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FOSSIL INSECTS FROM THE MIDDLE ECCA (LOWER PERMIAN) OF SOUTHERN AFRICA

by

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ABSTRACT

Three insects are recorded from carbonaceous shales of Middle Ecca age from Hammanskraal, near Pretoria. *Thaumatophora pronotalis* gen. et sp. nov., is an aquatic nymph of the Paraplecoptera showing lateral abdominal gills. *Sysciophlebia kovacsae* sp. nov. is a tegmen of a spiloblattinid cockroach. The third specimen is a small protopsyllidiid nymph. Only three insects of greater age are known from southern Africa.

INTRODUCTION

Most of the Palaeozoic insects known from southern Africa are recorded from the Middle Beaufort Series of Upper Permian age (Riek, 1973, 1974 and in press). Only three insects of greater age are known from this region, the blattodean *Rhodesiomylacris bondi* (Zeuner, 1955) from the Lower Beaufort, the paraplecopteron (?) *Boutakovia salei* (Pruvost, 1934) from the base of the Ecca, and the paraplecopteron *Hadentomoides duykensis* (Riek, 1974) from the top of the Dwyka Series and probably of late Upper Carboniferous age.

Three insects are recorded in this paper from carbonaceous shales of the Middle Ecca. A collembolan is also recorded from the same sediments (Riek, this volume). The insects were collected by Dr. Éva Kovács-Endrödy, at Hammanskraal, near Pretoria, during her study of the plant fossils. The insects consist of two nymphs and the fore wing of a cockroach. All are of considerable interest. The blattodean fore wing is referred to the Spiloblattidae, a family typical of the late Upper Carboniferous. One moderately-sized nymph is referred to the Paraplecoptera on the large paratergal processes on the pronotum and the presence of lateral abdominal gills. The second very small nymph, with a body length of 5 mm, is referred to the Protopsyllidiidae (Homoptera).

SYSTEMATICS

Order Blattodea

Family Spiloblattinidae

The family is characterized by the well developed Sc, extending at least to the middle of the wing, combined with the loss of the archedictyon. It is sometimes difficult to distinguish between Spiloblattinidae and some Poroblattinidae in which Sc is also well developed, but in the latter family the stem of Sc tends to be straight and not subparallel to the costal margin as in Spiloblattinidae.

The family is recorded mainly from the latter part of the Upper Carboniferous. A species from the Lower Permian of southern Africa is referred to the family and placed in a known genus.

Genus *Sysciophlebia* Handlirsch

Sysciophlebia Handlirsch 1906

Type species: Blattina euglyptica Germar 1851

Diagnosis

CuA sigmoidally curved and subparallel to caudal margin distally, and distal branches simple. Sc extending well towards apex of wing. Rs with branches tending to form a forward pectinate series.

The genus is recorded for the Upper Carboniferous of North America, Europe and Russia. A species from the Lower Permian of southern Africa is referred to the genus and compared with the type species, *euglyptica,* from the Upper Carboniferous of Europe.

Sysciophlebia kovacsae sp. nov.

Figure 1

Etymology

The species is named for Dr. Evá Kovács-Endrödy who discovered this and the other fossil insects, incidental to her studies of the plant fossils.

Type

H.T. 201, in Geological Survey, Pretoria.

Type locality

North-western corner of the farm Haakdoornfontein 119 JR, 7,25 km almost due south of Hammanskraal, near Pretoria. Middle Ecca.

Description

Fore wing (tegmen) complete except for clavus, base and part of apex. Length as preserved 21 mm in-

dicating a wing length of 23 mm. Sc extending to apical third of wing. Costal veinlets mostly simple, occasionally 2-branched towards wing base. R slightly sigmoidal towards base, 3-branched, branching about level with apex of clavus. Rs with 5 forward branches to wing margin, ending slightly above middle of apex. M parallel to R at base, first branching not preserved but apparently slightly after the origin of Rs. M with six branches, to wing apex. CuA appearing to arise as a forward branch of CuP near wing base. CuA sigmoidally curved, subparallel to hind margin distally, branching before the origin of Rs, with 11 or more branches to the posterior margin, distal branches simple, pectinate, first branch very deeply forked, second branch forked. CuP strongly curved to wing margin. Clavus not preserved.

Notes. The species can be compared closely with the type species *euglyptica* which, itself, varies somewhat in venation, especially in the branching of R and arrangement of the branches of Rs which sometimes appear more dichotomic than forwardly pectinate. The new species differs from *euglyptica* in the very deep forking of the first and second branches of CuA and the more abrupt forward origin of the stem of CuA.

Order Paraplecoptera

The Paraplecoptera is a large, very diverse, widely distributed order that made its first appearance in the Upper Carboniferous of North America, Europe and Russia, was abundant in the Permian of Russia, Moravia, North America and southern Africa, and apparently persisted to the Triassic of Siberia, Australia and Japan. The Paraplecoptera is most probably the ancestral group of all Neoptera.

The Paraplecoptera, Protoblattodea and Protorthoptera are recognised by me as being sufficiently distinct to warrant separate ordinal status. A few of the species at present referred to the Paraplecoptera may subsequently require re-allocation to other orders when more details of the morphology are known. The order Paraplecoptera is used in a broad sense to embrace those insects in which the median field of the fore wing is usually independent of the cubital field and the most posterior branch of CuA is not set off as a distinct vein (Cun or CuA2). The Protoperlaria are included in the Paraplecoptera. The order Protorthoptera embraces those "orthopteroids" in which there is partial fusion between MP and CuA and development of a distinct CuA2 but which, unlike Orthoptera *s. str.*, have numerous irregular branches to MA. The order Protoblattodea embraces those species in which there is a distinct clavus in the fore wing and partial fusion between MP and CuA. There will always be difficulty in the placement of some wings because, as in Recent Orthoptera, it is possible that the oblique branch of M fusing with CuA may assume a transverse alignment and appear similar to a cross vein.

The presumed nymphs of several species of Paraplecoptera have been described. The best documented are the presumed nymphs of the Lemmatophoridae (Carpenter, 1935) from the Upper Permian of Kansas. These nymphs, which are almost certainly correctly placed, are said to have gills, laterally, on the first nine abdominal segments. Although there may be some doubt about the structure and number of these processes as interpreted by Carpenter, the nymphs are very similar to those of Recent Plecoptera, and all Plecoptera nymphs are aquatic with the exception of a very few apomorphic species of Gripopterygidae. Carpenter illustrates the gills as inserted over the whole lateral margin of the segment, and thus reminiscent of a pleural lobe to the segment, whereas gills are normally inserted at or close to the postero-lateral margin of the segment. Thus, gill 9 as interpreted by Carpenter would more probably be gill 8 protruding caudally from its insertion posterolaterally on segment 8. This would mean only eight pairs of gills, However, Carpenter illustrates nine such processes on each side of the abdomen of each of the two types of nymphs occurring in the Lower Permian of Kansas illustrated by him.

Kaltanympha thysanuriformis (Sharov, 1957) from the Lower Permian of Kuzbass was referred to the Paraplecoptera. This generalised nymph has few



Figure 1. *Sysciophlebia kovacsae* sp. nov. Holotype.

distinctive atributes but it differs from other paraplecopteran nymphs in the apparent small size of the head.

The supposed crustacean, *Pygocephalus* cf *cooperi* of Dix and Pringle (1930), from the Upper Carboniferous of England, interpreted as the abdomen of a blattodean nymph by Rolfe (1967) is, in all probability, the abdomen of an aquatic nymph of the Paraplecoptera. There is a striking similarity between the terminalia of this nymph and female nymphs of some Recent Plecoptera. The lateral dark areas on the abdomen very probably represent lateral gills.

A nymph from the Lower Permian of southern Africa is referred to the Paraplecoptera. Lateral abdominal gills are presented on at least the basal six segments.

This nymph differs noticeably from the numerous nymphs referred to the Protoperlaria (= Paraplecoptera in part) (Carpenter, 1935) not only in the development of paratergal lobes on the pronotum but also in wing bud development and number of gills. Carpenter stated that gills are present on segments 1–9 in the nymphs from the Lower Permian of Kansas, whereas, at most, they occur on segments 1–8 (known only from 1–6 but lateral margins of segments 7 and 8 obscured) in the present nymph. Paratergal lobes are not developed in the Kansan nymphs and the wing buds were not clearly differentiated from the central part of the nota.

With reference to the paraplecopteran nymphs from the Lower Permian of Kansas, Carpenter (1935) stated "when we compare the Kansas permian nymphs with those of Recent Perlarians, we find at once such similarity that it is difficult to detect the differences which we might expect in view of the great age of the fossils". The nymphs were referred to the Paraplecoptera and not the Plecoptera because of the absence of adult Plecoptera and the abundance of adult Paraplecoptera supported by the abundance of nymphs.

The present nymph can be referred to the Paraplecoptera with just as much assurance because of the development of distinct paratergal processes on the pronotum and their similarity to the same structures in adult Paraplecoptera. Paratergal processes are absent or indistinct in both adult and nymphal Plecoptera.

The nymph is named to facilitate future reference to the specimen. It is difficult to differentiate between generic and specific characters. However, the form of the paratergal processes and the form of the tarsal segmentation are probably of generic significance. Family placement is left in abeyance until the fauna from this horizon is better known.

Genus *Thaumatophora* gen. nov.

Type species: Thaumatophora pronotalis sp. nov.

Diagnosis

Pronotum produced to large, convexly margined, sculptured, paratergal processes. Tarsi 3-segmented, first tarsomere short and quadrate.

Thaumatophora pronotalis sp. nov.

Figures 2–3

Type

H.T. 248, in Geological Survey, Pretoria.

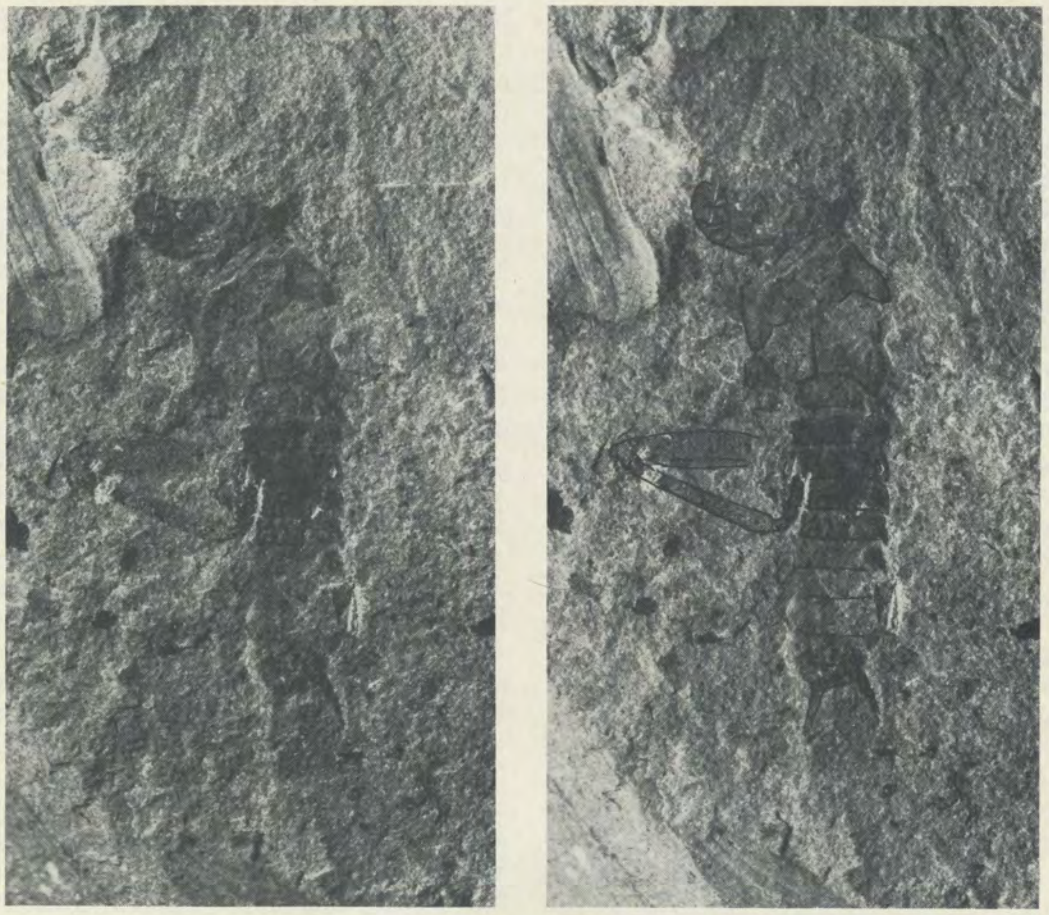
Type locality

North-western corner of the farm Haakdoornfontein 119 JR, 7,25 km almost due south of Hammanskraal, near Pretoria. Middle Ecca.

Description

Nymph. Immature, but with distinct wing-pads, nymph complete except for head and anterior part of pronotum. Length as preserved 13 mm, without the cerci, indicating a body length of 18 mm. Pronotum broader than mesonotum, with distinct paratergal processes, lateral margin of process markedly convex. Processes sculptured with irregular grooves, processes apparently thicker than central disc of pronotum. Mesonotum and metanotum slightly broader than long, without obvious sculpture or differentiated areas, the median ecdysial suture line distinct on metanotum, and with distinct postero-laterally directed wing-buds. The wing-buds are widely separated, especially on mesonotum, and the posterior margin of the wing rudiment is broadly free. Abdomen 10-segmented, segment 1 short and visible only at meson (covered laterally by hind wing-bud). Segment 2 short, segments 3–9 subequal, longer than segment 2, segment 10 about as long as segment 9, rounded postero-laterally. At least abdominal segments 1–6 with small lateral gills inserted close to the lateral margin posteriorly. (Lateral margins of segments 7 and 8 not exposed, segment 9 without gill.) Gills not distinctly defined but apparently short, finger-like and annulated. Cerci not fully preserved and with some margins indefinite, segmentation not distinct, preserved portion about as long as width of abdomen. The dark area between the bases of the cerci apparently represented an extrusion from the anus. Hind leg preserved, viewed posteriorly, stout. Coxa about as long as broad at base, tapering to apex. Trochanter triangular. Femur very broad, with a longitudinal carina towards lower margin (? representing the margin of the lower groove into which the tibia folds). Tibia slightly longer than femur but only about half as wide, lower margin with at least six stout spines from middle to apex. Tarsus short and stout, 3-segmented, first tarsomere short, quadrate, second transverse, third distinctly longer than first two combined.

Except for the large lobes on the pronotum, the nymph can be compared closely with the nymphs of Plecoptera, especially Eustheniidae which the nymph resembles even in the structure of the gills. It is not known whether lateral abdominal gills were present on segments 7 and 8 as the lateral margins are obscured. They were not present on segment 9 but were present on segments 1-6. In Eustheniidae, gills are present on segments 1–5 (*Stenoperla*) or 1–6 (most genera). The broad flattened hind leg of the fossil nymph differs



Figures 2 and 3. *Thaumatophora pronotalis* gen. et sp. nov. Holotype. 2. Untouched. 3. Retouched. (For size of specimens see text)

from that of the Eustheniidae mainly in the development of a distinct series of stout spines on the distal half of the lower margin of the tibia. The 3-segmented tarsus differs only in detail.

There are no characters of the nymph with the exception of the paratergal lobes on which it should not be referred to the Plecoptera. However, on this character the nymph is referred to the Paraplecoptera.

Order Hemiptera

Suborder Homoptera

Family Protopsýllidiidae

The family is recorded from the Upper Permian and Triassic of Australia, the Upper Triassic and Jurassic of Asia, and the Triassic of southern Africa. Nymphal exuviae have been recorded from all three regions. The Lower Permian nymph (H.I. 150a) resembles those previously described as far as can be ascertained from the somewhat imperfect preservation.

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