

GENNARO VIGGIANI - DONATELLA BATTAGLIA

Institute of Agricultural Entomology, University of Naples - Portici

Male genitalia in the Aphelinidae (Hym. Chalcidoidea) *

Until recent years (VIGGIANI, 1968; 1970; 1971; 1973) the male genitalia of the Hymenoptera Chalcidoidea was considered to have a remarkably uniform structure and consequently without taxonomic and phylogenetic value. In previous papers the senior author pointed out surprising variations in the structure of the copulatory organ of Trichogrammatidae and Mymaridae, which are of high diagnostic value for generic discrimination in this group of very small Hymenoptera. In general, a number of gradual and high modifications from phallus of Chalcidoid-type have been observed. Moreover, in some genera, variations of morphological details of the phallus are present and useful for the separation of the species in combination with other characters.

Among the minute parasitic Hymenoptera that rarely exceed 1 mm in length are the Aphelinidae, morphologically allied to Eulophidae and Trichogrammatidae. Most aphelinids are primary parasites of sternorhynchus Homoptera (Aphidoidea, Aleyrodoidea and Coccoidea); a few are known to develop on other hosts (eggs of Orthoptera and Lepidoptera; puparia of Diptera). Some species exhibit hyperparasitism. Approximately 50 genera and 1,000 species have been described, several of primary importance in biological control of pests (VIGGIANI, 1984). At present the suprageneric classification is in a state of flux. Jasnosh (1976) recognizes that the existing classifications are not supported by special comparative morphological and biological studies. Moreover, she points out the key significance of the male genitalia structure for the elucidation of generic relations and suprageneric groups-subfamilies.

Our present work * has been planned along this line and gives a first, comprehensive contribution to the knowledge of the external male geni-

* Presented at the XVII International Congress of Entomology, Hamburg, 20-26 August 1984.

Researches on the Hymenoptera Chalcidoidea of the first author: paper n. LXXXV.

talia in the Aphelinidae. The main purposes of this study are: 1. to clarify the general structure; 2. to study the variations into the present genera recognized on the basis of other external morphological characters; 3. to evaluate the significance of the observed variations in the taxonomy and phylogeny of the family.

In this contribution the male genitalia of 40 species belonging to 20 genera of Aphelinidae is described and illustrated with original drawings. Besides for a better understanding of some considerations, the copulatory organ of 2 genotypes described by other authors has been included in the paper.

The genera and species are arranged in alphabetical order, except the genotype, when studied, which is firstly presented.

MATERIAL AND METHODS

Dried, in alcohol or fresh specimens have been used. The mounting technique involved treating the dried specimens in a 10% solution of potassium hydroxide for 24-48 hours. After this step all types of specimens used followed the same technique procedure: about 30 m in alcohol 60-70%, glacial acetic acid and clove oil. The specimens were then dissected in the last medium and finally the external male genitalia mounted in balsam.

Genus *Ablerus* Howard

Type: *Centrodora clisiocampae* Ashmead

Ablerus macrocheta Silvestri (Fig. I, 1)

Phallobase shield-shaped (Fig. I, 1, p), without parameres and digiti; aedeagus robust, 7 times as long as wide, with rather short apodemes, about 1/4 of the penis body.

Ablerus macrocheta subsp. *inquirenda* Silvestri (Fig. I, 2).

Similar to *macrocheta*, but longer.

Ablerus pumilus Annecke & Insley (Fig. I, 3)

Small, with phallobase very short and broad, less than twice as long as wide; aedeagus robust, with two bacilliform apodemes slightly longer than the phallobase.

Comment. The male genitalia pattern seems rather uniform in this genus and very similar to that of *Azotus*. The main variations concern the size. The affinity between *Ablerus* and *Azotus*, also in other external morphological characters, give slight reasons to retain both genera valid.

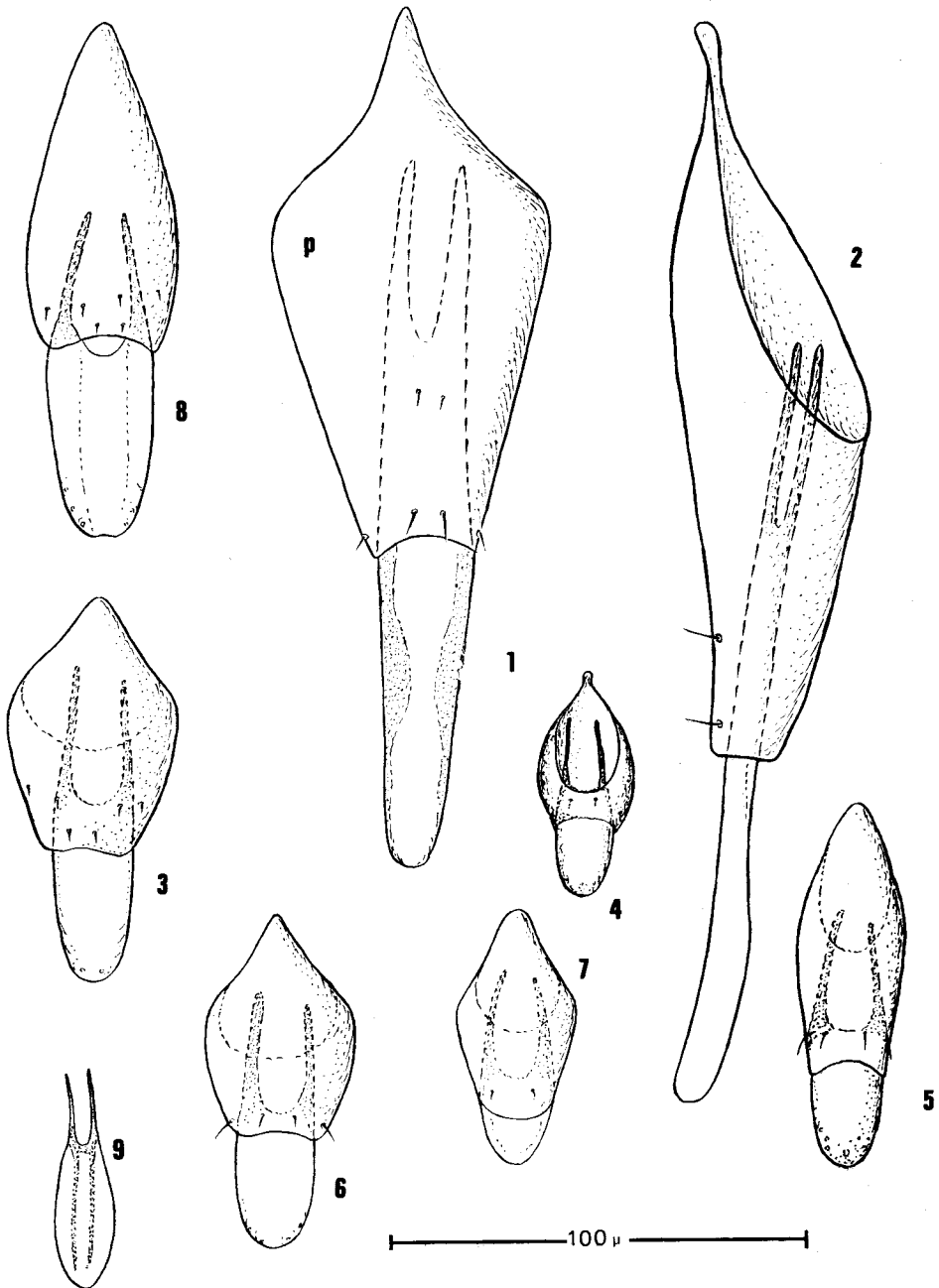


Fig. 1 - Male genitalia of: 1, *Alerus macrocheta* (ventral view); 2, *Alerus macrocheta* subsp. *inquirenda* (lateral view); 3, *Alerus pumilus* (ventral view); 4, *Azotus atomon* (dorsal view); 5, *Azotus celsus* (ventral view); 6, *Azotus delihensis* (ventral view); 7, *Azotus elongatulus* (ventral view); 8, *Azotus platensis* (ventral view); 9, *Cales noacki*. p = phallobase.

Genus *Aclerdaephagus* Sugonjaev

Type: *A. planus* Sugonjaev

Aclerdaephagus planus Sugonjaev (Fig. VI, 1)

The male genitalia of this species (SUGONJAEV, 1969) shows the general structure found in some *Coccophagus*.

Genus *Aphelinus* Dalman

Type: *Entedon abdominalis* Dalman

Aphelinus mali (Haldeman) (Fig. II, 1)

Elongate phallobase, narrowed in the basal third, without parameres. but with notable digital sclerites (d), each furnished with two apical claspers.

Aphelinus subflavescens (Westwood) (Fig. II, 2)

In this species, which was considered the type of the genus *Mesidiopsis* Nowicki, the male genitalia shows the general pattern of several *Aphelinus*, but with narrower digiti, distally not particularly sclerotized and provided with more robust distal claspers.

Comment. The variations observed in the male genitalia may be useful for species discrimination.

Genus *Aphytis* Howard

Type: *Aphytis chilensis* Howard

The male genitalia of *Aphytis* has been described and illustrated in several species by Rosen and DeBach (1979). It (Fig. II, 3) is characterized by the complete absence of parameres and a pair of elongate, movable digital sclerites, each furnished with a short subapical spine and a single apical clasper. A few exceptions to this general pattern have been described. In several cases the variations observed have taxonomic value at species level.

Genus *Archenomus* Howard

Type: *Archenomus bicolor* Howard

Archenomus bicolor Howard (Fig. III, 1-3)

Phallobase long and completely opened dorsally, pointed in the basal third and with triangular profile; laterally with two well-sclerotized arms (1 a) connected with the genital sternite; distally provided with two narrow and triangular lobes which are a little shorter of 1/3 of its total length; aedeagus very long, with basally fused apodemes.

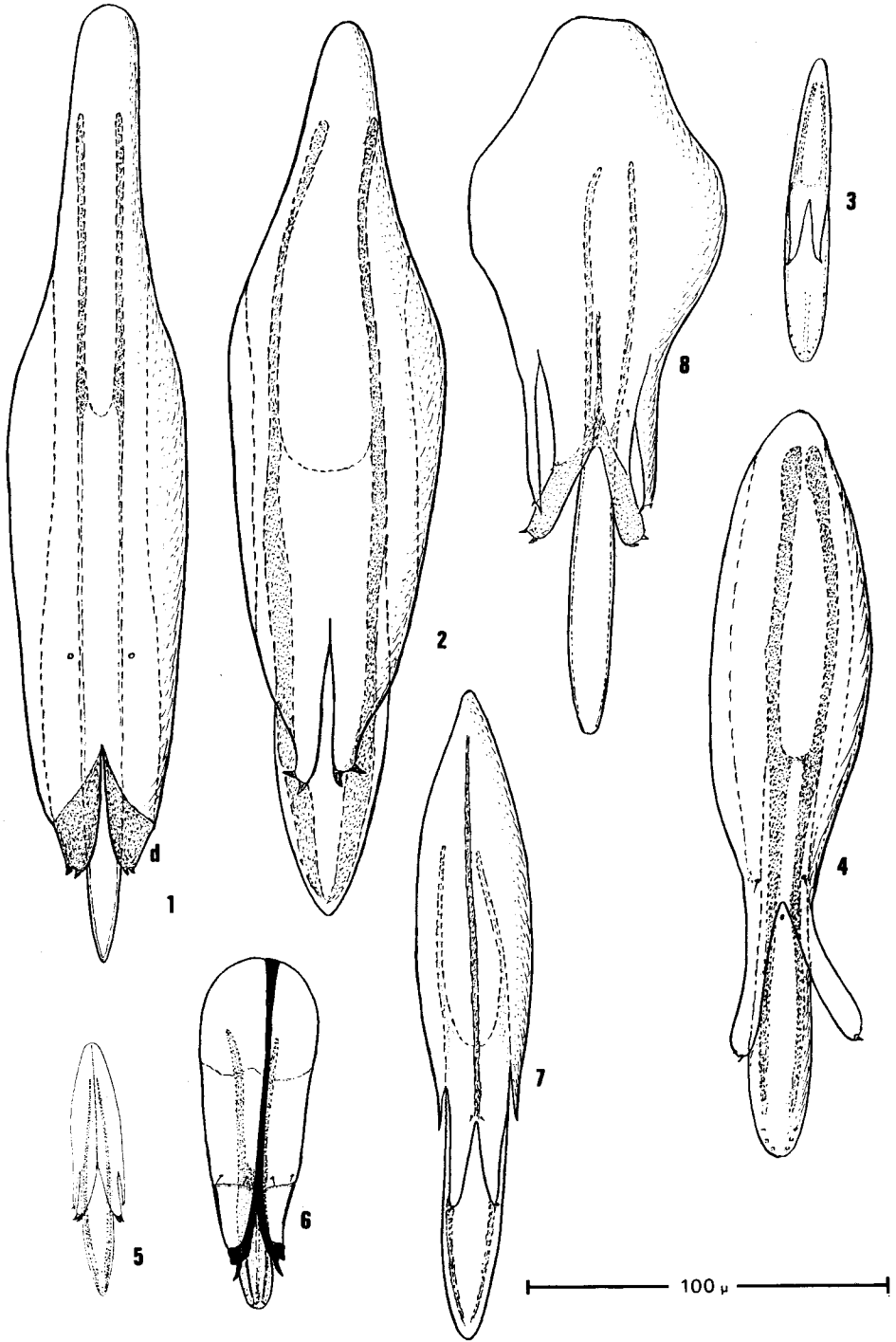


Fig. II - Male genitalia of: 1, *Aphelinus mali* (ventral view); 2, *Aphelinus subflavescens* (ventral view); 3, *Aphytis africanus* (ventral view); 4, *Botryoideclava bhartiya* (ventral view); 5, *Centrodora brevifuniculata* (ventral view); 6, *Eriaphytis orientalis* (ventral view); 7, *Marietta javensis* (ventral view); 8, *Oolathron miroyae* (ventral view). d = digitus.

Archenomus longiclava (Girault) (Fig. IV)

Similar to *bicolor*, but with distal lobes longer, about half of the phallobase length.

Archenomus opacus (Erdoes) (Fig. III, 4)

Phallobase very short, narrowed in the basal half; distally provided with two long and narrow lobes as long as the phallobase; aedeagus as long as three times the phallobase, basally truncate and without bacilliform apodemes.

Archenomus orientalis Silvestri (Fig. V)

Similar type of *bicolor* and *longiclava*, but with ventral lobes beginning at the same level of the lateral arms, and three times as long as the triangular body of the phallobase.

Comment. The interspecific variations observed in *Archenomus* appear to be of high taxonomic value for species differentiation.

The structure of the male genitalia in *Archenomus opacus*, belonging to the subgenus *Archenomiscus*, seems more similar to *Pteroptrix* than to *Archenomus*. It is our present opinion that *Archenomiscus* is to be considered a subgenus of *Pteroptrix*, but a definitive proposal will be done after a larger analysis of the complex.

Genus *Azotus* Howard

Type: *Azotus marchali* Howard (= *A. atomon* Walker)

Azotus atomon (Walker) (Fig. I, 4)

Phallobase about as long as a little more than twice its width, anterodorsally opened in about $2/3$ of its length, basally pointed and distally without parameres and digiti, with 4 setae near the ventral margin; aedeagus short, stout, with bacilliform apodemes, about as long as its body.

Azotus celsus (Walker) (Fig. I, 5)

Very similar to *A. atomon*, but with longer phallobase.

Azotus delihensis Lal (Fig. I, 6)

Rather small, with short phallobase only about $1/4$ longer than wide; apodemes of the aedeagus about as long as its body.

Azotus elongatulus Silvestri (Fig. I, 7)

Very small, with phallobase length a little shorter than its width; aedeagus with apodemes a little longer than its body.

Azotus platensis Brèthes (Fig. I, 8)

Rather similar to that of *A. celsus*, but a little larger.

Comment. See *Ablerus*.

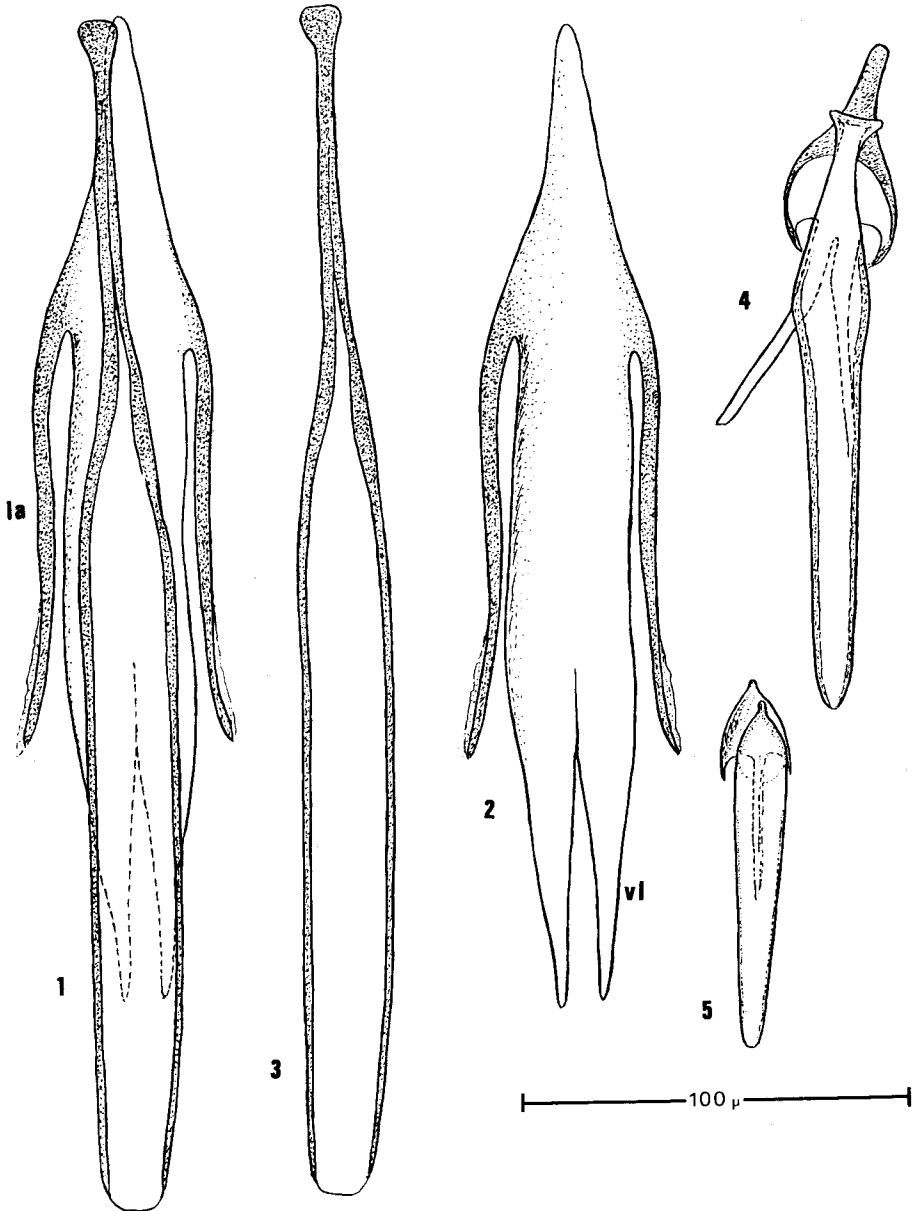


Fig. III - Male genitalia of: *Archenomus bicolor*, 1, dorsal view; 2, phallobase; 3, aedeagus. *Archenomus opacus*, 4, dorsal view. *Pteroptrix wanhsiensis*, 5, dorsal view. la = lateral arm. vl = ventral lobe.

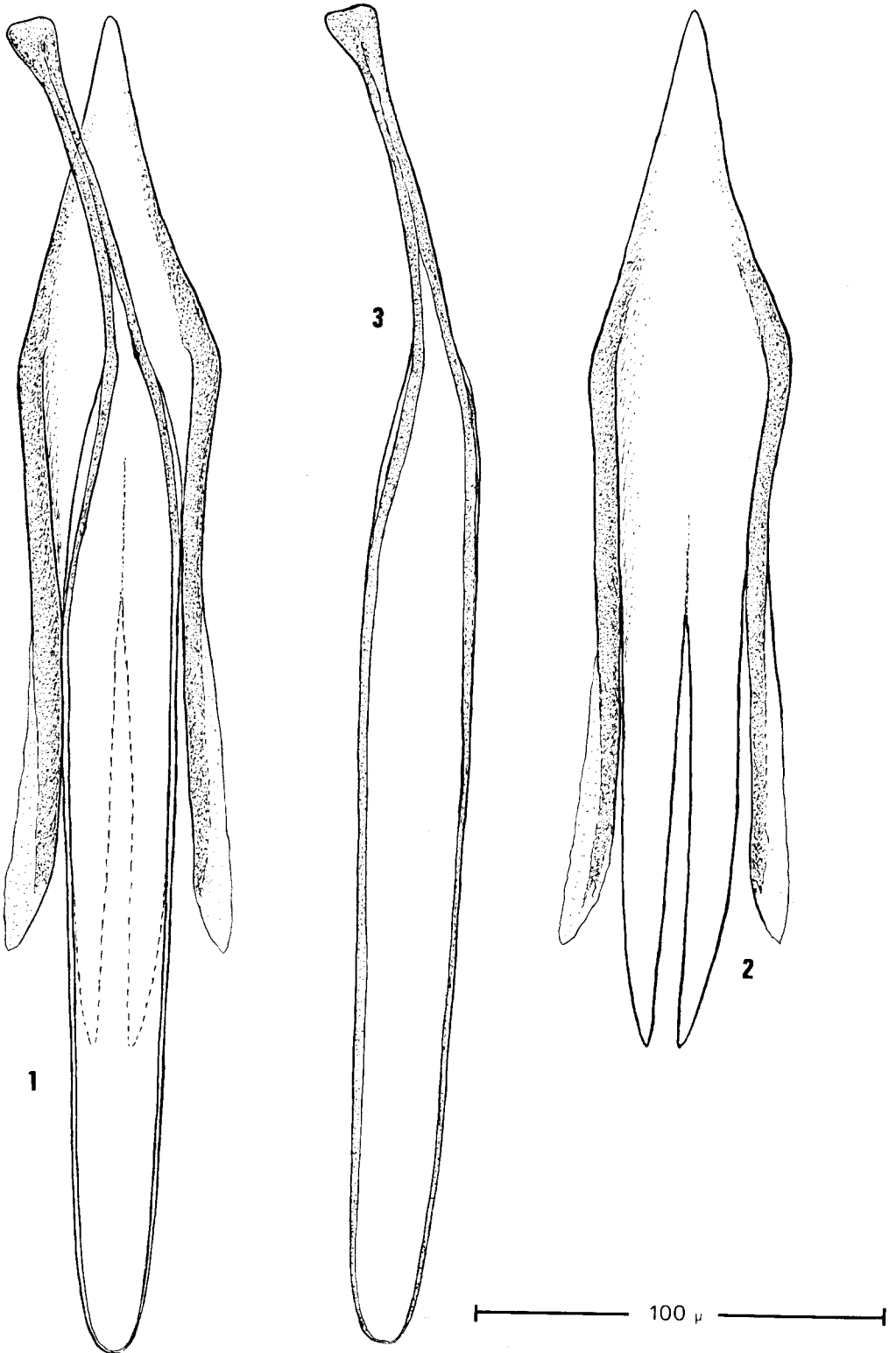


Fig. IV - Male genitalia of: *Archenomus longiclava*, 1, dorsal view; 2, phallobase; 3, acedeagus.

Genus *Botryoideclava* Subba Rao

Type: *Botryoideclava bharatiya* Subba Rao

Botryoideclava bharatiya Subba Rao (Fig. II, 4)¹

Phallobase boat-shaped slight more than three times as long as wide, with digiti about one third of its length, narrow, rather enlarged distally, and provided with one clasper.

Genus *Cales* Howard

Type: *Cales noacki* Howard

Cales noacki Howard (Fig. I, 9)

Very small, without phallobase; aedeagus with spatulate body and bacilliform apodemes as long as 1/2 of the latter.

Comment. To this genus are at present referred two species. The structure of the phallus in the genotype is unique among the aphelinids and remembers that found in some Trichogrammatidae Oligositinae.

Genus *Centrodora* Foerster

Type: *Centrodora amoena* Foerster

Centrodora brevifuniculata Viggiani (Fig. II, 5)

Phallobase tubular, basally pointed, provided of narrow parameres and larger digiti; the latter each with two claspers; aedeagus with bacilliform apodemes a little shorter than its body.

Comment. In this genus, which includes about 40 species, the general pattern of the male genitalia is as represented for *C. brevifuniculata*, that is of Chalcidoid type. The phallobase shows parameres and digiti with two claspers.

Genus *Coccophagoides* Girault

Type: *Coccophagus abnormicornis* Girault

Coccophagoides moeris (Walker) (Fig. VII, 1-4)

According to Zinna (1962) (under *C. similis* Masi) phallobase rather long, gradually antero-distally narrowed, completely opened dorsally, without parameres and digiti; aedeagus with bacilliform apodemes as long as its body.

Comment. In this genus, which includes about 15 species, the phallus is rather similar to that of *Encarsia* and this confirms other morpholo-

¹ The authors thank very much Dr. B. R. Subba Rao for providing the studied material.

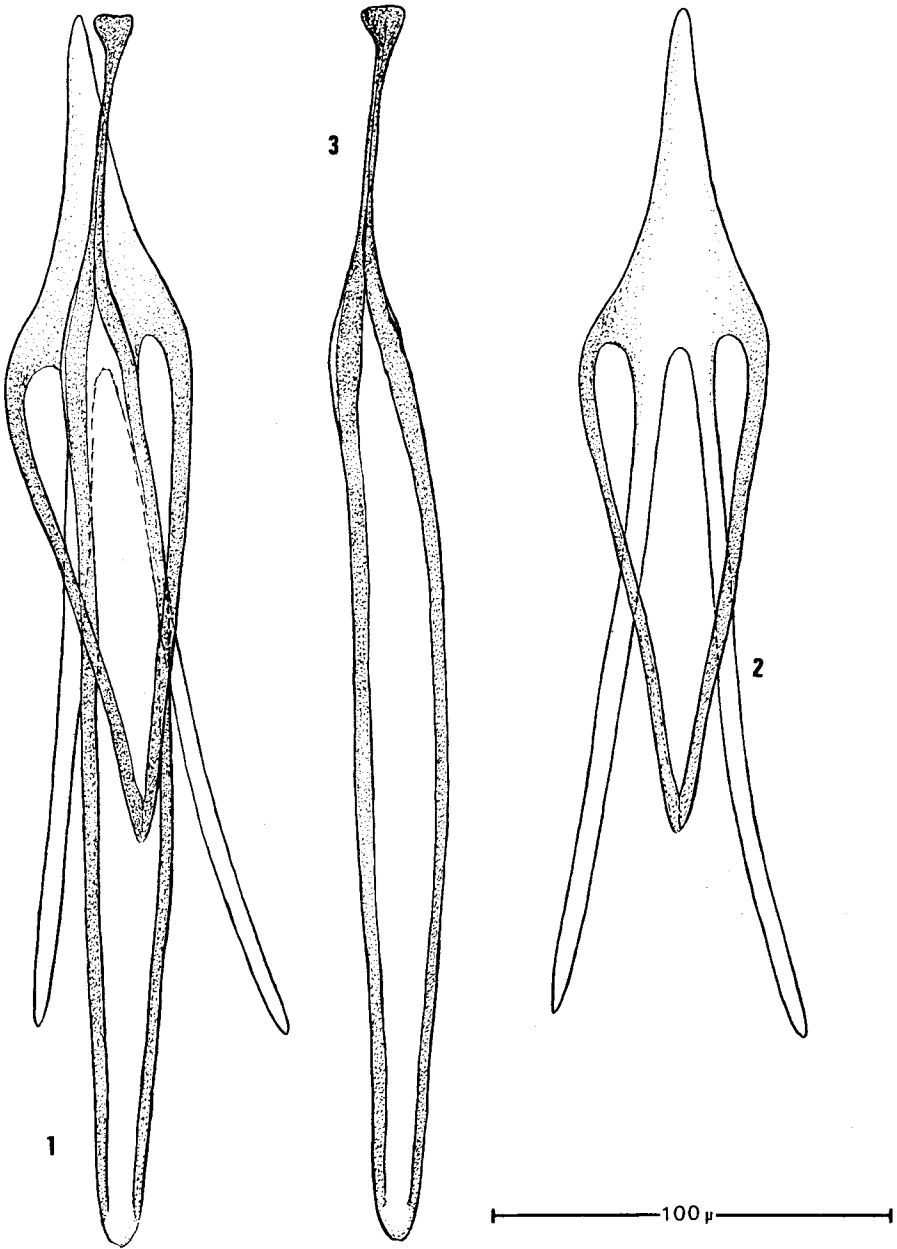


Fig. V - Male genitalia of: *Archenomus orientalis*, 1, dorsal view; 2, phallobase; 3, aedeagus.

gical and biological affinities. As the present knowledge is referred to only one species (*C. moeris*) a larger analysis is needed.

Genus *Coccophagus* Westwood

Type: *Entedon scutellaris* Dalman

Coccophagus aethochreus Annecke & Insley (Fig. VI, 2)

Phallobase rather short and narrow, long about 3 times as wide, basally truncated, dorsally opened and distally with two narrow and long digital lobes; at their base each with one long seta; aedeagus with a profile of a narrow triangle, basal width about 1/7 of its length, provided of bacilliform apodemes.

Coccophagus inaron (Walker) (Fig. VI, 3-4)

Phallobase rather similar to that of *aethochreus*, but with a larger base and triangular digital lobes, about 1/3 of its length.

Coccophagus lycimnia (Walker) (Fig. VI, 5)

Phallobase tubular, very narrow in the basal half like a petiole, digital lobes rather large, basal width as 1/3 of the length, at base, laterally each with one short seta; aedeagus with bacilliform apodemes as long as 1/2 of its body length.

Coccophagus margaritatus Compere (Fig. VI, 6)

Same type of *C. aethochreus*, but phallobase more pointed basally and longer; predigital setae shorter.

Coccophagus matsuyamensis Ishihara (Fig. VI, 7)

Similar to that of *C. ochraceus* but shorter, with phallobase as long as wide; digiti a little less than 1/2 of phallobase length.

Coccophagus ochraceus Howard (Fig. VI, 8)

Same type of *aethochreus*, but shorter, phallobase basally enlarged, wide as 2/3 as long; digiti short, rectangular in profile as long as 1/3 of the phallobase length; basal width of the aedeagus about 1/4 of its length.

Coccophagus paleolecanii Jasnosh (Fig. VI, 9)

Same type of *lycimnia*, but very large, with phallobase like a broad spoon and digital lobes very short; aedeagus broad, with bacilliform apodemes as long as the basal narrowed part of the phallobase; large genital pore.

Comment. About 190 species have been included in *Coccophagus*. As shown in the previous descriptions and illustrations the male genitalia of a few group representative species is characterized by a basic general pattern, but with remarkable variations concerning mainly the shape and size of phallobase and digiti. Such interspecific variations seem reflect

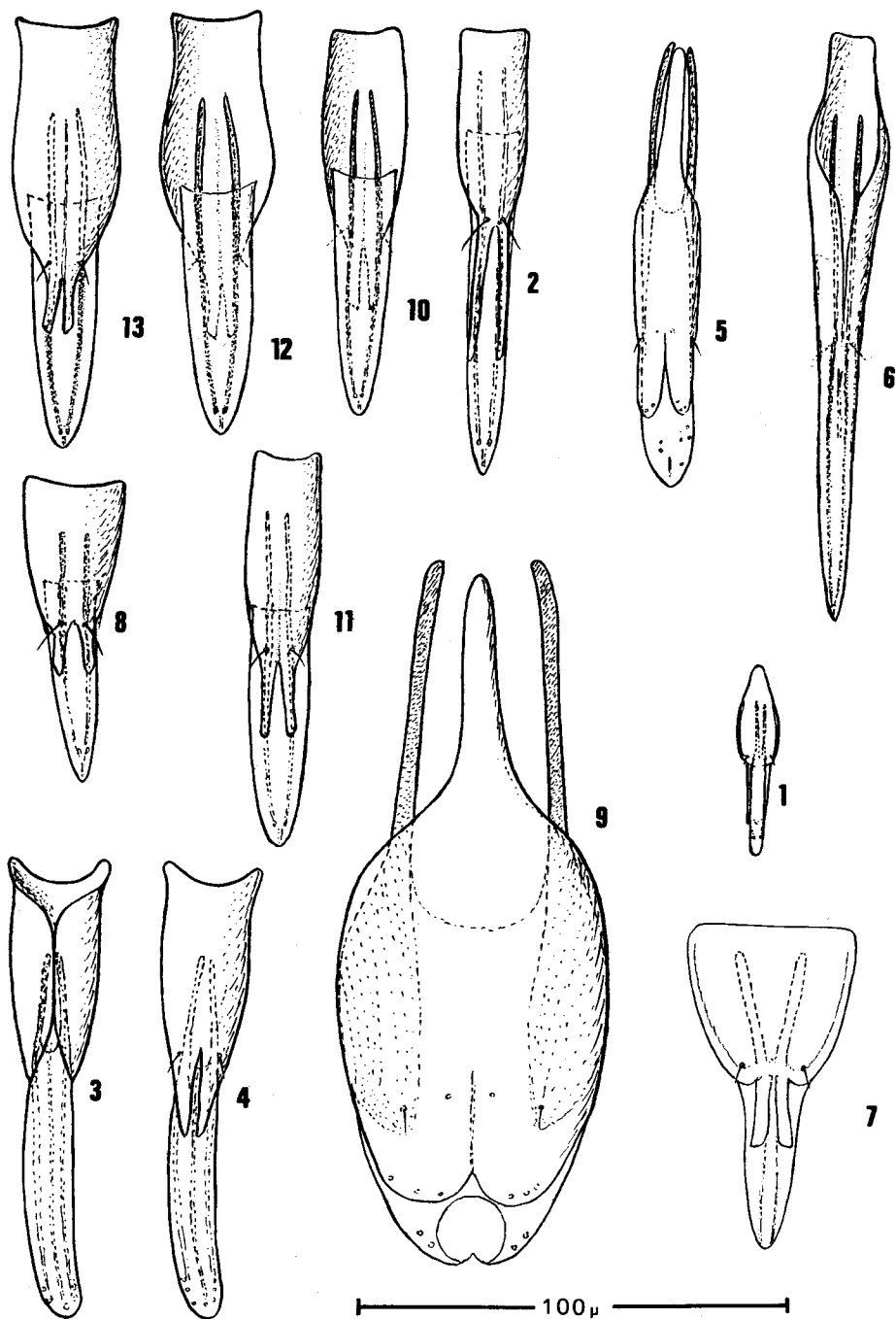


Fig. VI - Male genitalia of: 1, *Aclerdaephagus planus* (ventral view) (from Sugonjaev); 2, *Coccophagus aethochreus* (ventral view); 3 and 4, *Coccophagus inaron* (dorsal and ventral view) (from Zinna); 5, *Coccophagus lycimnia* (ventral view); 6, *Coccophagus margaritatus* (dorsal view); 7, *Coccophagus matsuyamensis* (ventral view); 8, *Coccophagus ochraceus* (ventral view); 9, *Coccophagus paleolecanii* (ventral view); 10-11, *Prococcophagus varius* (dorsal and ventral view); 12-13, *Prococcophagus saissetiae* (dorsal and ventral view).

other morphological and biological differences, to be considered in a modern revision of the genus which is needed.

Genus *Encarsia* Foerster

Type: *Encarsia tricolor* Foerster

Encarsia tricolor Foerster (Fig. VII, 5-7)

Very similar to the type observed in some *Coccophagus* (i. e. *C. lycimnia*), but without distinct digital lobes. Phallobase completely opened dorsally, narrowed in the basal half and aedeagus with apodemes a little longer than one third of its body length.

Encarsia asterobemisiae Viggiani & Mazzone (Fig. VII, 8-9)

Same type of *E. tricolor*, but shorter, with phallobase distally less pointed and aedeagus body clearly longer than the apodemes.

Encarsia pergandiella Howard (Fig. VII, 10-12)

Rather similar to *E. asterobemisiae*, but narrower and with body of the aedeagus about as long as apodemes.

Encarsia pseudopartenopea Viggiani & Mazzone (Fig. VII, 13-14)

Phallobase less narrowed than in *asterobemisiae*, broader in the pre-distal part; aedeagus with apodemes about 1/3 longer than its body.

Comment. In this large genus, with about 180 described species and many other undescribed, the male genitalia shows the same pattern found in some *Coccophagus* (e. i. *C. lycimnia*, *C. paleolecanii*) except the extreme reduction of the digital lobes. The interspecific variations found appear of taxonomic value.

Genus *Eretmocerus* Haldeman

Type: *Eretmocerus corni* Haldeman

Eretmocerus delhiensis Mani (Fig. VIII, 1-2)

Phallobase boat-shaped, about three times as long as wide, distally with subrectangular digiti, about five times as long as wide, provided with a terminal clasper; presence of two subdigital stylets as long as twice the digiti; aedeagus well developed, with apodemes long about one half its body.

Eretmocerus longicornis Viggiani & Battaglia (Fig. VIII, 3)

As in *delhiensis*, but with longer digiti in comparison with the subdigital stylets.

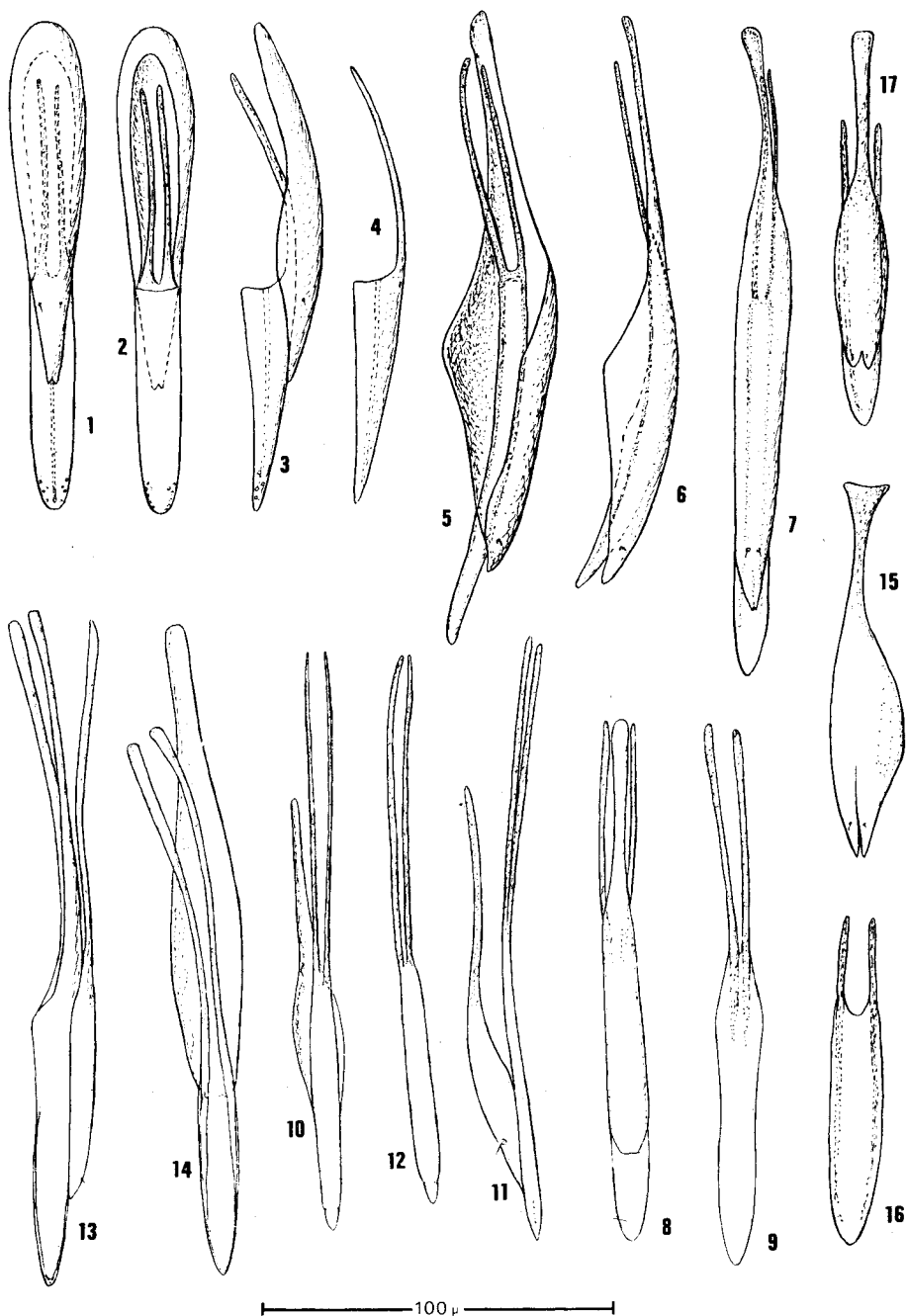


Fig. VII - Male genitalia of: *Coccophagoides moeris*, 1, 2 and 3, ventral, dorsal and lateral view; 4, aedeagus (from Zinna). *Encarsia tricolor*, 5, 6 and 7, dorsal, lateral and ventral view. *Encarsia asterobemisiae*, 8 and 9, ventral view and aedeagus. *Encarsia pergandiella*, 10 and 11, dorsal and lateral view; 12, aedeagus. *Encarsia pseudopartenopea*, 13 and 14, lateral and dorsal view. *Physcus testaceus*, 15, phallobase; 16, aedeagus. *Physcus viggianii*, 17, ventral view.

Comment. The male genitalia in this genus, which includes about 40 species, appears unique among the known aphelinids, because of the presence of the subdigital stylets.

Genus *Eriaphytis* Hayat

Type: *Eriaphytis orientalis* Hayat

Eriaphytis orientalis Hayat (Fig. II, 6)

According to Hayat (1978): « Phallobase almost cylindrical, anteriorly convex; aedigal apodemes slender and contained within the phallobase; digitus volsellaris strongly developed, each with a strongly sclerotized bar that originates from near the inner side at base of the digitus, and curves outwards at apex of the digitus, and bears a strong, slightly curved spine ».

Comment. Two species are included in *Eriaphytis*. The male genitalia of the genotype, rather similar to that of *Aphytis*, is mainly characterized by a sclerotized longitudinal, medial bar on the phallobase, distally in connection with the digiti.

Genus *Euxanthellus* Silvestri

Type: *Euxanthellus philippiae* Silvestri

Euxanthellus philippiae Silvestri

It appears of the same type of *Coccophagus* group *lycimnia*. At present the material available is not suitable for a careful description and illustration.

Comment. Four species are included in this genus, which has Ethiopian and Neotropical distribution. For some of them the male is not known.

Genus *Hispaniella* Mercet

Type: *Archenomus lauri* Mercet

Hispaniella lauri (Mercet)

According to Nikolskaja and Jasnoch (1966) the male genitalia of this species is of *Archenomus*-type.

Comment. Three species have been described under *Hispaniella*. Probably the species under this genus may be in future better considered as a group into at present rather heterogeneous genus *Archenomus*.

Genus *Marietta* Motschulsky

Type: *Marietta leopardina* Motsch.

Marietta javensis (Howard) (Fig. II, 7)

Phallobase rather long, boat-shaped, about four times as long as wide, provided with short and narrow parameres reaching the base of digiti; the latter are about as long as the parameres and each provided with a clasper; aedeagus rather robust with apodemes as long as $5/7$ of its body.

Comment. The male genitalia in *Marietta* appears one of the few key characters to distinguish the species of this genus including about 20 species, from those of *Aphytis*.

Genus *Oolathron* De Santis

Type: *Oolathron mireyae* De Santis

Oolathron mireyae De Santis (Fig. II, 8)

Phallobase clearly expanded along the middle part, provided with long and narrow parameres distally showing two short setae. Digiti sub-rectangular, shorter than the parameres, well sclerotized and provided with two claspers; aedeagus small and narrow with apodemes as long as its body.

Comment. The male genitalia of the monotypic genus *O. mireyae*, originally described here², is of the same type of *Centrodora*. The present authors are inclined to consider *Oolathron* junior synonym of *Centrodora*.

Genus *Physcus* Howard

Type: *Coccophagus varicornis* Howard

Physcus testaceus Masi (Fig. VII, 15-16)

Phallobase spoon-shaped, with petiole clearly enlarged at base; digital lobes triangular, rather short; aedeagus with apodemes as long as one half of its body.

Physcus viggianii Jasnosh (Fig. VII, 17)

As in *P. testaceus*, but phallobase narrower and with basal petiole uniform in width.

Comment. The phallus of the studied species of the rather large genus *Physcus* (about 60 described species) is of the same type of *Encarsia*, but with digital lobes more pronounced.

² The authors express their sincere thanks to Prof. L. De Santis, University of La Plata, Argentine, for providing the studied material.

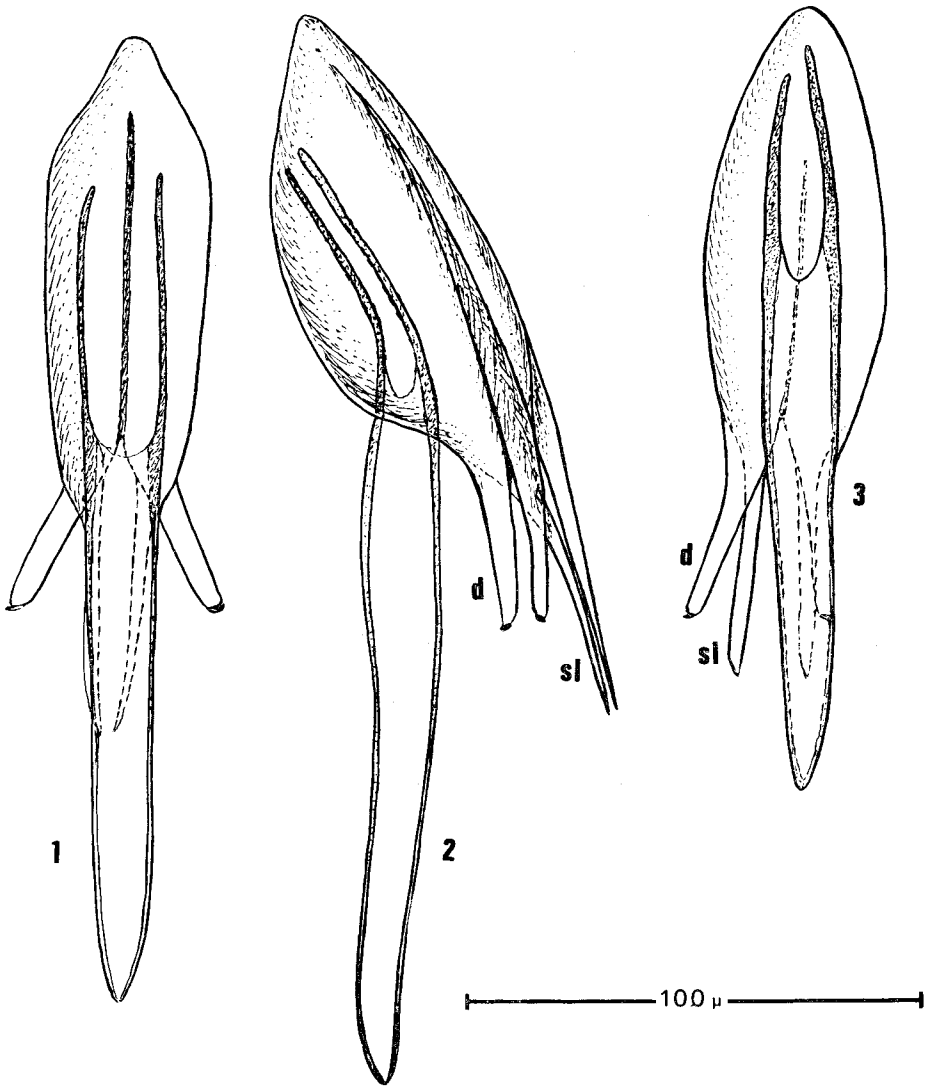


Fig. VIII - Male genitalia of: *Eretmocerus delhiensis*, 1, dorsal view; 2, lateral view, with parts artificially disposed; 3, *Eretmocerus longicornis* (dorsal view).
d = digiti; sl = subdigital stylets.

Genus *Prococcophagus* Silvestri

Type: *Prococcophagus varius* Silvestri

Prococcophagus varius Silvestri (Fig. VI, 10-11)

Same type of *Coccophagus ochraceus*, but with phallobase slightly larger.

Prococcophagus saissetiae Annecke & Mynhardt (Fig. VI, 12-13).

Rather undistinguishable from *P. varius*, only slightly longer.

Comment. The phallus of the studied species of *Prococcophagus* originally described and illustrated here, gives further evidence to consider *Prococcophagus* a junior synonym of *Coccophagus*.

Genus *Pteroptrix* Westwood

Type: *Pteroptrix dimidiatus* Westwood

Pteroptrix wanhsiensis Compere

The phallus illustrated by Nikolskaja & Jasnosh (1966) for this species is very similar to that of *Archenomus maritimus* (Nikolskaja). In a specimen from China ex *Aulacaspis*, identified by the present authors *P. wanhsiensis*, we observed the same type of genitalia (Fig. III, 5).

Comment. A more sound grouping of the species included in the genera *Archenomus*, *Hispaniella*, *Pteroptrix* and allied can not been proposed without taking into account the structure of the male genitalia. The present status seems highly artificial.

CONCLUDING REMARKS

The male genitalia of the Aphelinidae exhibits the same remarkable types of variations which have previously shown in the Trichogrammatidae and in the Mymaridae (Fig. IX). The Chalcidoid-type which is characterized by a boat-shaped phallobase provided with parameres and rather short, well sclerotized, plate-shaped digiti, the latter usually at least with two claspers, is represented only in a few genera (i. e., *Centrodora*-complex, *Marietta*, *Aphelinus*). This type of phallus evolves towards another more simplified structure, as present in *Aphytis*, which lacks of parameres, has rather long and narrow digiti provided with one clasper (Table 1).

A rather large number of genera, which are here called *Coccophagus*-complex and includes *Coccophagus*, *Coccophagoides*, *Encarsia* and *Physcus*, shows a male genitalia type basically characterized by a phallobase of different shape (trunk-conic or spoon-like) provided or not with narrow digiti without claspers. The main variations have been found in the genus *Coccophagus*, one of the most comprehensive in the Aphelinidae, in which the phallus characters, in combination with other morphological and biological features, can suggest a less artificial status.

The copulatory organ in *Coccophagoides* shows a transitional structure which shares characters of some *Coccophagus* (phallobase shape) with others of *Encarsia* and related genera (absence of digiti). In the latter

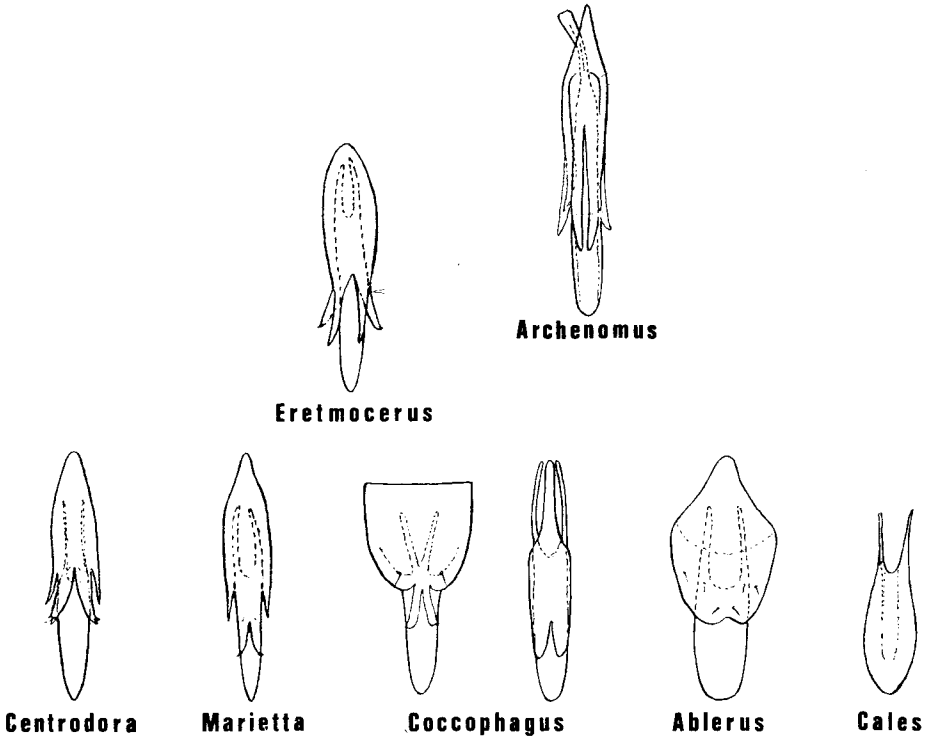
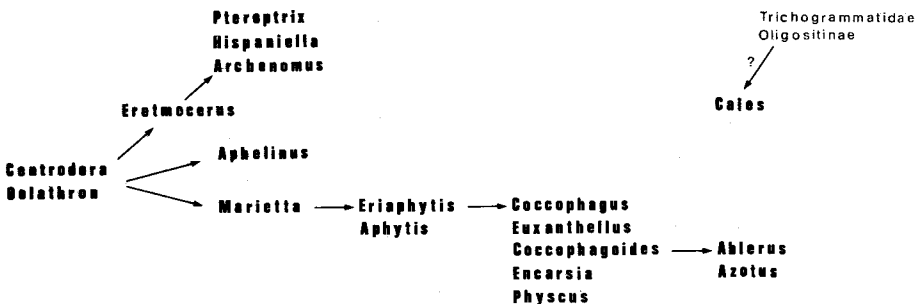


Fig. IX - Types of male genitalia in Aphelinidae.

genera (*Encarsia*, *Physcus*) the phallobase is spoon-shaped, distal-ventrally pointed, not divided in two lobes and without digiti.

Probably connected with the discussed phylogenetic trend is the type of phallus which exhibit the genera *Alerus* and *Azotus*. It is characterized by a rather broad and tubular phallobase, partially opened dorsally, lacking

TABELLA 1 - Hypothesis of phylogenetic relationships in a few Aphelinidae genera based on the male genitalia characters.



of parameres and digiti, with aedeagus rather short, but large and with bacilliform apodemes.

Another probable line of evolution from the Chalcidoid-type of phallus is represented by the genus *Eretmocerus* and the *Archenomus*-complex. In the first genus the male genitalia is characterized by two subdigital stylets connected with the phallobase.

The peculiar structure of the copulatory organ found in the genera *Archenomus*, *Hispaniella* and *Pteroptrix* shows a phallobase laterally provided with two long and well sclerotized arms linked to the genital sternites, and distally two long, stylet-shaped lobes; moreover the large aedeagus has fused bacilliform apodemes.

A peculiar position has the genus *Cales* with a very small and simplified phallus, reduced to the aedeagus, which is found in the Trichogrammatidae Oligositinae (VIGGIANI, 1971).

In the Aphelinidae the identification of most genera can be done only on the pattern of the male genitalia. The latter remains stable even in comprehensive genera including more than one hundred species, which appear morpho-biological complexes of really allied units (i. e., *Aphytis*, *Encarsia*). In large genera, including rather heterogeneous groups of species, for both morphology and biology, as in *Coccophagus*, some variations in the male genitalia pattern occur and need a careful taxonomic evaluation.

At species level, particularly between sibling species, the phallus characters can give valuable elements of their actual sibling status.

The classification and phylogeny of the Aphelinidae without taking into account the external features appear unsound. On the basis of the present knowledge the following suprageneric groups are preliminarily defined:

subfam. *Aphelininae* — Male genitalia of Chalcidoid-type, phallobase boat-shaped, well-sclerotized digiti with two or one claspers, aedeagus with two bacilliform apodemes.

Genera included: *Centrodora* Foerster, *Marietta* Motschulsky, *Aphelinus* Dalman, *Aphytis* Howard, *Botryoideclava* Subba Rao, *Eriaphytis* Hayat.

subfam. *Eretmocerinae* — Male genitalia of Chalcidoid-type, phallobase boat-shaped, digiti rather long and narrow, with one apical clasper, presence of two subdigital stylets, aedeagus with two bacilliform apodemes.

Genera included: *Eretmocerus* Haldeman.

subfam. *Coccophaginae* — Male genitalia with trunk-conic or spoon shaped phallobase, digiti, if present, never with apical claspers; aedeagus with two bacilliform apodemes.

Genera included: *Aclerdaephagus* Sugonjaev, *Coccophagus* Westwood, *Coccophagoides* Girault, *Euxanthellus* Silvestri, *Prococcophagus* Silvestri, *Encarsia* Foerster, *Physcus* Howard, *Ablerus* Howard, *Azotus* Howard.

subfam. *Pteroptricinae* — Male genitalia with phallobase showing a sub-triangular profile and provided with two lateral arms and two very long digital lobes without apical claspers; aedeagus with fused bacilliform apodemes.

Genera included: *Archenomus* Howard, *Hispaniella* Mercet, *Pteroptrix* Westwood.

subfam. *Calesinae* — Male genitalia without phallobase, represented only by the aedeagus.

Genera included: *Cales* Howard.

In the subfamily Aphelininae may be recognized the tribes Centrodorini (phallobase with parameres; genera included: *Centrodora* Foerster, *Marietta* Motschulsky) and Aphelinini (phallobase without parameres; genera included: *Aphelinus* Dalman, *Aphytis* Howard, *Botryoideclava* Subba Rao, *Eriaphytis* Hayat); in that of Coccophaginae the tribes Coccophagini (trunk-conic phallobase, basally trunked, with narrow digiti; genera included: *Aclerdaephagus* Sugonjaev, *Coccophagus* Westwood, *Coccophagoides* Girault, *Euxanthellus* Silvestri, *Prococcophagus* Silvestri), Encarsini (spoon-shaped phallobase, distal-ventrally pointed; genera included: *Encarsia* Foerster, *Physcus* Howard) and Azotini (trunk-conic phallobase, distally trunkated; genera included: *Ablerus* Howard, *Azotus* Howard).

The male genitalia of members of the subfamily Eriaporinae remains to be investigated.

SUMMARY

In the present study the male genitalia of 20 genera and 40 species of Aphelinidae is reviewed. For most species the phallus structure has been investigated for the first time. Some remarkable variations have been found from the Chalcidoid-type. In general the pattern of the copulatory organ remains stable in most genera; it means that this

character needs to be considered in the definition of each genus. Besides, several variations occur at species level which have high diagnostic value. The most heterogeneous genus appears *Coccophagus*. The variations observed in the features of the male genitalia suggest a revision of the present status, based also on the consideration of other morphological and biological characters, which can lead at least to a more natural grouping of the species.

The importance of the male genitalia features in the classification and phylogeny of the Aphelinidae is emphasized. On the basis of copulatory characters a preliminary suprageneric classification is proposed.

RIASSUNTO

Nel presente studio è stata fatta una revisione dell'organo genitale maschile di 20 generi e 40 specie di Aphelinidae. Per la maggior parte delle specie la struttura del fallo è stata studiata per la prima volta. Sono state trovate rimarchevoli variazioni rispetto al tipo Calcidoide. In generale, il modello di organo copulatore rimane stabile nella maggior parte dei generi, ciò significa che questo carattere dovrebbe essere preso in considerazione nella definizione del genere. Inoltre, a livello di specie, occorrono diverse variazioni che hanno un alto livello diagnostico. Il genere più eterogeneo sembra essere *Coccophagus*. Le variazioni osservate nelle caratteristiche dell'organo genitale maschile suggeriscono una revisione del presente stato, basata anche su altri caratteri morfologici e biologici, che possono condurre a un raggruppamento più naturale delle specie.

È sottolineata l'importanza dell'organo genitale maschile nella classificazione e nella filogenesi degli Aphelinidae. Su questa base si propone una preliminare classificazione sopragenerica della famiglia.

REFERENCES

- HAYAT, M. - 1978 - On the proposal of *Eriaphytinae*, a new subfamily in the Aphelinidae (Hymenoptera, Chalcidoidea). - *Polskie Pism. Entom.* **48**: 533-536.
- JASNOSH, V. A. - 1976 - Classification of the parasitic Hymenoptera of the family Aphelinidae (Chalcidoidea). - *Entom. Rev.* **55**: 114-120.
- NIKOLSKAJA, M. N. & V. A. JASNOSH - 1966 - Aphelinids of the European regions of the USSR and Caucasus. - Leningrad, Nauka Press: 294 pgg.
- ROSEN, D. & P. DE BACH - 1979 - Species of *Aphytis* of the world (Hymenoptera: Aphelinidae). - Dr. W. Junk BV, Publ., The Hague Boston, London: 801 pgg.
- SUGONJAEV, E. S. - 1969 - *Aclerdaephagus planus* Sugonjaev gen. et sp. n. (Hymenoptera, Aphelinidae)-parasite of *Nipponaclerda turanica* Arch. in South Tajikistan. - *Zool. zhurn.* **48**: 290-292.
- VIGGIANI, G. - 1968 - The significance of the male genitalia in Trichogrammatidae (Hymenoptera, Chalcidoidea). - XIIIth Int. Congr. Ent., Abstracts-Moscow: 324.
- VIGGIANI, G. - 1970 - Ricerche sugli Hymenoptera Chalcidoidea. XXIV. Sul valore tassonomico dell'organo copulatore nei Mimaridi del genere *Anagrus* Hal. - *Boll. Lab. Ent. Agr. Portici* **28**: 10-18.
- VIGGIANI, G. - 1971 - Ricerche sugli Hymenoptera Chalcidoidea. XXVIII. Studio morfologico comparativo dell'armatura genitale esterna maschile dei Trichogrammatidae. - *Boll. Lab. Ent. Agr. Portici* **29**: 181-222.

- VIGGIANI, G. - 1973 - Notizie preliminari sulla struttura e sul significato dell'armatura genitale esterna maschile nei Mymaridi (Hym. Chalcidoidea). - Boll. Lab. Ent. Agr. Portici 30: 269-281.
- VIGGIANI, G. - 1984 - Bionomics of the Aphelinidae. - Ann. Rev. Entomol. 29: 257-276.
- ZINNA, G. - 1962 - Ricerche sugli insetti entomofagi. - III. Specializzazione entomoparassitica negli Aphelinidae: Interdipendenze biocenotiche tra due specie associate. Studio morfologico, etologico e fisiologico del *Coccophagoidea similis* (Masi) e *Azotus maritensis* Mercet. - Boll. Lab. Ent. Agr. Portici 20: 73-184.