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INSECTS FROM THE ITALIAN UPPER TRIAS

RIASSUNTO: Si descrive una libellula del Triassico superiore, *Italophlebia gervasuttii* n.gen. n.sp. (*Odonata, Zygoptera, Emiphlebioidea*)appartente a *Italophlebiidae* n. fam. proveniente dalle Argilliti di Riva di Solto nelle Prealpi Bergamasche. L'apparato copulatore sul secondo segmento addominale, é simile a quello delle libellule attuali ed é la prima segnalazione di questo apparato negli *Odonata* triassici. Un'elitra di coleottero proveniente dallo stesso giacimento viene identificata come appartenente al genere *Holcoptera*. Si tratta della prima segnalazione di questo genere al di fuori della Gran Bretagna.

SUMMARY: A new family, genus and species of dragonfly, *Italophlebia gervasuttii (Odonata, Zygoptera, Hemiphlebioidea)*, is described from the Italian Triassic. The copulatory apparatus on the 2nd abdominal segment is similar that of to Recent dragonflies, and is the first evidence of this apparatus in Triassic *Odonata*.
A beetle (*Coleoptera*) elytron from the same Triassic deposit is identified as a species of *Holcoptera*, the first record of this genus outside Great Britain.

PAROLE CHIAVE: *Insecta, Coleoptera, Holcoptera, Odonata, Hemiphlebioidea,* Italia, Triassico, Fossili.

KEY WORDS: *Insecta, Coleoptera, Holcoptera, Odonata, Hemiphlebioidea*, Italy, Triassic, Fossil.

INTRODUCTION.

Through the kindness of Dr. Anna Paganoni (Museo Civico di Scienze Naturali, Bergamo) I was able to examine some fossil insects from the Argilliti di Riva di Solto formation. This is an organic shale from a locality some 20 km from Bergamo and attributed to the Lower Rhaetic. The insects were preserved on 5 separate pieces of compacted mudstone. Each contains a specimen of an adult dragonfly (*Odonata*) but on one there is an additional specimen, a single beetle (*Coleoptera*) elytron.

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Coleoptera
Family uncertain
Holcoptera Handlirsch, 1906.
Holcoptera schlotheimi (Giebel, 1856); Whalley, 1985

One of the problems with fossil beetles is the difficulty, often impossibility, of placing an isolated fossil elytron into a family. Many features of the elytra, such as detailed sculpturing, have not been well studied in fossil *Coleoptera*. However, it is even more frustrating with species of the fossil genus *Holcoptera* which have a particularly distinctive elytral pattern but for which no satisfactory assignment to a family, recent or fossil, has been made. Suggestions concerning the affinity of *Holcoptera* have ranged from *Feronia* in the *Adephaga* to Julodis in the *Polyphaga* (Zeuner, 1962; Whalley, 1985).

Currently species of *Holcoptera* are known only from the Upper Triassic and Lower Jurassic of Gr. Britain. The new specimen from the Triassic of Italy is therefore a particularly interesting record. The specimen matches *H. schlotheimi* from the British Rhaetic and Lower Lias in size, and is considerably smaller than *H. giebeli* Handlirsch, currently known only from the British Lower Lias (Whalley, 1985).

There are some slight differences in the shape of the stripes on the elytra between British specimens and the Italian one but there is some intra-specific variation in this pattern in species of *Holcoptera*. Material: single elytron, n. 3660, coll. Museo Civico di Scienze Naturali "Enrico Caffi", Bergamo, Italy (MCSNB).

Odonata

The remaining specimens are dragonflies and probably all represent the same species.

Zygoptera

In recent *Zygoptera* there are five or more antenodals in many species, all of which have a closed discoidal cell in the forewing. The remaining species have only two antenodals and, in all but two species, also have a closed discoidal cell in the forewing. The recent species with only two antenodals and an open discoidal cell in the forewing belong to two monotypic genera, *Hemiphlebia* Selys (*Hemiphlebioidea*) and Chorismagrion Morton (*Lestinoidea*), (Tillyard, 1928; Fraser, 1957; Hennig, 1981). The open discoidal cell in the forewing and only two antenodals are also found in the Permian zygopteran, *Permagrion*. The Italian Triassic specimens have two antenodals and an open discoidal cell in the forewing but a closed discoidal cell in the hindwing (the hindwings of *Permagrion* are

unknown).
The nodus is characteristic of *Odonata* but the form of this and the subnodus varies. Tillyard (1928) suggested several stages in the evolution of this structure. He showed that the position of the subnodal vein varies and that it may arise subapically or almost apically from the subcosta (Tillyard, 1928, fig.9: cf. fig. 1). The Italian specimens have a nodal structure similar to *Permagrion* but the first subnodal vein is directed posteriorly instead of, as more usual, anteriorly (fig.1) (Fraser, 1957); Rhodendorf, 1962; Carle, 1982).

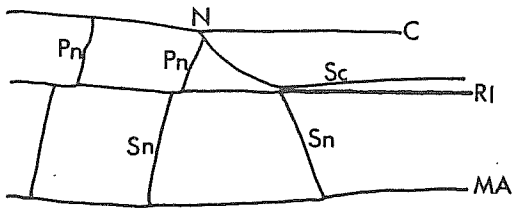

fig. 1. Veins at nodus in forewing of *Italophlebia* (C= costa; MA=anterior median vein; N= nodus; Pn= Post nodal cross-vein; R1= first radial vein; Sc= subcostal vein; Sn= subnodal veins.)

Fraser (1957) gave a key to the superfamilies of the *Zygoptera* in which he separated the *Hemiphlebioidea* from the *Coenagrioidea* + *Lestinoidea* on the basis of the discoidal cell of the forewing, the postnodal veins and the anal vein. In the *Hemiphlebioidea* the discoidal cell is open, the postnodal veins are not in alignment with the cross-veins from R1 to R2, and the anal vein is separate from the posterior border of the wing.
Fraser evidently attached more importance to two of these characters and placed *Permagrion* in the *Coenagrioidea*, even though it has an open discoidal cell in the forewing. The association of the anal vein and the hind wing margin on the petiole can be difficult to see in fossils and is very dependent on the preservation. Tillyard's 1928, fig.8, drawing of *Permagrion* shows Cu2 + 1A separate from the wing margin while in his figure of *Hemiphlebia* they appear to run together. In the Italian specimens the postnodals of the forewing are not in line with the cross-veins from R1 to R2, immediately behind, but they are not quite as irregularly placed as in *Hemiphlebia*. There is a greater degree of similarity between *Hemiphlebia* and the Italian specimens than with the coenagriid dragonflies.

Hemiphlebioidea

Zygoptera with discoidal cell open in forewing, closed in hindwing. Postnodals not exactly in line with cross-veins from R1 to R2 behind. Two antenodal veins.

Italophlebiidae fam. nov.
Type-genus Italophlebia gen. nov.

Medium sized dragonflies with strongly petiolate wings. Over 10 postnodal veins. Cells in median area of fore and hindwings broad with longest side not more than 1.3 times shortest side. Upper Trias, Italy.
While this new family has a few characters in common with the *Hemiphlebiidae*, like the two antenodals and open discoidal cell in the forewing, it differs in several ways. There are fewer postnodals (5-6) in *Hemiphlebiidae* and the cells in the median area of the wings are very elongate whereas the *Italophlebiidae* have more than 10 postnodals and the cells in the median area of the wings are much less elongate, some being almost square. The cell formed between Cu + M and 1A at the base of the forewing also differs in shape between the two families.

Italophlebia gen. nov.
Type-species *Italophlebia gervasuttii* sp. nov.

Diagnosis: hemiphlebiid *Zygoptera* with large cells in median area of fore- and hindwings. Forewing: distal margin (fig.2) of discoidal cell almost at right angles to costal margin. Subnodal vein angled basally rather than apically. Hindwing: hind margin of wing strongly angled (fig.3) to petiole.
Distribution: Upper Trias, Italy.

Italophlebia gervasuttii sp. nov.
Figs. 1-8

Forewings (fig.2): Length 34.3 mm including petiole 4.8 mm long. Sc reaches almost half lenght of wing terminating on costa. Single postnodal cross-vein from apex of Sc to R1 (fig.1). Two antenodal veins. Postnodals not exactly opposite cross-veins from R1 to R2 (fig.1). Part of basal area obscured; median area with prominent large cells. R1 approaches Sc very closely at nodus. Hind margin of discoidal cell curved. Pterostigma 3.3 mm long. Posterior margin of wing broadly convex, gently curving to petiole.
Hindwing (fig.3): Lenght 31.4 mm including petiole 5 mm long. Sc slightly under half lenght of wing. Two antenodal veins. Postnodals not in line with cross-veins behind. Discoidal cell closed. Median cells large. Pterostigma only slightly smaller than in forewing.

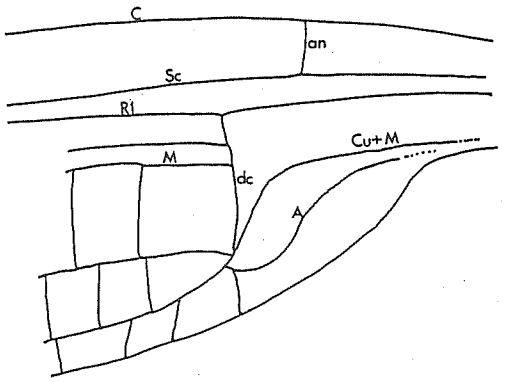

fig. 2. Forewing base *Italophlebia*. (A= anal vein; an = antenodal veins; C= costal vein; Cu+M= cubital plus median veins; dc= discoidal cell; M= medial vein; R1= first radial vein; Sc= subcostal vein.

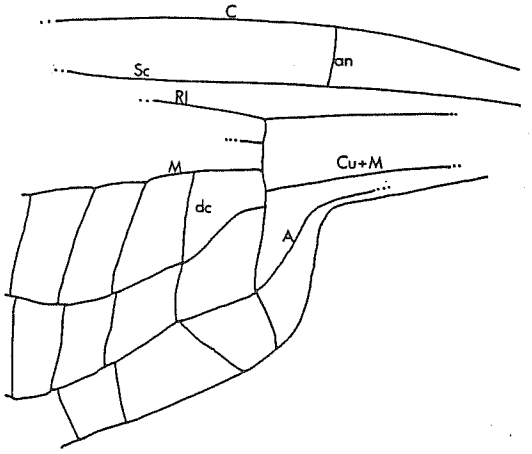

fig. 3. Hindwing base *Italophlebia* (abbreviations as in caption to fig.2.)

Posterior margin of wing almost concave, abruptly curving towards petiole.
Head and thorax: 8.5 mm lenght (together). Flattened, no details preserved.
Abdomen: Length 36.5 mm. Second and (?) third segment swollen, with trace of lateral structure (auricles). (This is the male copulatory apparatus). Abdomen probably slender towards middle, enlarged posteriorly. Male genitalia visible as partially preserved appendages.
Material: Holotype, (figs 4-6). Specimen n. 3460 part and counterpart. Triassic, Italy nr Bergamo, in coll. Museo Civico di Scienze Naturali "E.Caffi", Bergamo, Italy (MCSNB).
Paratype (fig. 7): 1 specimen, (forewing only) n. 6678, data as holotype.
Other material: 3 specimens: n. 5115; 6677, part and counterpart; 6679, all data as holotype.

Discussion.
Although there is one almost complete specimen with many details preserved, the remaining specimens are less well preserved. The single paratype is an almost complete forewing preserved in outline but with little venational details. Specimen n. 5115 is preserved in outline only and consists of two pairs of wings and part of the abdomen but hardly any venation can be seen. The remaining specimens are represented by isolated wings, which, although certainly *Zygoptera*, do not have much preserved detail but are probably the same species as the holotype.
Italophlebia gervasuttii is important because it throws new light on the morphology and even the probable behaviour of early dragonflies. In particular, on the second segment of the abdomen there are structures which can be interpreted as part of the copulatory apparatus. This is the first evidence from the Triassic of this structure on the second abdominal segment although there is now evidence of its presence in specimens from both the Mesozoic and Palaeozoic (Permian) of Russia (Pritikyna, unpubl.). This structure is significant in the mating behaviour of dragonflies. When mating, all dragonflies use this structure for the transferrence of sperm to the female and the curious "ring" or "wheel" position adopted by pairs of mating dragonflies is universal in Recent *Odonata* (Corbet, 1962). The presence of this structure in Triassic *Zygoptera* shows that this unique method of mating was well established early in the evolution of the *Odonata*.
The nodus, an *Odonata* autapomorphy, is slightly different in *I.gervasuttii* from that of any other known species. While the subcosta joins the costa in the usual way, the subnodal vein, forming a strengthening bar on the membrane, slopes (proximally) towards the base of the wing: usually the subnodal slopes distally, clearly towards the apex of the wing. Furthermore, there is a postnodal

cross-vein (fig.1, Pn) which touches the nodus and presumably helps to stiffen this part of the membrane. This postnodal cross-vein is clearly separate from the nodus in other species.
The forewing has the discoidal cell almost at right angles to the length of the wing; in most other species this is angled distally towards the wing apex. The closed discoidal cell in the hind wing has a very distinctive shape while the anal vein appears to run separately towards the petiole of the wing. The median cells of both wings are large and not like the usual rather elongate zygopterous type. The arculus is distinct and at right angles to the lenght of the wing.

Systematic position:
I. gervasuttii shows features of several of the major *Zygoptera* groups proposed by Fraser (1957). The open discoidal cell in the forewing and closed one in the hindwing one are similar to those in *Hemiphlebia* Selys and this, together with the lack of alignment of the postnodals with the cross-veins from R1 to R2 behind, are the main reasons for placing *I. gervasuttii* in the *Hemiphlebioidea*. The arrangement of the anal vein, which appears to run separately from the hindwing margin, is similar to that in many of the *Coenagrioidea* and *Lestinoidea* (*sensu* Fraser, 1957).
This species shows some of the characters of the Permian *Permagrion*, retaining several primitive characters like the open discoidal cell, while having some peculiarities of its own (eg. the asymmetry of the cross-veins of the post nodals with the cross veins behind).

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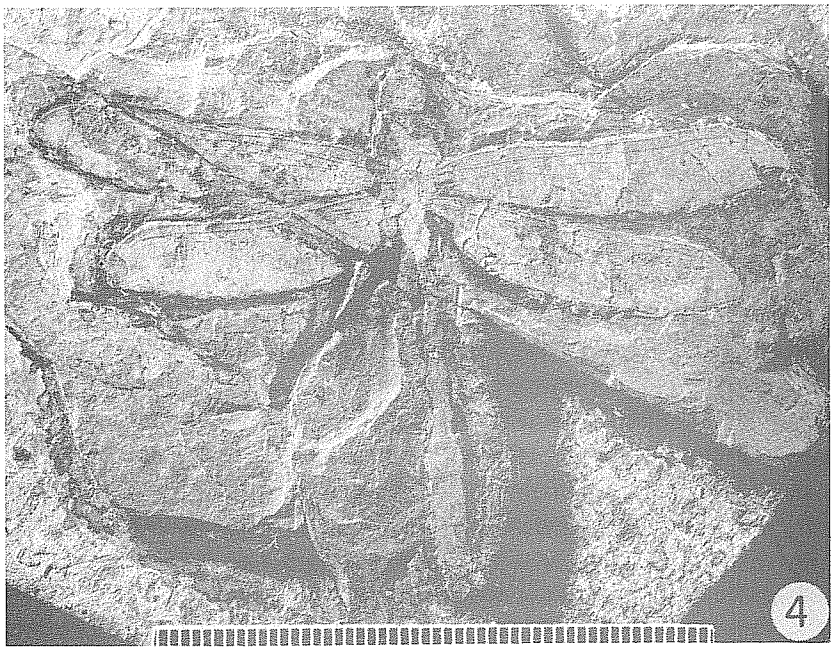
fig. 4. Forewing holotype *Italophlebia gervasuttii.* Specimen n° 3460. Arrow indicates enlarged 2nd (and ?3rd) abdominal segment, indicating presence of male copulatory apparatus. (part). (scale =mm).

fig. 5. Holotype *I. gervasuttii.* (counterpart).(scale=mm).

fig. 6. Holotype *I. gervasuttii.* (counterpart). Base of fore - (arrowed) and hindwings. (scale=mm).

fig. 7. Paratype *I. gervasuttii*, specimen n° 6678, forewing.

fig. 8. *I. gervasuttii*, specimen n° 6677, forewing.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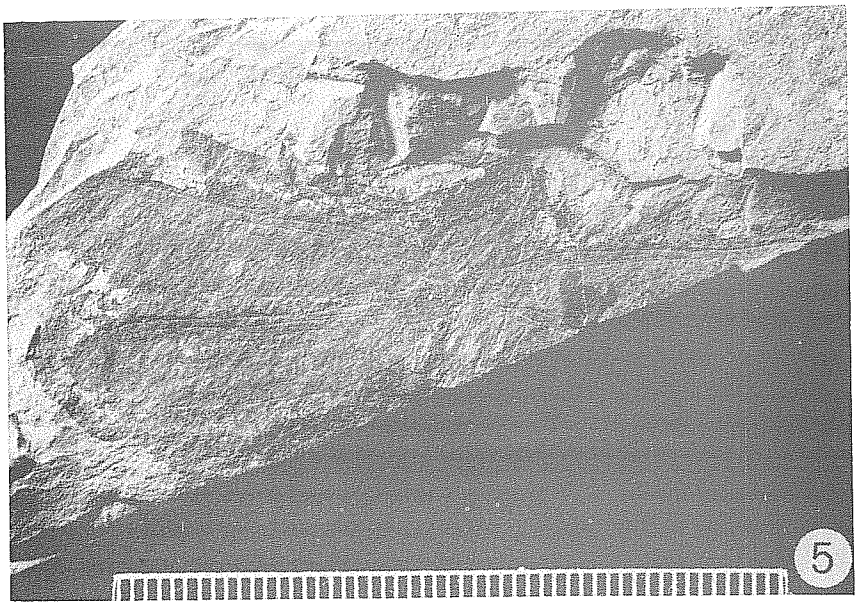
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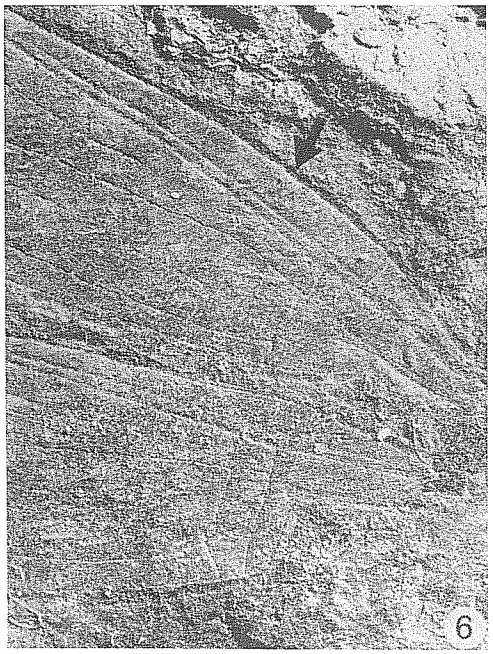
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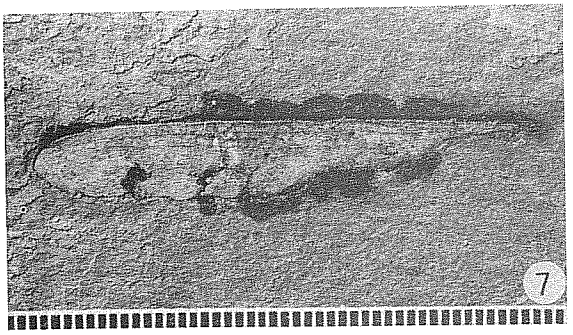
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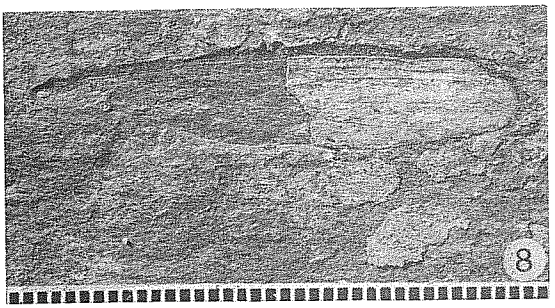
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