STUDIES ON BRUCHEISERINAE (NEUROPTERA: CONIOPTERYGIDAE), WITH DESCRIPTION OF THE SECOND GENUS OF THE SUBFAMILY

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The new long winged Brucheiserinae genus *Flintoconis,* with two species (*F. gozmanyi* sp. n. and *F. petorcana* sp. n.) is described, and additional descriptions of *Brucheiser penai* RIEK, 1975, as well as adult characteristics of the subfamily Brucheiserinae are given. Homologization of different parts of male of the terminalia and evaluation the similarity between the subfamilies Brucheiserinae (Neuroptera: Coniopterygidae) and Corydalinae (Megaloptera: Corydalidae) confirm the hypothesis that the family Coniopterygidae is one of the earliest taxonomic groups to diverge within the insect order Neuroptera.

Key words: Brucheiserinae, new genus, new species, homologization, Neuroptera, Megaloptera

INTRODUCTION

In the twenties of the last century NAVÁS (1927) described a rather unusual insect, *Brucheiser argentinus* NAVÁS, as a new genus and new species on the basis of a single male specimen collected in Argentina. He placed this insect in the new family Brucheiseridae, and, because of the shape of the tarsi and wings, in the order Megaloptera. In the original description of the new genus the presence of lateral lobes on the fourth tarsal segment were mentioned and figured which is a distinctive character of the family Sialidae (Megaloptera).

RIEK (1975) described the second *Brucheiser* species (*B. penai* RIEK) from Chile on the basis of a single female specimen. After evaluating 18 characters he concluded that Brucheiseridae is not a megalopterous family, but belonged in the Neuroptera. RIEK in his paper also figured the male terminalia of *B. argentinus*, however, these figures were not detailed enough. Moreover, written information about these structures was absent almost entirely from his work.

NEW (1989) downgraded the taxonomic rank of this group to subfamily level, placed it within the family Coniopterygidae, and MEINANDER (1990) accepted his opinion. NEW did not give a detailed explanation of this action, but in his key for the Neuroptera families the low number of the basal costal crossveins was the common feature of *Brucheiser* and the (other) coniopterygids.

SZIRÁKI (1996a) examined a female specimen of *B. argentinus*, and confirmed that *Brucheiser* is a coniopterygid genus; typical plicatures were found on the abdomen, which structures earlier were known only in the subfamily Aleuropteryginae (Neuroptera: Coniopterygidae). Besides, the structure of the sclerotized parts of the female internal genitalia also agrees with that of Aleuropteryginae.

SZIRÁKI and FLINT (2007) investigated larvae of a *Brucheiser* species (*B. penai*), and confirmed finally the systematic position of the subfamily Brucheiserinae within the family Coniopterygidae.

Owing to the courtesy of Dr. OLIVER FLINT, I have had the possibility of examining the Brucheiserinae material of the Smithsonian Institution, Washington, which contains males and females of *B. penai*, and several specimens of a hitherto undescribed genus with two species. Apart from the description of new taxa, this unique material offers the possibility for a new characterisation of the Brucheiserinae, for the first detailed description of the male terminalia in this subfamily, and for a comparison of these organs with the corresponding structures of Corydalinae (Megaloptera: Corydalidae).

MATERIAL AND METHODS

The examined material borrowed from the National Museum of Natural History, Smithsonian Institution, Washington, DC consisted of three male and three female specimens of *Brucheiser penai* preserved in alcohol, as well as fifteen, hitherto unknown, long winged (pinned and preserved in alcohol) Brucheiserinae specimens from Chile. Detailed investigation of male terminalia and female internal genitalia was carried out in situ, after boiling the abdomen in 10% KOH for five minutes.

ADULT CHARACTERISTICS
OF THE SUBFAMILY BRUCHEISERINAE

Length of the body between about 3–7 mm. Head relatively small, with well sclerotized frons, and with midfrontal-coronal apodeme. Antennae multisegmented, and about as long as the body. Pronotum large, and in usual position covering the head (Fig. 13 and RIEK 1975: figs 1, 5, 8). Wings of different length and shape, with two costal cross veins. Legs long and slender. The fourth tarsomere with two lateral lobes. The first two abdominal segments are very short. Spiracles present on the segments 1–8. Plicatures (Figs 1–2, 9, 22) are in two lateral rows and in a median row on the abdominal segments 3–6 and 2–6 respectively in females, on 3–7 (lateral) and 2–7 (median) in males.

In male terminalia the ectoproct well sclerotized with a dorsal and a pair of caudal projections, and with well developed, ventrally situated, clasper-like anterior and posterior appendages.

In female terminalia the eighth and ninth sternites fused. The bursa copulatrix with two ventro-lateral lobes. Its dorsal and lateral surface covered by slashed projections. Receptaculum seminis bladder, or sack like. Ductus seminalis long. The rather wide proximal part is attached to the bursa copulatrix between its lobes. Distal part of ductus seminalis long, thin, looped and coiled, and the loops are strenghtened by membraneous sheets. A separated postbursal accessory gland absent.

TAXONOMIC PART

Brucheiser penai RIEK, 1975

Examined material: Chile, Prov. Elqui, Cuesta de Pajonales, Atacama Desert, 1400 m a.s.l., 30 September 1980: 3 males and 3 females, leg.: L. E. PEÑA G.

Complementary to the description of the species: Length of the body 3.6–4.0 mm in males, 4.2–6.6 mm in females. Fore wing 3.6 mm in males, 4.5–4.8 mm in females. Hind wing 3.4–3.9 mm in males, 4.0–4–5 mm in females. Length of the antennae seems to be similar in both genders: 3.9–4.3 mm. Well-developed midfrontal-coronal suture present. Number of antennal segments 50–54 in males, 55–56 in females. Scape 1.3 times, pedicel about 2 times, median flagellar segments 3.3 times
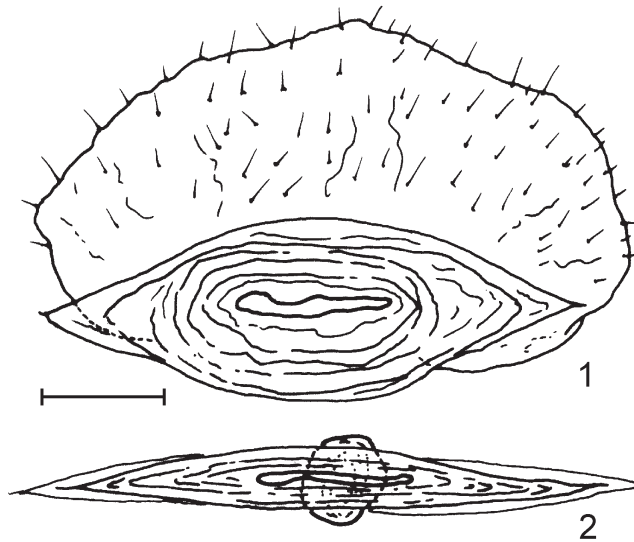

Figs 1–2. First median plicature of *Brucheiser penai*: 1 = female, 2 = male. Scale: 0.04 mm
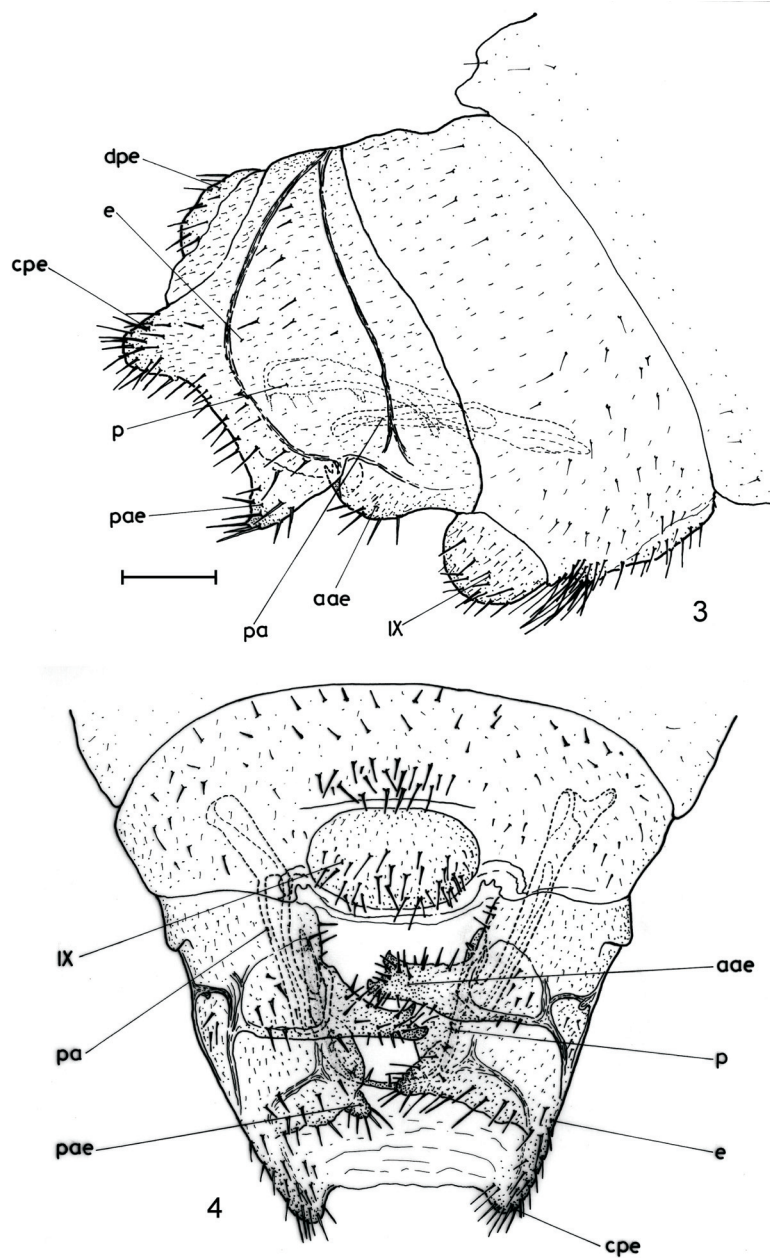
Figs 3–4. Male of *Brucheiser penai*: 3 = male terminalia, lateral view, 4 = male terminalia, ventral view. Scale: 0.15 mm; IX = 9th sternite, aae = anterior appendage of ectoproct, cpe = caudal projection of ectoproct (callus cerci), dpe = dorsal projection of ectoproct, e = ectoproct, p = penis, pa = paramere, pae = posterior appendage of ectoproct
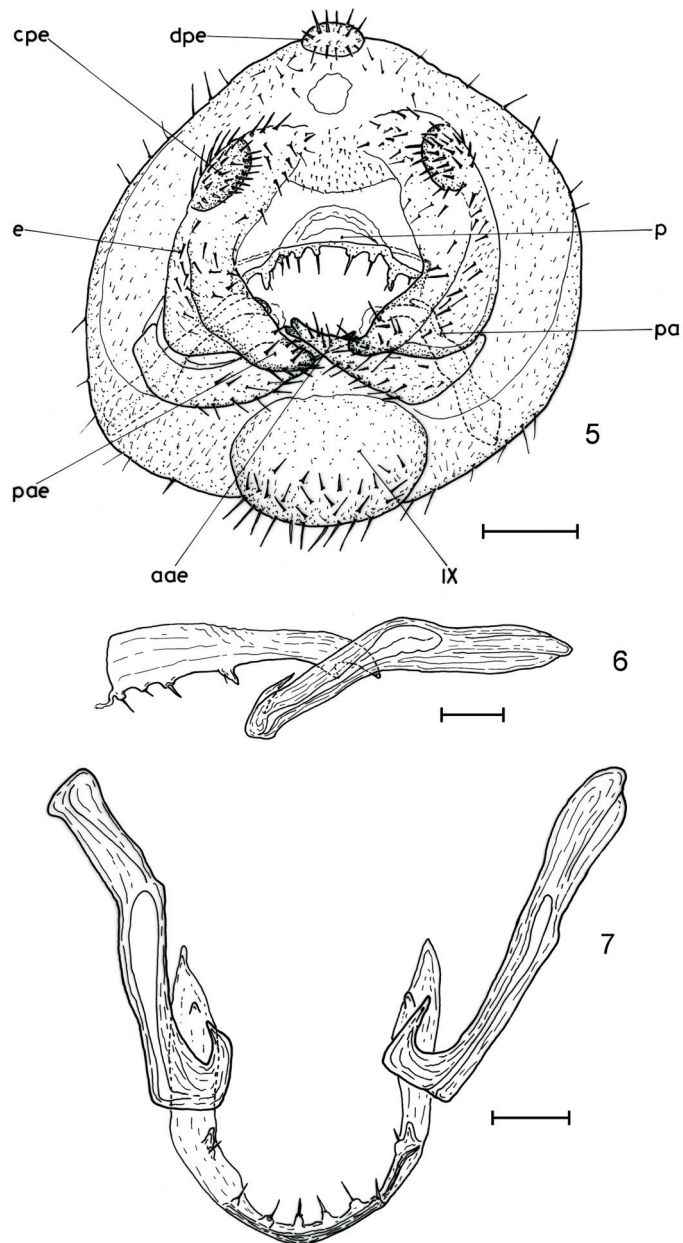
Figs 5–7. Male of *Brucheiser penai*: 5 = male terminalia, caudal view, 6 = paramere and penis, lateral view, 7 = paramere and penis, ventral view. Scale: 0.15 mm; IX = 9th sternite, aae = anterior appendage of ectoproct, cpe = caudal projection of ectoproct (callus cerci), dpe = dorsal projection of ectoproct, e = ectoproct, p = penis, pa = paramere, pae = posterior appendage of ectoproct
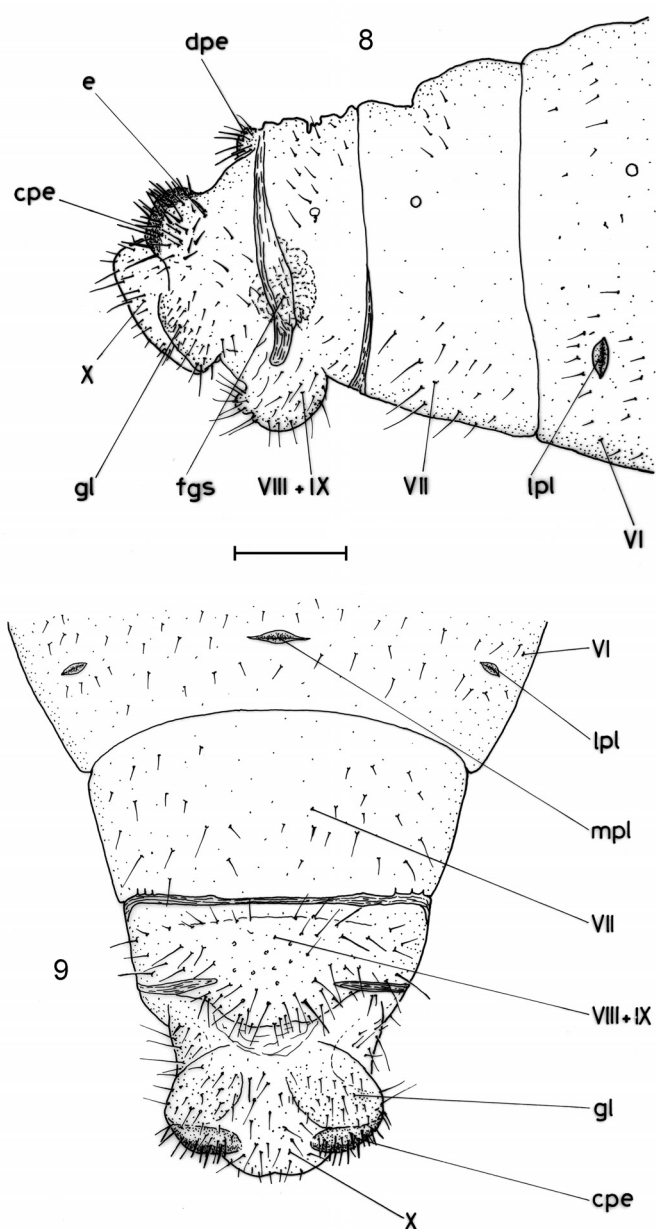
Figs 8–9. Female of *Brucheiser penai*, female terminalia: 8 = lateral view, 9 = ventral view. Scale: 0.3 mm. VI = 6th sternite, VII = 7th sternite, VIII+IX = the fused 8th and 9th sternites, X = 10th sternite, cpe = caudal projection of ectoproct (callus cerci), dpe = dorsal projection of ectoproct, e = ectoproct, fgs = folded glandular structure, gl = gonapophysis lateralis, lpl = lateral plicature, mpl = median plicature

as long as broad. The base of scape about 3 times as broad as pedicel, while pedicel somewhat wider than flagellar segments.

The first two abdominal segments are very short. Spiracles present on the segments 1–8. Plicatures (Figs 1–2, 9) are in two lateral rows and in a median row on the abdominal segments 3–6 and 2–6 respectively in females, while on 3–7 (lateral) and 2–7 (median) in males. Below the opening of the first median plicature (Figs 1–2) seems to be a glandular structure, which is larger in females than in males.

Male terminalia (Figs 3–7): The eighth segment is sclerotized somewhat more than the previous ones, and has a small ventral knob, covered by rather strong hairs. Ninth sternite rounded, swollen and very short. Ectoproct well sclerotized, with two dorsally converging, ventrally branching apodemes, with strong caudal, and small dorsal projections, and with two pairs of clasper-like, ventrally situated appendages. The anterior ventral appendage slightly forked, while the posterior one is rather blunt. Paramere moderately long, and curved inwards and forwards caudally. Penis consists of a well sclerotized, horseshoe-shaped ventral part and a slightly sclerotized dorsal arch. Ventral part of penis armed ventrally with teeth and hairs.

Female terminalia (Figs 8–9): The eighth and ninth sternites are fused, supported by an apodeme anteriorly, and has a rounded projection caudally. Ectoproct has rounded caudal and a small dorsal projections, and bordered anteriorly by a strong apodeme. Large part of the caudal projection of ectoproct strongly sclerotized. Gonapophysis lateralis weakly sclerotized, and elongated in dorso-ventral direction. There is a folded glandular structure laterally at the anterior apodeme of the ectoproct.

Female internal genitalia (Fig. 10): Bursa copulatrix rather large, and moderately sclerotized. Its dorsal and lateral surface covered by slashed projections, perhaps with glandular function. Receptaculum seminis weakly sclerotized, bladder like, with an unidentified darker structure inside. Duct of receptaculum semininis short. Ductus seminalis long. Its proximal end connected to the duct of receptaculum seminis, otherwise, its rather wide proximal part is attached to the bursa copulatrix between its vento-lateral lobes. Distal part of ductus seminalis extremely long, thin and looped many times. Median oviduct wide, and relatively well sclerotized. A separate postbursal accessory gland absent.
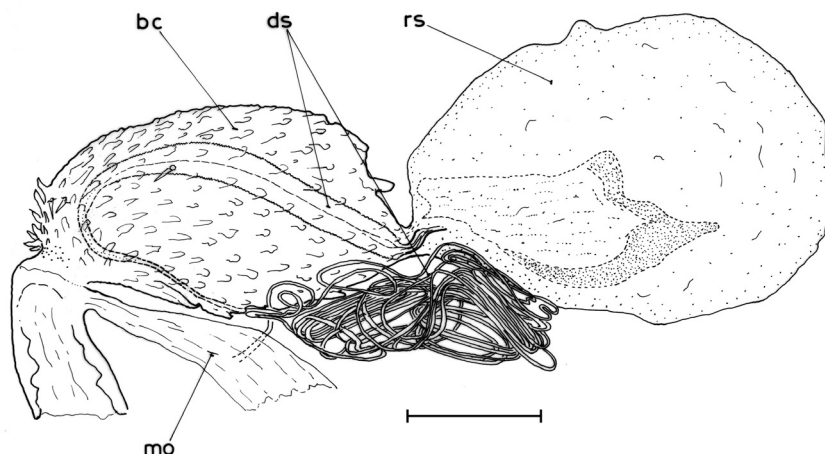

Fig. 10. *Brucheiser penai*, female internal genitalia, lateral view. Scale: 0.15 mm; bc = bursa copulatrix, ds = ductus seminalis, mo = median oviduct, rs = receptaculum seminis

Remarks: The most remarkable distinctive feature of *Brucheiser penai* may be found in the male terminalia, in which the ninth sternite is short and widely rounded, while it is elongate and – in caudal view – consists of a wider anterior and a narrower posterior part in *B. argentinus* (RIEK 1975: figs 15–16).

Flintoconis gen. n.

Type species by present designation: *Flintoconis gozmanyi* sp. n.

Relatively large bodied and long winged (Fig. 11) coniopterygids. Head rather small, and bent backwards tightly to the prothorax in usual position. (In this case it is hidden below the pronotum.) Postclypeus, upper part of labrum and the antennal sockets weakly chitinized, other parts of the head capsule well sclerotized, with a well developed, straight midfrontal-coronal apodeme (Fig. 12). Structure of labial and maxillary palpi as it is usual in Coniopterygidae. Frons and vertex are not separated from each other. Antennae are more than fifty segmented, and about as long as the body. Pronotum large, wide, with well sclerotized edges, and with a median and two transverse apodemes (Fig. 13). The anterior and posterior edges of pronotum are tucked up.

Wings are very long and rather narrow; the fore wings are about (or almost) two times as long as the body. The wing colour is grayish-brown with light stripes and spots (Figs 14–15). There are two costal cross veins. Longitudinal vein Rs forked, M unforked in both wings. In hind wing Rs branching from the R very near to the base. Two Rs-M cross veins in both wings. Cua, Cup and Aa veins are very long ones, and the two last longitudinal veins may be regarded as Ja and Jp with high probability (Fig. 16). It is worth mentioning that the number of the cross veins are somewhat larger than in other coniopterygids.

Legs are long and slender. Fourth tarsal segment with lateral lobes, as it is typical in the subfamily Brucheiserinae. First tarsal segment almost as long as the others together. The structure and situation of the plicatures are also the same as in the genus *Brucheiser* detailed above, i.e., those are in two lateral rows and in a median row on the abdominal segments 3–6 and 2–6 respectively in females, and on 3–7 (lateral) and 2–7 (median) in males, with a glandular structure in the first median plicature.

In male terminalia (Figs17–19, 26–29) both anterior and posterior appendages of the ectoproct are well separated, and the tenth gonocoxal complex, with or without a ventro-caudal projection is situated above the caudal end of the slender parameres. Anterior appendage forked. Appendages and caudal projection of ectoproct wel sclerotized. (For homologization of the different part of the male terminalia, see later.)

In female terminalia (Figs 20–23) the fused eighth and ninth sternites form a large, strong sclerite. At the base of this sclerite there is a folded glandular structure laterally. Caudal projection of ectoproct well sclerotized. The two gonapophyses laterales fused into a transverse ridge.

In the female internal genitalia (Figs 24–25) the bursa copulatrix large, with two ventro-lateral lobes. Its dorsal and lateral surface covered by slashed projections. Receptaculum seminis weakly sclerotized, sack like. Duct of receptaculum semininis short. Ductus seminalis long, its proximal end connected to the duct of receptaculum seminis, otherwise, its rather wide proximal part is attached to the bursa copulatrix between its lobes. Distal part of ductus seminalis extremely long, thin, looped and coiled. A separate postbursal accessory gland absent.

Remarks: Apart from the striking difference between the wings, the new genus is very close to *Brucheiser*, the other known genus of the subfamily. The main distinctive features of *Flintoconis* gen. n. are:
– elongated wings, with very long Cua, Cup and Aa, and with existing J veins;
– presence of the tenth gonocoxal complex instead of penis with U, or horse-shoe-shaped sclerotization;
– fused gonapophyses laterales in female terminalia.

Etymology – I dedicate this new genus to Dr. OLIVER FLINT, the excellent American entomologist, who recognized that these unusual insects collected partly by him are coniopterygids.
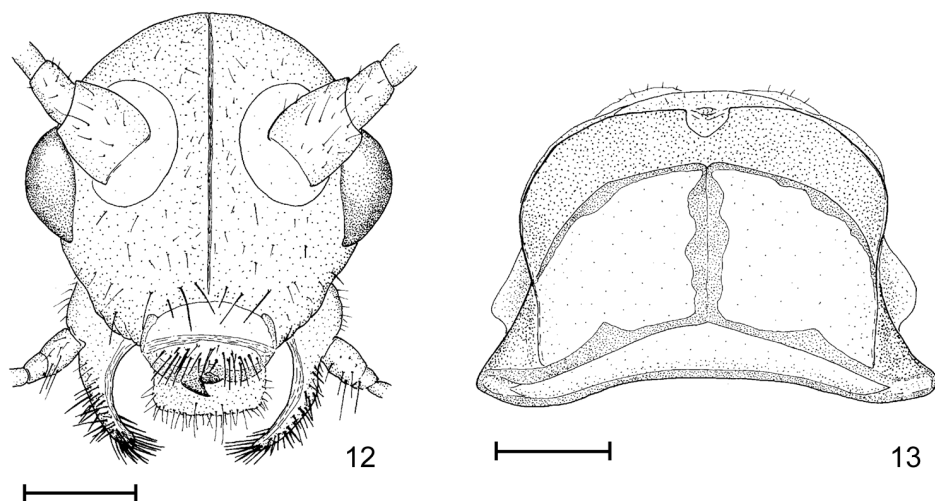
Figs 11–13. *Flictoconis* spp.: 11 = *F. gozmanyi* sp. n., female paratype, habitus, 12 = *Flintoconis* sp., female specimen from Aconcagua (Chile), head, 13 = *Flintoconis gozmanyi* sp. n., female paratype, prothorax, dorsal view. Scale in Fig. 12: 0.3 mm, in Fig. 13: 0.25 mm.
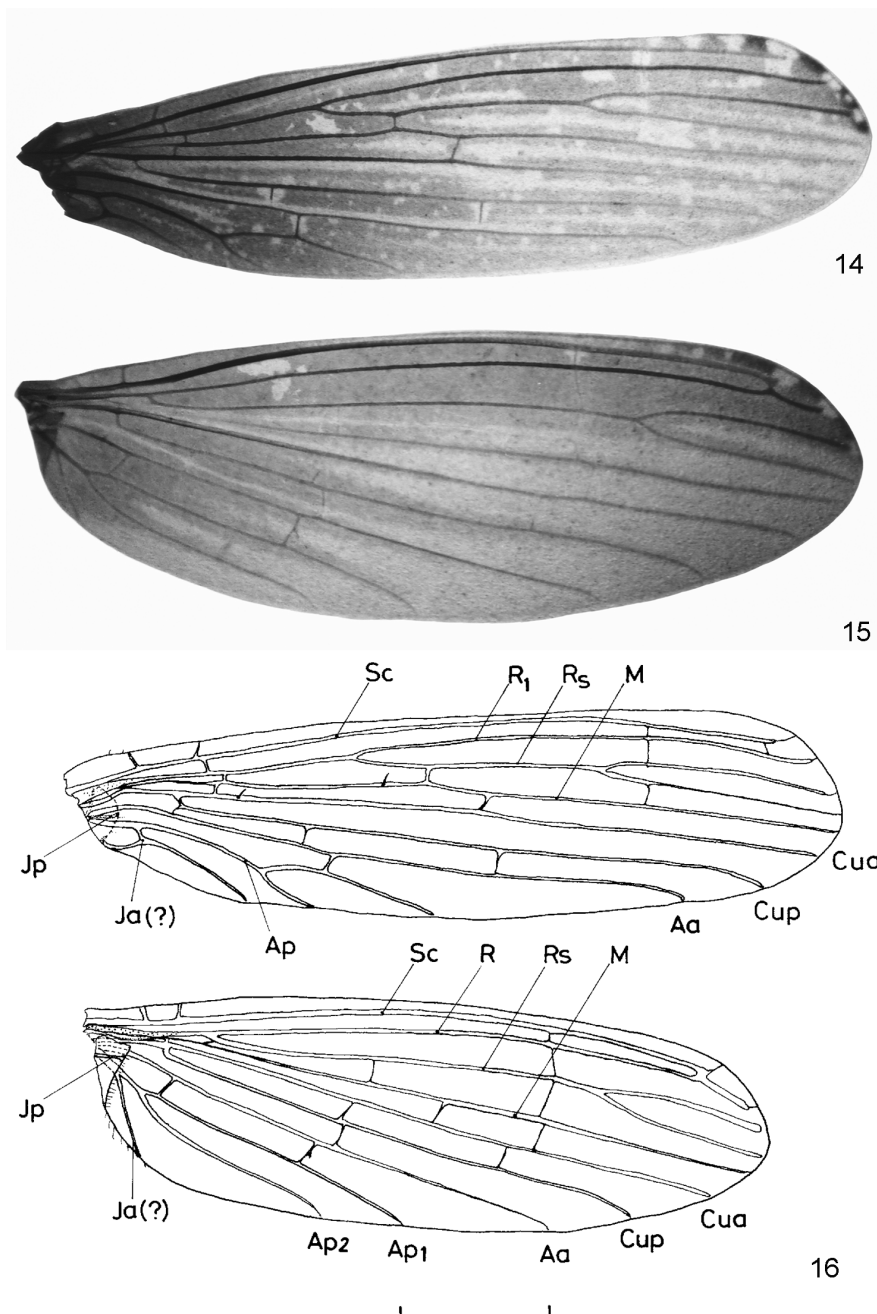
Figs 14–16. *Flintoconis gozmanyi* sp. n., holotype: 14 = fore wing, 15 = hind wing, 16 = wing venation. Scale: 2.1 mm

Flintoconis gozmanyi sp. n.
(Figs 11–25)

Holotype: male, "Chile: (Prov.) Elqui, Los Pajaritos, E Tres Cruces (= Chingoles), 19–20 Oct 1992, L. E. Pena G." – deposited in the Smithsonian Institution, Washington D. C. Paratypes: 1 male and 3 females, same data as holotype; 2 males and 2 females, Chile, Atacama (now Prov. Copiapo), 35 km S of Copiapo, 15–16 October 1992, at light, leg.: L. E. PEÑA G.; 1 male, Chile, Coquimbo (now Prov. Elqui), 15 km E of Choros Bajos at Rio Los Choros, 300 m. a.s.l., 10–11 November 1981, leg.: D. and M. DAVIS – deposited in the Smithsonian Institution, Washington D. C. and in the Hungarian Natural History Museum.

Description: Length of the body 4.1–5.5 mm. The shape, structure and position of the head (Fig. 11) as is detailed in the description of the genus. Head capsule dark brown, eyes moderately large, black.

Apart from their light brown basal part, palpi are pale ochreous. Antennae dark brown, 4.2–5.2 mm, 55–63 segmented in females, 5.1–7.0 mm, 63–67 segmented in males. Scape in lateral view about 1.5 times as long as broad, and 1.5 times as broad as the median flagellar segments. Pedicel almost two times as long as broad, flagellar segments 1.5–2 times as long as broad. The ordinary hairs bent forwards and situated irregularly. The short, stright setae are situated on the apical part of the flagellar segments.

Thorax pale ochreous, with dark brown apodemes and shoulder spots. Shape and structure of pronotum (Fig. 13) as detailed in the description of the genus. Coxa, trochanter, the first tibia and the basal part of the second and third tibiae dark brown, other parts of the legs more or less lighter. Length of fore wing 8.5–9.2 mm, of hind wing 8.0–8.7 mm. The hind wing distinctly wider than the fore wing. Ground colour of the wings dark greyish-brown, with light stripes and spots. Light spots are on both wings before the distal part of Sc, at the end of Sc, R1, R2, and around some cross veins (Figs 14–15). In addition to these, in fore wing there are small light spots almost everyvhere, and narrow light strips between and along longitudinal veins R1-Aa, while in hind wing there are distally widening stripes between the longitudinal veins R1-Ja. Longitudinal veins and the stronger cross veins are brown. Structure of the venation as Fig. 16, and as given in description of the genus. There are only a few short fringes on both wings. Outstanding setae of M are absent, but there is a somewhat stronger bristle at about the basal third of M, and at the very basal part of Cua.

Abdominal segments are moderately sclerotized, with plicatures as in the description of the genus.

Male terminalia as in Figs 17–19. On the caudal edge of the eighth sternite a small hairy knob is situated, with two larger setae. Ninth sternite is a strongly sclerotized, in lateral view curved, in ventral and in caudal view blunt, V-shaped plate. The ectoproct well sclerotized, and has a strong apodeme ending in a short transverse section near to the base of the anterior appendage. Dorsal projection of ectoproct is a moderately large knob, with long setae. Caudal projection of ectoproct in lateral view prominent. Anterior appendage of ectoproct long, with pointed arms. At the base of this organ there is the rather small ninth gonapophysis. Posterior appendage of ectoproct with an acute tip, and with a slightly Y-shaped basal apodeme. Paramere moderately long and slender, with a stem straight in ventral view, and with a caudal part curved inwards and forwards. The tenth gonocoxal complex is represented by a sclerotized sheet of irregular H-shape, ending ventrally in a pair of slightly bent horns.

Female terminalia as in Figs 20–23. The fused eighth + ninth sternite strongly sclerotized. Its dorsal edge – probable depending on the function – may be in twisted (Figs 20, 23), or in expanded
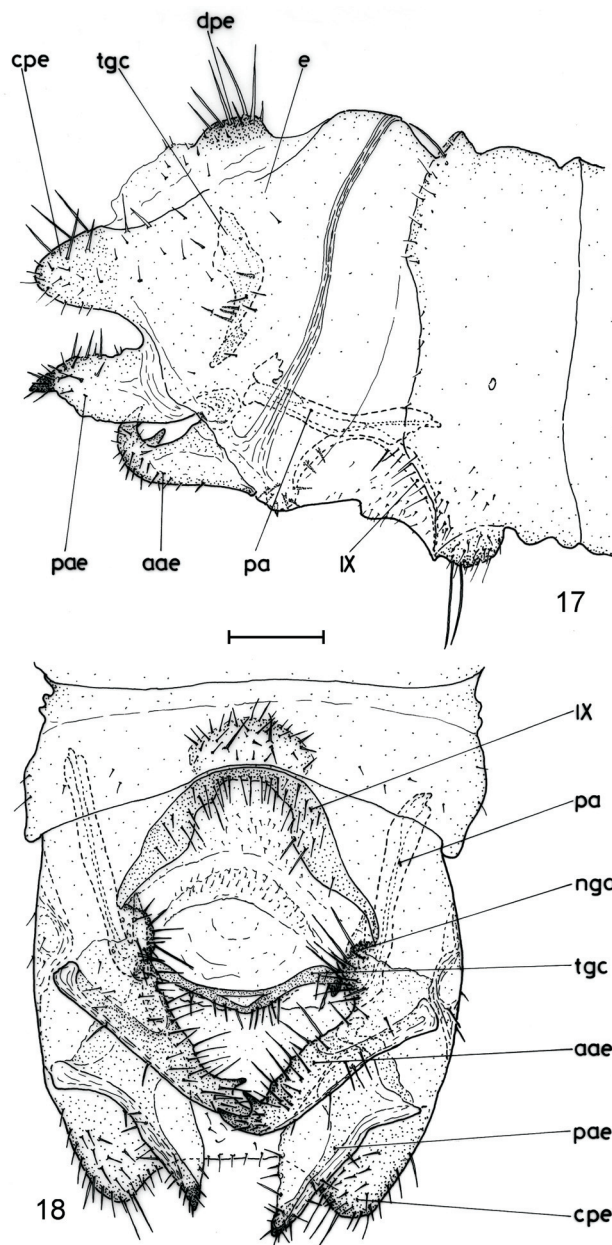
Figs 17–18. Male terminalia of *Flintoconis gozmanyi* sp. n.: 17 = lateral view, 18 = ventral view. IX = 9th sternite, aae = anterior appendage of ectoproct, cpe = caudal projection of ectoproct, dpe = dorsal projection of ectoproct, e = ectoproct, nga = ninth gonapophysis, pa = paramere, pae = posterior appendage of ectoproct, tgc = tenth gonocoxal complex. Scale: 0.15 mm

(Fig. 21) position. The ridge formed by the fused gonapophyses laterales is thick and broad. The ectoproct moderately sclerotized. Its dorsal projection rather broad, while the caudal projection small, but well sclerotized.

Female internal genitalia as in Figs 24–25. Vagina large, laterally expanded, well sclerotized. Bursa copulatrix and ductus seminalis strongly, receptaculum seminis and median oviduct moderately sclerotized. Median oviduct broad, receptaculum seminis forms a horizontally curved sac. Otherwise, as it is detailed in the description of the genus.

Etymology – I dedicate this new species to the memory of Dr. LÁSZLÓ GOZMÁNY. He was an outstanding lepidopterologist, a wise man, and colleague always ready to help.

Flintoconis petorcana sp. n.
(Figs 26–29)

Holotype: male, "Chile: (Prov.) Petorca, Finca Talanquén, S La Lígua, Oct 1984 (?), L. E. Pena G." – deposited in the Smithsonian Institution, Washington D. C.
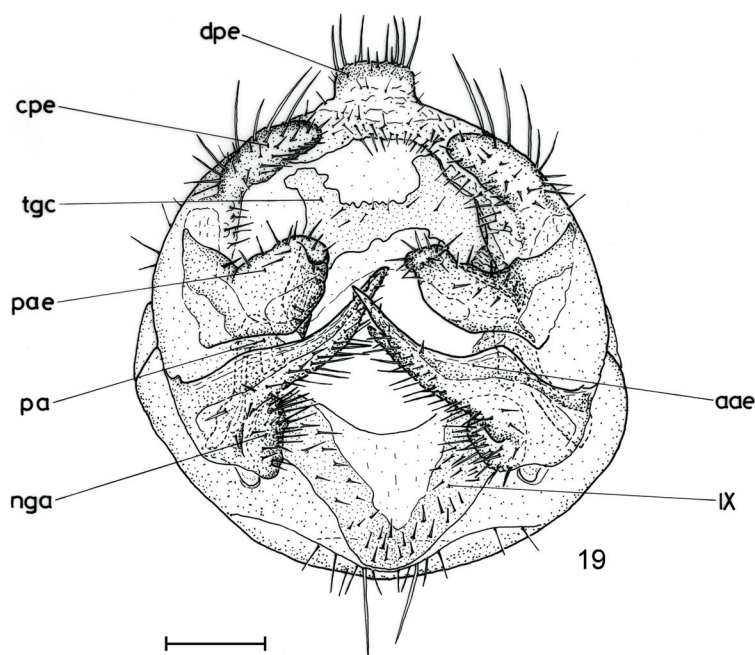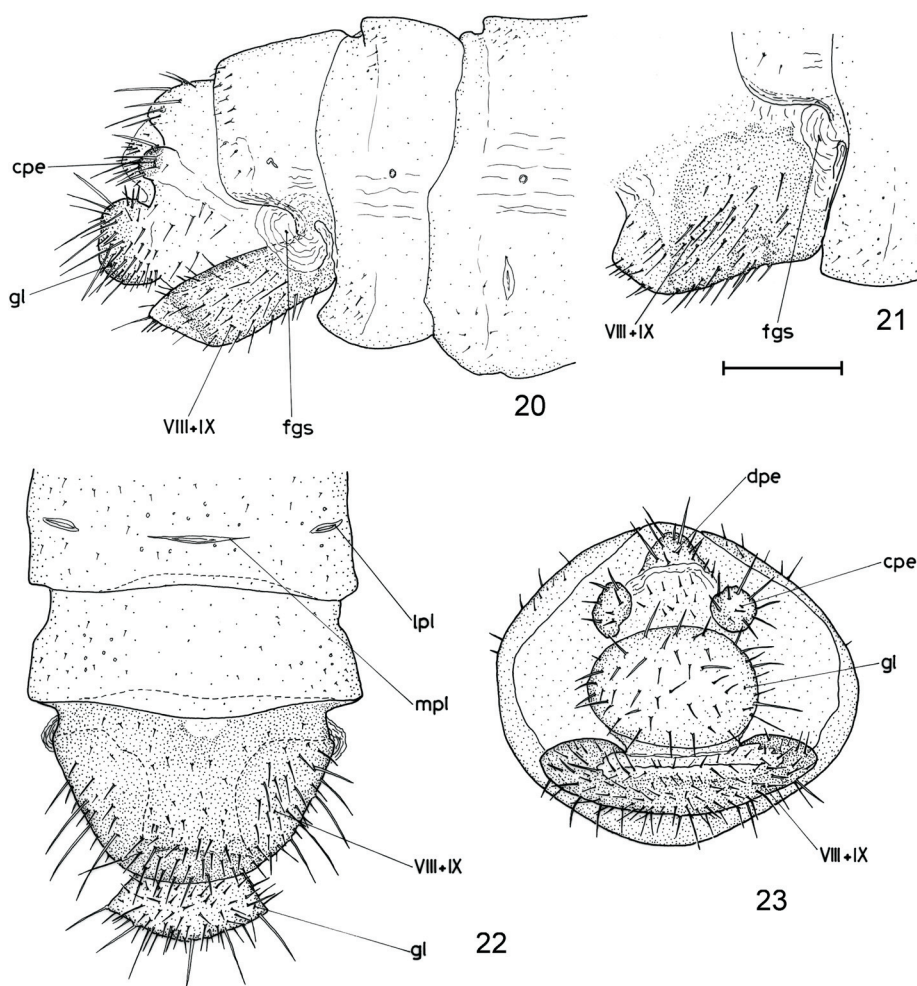

Fig. 19. Male terminalia of *Flintoconis gozmanyi* sp. n.: IX = 9th sternite, aae = anterior appendage of ectoproct, cpe = caudal projection of ectoproct, dpe = dorsal projection of ectoproct, nga = ninth gonapophysis, pa = paramere, pae = posterior appendage of ectoproct, tgc = tenth gonocoxal complex. Scale: 0.15 mm

Description: Length of the body 6.4 mm. The shape, structure and position of the head as it is detailed in the description of the genus. Eyes moderately large, black. Head capsule, palpi, antennae, abdomen and large part of the thorax brown. Pronotum – apart from the dark apodemes – light brown. Shoulder spots dark brown.

Tip of the antennae broken; remaining parts 65 (right) and 70 (left) segmented. Scape in lateral view about 1.5 times as long as broad, and 1.5 times as broad as the median flagellar segments.

Figs 20–23. Female terminalia and internal genitalia of *Flintoconis gozmanyi* sp. n.: 20 = female terminalia of a specimen with twirled edges of the fused 8th and 9th sternites, lateral view, 21 = fused 8th and 9th sternites of an other female specimen in expanded position, 22 = female terminalia, ventral view, 23 = female terminalia, caudal view. VIII+IX = the fused 8th and 9th sternites, cpe = caudal projection of ectoproct, dpe = dorsal projection of ectoproct, fgs = folded glandular structure, gl = gonapophysis lateralis, lpl = lateral plicature, mpl = median plicature. Scale: 0.3 mm

Pedicel almost two times as long as broad, flagellar segments 1.5 times as long as broad. The ordinary hairs bent forwards and situated irregularly. Short, straight setae are on the apical part of the flagellar segments.

Shape and structure of pronotum as detailed in the description of the genus. Legs dark brown. Length of fore wing 9.2 mm, of hind wing 8.6 mm. Hind wing distinctly wider than fore wing. The wing colour and pattern are similar to those of *F. gozmanyi*; ground colour is dark greyish-brown, however, the fore wing with broad pale stripes and many spots of different size and irregular shape, thus larger part of the wing surface pale. Longitudinal veins and the stronger cross veins are brown. On both wings there are only a few short fringes. Outstanding setae of M are absent, but there is a somewhat stronger bristle at about the basal third of M and at the very basal part of Cua. The structure of the venation is similar to that of *F. gozmanyi*, but in fore wing of *F. petorcana* there is a Cua-Cup
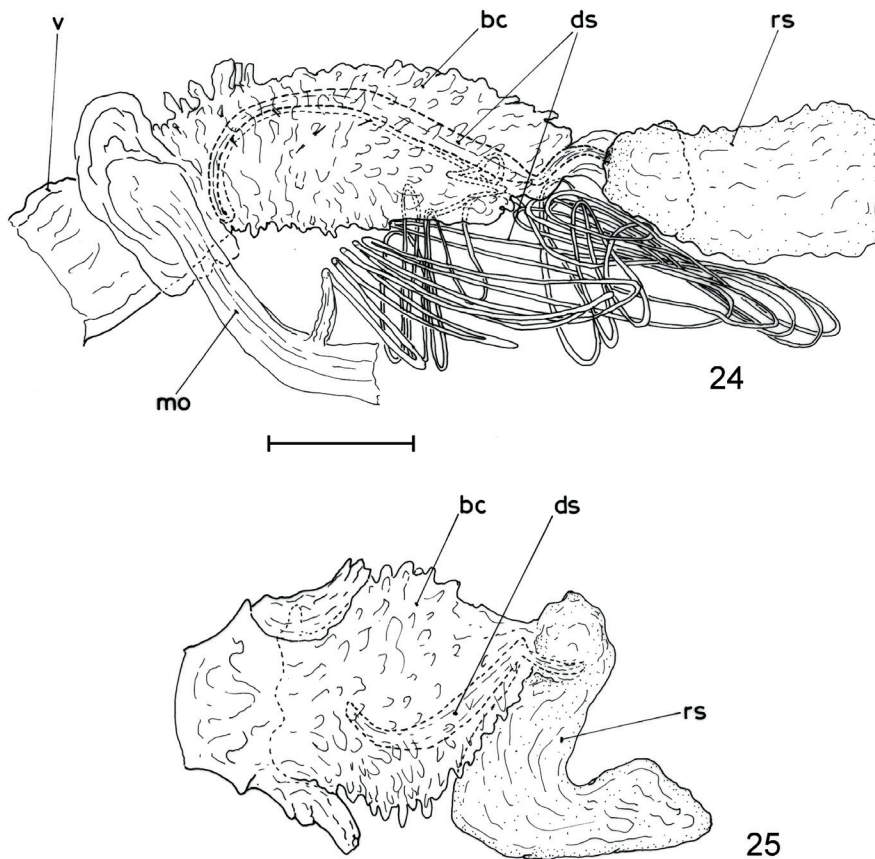
Figs 24–25. Female terminalia and internal genitalia of *Flintoconis gozmanyi* sp. n.: 24 = female internal genitalia, lateral view, 25 = female internal genitalia (without the coiled part of ductus seminalis), dorsal view. bc = bursa copulatrix, ds = ductus seminalis, mo = median oviduct, rs = receptaculum seminis, v = vagina. Scale: 0.15 mm

crossvein near to the middle of the wing, and there are distal M-Cua and Cua-Cup crossveins too. Longitudinal vein Aa forked near to the distal Cup-Aa crossvein. In the hind wing the fork of Rs is before the distal crossvein series, which contains a member between the branches of Rs. There is also a basal Cup-Aa crossvein. Because only the holotype only is available of *F. petorcana*, there is impossible to judge the taxonomic value of the above mentioned eidonomical differences between the two *Flintoconis* species.
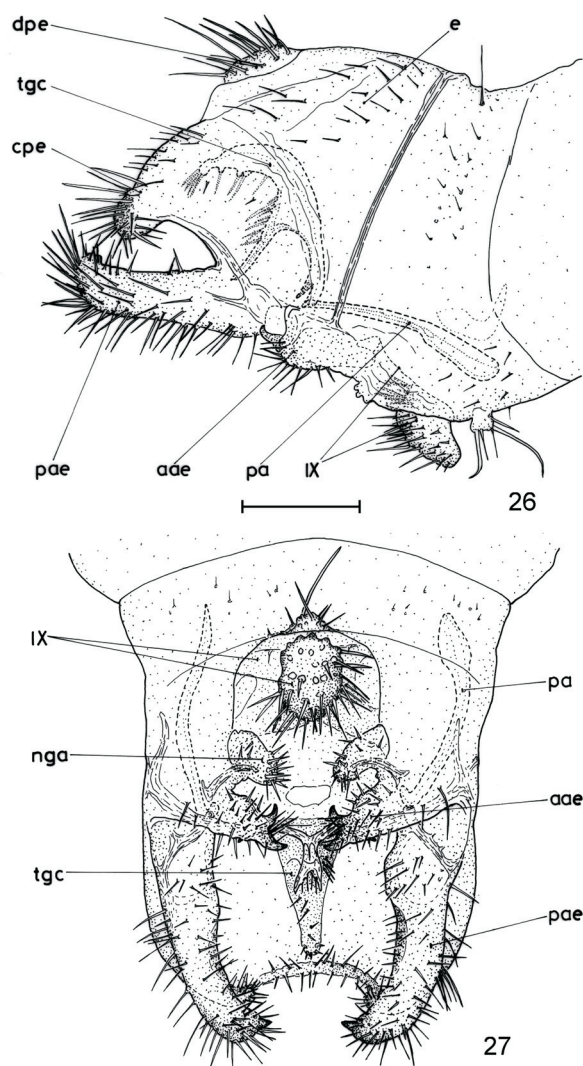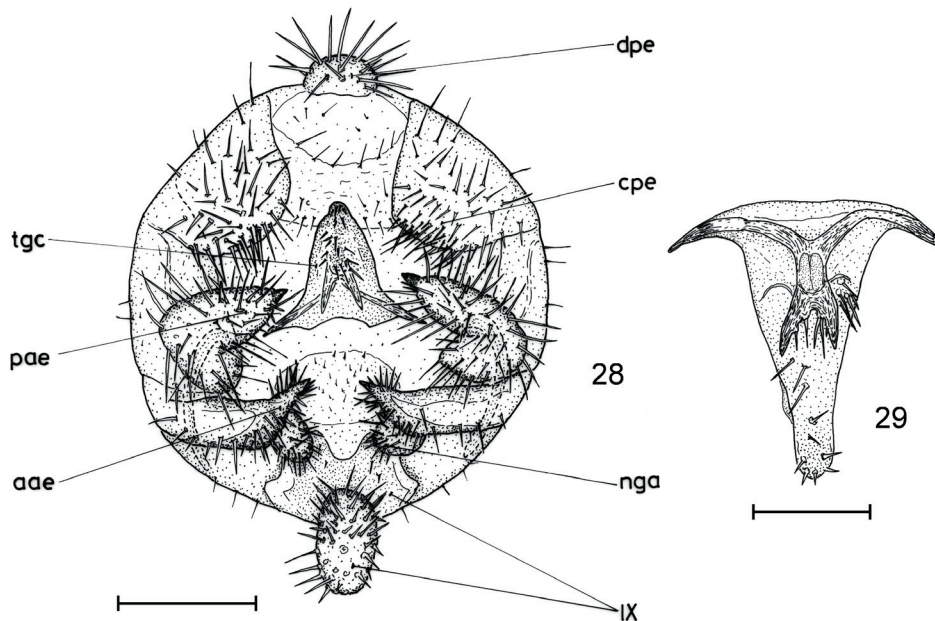

Figs 26–27. *Flintoconis petorcana* sp. n.: 26 = male terminalia, lateral view, 27 = male terminalia, ventral view. IX = 9th sternite, aae = anterior appendage of ectoproct, cpe = caudal projection of ectoproct, dpe = dorsal projection of ectoproct, e = ectoproct, nga = ninth gonapophysis, pa = paramere, pae = posterior appendage of ectoproct, tgc = tenth gonocoxal complex. Scale: 0.3 mm

Abdominal segments are moderately sclerotized with plicatures as in the description of the genus.

Male terminalia as in Figs 26–29. On the caudal edge of the eighth sternite a small hairy knob is situated, with two longer setae. Ninth sternite is a strongly sclerotized plate, with a large, setose and curved projection. The ectoproct well sclerotized, with a moderately strong apodeme ending near to a short transverse apodeme at the base of the anterior appendage. Dorsal projection of ectoproct is a moderately large knob, with long setae. Caudal projection of ectoproct rounded distally. Anterior appendage of ectoproct moderately long, curved strongly invards, with short, hooked arms. At the base of this organ there is the prominent ninth gonapophysis, with distinct apodeme. Posterior appendage of ectoproct large, with a stout apical tooth, and with a branching basal apodeme. Paramere moderately long, with a bent stem, and with a short caudal part curved inwards. The tenth gonocoxal complex is a subtriangular sclerite, with irregularly situated hairs, with a strong, forked projection, and ending ventrally in a pair of slightly bent spurs.

Remarks: The new species is rather close to the above described type species of the genus *Flintoconis*. The main distinctive features of *F. petorcana* sp. n. are:
– moderately long anterior appendage of ectoproct;
– large posterior appendage of ectoproct, with stout apical tooth;
– subtriangular tenth gonocoxal complex, with strong, forked projection.

Figs 28–29. *Flintoconis petorcana* sp. n.: 28 = male terminalia, caudal view, 29 = tenth gonocoxal complex, ventral view. IX = 9th sternite, aae = anterior appendage of ectoproct, cpe = caudal projection of ectoproct, dpe = dorsal projection of ectoproct, nga = ninth gonapophysis, pae = posterior appendage of ectoproct, tgc = tenth gonocoxal complex. Scale in Fig. 28: 0.3 mm, in Fig. 29: 0.15 mm

Flintoconis sp.

Examined material – Chile, Acgua (Aconcagua, now Prov. Los Andes), Rio Blanco, 10 March 1968: 1 female, leg.: O. FLINT and L. E. PEÑA G.; Chile, (Prov.) Antofagosta, Poposo, October 1983: 1 female, leg.: L. E. PEÑA G.; Chile, (Prov.) Curico, El Coigo, E of Potrero Grande, 6–7 January 1998: 1 specimen without abdomen, leg.: L. E. PEÑA G.; Chile, Santiago (now Prov. Cordillera), El Alfalfal, 29 February 1968: 1 female, leg.: O. FLINT and L. E. PEÑA G.

Remarks: As the intraspecific variability of eidonomical features and of female internal genitalia in this genus is not known enough, specific identification of the above listeded specimens is impossible.

DISCUSSION

Although the systematic position of Brucheiserinae is firm within the Coniopterygidae (Neuroptera), some interesting common features of this subfamily and Megaloptera are given below.

The widened pronotum and the shape of the fourth tarsomere (with lateral lobes) resemble the Sialidae (Megaloptera).

The jugal veins are reduced in many insects, however, they are probably present in the original paired condition in both wings of *Flintoconis* and – according to KUKALOVA-PECK (1983) – also in Corydalidae (Megaloptera).

Male terminalia of the two genera of Brucheiserinae also show rather clear similarities to the same organs of Corydalinae (Megaloptera: Corydalidae). Therefore, considering that Megaloptera is one of the most primitive holometabolous insect orders (GLORIOSO 1981), it stands to reason to compare the terminalia of these two groups in establishing the homologies.

The ninth sternite (Figs 4, 18, 27, 30) is easily recognizable, with relateively few modifications both in Corydalinae and Brucheiserinae.

The ectoproct of Coniopterygidae – according to MEINANDER (1972) – consists of the ninth and tenth tergites, and perhaps a part of the "ninth gonocoxite" (i.e. coxa of the ninth abdominal segment), while ASPÖCK (2002*a*, 2002*b*) interprets this structure as the fused tenth and eleventh abdominal tergites in Neuropterida (Raphidioptera, Megaloptera, Neuroptera) in general. In Corydalinae (as in many other neuropterids) there is a large, tergite-like structure after the eighth tergite (Figs 31–32). It is considered as a ninth tergite by ACKER (1960) and GLORIOSO (1981), however, as it bears the cercal callus caudally (undoubtedly a part of the eleventh abdominal segment), it should be regarded, agreeing with ASPÖCK, as ectoproct, which in this case contains the tergites 9–11, and probably some parts of

the corresponding coxites. In Brucheiserinae the ectoproct also contains abdominal tergites 9–11, and in all probability at least some parts of the coxites of these segments. In *Brucheiser penai* the last three tergites are separated from each other by the two dorsally converging apodemes, while the ventral branching of these apodemes (Fig. 4) probably shows the suspected territory where the ninth and (a part of the) tenth coxites merged into the ectoproct. In Brucheiserinae the caudal projection of ectoproct may be regarded as callus cerci (see discussion below on female external genitalia also). There is a sclerite over the anus in some Corydalinae. This sclerite, which may be homologous with the dorsal projection of ectoproct in Brucheiserinae (Figs 5, 19, 28), is regarded as the eleventh tergite by ACKER (1960) and GLORIOSO (1981). Really it should be only a part of the eleventh tergite, as the apodeme bordering it anteriorly continues laterally, showing that the other parts of the ectoproct originated also from the eleventh tergite near to the callus cerci (Fig. 32).

The clasper-like parts of the male insect genitalia connected to the ninth tergite often called "gonocoxite", however – accepting the opinion of SNODGRASS (1957) and KUKALOVA-PECK (1987) – these structures really are styli (i.e. legs from prefemur to posttarsus originally). On the other hand, both in Corydalinae and Brucheiserinae there are two pairs of clasper-like appendages connected to the ectoproct (Figs 3–5, 17–19, 26–28, 30–32). The anterior appendage of the ectoproct of the Corydalinae correctly was regarded by GLORIOSO as the ninth (gono)-stylus, and it surely represents the same organ also in the Brucheiserinae. The possible interpretation of the the posterior appendage of the ectoproct seems to be somewhat more questionable. The posterior pair of claspers of Corydalinae was called by GLORIOSO (following ACKER) tergite 10, although the well developed callus cerci of this subfamily renders the probable position of the tergite 10 before itself. Discussing the tenth segment, ASPÖCK (2002*b*) stated that the sclerites other than the tergite do not retain their original position, and she regarded the penis of Coniopterygidae (and Coleoptera) as the merged tenth styli. On the other hand, GLORIOSO (1981) interpreted the paired median projection in the terminalia of Corydalinae as tenth styli. However, if one regards the anterior appendage of the ectoproct as stylus of the ninth segment, there is no reason to reject the possibility of a similar evolution in the case of the tenth segment. Moreover, SNODGRASS (1957, pp. 33–34 and Fig. 9K) mentioned and figured the muscle of the posterior appendage of ectoproct (in his terms: "dorsal arm of telomere" of Corydalinae inserted in the ectoproct ("basimere") quite similarily to the muscle of the ninth stylus ("basal arm of telomere"). Consequently, it seems to be the most probable that the posterior appendage of the ectoproct of Corydalinae also represents a stylus,

namely the stylus of the tenth abdominal segment, and surely the situation is the same in Brucheiserinae.

The paramere has a similar shape and structure, in many neuropterous taxonomic groups. Accepting ASPÖCK's opinion (ASPÖCK 2002*a*, *b*), it may be regarded (at least partly) as the tenth gonapophysis, i.e. the coxal endite of the tenth abdominal segment in many cases. However, in Brucheiserinae (and surely in some genera of Aleuropteryginae) it may be suspected that this organ originated from a part of the basal apodeme of ninth gonapophysis, as seems probable regarding the situation of these structures in *Flintoconis petorcana* (Fig. 27).

The penis of insects usually has a tubular, or sac-like, often membraneus structure, with some sclerotizations. The origin of this organ is rather controversial. According to SNODGRASS (1957) the "phallic organs" derived from ectodermal outgrowths (probable) of the tenth sternite. ASPÖCK (2002*b*) regards the penis ("mediuncus") as the modified tenth styli. According to KUKALOVA-PECK (1987) the penis of insects represents the trochanteral endites of the ancient abdominal leg. The latter homologization would be acceptable in Brucheiserinae, where there are median plicatures on some pregenital abdominal segments, which may be also regarded as sac-like, merged descendants of the medially situated (trochanteral) endites. However, in *Flintoconis* there is a more or less platelike sclerite in a similar position to the usual penis of the other Coniopterygidae. This sclerite of *Flintoconis* ("gonocoxal complex") my be homologous with a similar structure in male genitalia of Corydalinae (Fig. 30). This seems to be especially clear in the case of *F. petorcana* (Fig. 29). In the terminalia of Corydalinae the tenth "gonocoxite" (it is probably derived from some parts of coxa and trochanter of tenth abdominal leg) is a well developed sclerite with a paired median projections. The latter projections named by GLORIOSO (1981) as "gonostylus X" but, agreeing with ASPÖCK (2002*b*), it should be regarded as the tenth gonapophyses. In *F. petorcana* the main part of the gonocoxite complex also is the tenth "gonocoxite", while its narrowing upper (caudal) part represents the fused gonapophyses. The fusion of the tenth gonapophyses with each other and with the corresponding "gonocoxite" occurs in some Corydalinae also (GLORIOSO 1981: fig. 32). In both species of *Flintoconis* the ventral part of gonocoxite complex ends laterally in acute thorns, which may be also found in the Corydalinae (GLORIOSO 1981: fig. 38). Moreover, a ventro-median projection may be present in both taxa.

In Corydalinae a pair of genital papilli (Fig. 30) may be present lateral to the genital opening. These structures represent probably the inner pair of the endites of tenth abdominal segment, and they may be homologous with a pair of small, oval spots situated medially in the ventral part of the gonocoxal complex of *F. petorcana* and, in wider sense, with the median plicatures of Brucheiserinae. It is very

probable, that the penis of *Brucheiser* is also homologous with the above discussed genitalic structures of Corydalinae, and it may be possible that the phallic organ of the other coniopterygids has the same complex origin.
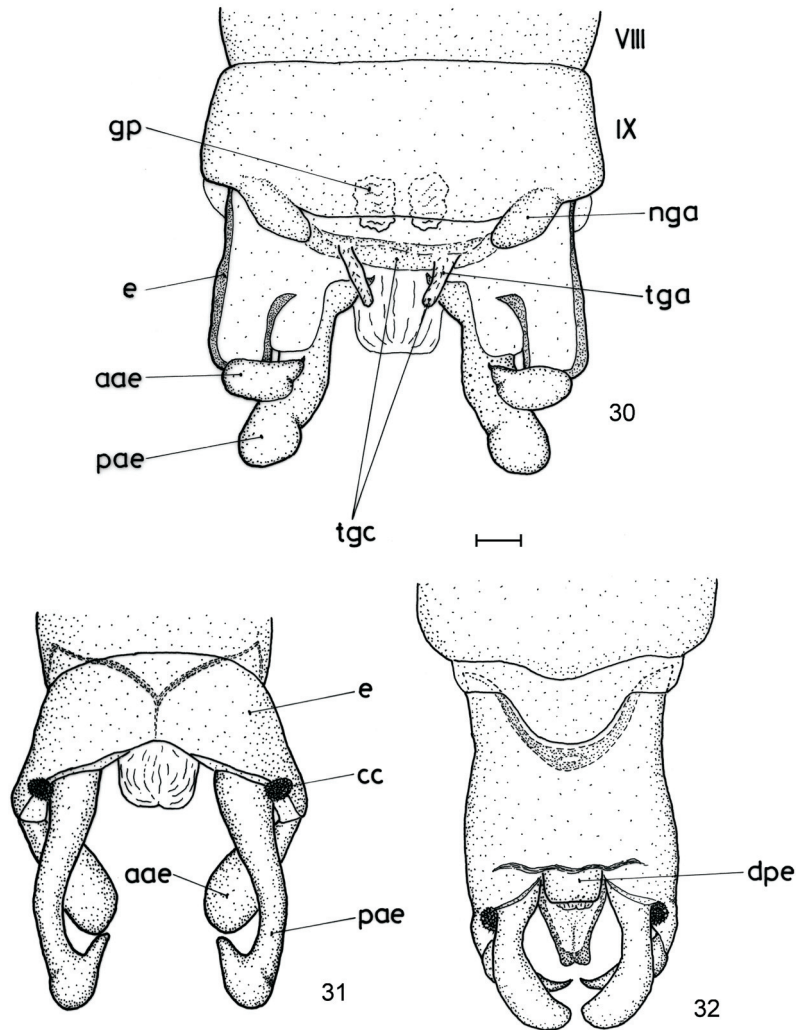
Figs 30–32. Male terminalia of Corydalinae: 30 = *Acanthacorydalis orientalis* (MCLACHLAN, 1899), ventral view, 31 = *Corydalus cornutus* (LINNEAUS, 1758), dorsal view, 32 = *Neoneuromus* sp., dorsal view. Scale: 1 mm; VIII = 8th sternite, IX = 9th sternite, aae = anterior appendage of ectoproct, cc = callus cerci, dpe = dorsal projection of ectoproct, e = ectoproct, gp = genital papilla, nga = ninth gonapophysis, pae = posterior appendage of ectoproct, tga = tenth gonapophysis, tgc = tenth gonocoxal complex. Redrawn after GLORIOSO (1981), with modified interpretation

The above discussed similarities between the coniopterygid subfamily Brucheiserinae (Neuroptera), and the surely archaic subfamily Corydalinae (Megaloptera) seem to confirm the opinion of those researchers (WITHYCOMBE 1925, KIS *et al*. 1970, MEINANDER 1972, SZIRÁKI 1996*b*) who regarded Coniopterygidae as one of the earliest derived taxonomic group within the insect order Neuroptera.

Regarding the female external genitalia, the caudal process of the ectoproct (Figs 9, 20) is discussed first. Considering its structure and its situation within the terminalia, it surely is homologous with the similar part of male ectoproct (Figs 3–5, 17–19, 26–28). Moreover, in the case of the females this rounded, densely setose organ has a more darkened and hardaned cuticle. These features confirm the opinion of RIEK (1975), who regarded this part of terminalia as a trichobothrium, *i.e.* callus cerci, which is known in Megaloptera and in many Neuroptera, but was not recognized earlier in the family Coniopterygidae.

The female internal genitalia of *Brucheiser penai* are very similar to those of *B. argentinus*, in which species with such organs were described earlier (SZIRÁKI 1996*a*), and also rather similar to *Flintoconis*. The looped distal part of ductus seminalis seems to be much more longer in *B. penai* than in *B. argentinus*, and the receptaculum seminis is bladderlike in *Brucheiser*, but there is a more elongated sac in *Flintoconis gozmanyi*.

Plicatures (eversible sacs) are peculiar organs in two of the coniopterygid subfamilies. They are situated in two lateral rows in Aleuropteryginae, and in two lateral rows and in a median row in Brucheiserinae on the ventral side of abdomen. The presence of plicatures in the subfamily Brucheiserinae was recognized about ten years ago (SZIRÁKI 1996*a*), though – without recognition of their nature – these structures were mentioned in the original description of *B. penai*, as "very small sclerotized areas" (RIEK 1975).

One (coxal) or two (trochanteral and coxal) pairs of vesicles are present on some abdominal segment of Machilidae (Archeognatha) (e.g. STACH 1958), representing the endites of the basal part of the abdominal leg (KUKALOVA-PECK 1987). Because of their structure and position, there is a high probability that the plicatures of Aleuropteryginae and Brucheiserinae are homologous with the ventral vesicles of Archeognatha.[*] Therefore, the median plicatures of Brucheiserinae surely represent the merged inner pair of endites. It is worth mentioning that, apart from Brucheiserinae, merging of the inner pair of endites occurs also in some other

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*   This homology was mentioned by the author in his DSc theses in 2004, and – independently – by DOMINIQUE ZIMMERMANN in her lecture presented on the 9th International Symposium on Neuropterology in Ferrara in 2005.

cases, as in the instance of the thoracic accessory gills of the mayfly species *Ephemerella hecuba* (EATON, 1884) (ŠTYS & SOLDÁN 1980, figs 21–23).

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REFERENCES

ACKER, T. S. (1960) The comparative morphology of the male terminalia of Neuroptera. *Microentomology* **24**: 25–84.

ASPÖCK, U. (2002*a*) Homology of male genital sclerites in Neuropterida – an adventure. *Acta Zoologica Academiae Scientiarum Hungaricae* **48** (Supplement 2): 51.

ASPÖCK, U. (2002*b*) Male genital sclerites of Neuropterida: an attempt at homologisation (Insecta: Holometabola). *Zoologischer Anzeiger* **241**: 161–171.

GLORIOSO, M. J. (1981) Systematics of the dobsonfly subfamily Corydalinae (Megaloptera: Corydalidae). *Systematic Entomology* **6**: 253–290.

KIS, B., NAGLER, C. & MANDRU, C. (1970) Insecta, Neuroptera. *Fauna Republicii Socialiste România* **8**(6): 1–343.

KUKALOVA-PECK, J. (1983) Origin of insect wing and wing articulation from the arthropodan leg. *Canadian Journal of Zoology* **61**: 1618–1669.

KUKALOVA-PECK, J. (1987) New Carboniferous Diplura, Monura, and Thysanura, the hexapod ground plan, and the role of thoracic side lobes in the origin of wings (Insecta). *Canadian Journal of Zoology* **65**: 2327–2345.

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

MEINANDER, M. (1990) The Coniopterygidae (Neuroptera, Planipennia). A check-list of the species of the world, descriptions of new species and other new data. *Acta zoologica fennica* **189**: 1–95.

NAVÁS, L. (1927) Veinticino formas nuevas de insectos. *Boletin de la Sociedad ibérica de Ciencias Naturales* **26**: 48–75.

NEW, T. (1989) Planipennia. *In* FISCHER, M. (ed.): *Zoologie IV, Arthropoda: Insecta.* Walter de Gruyter, Berlin–New York, 132 pp.

RIEK, E. F. (1975) On the phylogenetic position of Brucheiser argentinus Navás, 1927 and description of a second species from Chile (Insecta: Neuroptera). *Studies on the Neotropical Fauna* **10**: 117–126.

SNODGRASS, R. E. (1957) A revised interpretation of the external reproductive organs of male insects. *Smithsonian Miscellaneous Collections* **135**: 1–60.

STACH, J. (1958) The Machilidae (Thysanura) of Bulgaria. *Acta zoologica cracoviensia* **3**: 1–47.

ŠTYS, P. & SOLDÁN, T. (1980) Retention of tracheal gills in adult Ephemeroptera and other insects. *Acta Universitatis Carolinae. Biologica* **1978**: 409–435.

SZIRÁKI, GY. (1996*a*) The internal genitalia of females of some coniopterygid genera, compared with other neuropteroid taxa (Insecta: Neuroptera: Coniopterygidae). Pp. 217–228. *In*: CANARD, M. *et al.* (eds): *Pure and applied research in Neuropterology. Proceedings of the Fifth International Symposium on Neuropterology, Cairo, Egypt, 2–6 May 1994.* Michel Canard, Toulouse.

SZIRÁKI, GY. (1996*b*) Female internal genitalia of Megalithone tillyardi Riek, 1974 with comments on systematic position of neuropterous families (Neuroptera: Ithonidae). *Folia entomologica hungarica* **57**: 277–284.

SZIRÁKI, GY. & FLINT, O. S. JR. (2007) Larva of Brucheiser penai Riek, 1975 (Neuroptera: Coniopterygidae). *Annali del Museo Civico di Storia Naturale di Ferrara* **8**: 45–48.

WITHYCOMBE, C. L. (1925) Some aspects of the biology and morphology of the Neuroptera. With special reference to the immature stages and their possible phylogenetic significance. *Transactions of the Entomological Society of London* **1924**: 303–411.