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CONTRIBUTION TO KNOWLEDGE OF FEMALE INTERNAL GENITALIA OF NEUROPTERA

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In continuing earlier research on female internal genitalia (FEIG) of Neuroptera, further examinations were carried out on some species of the families Coniopterygidae and Ascalaphidae. In the coniopterygid subgenus *Metaconiopteryx* KIS, 1968 the correct association of females with the corresponding males became possible as a result of the examination of FEIG of the type material of *Coniopteryx (Metaconiopteryx) arcuata* KIS, 1965. A comparison of male and female internal genitalia in this subgenus suggests that a lock and key mechanism was involves in the evolution of this group. As regards the family Ascalaphidae, four taxa, *Ascalaphus sinister* WALKER, 1853, *Bubopsis andromache firyuzae* SZIRÁKI, 2000 (Ascalaphinae), *Idricerus sogdianus* MCLACHLAN, 1875 and *Protidricerus elwesi* (MCLACHLAN, 1875) (Haplogleniinae) were investigated. In FEIG of these species no distinctive features were found for separation of the two ascalaphid subfamilies.

Key words: Ascalaphidae, Coniopterygidae, female internal genitalia, lock and key mechanism, male genitalia, *Metaconiopteryx*

INTRODUCTION

In course of the initial investigation of female internal genitalia (FEIG) of coniopterygid species occurring in Hungary (SZIRÁKI 1992*c*) the four *Coniopteryx (Metaconiopteryx)* KIS, 1968 species, among others, were studied and described. Recently I had the opportunity to examine the type material of *Coniopteryx (M.) arcuata*, and an alteration subsequently became necessary in two of the four species.

Female internal genitalia have been poorly investigated in ascalaphids as well as in most other groups of Neuroptera, although detailed studies of this organ system would be useful for more accurate determination of these insects. The aim of present research was to investigate the question, if there are any differences in the structure of FEIG of the two traditionally recognized subfamilies (Ascalaphinae and Haplogleniinae) of the family Ascalaphidae.

MATERIALS AND METHODS

All the investigated material is deposited in the collection of the Hungarian Natural History Museum. The method used for studying the ectodermal parts of FEIG was the same as it was detailed in earlier papers (*e.g*. SZIRÁKI 1992*a*). As regards the male genitalia, I follow the terminology used by MEINANDER (1972), while terminology of female internal genitalia is as in SZIRÁKI (1998, 2000).

RESULTS

CONIOPTERYGIDAE

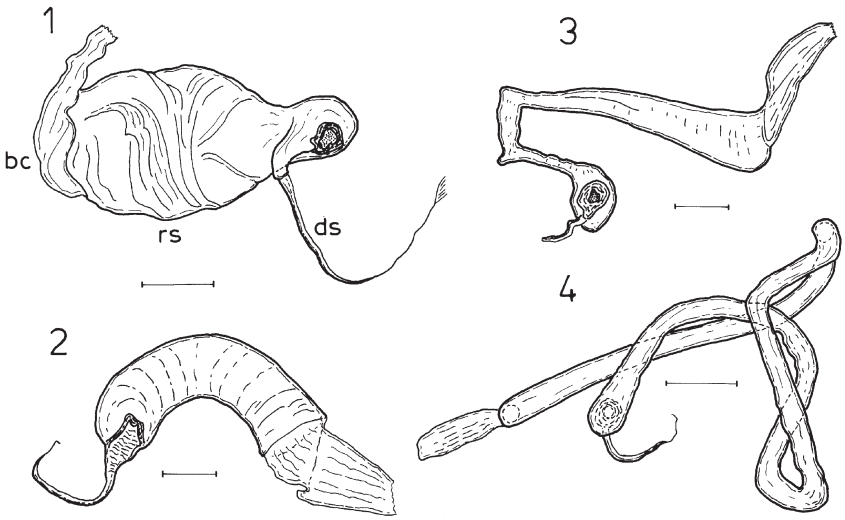
In our earlier work on the FEIG of the four *Metaconiopteryx* species, investigation of *Coniopteryx (Metaconiopteryx) esbenpeterseni* TJEDER, 1930 was the first step. In this case association of females with the corresponding males was done on the basis of a pair of insects having been collected in copula (SZIRÁKI 1992*a*: Figs 29–32, 1992*c*: Fig. 14), and for this reason it seemed to have a high probability.

After this, the females which had the most similar, but differing internal genitalia compared with "*C. (M.) esbenpeterseni*", were regarded as representatives of *C. (M.) arcuata* (SZIRÁKI 1992*a*: Figs 26–28, 1992*c*: Fig. 17.), as the male internal genitalia of the above mentioned two species are the most similar to each others within the subgenus *Metaconiopteryx* (Figs 5–6).

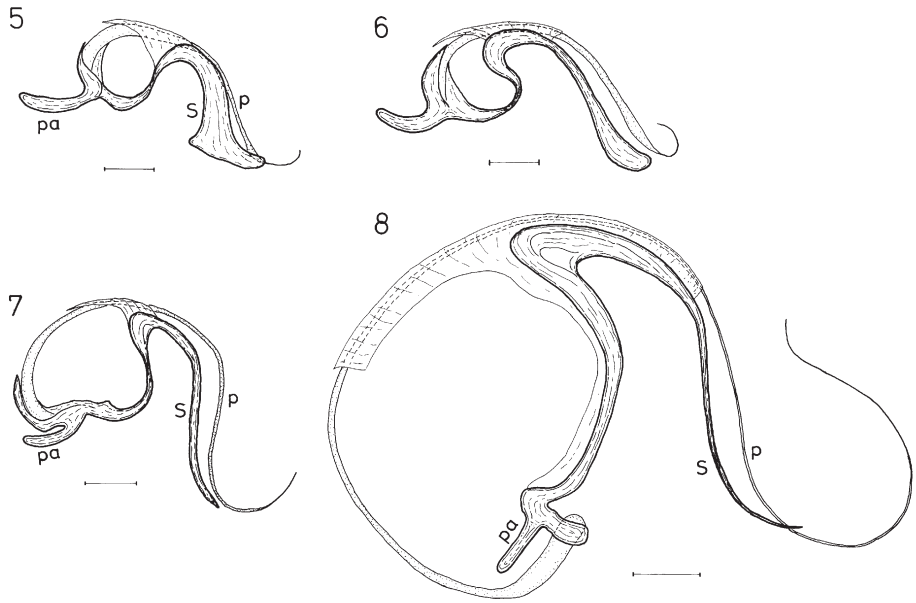
On the other hand, it is worthmentioning that these females were usually collected with either males of *C. (M.) esbenpeterseni* or with males of *C. (M.) arcuata* KIS, 1965), or together with both of them.

After the examination of the type material of *C. (M.) arcuata* it turned out that the FEIG regarded earlier as this organ of *C. (M.) esbenpeterseni* (SZIRÁKI 1992*c*: Fig. 14) really belong to *C. (M.) arcuata* (Fig. 1). Hence it follows that (1) FEIG thought earlier to be this organ of *C. (M.) arcuata* (SZIRÁKI 1992*c*: Fig. 16) actually belongs to its nearest related species, *C. (M.) esbenpeterseni* (Fig. 2), and (2) the earlier association of a female *C. (M.) arcuata* with a male of *C. (M.) esbenpeterseni* was the result of an interspecific copulation.

As regards the two other *Metaconiopteryx* species, populations of *Coniopteryx (M.) lentiae* H. ASPÖCK et U. ASPÖCK, 1964 or *Coniopteryx (M.) tjederi* KIMMINS, 1934 are distinguishable from populations of *C. (M.) arcuata* owing to some eidonomical features (SZIRÁKI 1992*b*), while *C. (M.) tjederi* is close to *C. (M.) lentiae*, but their coexistence is rare. The association of females with the corresponding males, and description of their FEIG was consequently correct in the case of the latter two species in 1992.



Figs 1–4. Bursa copulatrix and receptaculum seminis of *Coniopteryx (Metaconiopteryx)* species: 1 = *Coniopteryx (M.) arcuata*, 2 = *C. (M.) esbenpeterseni*, 3 = *C. (M.) lentiae*, 4 = *C. (M.) tjederi,* bc = bursa copulatrix, ds = ductus seminalis, rs = receptaculum seminis. Scale in Figs 1–3: 0.03 mm, in Fig. 4: 0.06 mm



Figs 5–8. Male genitalia of *Coniopteryx (Metaconiopteryx)* species: 5 = *C. (M.) arcuata*, 6 = *C. (M.) esbenpeterseni*, 7 = *C. (M.) lentiae*, 8 = *C. (M.) tjederi*, p = penis, pa = paramere, s = stylus. Scale in Figs 5–7: 0.03 mm, in Fig. 8: 0.06 mm. (after ASPÖCK *et al*. 1980)

As a result of the correction discussed above, a distinct correspondence in the structure of male and female internal genitalia of the same *Metaconiopteryx* species appeared. The relatively short and broad male internal genitalia of *C. (M.) arcuata* belong to a relatively short and wide bursa copulatrix + receptaculum seminis, and the narrower and longer the male internal genitalia, FEIG also the narrower and longer in the three other species (Figs 1–8). This pattern of the structure of internal genitalia of both sexes suggests that a lock and key mechanism was involved in the evolution of this coniopterygid group.

ASCALAPHIDAE
Ascalaphinae

Ascalaphus sinister WALKER, 1853
(Figs 9–10)

Material examined: Laos, Prov. Champarsak, Dong Hua Xao, 2 km S of Nong Luong, 1–5. 04. 1998, leg. G. CSORBA and O. MERKL – 1 female specimen.

Vagina short and wide. Bursa copulatrix and receptaculum seminis are only slightly separated. In dorsal view the bursa copulatrix somewhat elongated, with a widened caudal part. Its wall is wrinkled and moderately sclerotized.

The free part of ductus seminalis is rather wide, relatively short, entirely covered by glandular setae and originates from the posterior part of the receptaculum seminis, where its wall is strongly sclerotized because of a sphincter. It is probable, that the "original basal part" of ductus seminalis, which may be found in some other ascalaphids, in this case melt into the spermatheca entirely. The ectodermal part of the oviduct is distinctly sclerotized with internal setae.

The postbursal accessory gland has a round reservoir with a short and wide duct, and with a pair of extremely long, distally narrowing tubes.

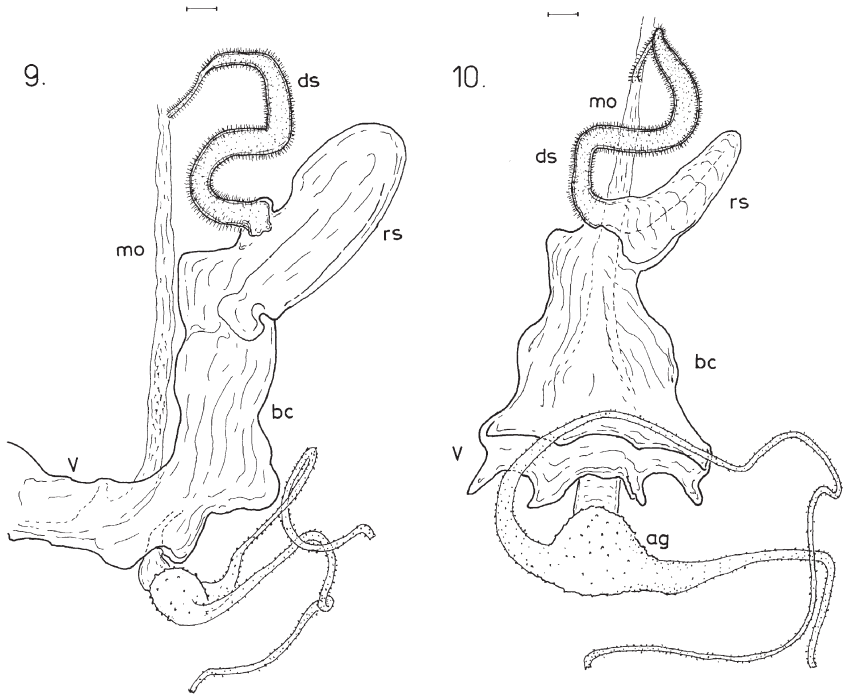
Bubopsis andromache firyuzae SZIRÁKI, 2000
(Fig. 11)

Material examined: Turkmenia, Kopet Dagh Mts, Firyuza, 400 - 600 m. a.s.l., 25.06.1992, leg. GY. FÁBIÁN, B. HERCZIG, A. PODLUSSÁNY, Z. VARGA – 1 female specimen (paratype).

Vagina relatively long, flat, but rather wide. The bursa copulatrix narrow in lateral view, with strongly sclerotized walls. Receptaculum seminis large and pyriform.

Ductus seminalis broader after the median loop than before, sharply turning before the end, moderately wide and long. Its free, looped part covered by glandular setae, while its basal part originates from a knob of the receptaculum seminis, runs backwards, and connected to the ventral surface of spermatheca, and partly of bursa copulatrix. Ectodermal part of the oviduct distinctly sclerotized.

Postbursal accessory gland has a reservoir with a short and wide duct and a pair of long tubes.



Figs 9–10. Female internal genitalia of *Ascalaphus sinister*: 9 = lateral view, 10 = dorsal view, ag = postbursal accessory gland, bc = bursa copulatrix, ds = ductus seminalis, mo = median oviduct, rs = receptaculum seminis, v = vagina

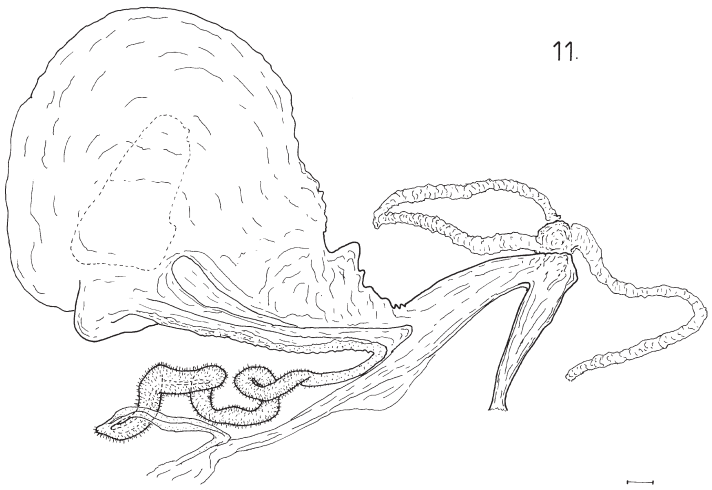


Fig. 11. Female internal genitalia of *Bubopsis andromache firyuzae*, lateral view. Scale: 0.08 mm. (after SZIRÁKI 2000)

Haplogleniinae

Protidricerus elwesi (MCLACHLAN, 1891) (Figs 12–13)

Material examined: Pakistan, Islamabad, 26–27. 06. 1992, leg. G. CSORBA and M. HREBLAY – 1 female specimen.

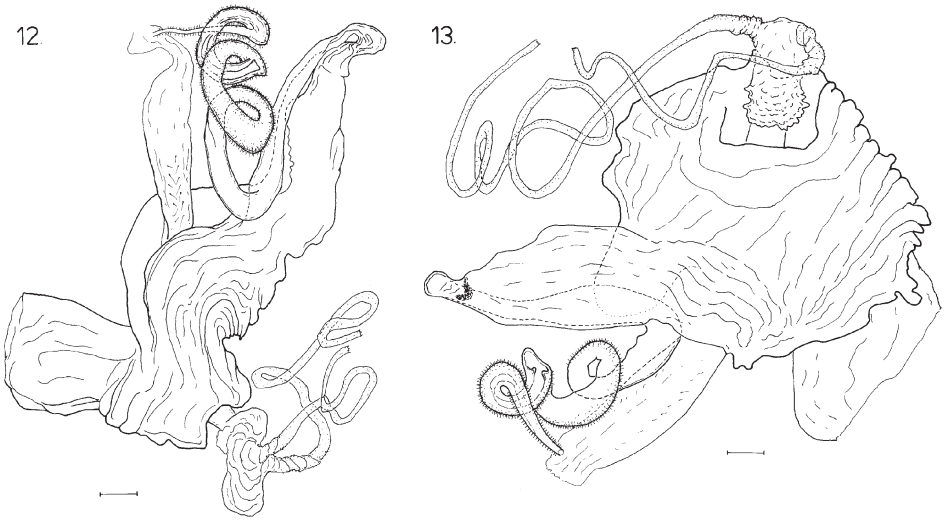
Vagina very broad. Bursa copulatrix strongly sclerotized and wrinkled, about as long as wide in dorsal view. Receptaculum seminis elongated, with thin walls.

Ductus seminalis rather long, and only partly covered by glandular setae only. Its basal part begins at a knob on the tip of the receptaculum seminis with a sphincter and runs backwards. The split sclerotization (SZIRÁKI 1998) of the terminal loop of this organ is very strong. The ectodermal part of the oviduct distinctly sclerotized, with moderately long internal setae.

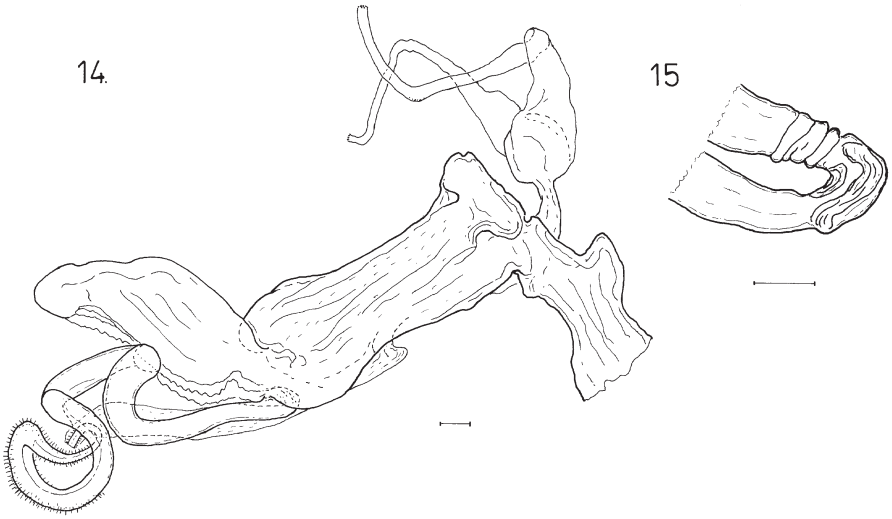
The reservoir of the postbursal accessory gland elongated with a wrinkled dorsal surface. Basal part of the two tubes very wide with some irregular annulations.

Idricerus sogdianus MCLACHLAN, 1875 (Figs 14–15)

Material examined: Kazachstan, valley of Issy, 21. 08. 1997, leg. A. Orosz – 1 female specimen; Kazachstan, Alma-Ata, 21. 07. 1958, leg. N. Scopin – 1 female specimen; Jammu and Kashmir under administration of Pakistan, Sost, 16. 06. 1992, leg. G. CSORBA and M. HREBLAY – 2 female specimens.



Figs 12–13. Female internal genitalia of *Protidricerus elwesi*: 12 = lateral view, 13 = dorsal view. Scale: 0.08 mm



Figs 14–15. Female internal genitalia of *Idricerus sogdianus*: 14 = the whole internal genitalia in lateral view, 15 = bend of ductus seminalis with sphincter, ventral view. Scale in Fig. 0.08 mm, in Fig 15: 0.04 mm

Vagina moderately broad and strongly sclerotized. Bursa copulatrix somewhat elongated. Its wall moderately sclerotized only, with internal setae. Receptaculum seminis weakly sclerotized and moderately large.

The basal part of ductus seminalis with very thin walls, attached to the spermatheca and runs backwards. Later this duct turns forwards. In this bend there is a sphincter, and from this point the sclerotization is strong. Glandular setae are situated on the terminal loop. Ectodermal part of the oviduct weakly sclerotized with internal setae.

Reservoir of the postbursal accessory gland globular, while its duct somewhat elongated and curved. The basal part of the two tubes is very broad and tapering gradually.

CONCLUSIONS

In the case of the coniopterygid subgenus *Metaconiopteryx* KIS, 1968 the correct association of females with the corresponding males was possible as a result of the examination of female internal genitalia of the type material of *Coniopteryx (Metaconiopteryx) arcuata* KIS, 1965. Moreover, a comparison of the male and female internal genitalia in this subgenus suggests that a lock and key mechanism was involved in the evolution of this group of Neuroptera.

According to the results of morphological studies on Ascalaphidae, FEIG of the examined species are rather similar to each others. However, two basic types may be recognized.

In the first case (Type I) the well sclerotized basal part of the ductus seminalis originated from a knob on the anterior part of receptaculum seminis, with or without distinctly sclerotized parts of a sphincter (surely with a pumping function). From here the duct runs backwards, and more or less is connected to receptaculum seminis. Near to the connection of spermatheca and bursa copulatrix it turns forwards and after some loops reaches the median oviduct (Figs 11–13).

In the second case (Type II) the basal section of ductus seminalis merged into the receptaculum seminis, or at least is connected tightly to this organ, and thin walls are present in this position. Near to the connection of the spermatheca and bursa copulatrix it becomes free, contains a sphincter, turns forwards with strongly chitinized walls, and after a few loops reaches the median oviduct (Figs 9–10, 14–15 and SZIRÁKI 1996: Fig. 26).

The main difference between the two types is that in FEIG "Type II" the structure supporting a pumping function situated in the bend of the ductus seminalis near to the connection of bursa copulatrix and spermatheca, while in "Type I" it is proximal to this part.

From a phylogenetical point of view, the FEIG "Type I" seems to be the plesiomorphic character state, as this is very similar to female internal genitalia of *Palpares libelluloides* (LINNAEUS, 1764) (SZIRÁKI 1996: Fig. 25) and of *Acanthaclisis occitanica* (VILLERS, 1789) (unpublished). The latter species is an ancient representative of the family Myrmeleontidae (KRIVOKHATSKY 1998), the nearest relative of Ascalaphidae.

On the other hand, the examined species with one of these two types of FEIG are not the same as those which belong to one or to other subfamily of Ascalaphidae. *Bubopsis andromache firyuzae* (Ascalaphinae) and *Protidricerus elwesi* (Haplogleniinae) have FEIG "Type I", while *Ascalaphus sinister* (Ascalaphinae), *Idricerus sogdianus* (Haplogleniinae) and *Libelloides sibiricus* (Ascalaphinae) (SZIRÁKI 1996) have "Type II". Consequently, FEIG of the hitherto investigated species do not offer further distinctive features for the separation of the subfamilies Ascalaphinae and Haplogleniinae, and the apomorphic character state in FEIG "Type II" developed independently in the two subfamilies – supposing that they really are monophyletic groups.

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REFERENCES

ASPÖCK, H., ASPÖCK, U. & HÖLZEL, H. (1980) *Die Neuropteren Europas. Eine zusammenfassende Darstellung der Systematik, Ökologie und Chorologie der Neuropteroidea (Megaloptera, Raphidioptera, Planipennia) Europas,* vol. 1–2. Goecke et Evers, Krefeld, 495 et 355 pp.

KRIVOKHATSKY, V. A. (1998) *Zoogeography of Palaearctic antlions (Neuroptera, Myrmeleontidae).* Zoological Institute R.A.S., St. Petersburg, 90 pp.

MEINANDER, M. (1972) A revision of the family Coniopterygidae (Planipennia). *Acta Zool. Fennica* **136**: 1–357.

SZIRÁKI, GY. (1992*a*) Female internal genitalia of the Coniopteryx species of Central Europe (Neuroptera, Coniopterygidae). *Acta zool. hung.* **38**: 359–371.

SZIRÁKI, GY. (1992*b*) A possibility for the identification of female coniopterygids (Neuroptera). Pp.110–114. *In* ZOMBORI, L. & L. PEREGOVITS (eds) *Proceedings of the 4th ECE/XIII. SIEEC, Gödöllő 1991*, vol.1. Hungarian Natural History Museum, Budapest.

SZIRÁKI, GY. (1992*c*) Coniopterygidae of Hungary with a key to the identification of Coniopteryx Curtis females (Insecta: Neuroptera: Coniopterygidae). Pp. 359–366. *In* CANARD, M., ASPÖCK, H. & MANSELL, M.W. (eds) *Current research in neuropterology. Proceedings of the Fourth International Symposium on Neuropterology, Bagneres-de-Luchon, France,1991.* Toulouse.

SZIRÁKI, GY. (1996) The internal genitalia of females of some coniopterygid genera, compared with other neuropteroid taxa (Insecta: Neuroptera: Coniopterygidae). Pp. 217–228. *In* CANARD, M., ASPÖCK, H. & MANSELL, M.W. (eds) *Pure and applied research in Neuropterology. Proceedings of the Fifth International Symposium on Neuropterology, Cairo, Egypt, 1994.* Toulouse.

SZIRÁKI, GY. (1998) Female internal genitalia of some Neuroptera of phylogenetic interest. *Acta Zool. Fennica* **209**: 243–247.

SZIRÁKI, GY. (2000) Data to the knowledge of the Asian Ascalaphidae (Neuroptera), with description of a new subspecies. *Folia ent. hung.* **61**: 87–93.

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