinct, or very deeply impressed but carinately margined (Fig. 1). In the Chalcidini the scrobe is impressed in the form of an inverted V; it shows no or a very superficial sculpture relative to the front, but there is neither a margin nor a abrupt change in the sculpture (Fig. 2, 5 and 10). The following states were observed:
a1 - Scroble distinctly impressed; interantennal projection convex but not strongly protruding, only finely carinated at its top, the carina not expanded into a foliaceous lamina (Fig. 2 and 3): Spilocharcis of the oiketicus, mariae, pygmaea, referator, flava, hollandi, alienata and apaiis groups; some species of the xanthostigma and debilis groups;

a2 - Similar to state a1, but the carina expanded into a foliaceous lamina (Fig. 24): Spilocharcis of the femorata group.

b1 - Scroble deeply impressed; interantennal projection strongly protruding, forming sometimes dorsally a lamina (Fig. 4, 5, 6, 7, 8 and 9): Spilocharcis of the nigricornis, blanda, dimidiata, transita, N, biannulata, discolor groups; most of the species of the xanthostigma group; some species of the debilis group; Chalcis spp.

b2 - Similar to state b1 but scroble less impressed (Fig. 10): some species of Melanosmicra.

c - Scroble virtually absent (Fig. 11, 12, 13 and 14); interantennal projection hardly visible: Spilocharcis of the maculipennis, rufoscutellaris, rufodorsalis, fulvo-maculata and side groups; some species of the pygmaea group; some Melanosmicra.

It is difficult to assess the polarity of the character within the tribe and then within Spilocharcis. States a1 or b1 could be considered as the primitive ones. State c is clearly a derived one but this does not necessarily demonstrate a close relationship because it is the result of a simplification of the structures due to the reduction in size of the individuals, which occurred several times. On the other side, the detailed examination of the species shows that each group bearing state b1 of the character shows a unique derived state. In this matter the dorsal part of the interantennal lamina seen in lateral view is very useful for recognition of the natural groups.

Foraminal cavity

Some natural groups of Spilocharcis have a very deep foraminal cavity, at least dorsally delimited by a carina (Fig. 25); in its center the foramen magnum can be seen. This state is always correlated with the expansion in curved laminae of the anterior margins of the pronotum and pro sternum (Fig. 30). A transverse furrow, called here the basal furrow, is sometimes formed between the lamina and the edge of the collum. In the N group a postbasal furrow has also been observed (Fig. 103); it is impressed on the collum. A foraminal cavity can also be seen in Brachymeria species, but it is different. First it is not so deep and never carinately margined; secondly it is not correlated with the expansion of the anterior margin of pronotum, but by the development of the ventral part of the foraminal margin. So the two Structures are not homologous.

The different states observed within the tribe are the following:
a - Foraminal cavity deep and dorsally delimited by a sharp carina (Fig. 25): *Spilochalcis* of the *nigricornis*, *oiketicus*, *blanda*, *transitiva*, *N*, *alienata* and *hollandi* groups.

b - Foraminal cavity more or less distinct but not carinately margined at all (Fig. 26): *Spilochalcis* of the *dimidiata* and *biannulata* groups; some species of the *apais*, *blanda*, *flava* and *femorata* groups;

c - Back of the head with a deep and large depression, this one not margined, and surmounted by a transverse carina expanded into a foliaceous lamina (Fig. 99 and 100): *Spilochalcis* of the *hollandi* group.

d - A similar depression, by not surmounted by a foliaceous lamina; basal furrow of the pronotum well expanded (Fig. 102): *Spilochalcis* of the *referator* group; some species of the *discolor* and *flava* groups.

e - Foraminal cavity indistinct or absent (Fig. 27): many natural groups of *Spilochalcis*, *Chalcis* and *Melanosmicra* spp.

State a seems to constitute a derived one within the Chalcidini. However the character analysis revealed that it is present in a number of different species groups of *Spilochalcis*. It also demonstrated that the absence of foraminal cavity may be a primitive state, or the result of a secondary loss. These regressions are attested by states b, c and d which correspond to different vestiges of the foraminal cavity. We can postulate that it appeared rather early and may represent the plesiomorphic condition of the character for the genus *Spilochalcis*.

The construction of the cladogram will indeed depend on the stage when the foraminal cavity appeared.

**Hyostomal process**

In some *Spilochalcis* the hyostomal carina is expanded into a lamina. In several cases a process, called here the hyostomal process has been seen at the upper corner of the proboscidial fossa (Fig. 26 and 102).

**Antennal scape**

This character was used by Burks (1940) for recognition of natural groups of *Spilochalcis*. In order to define the apomorphic states, the following conditions should be considered:

- Length of the female scape.
- Relative breadth of female scape.
- Sexual dimorphism in length of scape.
- Sexual dimorphism in shape of scape.

The first two conditions can define the following apomorphy: "scape short and compact, as well as the flagellum; apex of scape at most reaching ventral level of median ocellus" (Fig. 91): in *Spilochalcis* of the *xanthostigma* and *biannulata* groups;
in some species of the *discolor* group. However such a state does not mean a close relationship between these groups, because it evidently results from parallel evolutions.

Generally the scape is a little broader and shorter in the male than in the female (Fig. 92 and 93). In the *flava, femorata* and *pygmaea* groups, this feature is outstanding; this state is correlated with an also outstanding sexual dimorphism of the head: in the males of these groups the frontovertebra is distinctly narrower than in the females (Fig. 95).

In *Spilochalcis* of the *mariae* group and most of the species of the *fulvomaculata* group, the scape is longer in the male and enlarged at its apex (Fig. 28 and 29). In many species of the *side* group the whole male scape is expanded, and bears a distinct sensilla on its ventral margin (Fig. 94).

**Pronotal carina**

In many different species groups of *Spilochalcis* a pronotal carina, setting off the collar, is expanded laterally into a foliaceous translucid lamina (Fig. 30). It is most often broken mesally where a small arched carina takes place.

As this character state has been found in many different species groups (*xanthostigma, nigricornis, oiketicus*, *mariae, blanda, transitiva, dimidiata, N, bian-nulata* and *apatis* groups) of *Spilochalcis*, it is considered to be the primitive state of the character for the genus. However several regressions or secondary evolutions of this carina occurred which cannot be quoted here.

In *Chalcis* and *Melanosmicra* this carina is absent and no vestige of it could be found. Thus this carina is supposed to be a derived character state which would distinguish *Spilochalcis* within the tribe.

**Mesoscutal sculpture**

The following states were observed in the Chalcidini:

a - Mesoscutum deeply and closely punctured (Fig. 33): in most of the natural groups of *Spilochalcis; Chalcis* spp.

b1 - Mesoscutum transversely punctate-strigose (Fig. 34): some species of the *mariae and fulvomaculata* groups.

b2 - Mesoscutum transversely strigose, the carinae strong (Fig. 35 and 36): *Spilochal-cis* of the *mariae, bian-nulata* and *dimidiata* groups, most of the species of the *pygmaea* group.

c - Mesoscutum superficially and sparsely punctured, the punctures alternating with squamae (Fig. 37): *Spilochalcis* of the *rufoscutellaris and maculipennis* groups.

d - Mesoscutum alutaceous (Fig. 38): the smallest species of the *fulvomaculata, rufodorsalis* and *rufoscutellaris* groups.

e - Mesoscutum sparsely punctate, the interspaces alutaceous or smooth (Fig. 39): *Melanosmicra* spp. and S. *xantha* Burks, which belongs to the *xanthostigma* group.
State **a** is considered as the primitive one since it is generalized in Chalcididae. A transformation series evidently occurred leading, from state **a** to state **b2**. States **b2**, **c** are apomorphic but do not mean close relationships between the groups which exhibit them, as they result from parallel evolution. State **e** is correlated with other significant characters and considered to be a synapomorphy for *Melanosmicra*.

**Preapical carina of the scutellum**

In many species of Chalcididae a preapical carina is conspicuous at the posterior margin of the scutellum; this is also the case in Chalcidini. The following states were observed:

- **a** - Preapical carina developed as well in its median part as its sublateral parts, broadly rounded, with distinct crenulae on the rim formed dorsally (Fig. 42): *Spilochalcis* of the *xanthostigma*, *nigricornis*, *oiketicusi* and *biannulata* groups; *Chalcis* spp.

- **b** - Preapical carina developed as well in its median part as its sublateral parts but distinctly angular at its apex (Fig. 43): *Spilochalcis* of the *apaiis*, *rufodorsalis*, *rufoscutellaris*, *debilis*, *mariae*, *fulvomaculata* and *side* groups; the primitive species of *Melanosmicra*.

- **c** - Preapical carina expanded sublaterally into transverse or rounded lobes, united by a distinct and sometimes foliaceous lamina (Fig. 44): *Spilochalcis* of the *blanda*, *N*, *discolor*, *alienata*, *pygmaea*, *hollandi*, *referator*, *flava* and *femorata* groups; some *Chalcis*.

- **d** - Preapical carina expanded into two lateral rounded or triangular lobes, these always broadly separated (Fig. 45): *Spilochalcis* of the *dimidiata* and *transitiva* groups.

- **e** - Preapical carina very close to the posterior margin of the scutellum, mainly in its median part, the frenal area transverse or absent (Fig. 46); some species of the *nigricornis*, *apaiis*, *rufodorsalis* and *rufoscutellaris* groups; all the species of the *maculipennis* group; some *Melanosmicra*.

State **a** is considered as the plesiomorphic one for the tribe. The other ones are supposed to be derived. However, they are significant only when correlated with other synapomorphies. The distribution of state **b** within the tribe shows that it cannot be used for the character analysis, as well as state **e**. States **c** and **d** are really synapomorphies for the species groups of *Spilochalcis* which exhibit them.

**Prepectus**

In the Chalcididae the prepectus has generally the shape of a semi-annular and transverse sclerite. It bears in its median part various processes, typical for each group of the family. In the Chalcidini it bears two submedian keels delimiting a median areola (Fig. 49). I consider this state as an apomorphic one for the tribe within the Chalcididae. Within *Spilochalcis* two derived states were observed. In *S.*
biannulata Ashmead, for example, the submedian keels are fused in a median carina; this apomorphic feature has been observed several times within the genus. In the maculipennis group the submedian carinae are regressed.

**Mesopleuron**

In some species groups of *Spilochalcis* there is a transverse ventral carina on the mesopleuron, delimiting anteriorly a horizontal ventral area, sometimes called "mesosternal shelf" (Fig. 48). Such a carina can also be seen in other Chalcididae, but it is not homologous with the preceding one. For instance, in *Brachymeria*, the epicnemium is rather distinct because it is margined by continuous lateral and ventral epicnemial carinae. Moreover, in that genus, the mesopleural area situated between the femoral groove and the epicnemium is laterally oriented (Fig. 47).

In *Spilochalcis* the transverse carina of the mesopleuron, when present, in fact prolongs a carina bordering anteriorly to the femoral groove, and consequently it is not homologous with the ventral part of the epicnemial carina of *Brachymeria*. Moreover, the space preceding the femoral groove is anteriorly rather than laterally oriented and can be distinguished from the epicnemium by a large areola.

Whether or not a transverse carina is present, the mesopleuron in Chalcidini shows a unique structure within the family and represents an apomorphy of the tribe. Within the tribe the following states were noted:

a - A ventral transverse carina present and distinct on the mesopleuron, delimiting anteriorly a horizontal ventral area (Fig. 48): *Spilochalcis* of the nigricornis, oiketicus, xanhostigma, biannulata, transitiva, dimidiata, blanda, debilis, apais and rufodorsalis groups.

b - Transverse carina absent or hardly visible but mesopleuron with an angular outline (seen in lateral view), because a horizontal ventral area is more or less distinct: *Spilochalcis* of the discolor, alienata and referator groups.

c - Transverse carina absent, mesopleuron with a rounded outline (Fig. 49): *Chalcis* and *Melanosmicra* spp.; *Spilochalcis* of the maculipennis, rufoscutellaris, mariae, fulvomaculata, side, pygmaea, hollandi, flava and femorata groups.

d - Transverse carina present, continuous with the true epicnemial carina: *Spilochalcis* mesomelas (Walker).

We can see an evident transformation series from state a to state c.

The character analysis shows that the complex of groups exhibiting state a is strongly heterogeneous. If the transverse carina of the mesopleuron did appear only once during the evolution of the tribe, it may probably represent the primitive condition of the character for *Spilochalcis*. In this case four complete and parallel regressions of this carina must be considered.

Such regressions can be seen within some aggregates comprising closely related groups, or within some species groups, i. e., State a to state b within the nigricornis group; State b in the alienata group to state c in the flava group.
Conversely, if state c is supposedly the primitive one for the genus we must consider five or six independent acquisitions of the same feature. Because it seems much more reasonable to consider parallel evolutions resulting in regressions, than resulting in the same acquisition, I think that state a is really the plesiomorphic one for the genus Spilochalcis.

**Dorsellum**

Three main different states could be observed in the Chalcidini:

a - Dorsellum little distinct, impressed or crenulate, pubescent (Fig. 51, 53, 54 and 57): Chalcis and Melanosmica spp.; Spilochalcis of the apaiis, Rufodorsalis, Maculipennis, Rufoscutellaris, Nigricornis, Oiketicus, Blanda, Mariae, Fulvomaculata and side groups; some species of the dimidiatu and xanthostigma groups.

b - Dorsellum well distinct, smooth and shining, not impressed, glabrous, delimited on each side by a deep fovea (Fig. 56): Spilochalcis of the biannulata, transitiva, alienata, femorata, flavo, referator and pygmaea groups; the other species of the dimidiatu group.

c - Dorsellum well distinct, but dull, often with a transverse areolate furrow laterally (Fig. 42); the other species of the xanthostigma group.

As state a is generalized within the Chalcididae and also within the tribe, it is considered to be the plesiomorphic one. State b seems to be significant when correlated with other important characters (malar sulcus, preapical carina of the scutellum). It is supposed to have appeared only two times during the evolution of the tribe.

**Propodeum**

The structure of the propodeum in Spilochalcis is typical within the family and must be described in detail. I describe here what seems to be the groundplan character for the genus (Fig. 54 and 56).

First the spiracular aperture is longitudinally oriented instead of being transversely or obliquely oriented. In front of it, a little laterally, a transverse, pubescent area may be seen: this is the unusually small callus. A median keel is always developed in the anterior half of the propodeum; it is split in two posterior costulae. These costulae delimit anteriorly an articular area preceding the petiolar cavity. The medio-anterior part of the propodeum often shows anterior costulae; behind them there are longitudinal keels. A combination of these keels and the costulae gives to this part an areolate appearance. However all these keels are sometimes absent and this area is then rugose or reticulate. Laterally, between the anterior and posterior costulae, is the spiracular areola (a1). Still more laterally, above the metacoxa, is the supracoxal areola (a2). The petiolar cavity is at least laterally bordered by the pararticular areola (a3) and ventrally by a triangular areola, the subarticular areola (a4). The spiracular areola is often little distinct because it may be anteriorly open or fused with a secondary areola.
From this groundplan several apomorphies have been noted (for instance development of apophyses, expansion of the foraminal margin, regression of the anterior costula...) which cannot be quoted in detail here.

**Procoxal carina**

A carina, sometimes expanded into a foliaceous lamina, is present in many species groups of *Spilochalcis* (Fig. 31). It is always correlated with the presence of the transverse carina of the mesopleuron; refer to the analysis concerning this character.

**Procoxal bristles**

In all the Chalcidini, a very distinctive line of bristles is present on the posterior side of the procoxa (Fig. 32). It constitutes a unique apomorphy of the tribe within the family.

**Mesocoxal bristles**

In the *Melanosmicra + Spilochalcis* aggregate, distinct isolated hairs can be seen on the laterodorsal side of the mesocoxa, in the center of a bare area (Fig. 40): they are called the mesocoxal bristles. The mesocoxa of *Chalcis* is uniformly pubescent in this area an does not show such bristles (Fig. 41). Similar mesocoxal bristles are also present in *Brachymeria* and seem to be the groundplan for the Chalcidinae. In such a case their absence should be interpreted as a regression.

**Metafemur: marginal bristles**

In all the Chalcidini, a line of distinct bristles (distinct by their length and their breath) is visible along the ventral margin of the metafemur, on its internal side (Fig. 58 and 59): they are called here the marginal metafemoral bristles. They are followed by submarginal bristles which are intermediate between the usual bristles and the marginal ones.

**Metafemur: teeth** (Fig. 60, 63, 64, 65, 66 and 67)

The teeth of the metafemur were used by Ashmead (1904) to erect several new genera among the Chalcidini. The survey of an extensive material showed that Burks (1940) was right in including these genera in *Spilochalcis*. There is not only an intrageneric variation of the character states, but also a variation within some of the natural groups of *Spilochalcis*, the best representatives in this matter being the *nigricornis* group (Fig. 108) and the *blanda* group (Fig. 109). It seems that the plesiomorphic state for the character is: metafemur with a distinct but short basal tooth, followed by many short and closely set teeth; a short internal basal tubercle or tooth is also often present. This state is generalized within the subfamily.
Claws

In Chalcididae the claws are usually curved and show a basal lobe (Fig. 107). Two significant apomorphies have been observed within the Chalcidini, both concerning the genus *Chalcis*. In this genus the claws are little curved in both sexes. Moreover the claws - which are normally pectinate in both sexes in the other Chalcidini - are unarmed in females, while there are strongly pectinate and bifid at apex in males (Fig. 72 and 73).

**Abdominal petiole: structure and length**

The structure of the abdominal petiole of the Chalcidini is unique within the Chalcididae and represents an apomorphy of the tribe (Fig. 76).

The petiole first shows a basal part articulated with the propodeum, followed by the basal lamina. This lamina is generally not continuous and comprises a dorsal and a ventral part; at the lateral break a small longitudinal carina is visible; the ventral lamina is situated a little behind the dorsal one. The basal lamina is followed by the body of the petiole, the length of which is extremely variable (Fig. 110): the petiole may be annelliform like in *Spilochalcis fusiformis* Ashmead or *S. leucotetus* (Walker) or very long and fine in some species of the *debilis* group. But as many intermediates of these extreme states have been encountered, the length of the abdominal petiole is not considered significant at the generic level.

**Female hypopygium**

The position of the female hypopygium, mainly the position of its apex relative to the apex of the gaster was used by Burks (1939) to distinguish several genera of Chalcidini, such as *Chalcis, Melanosmicra* (mentioned as *Platyochalcis*) and *Metadontia*. It must be noticed that Burks (1940) defined *Metadontia* in a more restricted sense than Ashmead (1888) did originally. Ashmead used the metafemoral teeth to erect the genus.

The position of the apex of the hypopygium, relative to the apex of the gaster is variable within *Spilochalcis*. Many intergrades have been found between a hypopygium removed from the apex of the gaster to other ones situated at or near it.

Thus both preceding character states, used to separate *Metadontia*, do not appear to have any taxonomic value.

In the Chalcididae, the female hypopygium is mesally emarginate on its posterior margin, and a small median lobe can be seen within the emargination (Fig. 113). This character state, considered as the primitive one for the Chalcidini, has been observed in all *Spilochalcis* species.

In *Chalcis* the female hypopygium projects backwards in its median part (Fig. 111). This state is considered as a significant derived one.

In *Melanosmicra*, the female hypopygium does not protrude posteriorly. However it is sclerotized at apex in the median part, and densely pubescent (Fig. 112). This character state is also considered to be a significant apomorphy.
Male hypopygium

In *Chalcis* the male hypopygium is enlarged and posteriorly emarginate (Fig. 114). This is also considered to be a significant apomorphy. It is probably related with the shape of the female hypopygium; this point must however be confirmed by the observation of the mating behaviour.

Male genitalia

A short description of the male genitalia in the Chalcidini is necessary before mentioning the different variations observed.

As in the other Chalcididae, the male genitalia are composed of two independently mobile parts: a sheath and the aedeagus (Fig. 116 and 117).

The sheath has a basal phallobase which is laterally prolonged into parameres, each bearing generally one apical parameral bristle. Between the parameres the median ventral lamina is distinguished, separated from them by an emargination or an incision of the phallobase. Medial of the parameres are inserted the volsellar digitii. The phallobase itself appears as two lateral parts broadly separated dorsally and more or less united ventrally. They were called lamina parameralis by Boucek (1952). When separated, their ventral margin is strengthened by a sclerotized line, the ventral frame. The edge of the median ventral lamina shows also a marginal frame.

Several apomorphies concerning the following characters of the male genitalia are significant: the ventral frame, the median ventral lamina, the shape of digitii and of the aedeagus.

Phallobase

In *Spilochalcis* of the apaiis, nigricornis, oiketicusi, mariae, fulvomaculata, side, alienata, pygmaea, hollandi, flava and femorata groups, in some species of the xanthostigma group and in *Chalcis*, the phallobase is completely open ventrally and the ventral frame is present (state a) (Fig. 121, 122, 124, 125, 132, 133 and 134).

In some *Spilochalcis* of the xanthostigma, N, nufodorsalis and debilitis groups, in S. biannulata and in some species of Melanosmicra, the phallobase is partly open ventrally and traces of the ventral frame can be observed. While these traces are situated near the base of the sheath in the xanthostigma group (state b1), in the N group (Fig. 118 and 127) and in other cases they are near the median ventral lamina (state b2) (Fig. 116, 119 and 128).

In *Spilochalcis* of the nufodorsalis, nufoscutellaris, dimidiata, transitiva groups, in some species of the discolor group, in one species of the N group and in some Melanosmicra, the phallobase is completely closed ventrally and no ventral frame is seen (state c) (Fig. 117, 120, 129, 131 and 135).

As state a is the most frequently encountered condition in the Chalcidini, it is considered as the primitive one for the tribe. It also agrees with the groundplan of the Hymenoptera where the sheath is composed of two series of lateral pieces: the
gonocoxites and gonostyli. If we consider state c as the primitive one, we must suppose that states b1 and b2, complementary in relation to state a, appeared independently, which would not seem reasonable.

Concerning the median ventral lamina, three extreme states are observed:

- **State a1**: Median ventral lamina broadly rounded and separated from the parameres by an emargination of the phallobase or a small incision (Fig. 116, 117, 118, 121 and 122): *Spilochalcis* of *xanthostigma*, *rufodorsalis*, *oiketicusi*, *dimidiata*, *N*, *biannulata* groups and some species of the *discolor* group; *Chalcis* and *Melanosmica* spp.

- **State a2**: In the *Spilochalcis* of the *debilis*, *mariae*, *fulvomaculata* and *side* groups and some species of the *nigricornis* group, the ventral lamina is somewhat narrower, often truncate or subtriangular at its apex (Fig. 123, 125 and 126).

- **State b**: Median ventral lamina long and narrow, separated from the parameres by a deep incision (Fig. 132 and 133): In *Spilochalcis* of the *alienata*, *pygmaea*, *hollandi*, *referator*, *flava*, and *femorata* groups.

As state a1 is the generalized one within the Chalcididae and Chalcidini, it is considered to be the plesiomorphic one. State a2 represents only a variation of this state. State b is very significant because it is correlated with many phenotypic characters and also (and mostly) with some important apomorphies (malar sulcus, preapical carina of the scutellum, dorsellum, propodeum).

**Parameres**

In *Chalcis* the parameres are rather long and slender, their apex sometimes exceeding the apex of the digiti (Fig. 116).

**Volsellar digiti**

The digiti as figured for *Spilochalcis* aff. *oiketicusi* (Cameron) seem to be the groundplan for the Chalcidini (state a) (Fig. 122). Several apomorphies were encountered concerning the shape, the length or the ornamentation of the digiti:

- **State b**: Digit i with the apical part (between the condyle and the apex) short; hooks in small number (Fig. 116): *Chalcis* spp.

- **State c**: Digit i long and slender (Fig. 121, 123 and 125): *Spilochalcis* of the *nigricornis*, *debilis*, *mariae* and *fulvomaculata* groups.

- **State d**: Digit i slender but emarginate, the condyle distinctly protruding (Fig. 126): *Spilochalcis* of the *side* group.

- **State e**: Digit i strongly emarginate, angular at the condyle level (Fig. 128): *Spilochalcis* *biannulata*.

- **State f**: Digit i broad and short, basal hooks distinctly longer than the apical ones (Fig. 117 and 118): *Melanosmica* spp; some species of the *xanthostigma* group.
Aedeagus

Several apomorphies were observed concerning the following characters: phal-lotreme; relative length of apodemes; aedeagus ornamentation and aedeagus shape.

In the mariae group (and some species groups close to it but not quoted here) the phallostreme is broadly open (Fig. 124). In the same groups, the aedeagus is very long but the apodemes are unusually short.

In Melanosmicra and some species of the xanthostigma and nigricomis groups the aedeagus is broadly rounded apically (Fig. 117 and 118).

In Chalcis, the aedeagus bears in the apical part two pairs of dorsal laminae (Fig. 116); the first ones are inserted in the middle of this part, the second ones on each side of the phallostreme.

Cladogram construction

In the present analysis, I have excluded several undescribed species, belonging to undescribed natural groups. I have also excluded some described species, the names of which could not be used for natural groups. This exclusion is done because of unsolved nomenclatural problems (i.e. variegata Sichel, homonym of variegata Fabricius) or because the necessary analysis could not be completed. In both cases these species are rare and their exclusion does not change the general scheme suggested here. The construction of a cladogram or a phylogenetic tree depends mainly on the relative weight of the characters used during the analysis. Therefore a cladogram represents a phylogenetic hypothesis.

Within the Chalcididae, the Chalcidini are distinguished by the following apomorphies: prepectus with two submedian keels, structure of the mesopleuron, structure of the propodeum, procoxal bristles, marginal metafemoral bristles, structure of the abdominal petiole.

The species belonging to Chalcis share very distinct apomorphies: apical mesotibial spur absent; claws little curved in both sexes (Fig. 72 and 73); male claws pectinate and bifid at apex; female hypopygium strongly protruding in median part (Fig. 111); male hypopygium enlarged and posteriorly emarginate (Fig. 114); phallobase with a dorsal expansion; parameres long and slender; aedeagus with dorsal expansions (Fig. 116); species parasitizing Stratiomyidae; eggs deposited in eggs or larvae.

Melanosmicra Ashmead, 1904 was forgotten by subsequent authors. Melanosmicra immaculata Ashmead, 1904, its type species, is evidently congeneric with Playchalcis flavicollis Cameron, 1904, the type species of the genus Playchalcis, which is a junior synonym of Melanosmicra.

The species of Melanosmicra share also distinct apomorphies: metafemur in females with a long and curved inner tooth, this tooth inserted close to its base (Fig. 61 and 62); female hypopygium densely pubescent medially at apex (Fig. 112) and distinctly protruding when valvulae are extended. Other characteristics are: thorax somewhat or strongly flattened, the punctuation sparse; metapleuron densely pubescent dorsally; apical spine of the metatibia always long and curved (Fig. 60); phal-
lobase closed on its ventral side, the ventral frame absent or hardly visible, digit
short and broad, with a reduce number of hooks, the basal ones being longer than
the apical ones; aedeagus broad and apically rounded (Fig. 117).

The propodeum is also typical (Fig. 52): a basal median projection is always
visible, followed by a median keel. This keel is split posteriorly into costulae which
delimit a very distinct articular area; the propodeum, in the primitive species, is
rather long and protrudes a little backwards in its median part.

Two species groups can be distinguished within the genus. In the primitive im-
maculata group the mandibular formula is 2-3 (Fig. 77), upper teeth being longer
than the other; interantennal projection is well protruding (Fig. 10); thorax is some-
what flattened with a rather dense punctuation (Fig. 3f); preapical carina of scutel-
ulum is complete, not fused with its posterior margin; propodeum is long and
protruding backwards; metacoxa and metafemur are long and slender. In flavicollis
group, which includes the evolved species of the genus, the head is transverse; mandi-
bles are very fine and of the 2-2 formula with lower tooth longest (Fig. 78); antennal
scrobe is shallow and interantennal projection hardly visible; thorax is strongly
flattened with a very sparse punctuation; preapical carina of the scutellum is fused
mesally with its posterior margin; propodeum is shorter; metacoxa and metafemur
are short and compact.

Melanosmicra seems to make a link between Chalcis and the xanthostigma group
of Spilochalcis. With the former genus, the primitive species of Melanosmicra share
the same states of the following characters: mandibles, metacoxa and metafemur.
Moreover, some Chalcis, like C. myrifex (Sulzer), exhibit the inner metafemoral
tooth found in females of Melanosmicra; in both cases they are regressed in males.
The propodeum in Chalcis, although more rugose than in Melanosmicra, shows the
same features (Fig. 51): general shape, basal projection, posterior costulae and arti-
cular area. At last in both genera the female hypopygium is protruding.

Conversely the male genitalia of both preceding genera are strongly different. In
fact the male genitalia of Melanosmicra are very similar to some species of the xan-
thostigma group, like Spilochalcis pulchripes (Cameron) (Fig. 117 and 118).

Owing to the diversity of the genus, I could not find any evident apomorphy to
distinguish the set of species groups which I have included in Spilochalcis. However,
it seems that the presence of several carinae (pronotal carina, procoxal carina and
transverse carina of the mesopleuron) are synapomorphies for Spilochalcis.

Although it is possible that these structures regressed in Chalcis and Melanos-
micra as a result of secondary evolutions, I have not seen any transformation series
which would give evidence of these regressions.

The xanthostigma group is distinguished by the following apomorphies (Fig. 3, 5
and 6): head transverse in frontal view, subquadrate; mouth very broad; mandibles
either very long or robust with the teeth blunt. It is considered a sister group of all
other Spilochalcis because I could not find any evident apomorphy common to the
xanthostigma group and other strains or species groups of Spilochalcis.
Classification of the Chalcidini

_Thaumapus_ Kirby, 1883 is based on _Smicra decora_ Walker, 1861 (a junior synonym of _S. masus_ Walker, 1841) which belongs to the _dimidiata_ group in the present paper. The type species of _Xanthomelanus_ Ashmead, 1904 is _Chalcis dimidiata_ Fabricius, 1804, and is therefore a junior synonym of _Thaumapus_.

The distribution of the character states within the Chalcidini indicates that _Thaumapus_ must be included in _Spilochalcis_. The following genera are also synonyms of _Spilochalcis_:

_Metadontia_ Ashmead, 1888 based on _Smicra montana_ Ashmead, 1887 which is a junior synonym of _Chalcis amoena_ Say, 1836 and corresponds to the _flava_ group.

_Mischosmicra_ Ashmead, 1904 (type species _Mischosmicra kahlili_ Ashmead, 1904 which is a junior synonym of _Chalcis debilis_ Say, 1836): it is equivalent to the _debilis_ group of _Spilochalcis_.

_Ceratosmicra_ Ashmead, 1904 (type species _Ceratosmicra petiolata_ Ashmead, 1904), regarded as the _fulvomaculata_ group because _C. petiolata_ belongs to this group.

It may be mentioned that Burks (1940 and 1968) placed in _Ceratosmicra_ at least three different species groups:

_C. debilis_ (Say) and _C. paea_ Burks in the _debilis_ group of _Spilochalcis_.

_Smicra immaculata_ Cresson, _C. meteori_ Burks and _C. campoplegicis_ Burks [a junior synonym of _S. petioliventris_ (Cameron)] in the _fulvomaculata_ group of _Spilochalcis_.

I am not sure of the position of _C. provancheri_ Burks, which may belong to the _xanthostigma_ group of _Spilochalcis_.

_Psychidosmicra_ Blanchard, 1935 (type species _Psychidosmicra australis_ Blanchard, 1935) is the same as the _oiketicusi_ group of _Spilochalcis_.

_Mixochalcis_ Blanchard, 1935 (type species _Mixochalcis sibinecola_ Blanchard, 1935) corresponds to the _nigricornis_ group.

_Eterochalcis_ Burks, 1939 (type species _Smicra maculippennis_ Cameron, 1884) is equivalent to the _maculippennis_ group of _Spilochalcis_.

_Epinaeus_ Kirby, 1883 is based on _Smicra dux_ Walker, 1861, which can be included in the _femorata_ group of _Spilochalcis_.

The distribution of the derived character states within the tribe shows that if we regard them as valid genera, we must divide _Spilochalcis_ following the natural groups previously mentioned.

Must also be taken into account the fact that for most of the characters, transformation series occur and intergrades linking the extreme states of the same character can be found. The character analysis shows that parallel evolutions occur frequently, as a result of the reversibility of character states. As natural groups of _Spilochalcis_ can hardly be distinguished by using synapomorphies, each group is mainly defined by a combination of multiple apomorphies. Consequently I propose to synonymize _Thaumapus, Xanthomelanus, Metadontia, Ceratosmicra, Psychidosmicra, Mixochalcis_ and _Eterochalcis_ with _Spilochalcis_ Thomson, 1876.
Delvare: Classification of Chalcidini

Conclusions

No significant synapomorphy could be found to distinguish *Spiloachalcis*. There is thus a little doubt concerning the origin of *Chalcis* and *Melanosmicra*. They might have arisen within a strain of *Spiloachalcis*. However I consider this to be very unlikely. The position of the *xanthostigma* group, the validity of the *blanda*, *discal*, *alienata*, *flava* and *apais* groups must be confirmed by the study of further material and by biological data.

References

Table II. Derived character states in the Chalcidini, based on outgroup comparisons.

<table>
<thead>
<tr>
<th>No.</th>
<th>Attribute</th>
<th>Derived character state</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Female hypopygium</td>
<td>protruding backwards (Fig. 111).</td>
</tr>
<tr>
<td>2</td>
<td>Male hypopygium</td>
<td>enlarged and posteriorly emarginate (Fig. 114).</td>
</tr>
<tr>
<td>3</td>
<td>Apical spur of the mesotibia</td>
<td>absent.</td>
</tr>
<tr>
<td>4</td>
<td>Claws, ornamentation</td>
<td>sexual dimorphism: female claws unarmed; male claws strongly pectinate (Fig. 72, 73).</td>
</tr>
<tr>
<td>5</td>
<td>Claws, shape</td>
<td>little curved claws (Fig. 72).</td>
</tr>
<tr>
<td>6</td>
<td>Hosts</td>
<td>Stratiomyidae.</td>
</tr>
<tr>
<td>7</td>
<td>Oviposition behaviour</td>
<td>eggs laid in eggs or larvae.</td>
</tr>
<tr>
<td>8</td>
<td>Malar furrow</td>
<td>present and bordered by an external carina</td>
</tr>
<tr>
<td>9</td>
<td>Female hypopygium</td>
<td>pubescent at apex in the median part (Fig. 112).</td>
</tr>
<tr>
<td>10</td>
<td>Neseoscutum, sculpture</td>
<td>sparsely punctured, smooth between the punctures (Fig. 39).</td>
</tr>
<tr>
<td>11</td>
<td>Inner basal tooth of the</td>
<td>present, long and curved in females (Fig. 61, 62).</td>
</tr>
<tr>
<td></td>
<td>metafemur</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Apical spine of the metatibia</td>
<td>long and curved (Fig. 60).</td>
</tr>
<tr>
<td>13</td>
<td>Pronotal carina</td>
<td>present and laterally expanded into foliaceous laminae of rounded outline (seen in frontal view); replaced mesally by a weaker arched carina (Fig. 30). present, delimiting a flat anterior area (Fig. 31). present, delimiting a ventral area (Fig. 48). transverse in frontal view, mouth very broad (Fig. 3). either long or robust with blunt teeth (Fig. 79, 80). present, deep and delimited, at least dorsally, by a sharp carina (Fig. 25). deep and crenulate, strongly convergent (Fig. 33). basal ones regressed, apical ones progressively larger (Fig. 64). Psychidae of the genus Oiketicus. long and slender (Fig. 121, 123, 125). robust, with truncate teeth (Fig. 83, 84). with conspicuous pubescence.</td>
</tr>
<tr>
<td>No.</td>
<td>Attribute</td>
<td>Derived character state</td>
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<td>-----</td>
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<td>----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>25</td>
<td>Metacoxa</td>
<td>long and slender.</td>
</tr>
<tr>
<td>26</td>
<td>Claws</td>
<td>strongly pectinate in both sexes (Fig. 74).</td>
</tr>
<tr>
<td>27</td>
<td>Hosts</td>
<td>Limacodidae and Megalopygidae.</td>
</tr>
<tr>
<td>28</td>
<td>Median ventral lamina</td>
<td>narrow (Fig. 123, 125, 126).</td>
</tr>
<tr>
<td>29</td>
<td>Propodeum</td>
<td>articular areola distinct; anterior costula absent (Fig. 54).</td>
</tr>
<tr>
<td>30</td>
<td>Propodeum</td>
<td>para-articular apophyses strongly protruding backwards; articular areola distinctly enlarged; subarticular areola sometimes enlarged and delimited by foliaceous laminae (Fig. 55).</td>
</tr>
<tr>
<td>31</td>
<td>Phallobase</td>
<td>arms of the ventral frame fused apically on a long distance (Fig. 123).</td>
</tr>
<tr>
<td>32</td>
<td>Mesoscutum, sculpture</td>
<td>mesoscutum strigose (Fig. 34, 35).</td>
</tr>
<tr>
<td>33</td>
<td>Scape</td>
<td>sexual dimorphism; scape longer (sometimes strongly so) in male than in female, at least apically enlarged (Fig. 28).</td>
</tr>
<tr>
<td>34</td>
<td>Foraminal cavity</td>
<td>regressed (Fig. 27).</td>
</tr>
<tr>
<td>35</td>
<td>Transverse carina of the mesopleuron and procoxl carina</td>
<td>regressed (Fig. 49).</td>
</tr>
<tr>
<td>36</td>
<td>Pronotal carina</td>
<td>regressed.</td>
</tr>
<tr>
<td>37</td>
<td>Malar bristles</td>
<td>present and outstanding in males (Fig. 16).</td>
</tr>
<tr>
<td>38</td>
<td>Phallotreme</td>
<td>broadly open (Fig. 124d).</td>
</tr>
<tr>
<td>39</td>
<td>Scrobe and interantennal projection</td>
<td>scrobe shallow; interantennal projection hardly expanded (Fig. 11).</td>
</tr>
<tr>
<td>40</td>
<td>Malar space, sculpture</td>
<td>malar space with elongate squamae (Fig. 21).</td>
</tr>
<tr>
<td>41</td>
<td>Malar sulcus</td>
<td>absent because regressed (Fig. 21).</td>
</tr>
<tr>
<td>42</td>
<td>Malar space</td>
<td>unusually long (Fig. 12).</td>
</tr>
<tr>
<td>43</td>
<td>Volsellar digiti</td>
<td>distinctly emarginate, with a protruding condyle (Fig. 126).</td>
</tr>
<tr>
<td>44</td>
<td>Hypostomal process</td>
<td>present and conspicuous (Fig. 26).</td>
</tr>
<tr>
<td>45</td>
<td>Preapical carina of the scutellum</td>
<td>present and sublaterally expanded into lobes or laminae (Fig. 44).</td>
</tr>
<tr>
<td>46</td>
<td>Malar furrow</td>
<td>broad and deep, bordered by two distinct carinae (Fig. 23).</td>
</tr>
<tr>
<td>47</td>
<td>Face, sculpture.</td>
<td>finely alutaceous, with sparse and fine punctures (Fig. 15).</td>
</tr>
<tr>
<td>48</td>
<td>Occipital vertical furrow</td>
<td>present.</td>
</tr>
<tr>
<td>49</td>
<td>Dorsellum</td>
<td>well delimited; convex, bare and shining (Fig. 56).</td>
</tr>
<tr>
<td>No.</td>
<td>Attribute</td>
<td>Derived character state</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------------</td>
<td>-----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>50</td>
<td>Ventral frame and phallobase</td>
<td>ventral frame regressed; phallobase at least partly closed on its ventral side. (Fig. 128, 131).</td>
</tr>
<tr>
<td>51</td>
<td>Volsellar digiti</td>
<td>emarginate on their external margin (Fig. 127).</td>
</tr>
<tr>
<td>52</td>
<td>Prepectus</td>
<td>submedian carinae fused.</td>
</tr>
<tr>
<td>53</td>
<td>Volsellar digiti</td>
<td>strongly emarginate; angular at the level of the condyle (Fig. 128).</td>
</tr>
<tr>
<td>54</td>
<td>Antennal scrobe</td>
<td>dorsally delimited by a carina (Fig. 96).</td>
</tr>
<tr>
<td>55</td>
<td>Pronotum</td>
<td>a transverse post-basal furrow impressed on collum (Fig. 103).</td>
</tr>
<tr>
<td>56</td>
<td>Parameres</td>
<td>two apical bristles on the right paramere (Fig. 127).</td>
</tr>
<tr>
<td>57</td>
<td>Mandibles</td>
<td>2-2 formula; the teeth bordered ventrally by a foliaceous lamina (Fig. 87). bilobed, the lobes widely separated (Fig. 45).</td>
</tr>
<tr>
<td>58</td>
<td>Preapical carina of the scutellum</td>
<td>only ventrally expanded; sloping forwards (Fig. 75).</td>
</tr>
<tr>
<td>59</td>
<td>Basal lamina of the abdominal petiole</td>
<td>compressed into a well expanded translucent lamina (Fig 9).</td>
</tr>
<tr>
<td>60</td>
<td>Interantennal projection</td>
<td>metafemur four-toothed, the last tooth large and triangular (Fig. 65).</td>
</tr>
<tr>
<td>61</td>
<td>Metafemur, teeth</td>
<td>deeply incised apically; median ventral lamina long and narrow (Fig. 132).</td>
</tr>
<tr>
<td>62</td>
<td>Phallobase</td>
<td>metafemur with 5-8 long teeth (Fig. 67).</td>
</tr>
<tr>
<td>63</td>
<td>Metafemur, teeth</td>
<td>a broad foraminal depression, surmounted by a transverse and high foliaceous lamina, this latter forming a deep furrow with the occiput (Fig. 99, 100).</td>
</tr>
<tr>
<td>64</td>
<td>Head</td>
<td>a broad foraminal depression (Fig. 101, 102).</td>
</tr>
<tr>
<td>65</td>
<td>Head</td>
<td>face with an arched subantennal carina (Fig. 97, 98).</td>
</tr>
<tr>
<td>66</td>
<td>Mandibles</td>
<td>2-2 formula, but fine; the teeth of equal length, acute (Fig. 88).</td>
</tr>
<tr>
<td>67</td>
<td>Scutellum</td>
<td>distinctly convex, mostly at base.</td>
</tr>
<tr>
<td>68</td>
<td>Metafemur, teeth</td>
<td>metafemur with closely set teeth, the basal one indistinct or short.</td>
</tr>
<tr>
<td>69</td>
<td>Phallobase</td>
<td>with a short to very short apical spine. short (Fig. 133).</td>
</tr>
<tr>
<td>No.</td>
<td>Attribute</td>
<td>Derived character state</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>72</td>
<td>Metafemur, teeth</td>
<td>basal tooth distinctly longer than the following ones; inner acute tooth (Fig. 68, 69)</td>
</tr>
<tr>
<td>73</td>
<td>Interantennal projection</td>
<td>never strongly protruding, but dorsally compressed into a translucid lamina. (Fig. 24).</td>
</tr>
<tr>
<td>74</td>
<td>Propodeum</td>
<td>rather long, but irregularly areolate, the articular area hardly or not distinct (Fig. 57).</td>
</tr>
<tr>
<td>75</td>
<td>Scape</td>
<td>short but not compact.</td>
</tr>
<tr>
<td>76</td>
<td>Malar furrow</td>
<td>shallow or absent; internal carina absent or present only towards the mouth; external carina complete (Fig. 19).</td>
</tr>
<tr>
<td>77</td>
<td>Mesoscutum, sculpture</td>
<td>punctuation sparse, superficial; punctures alternating with squamae (Fig. 37).</td>
</tr>
<tr>
<td>78</td>
<td>Preapical carina of the scutellum</td>
<td>mesally fused with the posterior margin of the scutellum or very close to it; frenal area reduce (Fig. 46).</td>
</tr>
<tr>
<td>79</td>
<td>Head</td>
<td>rounded in frontal view (Fig. 13).</td>
</tr>
<tr>
<td>80</td>
<td>Malar furrow</td>
<td>narrow, superficial and not bordered by carinae (Fig. 13).</td>
</tr>
<tr>
<td>81</td>
<td>Head</td>
<td>very transverse in frontal view, with antennal scrobe hardly set up (Fig. 14).</td>
</tr>
<tr>
<td>82</td>
<td>Mandibles</td>
<td>aberrant, 3+1 - 3+1 toothed (Fig. 90).</td>
</tr>
<tr>
<td>83</td>
<td>Prepectus</td>
<td>submedian carinae regressed.</td>
</tr>
</tbody>
</table>
Figs. 1-8. 1, Head of Brachymeriini (female): Brachymeria sp. (x50). 2-8. Heads of selected species of Chalcidini (females): 2, Spilochalcis miniata (Cameron) (mariae group) (x50); 3, S. lecta (Cresson) (xanthostigma group) (x75); 4, Chaclis myrifex (Sulzer) (x50); 5-6, Undetermined Spilochalcis of the xanthostigma group (x50); 7, Undetermined Spilochalcis of the nigricornis group (x35); 8, S. santaremensis Ashmead (x50).
Figs. 9-16. Heads of selected species of Chalcidini (females except otherwise mentioned): 9, Spilocharcis decisa (Walker) (transitiva group) (x50); 10, Melanosmica variventris (Cameron) (x75); 11, S. fulvovariegata (Cameron) (fulvomaculata group) (x75); 12, Undetermined Spilocharcis of the side group (x100); 13, Undetermined Spilocharcis of the rufoscutellaris group (x150); 14, S. maculipennis (Cameron) (maculipennis group) (x100); 15, Undetermined Spilocharcis of the blanda group: sculpture of the face (x200); 16, S. miniata (Cameron), male: face showing the malar bristles (Mlb) (x150).
Figs. 17-24. Malar furrow of selected species of Spilochalcis: 17, S. miniata (Cameron) (mariae group) (x100); 18, Undetermined species of the oiketicus group (x150); 19, Undetermined species of the apais group (x150); 20, S. fulvovariata (Cameron) (fulvomaculata group) (x350); 21, Undetermined species of the side group (x350); 22, S. maculipennis (Cameron) (maculipennis group) (x200); 23, S. decisa (Walker) (transitiva group) (x150); 24, S. femorata (F.) (femorata group) (x100).
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Figs. 33-41. 33-39. Mesoscutal sculpture of Chalcidini: 33, Undetermined *Spilochalcis* of the oiketicusi group (x35); 34, *S. fulvomaculata* (Cameron) (fulvomaculata group) (x75); 35, *S. miniata* (Cameron) (mariae group) (x50); 36, *S. dimidiata* (F.) (dimidiata group) (x35); 37, Undetermined *Spilochalcis* of the nsoscutellaris group (x150); 38, Undetermined *Spilochalcis* of the fulvomaculata group (x150); 39, *Melanosmicra variventris* (Cameron) (x75). 40-41. Mesocoxa of Chalcidini: 40, *Spilochalcis santaremensis* Ashmead: mesocoxa in inner view showing the mesocoxal bristles (Msob) (x200); 41, *Chalcis myrifex* (Sulzer): mesocoxa in dorsal view (x100).
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Figs. 68-76. 68-71. Hind legs of Chalcidini: 68, Spilochalcis femorata (F.), metafemur showing the outer basal tooth (x50); 69, Same species, enlarged base of metatibemur in inner view showing inner basal tooth (x75); 70, S. pygmaea(F.), hind leg (x35); 71, Undetermined Spilochalcis of side group, metacoxa showing reticulation of outerdorsal area (x200). 72-74. Claws of Chalcidini: 72, Chalcis myrifex (Sulzer), female (x350); 73, C. myrifex, male (x500); 74, Undetermined Spilochalcis of the nigricornis group, female (x350). 75-76. Abdominal petiole of Chalcidini: 75, Spilochalcis decisa (Walker) (x150); 76, S. femorata (F.) (x100).
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Figs. 105-110. 105-106. Apical spur of mesotibia in Chalcidini: 105, Undetermined species of Chalcis; 106, Spilochalcis flava (F.). 107, Claws of Spilochalcis decisa (Walker). 108, Teeth of metafemur in nigricornis group of Spilochalcis: a, b, undetermined species; c, S. lasnierii (Guérin). 109, Teeth of metafemur in the blanda group of Spilochalcis: a, S. marginata Ashmead; b and c, undetermined species. 110. Abdominal petiole of Spilochalcis: a, S. fusiformis Ashmead; b, S. rodriguezi (Cockerell); c, S. miniata (Cameron); d, undetermined species of the xanthostigma group; e, S. megalospitus Cameron; f, S. petioliventris Howard; g, S. paya (Burks); h, S. debilis (Say).
Figs. 118-124. Male genitalia of *Spilochalcis* (ventral view): 118, Undetermined species of the *xanthostigma* group; 119, *S. lecta* (Cresson) (*xanthostigma* group); 120, Undetermined species of the *xanthostigma* group; 121, Undetermined species of the *nigricomis* group: apex of phallobase enlarged; 122, Undetermined species of the *oiketicus* group: apex of phallobase enlarged; 123, *S. debilis* (Say) (*debilis* group); 124, *S. mariae* (Riley) (*mariae* group): a, sheath; b, aedeagus; c, apex of phallobase enlarged; d, apex of aedeagus showing phallothreme (*Ph*). *Vfr*, ventral frame.
Figs. 125-131. Male genitalia of *Spilocheleis* (ventral view): 125, *S. fulvovariegata* (Cameron) (*fulvomaculata* group); 126, *S. delumbis* (Cresson) (*side* group): apex of phallobase; 127, Undetermined species of the *N* group: a, sheath; b, apex of phallobase enlarged; 128, *S. biannulata* (Ashmead); 129, *S. exinaniens* (Walker); 130, Undetermined species of the *discolor* group; 131, *S. santaremensis* Ashmead.
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Fig. 136. Cladogram showing the distribution of shared derived characters in genera of Chalcidini and species groups of Spirochalcis. Characters defined in Table II. O = synapomorphies; O = multiple apomorphies; --- = reversals.